Cobenefits and Tradeoffs in Reducing Short-Lived Climate Forcers and Air Pollutants by Deep Decarbonization in Asia

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1. Introduction

In the Paris Agreement adopted by the United Nations Framework Convention on Climate Change (UNFCCC) Parties, it is required for all UNFCCC parties to reduce GHG emissions, in order to achieve the international target to “hold the increase in the global average temperature to well below 2˚C above pre-industrial levels” (so-called “2˚C target”). However, due to the rapid growth over the past decades in Asian developing countries, Asia became major emitters of CO2 in the world; in addition, they have been facing with serious air pollution. Thus, Asian developing countries need to take much further efforts than the current mitigation measures on greenhouse gases and air pollutants.

The objective of this study is to analyze emissions projections of CO2, air-pollutants and short-lived climate forcers (SLCFs) in Asia and the world, by considering various combinations of decarbonization measures and air pollutants control measures, and also to evaluate mitigation costs and cobenefits or tradeoffs in reducing air pollutants in response to decarbonization measures for achieving the 2˚C target.

2. Method

In order to analyze future emissions projections, mitigation potentials and costs by combinations of various kinds of technologies, this study uses a technology bottom-up model with a detailed technology selection framework, named the AIM/Enduse model. The AIM/Enduse model is a partial equilibrium, recursive dynamic optimization model, to minimize the total system costs including initial cost, operation and management cost, energy cost, carbon tax, energy tax, subsidy.

AIM/Enduse[Global] covers 32 of the world's geographical regions, especially focusing on Asia in detail such as Japan, China, India, ASEAN. As for the target gases, this study covers not only long-lived GHGs (CO2, N2O, HFCs, PFCs, SF6) but also SLCPs (CH4, BC) and air pollutants (SO2, NOx, PM2.5, PM10, OC, CO, NH3, NMVOC), in major multiple sectors such as energy supply, industry, residential & commercial, transport, agriculture, waste, industrial process, and fuel mining. Based on mitigation option database of realistic and currently existing technologies, mitigation potentials and costs can be analyzed.

3. Result and discussions

CO2 emission pathways toward the global 2˚C target can be projected in various ways by considering different combinations of decarbonization measures. However, even if features of CO2 emission pathways are the similar or same, emission projections of non-CO2 emissions are widely different depending on combinations of decarbonization measures and end-of-pipe measures.

Figure 1 shows an example result about emissions projections and sector-wise mitigation potentials in China, India, and ASEAN, regarding CO2, SLCFs (BC, CH4), and major air pollutants (SO2, NOx, CO, etc), when comparing between the reference and the 2˚C target scenarios. Major emission sources of air pollutants and SLCFs are diverse in different technologies in different sectors. Thus, major sectors with large mitigation potentials differ in each gas, which will induce various different levels of cobenefits and tradeoffs.

Large mitigation potentials are found in power and industry sectors for CO2 and SO2; transport, power, and industry sectors for NOx; residential and transport sectors for BC; and transport, industry and residential sectors for CO. It is also important to note is that, emissions of CO2, BC, SO2, NOx, CO are

mainly from energy sources, but major sources of CH4 are non-energy related sectors such as agriculture, waste and fuel mining sectors. Thus, cobenefits in reducing CH4 are not expected in response to decarbonization measures.
This study also analyzed required mitigation costs and cost cobenefs. The larger decarbonization measures are taken, the more energy shifting occurs from fuel to renewables and the more additional investments are required than end-of-pipe measures.

Keywords: SLCFs, Air Pollutants, Decarbonization, Mitigation Scenarios