JAPAN'S ENERGY OUTLOOK FOR 2050 – THE OPEN SOURCE STOCHASTIC SECTORAL ENERGY FORCASTING MODEL[1]

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Overview

The increasing understanding of climate change and the expected environmental as well as economic impacts of global warming will put significant constraints on the Japanese energy sector. In order to tackle with these issues, Japanese government currently attempts to develop new measures to mitigate national green house gas emissions by 60% to 80% until 2050. For achieving such a goal, it is straightforward that the battle against climate change can only be solved by promoting effective and innovative low carbon technologies to the energy market and considering consumer behaviors. However, the limited time given to mitigate climate change does not forgive any misled research or policy. On these backgrounds, open source long range stochastic energy projection model is developed on a sectoral basis to comprehensively evaluate the impact of different policies and consumer behavior on the market penetration of low carbon technologies. The tool is fundamentally an engineering-economic model with technology adoption decisions based on cost and energy performance characteristics of competing technologies where logit-type technology selection model and stock turn over model play a key role. Moreover, the core of this model is basically an end-use model considering energy service demand, e.g. a certain temperature or luminous intensity in building sector, automobile ownership in transport sector. Due to the consideration of energy service, for example in building sector, passive building systems as well as interactions between technologies (such as internal heat gains) are explicitly incorporated in a consistent way. Furthermore, it is possible to evaluate the impact of future stochastic behavior of income growth, demography, and energy prices on energy demand through Monte Carlo simulation.

Methods

- Sectoral engineering-economic model, composed of logit selection module and stock turnover module, with technology adoption decisions based on cost and energy performance characteristics of competing technologies.
- Monte Carlo simulation analysis

Results

- Engineering-economic model based on logit function, Bass-model and stock turnover model is explained as a method to develop energy forcast of Japan's industrial, commercial/residential, transportation and electric power sector to 2050.

- By decreasing fuel combustion and increase use of renewable energy, CO_2 emissions in technology advancement scenario will be diminished by 83 million carbon-equivalent tons up to 2050 in comparison with reference scenario.

- The uncertainy of energy forcast is analyzed through Monte Carlo simulation assuming that economic growth, demographic factor and energy prices have hypothetical statistical distribution.

Conclusions

- With maximum introduction of low-carbon technology, it is potentially possible to delineate the picture of reducing CO_2 emissions by more than 40% from the current level of CO_2 emissions up to 2050.

- Since long-term energy forcast for 2050 remain quite uncertain considering the future variance of economic and demographic factor, it is important for policymakers to develop a robust energy policy taking into consideration the variability of future energy demand growth.

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