[*A STUDY ON JAPAN'S ENERGY DEMAND AND SUPPLY TO ACHIEVE 80% REDUCTION OF CO2 EMISSION IN 2050*]

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Overview

Against the Government's policy to achieve 80% reduction of GHG in 2050 by utilizing new technologies including CCUS, we analyze the energy demand and supply balance to achieve 80% reduction of CO2 emission in 2050 with existing zero emission technologies including renewables and nuclear power. Also, we clarify the options which achieve 80% reduction of CO2 emission if nuclear power generation capacity is constrained in Japan.

Methods

We estimate the energy demand by use of the econometric model which includes the structure to calculate the real GDP and industrial outputs. As for the energy supply, we estimate the electricity generation and capacity in 2050 with optimization model in which power generation cost is minimized under CO2 restriction. Electricity demand and some variables are mutually used in these models. That's why we get consistent results with macroeconomic situation, industrial structure, and energy demand and supply.

Results

We assume the rate of economic growth and the change in the final energy consumption intensity until 2030 are the same as those in Long-term energy supply and demand outlook of Japan. After 2030, GDP growth rate and the change in the final energy consumption intensity are assumed to fall down. The entire potentials of the renewables will be exploited in 2050 (Solar PV: 360GW, Wind: 75GW). Moreover, assuming output of renewables never curtailed by installing batteries on a massive scale, generation capacity of nuclear power plants has to reach 29GW to achieve 80% reduction of CO2 emission while maintaining network stability. The ratio of zero emission power supply reaches 84% in 2050, while capacity of LNG power plants remains 67GW.

29GW of the nuclear generation capacity means some new nuclear power units should be constructed by 2050 even if capacity factor is assumed to be as high as 86.7%. Japan does not have much time left to decide on the use of nuclear power.

Another two options to achieve 80% reduction of CO2 emission in case of the restriction of nuclear power capacity are taken into account in this analysis. One is the CCUS, the other is the economic stagnation. When capacity of nuclear power remains 16.8GW in 2050, CCUS of 30Mt-CO2 in 2050 is required in the first case. In the second case, economic growth rate has to fall to zero to reach 80% reduction of CO2. Accomplishment of these conditions seems not to be easy.

Conclusions

Since power generated by renewables are already fully exploited, if 'methanation', which is one of the methods to use CO2, is to be used on a large scale, import of hydrogen or additional zero-emission power supply is indispensable in Japan. Furthermore, if CCUS costs put additional burden on Japanese manufacturing industries, it may impair their international competitiveness.

With the service life of nuclear power plants at 60 years, the fleet will start to shrink drastically beyond 2050. Thus, further measures should be taken to limit CO2 emission onward.