ECONOMIC IMPACTS OF LONG-TERM CLIMATE MITIGATION TARGETS IN JAPAN CONSIDERING TECHNOLOGICAL CONSTRAINTS

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Overview

The achievement of long-term targets for climate mitigation in Japan faces several uncertainties with respect to the availability of power generation technologies. Starting with the difficult situation of nuclear power deployment after the 2011 events, the effect of technological constraints on the reduction of large amounts of greenhouse gases (GHGs) in the country, and the associated economic burden remains unclear. We assess the feasibility of climate mitigation targets in Japan up to year 2050 with a computable general equilibrium (CGE) model under several technological constraints in the power sector.

Methods

The Asia-Pacific Integrated Assessment Model CGE (AIM/CGE) model is applied for the case of Japan to assess a set of scenarios considering climate mitigation and technology constraints. The AIM/CGE is a computable general equilibrium model covering the whole economic activities and a full set of GHGs and air pollutants [1,2]. It has a detailed description of the energy sector, the agricultural sector and the land use activities. The scenarios consider a combination of climate mitigation policy and technology dimensions. For the climate mitigation policy, we consider a business as usual (*BaU*) case without mitigation actions, and a mitigation target aiming for the National Determined Contribution (NDC) submitted by the Government of Japan [3] inclusive of a 80% reduction target compared to 2005 levels (*NDC80*). The technology dimension considers a case with availability of all technologies (*Default*), and cases restriciting the availability of nuclear power, carbon capture and storage (CCS), among others.

Results

The preliminary results shows that long-term mitigation can be realized under different situations of nuclear power availability. The effect of nuclear power availability on the energy supply mix and the mitigation cost was small compared to the overall effect of mitigation. For example, limited availability of nuclear power lowered electricity consumption in 2050 up to 10%. In contrast, considering a mitigation target lowered electricity consumption in 2050 by more than 15%. These changes in electricity consumption were driven by electricity prices, which jumped around threefold in 2050 in mitigation scenarios. In terms of economic impact, while GDP losses compared to the BaU case in 2050 for the scenario with all technologies available was 3.7%, the scenarios with limited nuclear power supply had values between 3.4 and 3.7%. These findings suggest that the availability of other technologies, such as carbon capture and storage (CCS) and renewable energy, deserve equal attention when analyzing the feasibility of long-term mitigation targets.

Conclusions

We showed quantitatively that nuclear supply can be substituted with other sources (mainly natural gas) to achieve long-term mitigation targets. However, it is not clear whether these scenarios will be acceptable from other points of view. The role of nuclear power needs consideration from perspectives other than GHG mitigation policy, such as energy security and public acceptance. Further analyses will cover the effect of limited availability of key mitigation technologies (such as CCS and renewable energy) on the feasibility of mitigation targets and on the energy system.

References

1. Fujimori, S. et al. AIM/CGE [basic] Manual, Discussion Paper Series, National Institute for Environmental Study (NIES), (2012).

2. Fujimori, S. et al. SSP3: AIM implementation of shared socioeconomic pathways. Global Environmental Change 42 (2017): 268-283.

3. Government of Japan . Submission of Japan's Intended Nationally Determined Contribution (INDC). Bonn, Germany: United Nations Framework Convention on Climate Change; (2015).