The impact of nuclear policy changes on climate change mitigation policy in Asia

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1. Introduction

According to IEA Blue-map scenario[1], nuclear power is expected as one of the major GHG abatement technologies and would contribute for about 6% of the global GHG emission reduction at 2050. Since the large-scale accident of Fukushima nuclear power plant after March 11, 2011, future of nuclear policy both in Japan and world has become unclear, with decrease in the public's acceptance of nuclear energy and enhancement of stricter safety standards for nuclear power plant constructions and operations. On the other hand, a significant increase in GHG emissions is expected in the Asia region by 2050[2]. Thus, changes of nuclear policies as GHG mitigation options in the region are likely to affect GHG abatement potential and costs at global scale. This study focuses on the effect of nuclear policy changes in the Asian region, and estimates the impact on technology selections and GHG abatement costs using a global-scale integrated assessment model.

2. Methods

For the assessment of the effect of nuclear policy changes, we have developed the AIM/Backcasting [global] model (AIM/BCM[Global]), that simulates selections of technologies and energy consumption patterns to minimizing total cost during analytical period, 2005-2050 under several constraints, such as satisfying energy service demands and emissions limit. The AIM/BCM[Global] covers the whole world, which we breaks into 32 regions. It deals with six types of GHG, i.e. CO_2, CH_4 N_2O, HFCs PFCs and SF_6, from energy supply sectors, energy end-use sectors and non-energy use sectors in each region. Inputs of the model, such as assumptions of future energy demand, future prices of fossil fuels and technology cost, were set based on statistics and service demand calculation modules.

We assumed three nuclear policy scenarios, which were described below (Fig.1).

(1) Reference: No impact on global nuclear policy by the accident. All nuclear plant that are under construction, planned and proposed can be used in the future.

(2) 50% construction: Half of planned and/or proposed nuclear power plants in the Asian region does not allow to start commercial operation in the future. .

(3) No construction: There will be no new plants after the accident in the Asian region, but the existing nuclear plants can be used until their lifetime (40 years).

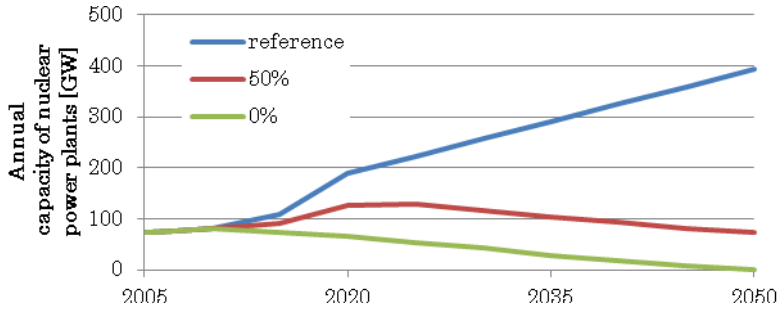


Fig.1 Assumptions of annual capacity of nuclear power plants in Asia

3. Results

Primary energy consumption (Fig.2)

In the reference scenario, global total primary energy consumption increases from 460 EJ in 2005 to 635 EJ in 2050. In Asia, it increases more rapidly than global primary energy consumption,

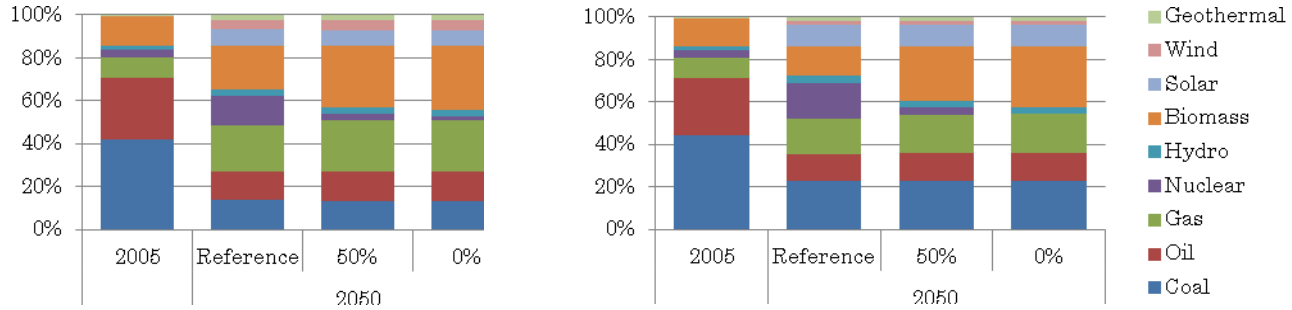
which is 1.63 times that in 2005. In the nuclear constraint scenario, global primary energy consumption decreases about 20 EJ from that in the reference scenario. Both in the world and in Asia, the energy consumption from biomass and natural gas increase instead of nuclear energy consumption in the reference scenario.

Electricity (Fig.3)

In the reference scenario, global total generated electricity increases from 17.1 PWh in 2005 to 43.8 PWh in 2050. In Asia, it increases more rapidly than global generated electricity to 20.6 PWh, which is 3.4 times that in 2005. In the nuclear constraint scenario, the share of nuclear power generation is decreased, and the share of gas power generation without CCS and biomass power generation without CCS is increased alternatively.

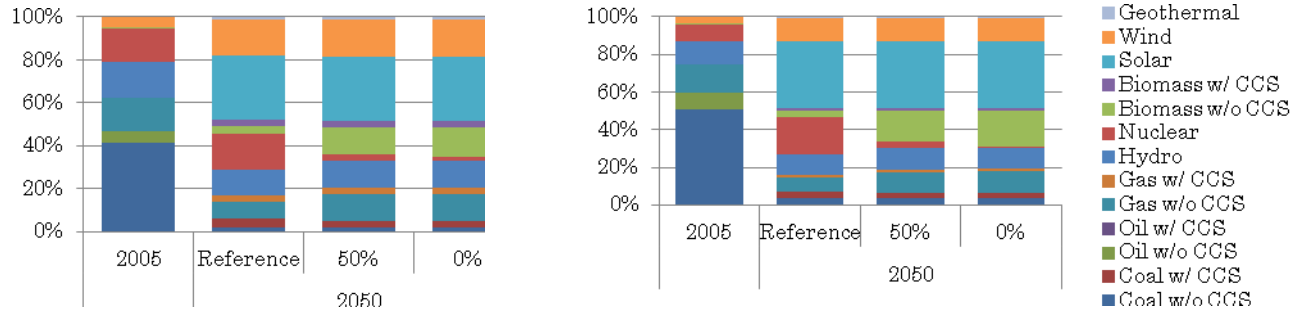
Additional costs

The additional costs of the nuclear constraint scenario until 2050, discounted at 5%, are 2,063 billion dollar in the 50% scenario and 2,574 billion dollar in the 0% scenario respectively.



(a) World (b) Asia

Fig.2 Composition of primary energy consumption in 2050



(a) World (b) Asia

Fig.3 Fuel composition of power generation in 2050

4. Conclusion

This study estimates the impact on the technology selection and the GHG abatement cost by changes of nuclear policies using the AIM/BCM[global]. The analysis leads to the result that gas power generation without CCS and biomass power generation without CCS increase instead of nuclear power generation both in 50% and 0% scenarios. These results show availability of technology to achieve GHG emission reduction required to stabilize GHG concentration level at 450 ppm CO_2-eq.,by 2050 even without new nuclear power plants in Asia.

References

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3) Kainuma M., Matsuoka Y., Morita T.(Eds.); Climate Policy Assessment: Asia-Pacific Integrated Modeling,2003,Springer