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Flexible operation of the Cap-and-Trade System for the air pollutants in the Seoul Metropolitan area

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ABSTRACT

To improve the air quality in the Seoul Metropolitan area (SMA), the Korean government has implemented special measures in the 1990s. As part of these measures, the Cap-and-Trade System (CATS) was introduced and executed in July 1, 2007 for the oxides of nitrogen (NOx) and sulfur (SOx) to provide added flexibility for large sources to meet the required emission reductions. However, the trade via the SMA CATS for the air pollutants has not been active because of the limited buyers and sellers within the system as well as limited tradable species. For more flexible operation of the SMA CATS, following strategies have been suggested and their merits are discussed; (1) to link the SMA CATS with the Korea Voluntary Emission Reduction (KVER) program which is a program to manage greenhouse gases (GHGs), and (2) to extend the system, such as extension of the tradable species, participants, and introducing a project-based certification mechanism for pollutants reduction.

1. Introduction

The Seoul Metropolitan Area (SMA) in the Republic of Korea is a densely populated area, consisting of the major part of Gyeonggi Province, Seoul City and Incheon City. The SMA takes up only 12% of the total national land area in Korea, yet accounts for 49% of the total population, with a population density over 4 times higher than the Korea's average population density. Thus, the air quality in the SMA has been deteriorated during the 1970s with rapid industrialization.

However, the air quality in the SMA has been improved by various government efforts. The concentrations of primary pollutants, such as total suspended particles (TSP), carbon monoxide (CO) and sulfur dioxide (SO_2), have decreased drastically since the 1980s mainly due to government policies such as limiting the use of solid fuels and heavy oils for heating and cooking in the SMA since 1985. The ambient lead (Pb) concentration has also decreased drastically since the 1990s due to the use of unleaded gasoline (Kim, 2010). However, these measures have reached their limits of effectiveness; therefore, unsolved air pollution problems still exist. Due to the increased number of vehicles, the concentrations of nitrogen dioxide (NO_2) and secondary pollutants such as ozone (O_3), which is formed by the photochemical reaction by NOx and volatile organic compounds (VOCs), have not decreased (Kim, 2010). Compared with other mega-cities in the world, the level of air pollution in the SMA is 1.7–3.5 times higher, and also worse than the other major cities in Korea (Kim, 2007). For example, 75% of the ozone warning announcements in Korea have been issued in the SMA. The annual cost of the social damage caused by air pollution has been estimated at about 10 billion US dollars (GRI, 2003), and the adverse health effects from air pollution are also serious (KMOE, 2009).

To further improve air quality, the 'Special Measures for Metropolitan Air Quality Improvement' was prepared in December 2002 by the 'Seoul Metropolitan Air Quality Improvement Promotion Program Organization' under the Korean Ministry of Environment (KMOE), with the 'Special Act on Metropolitan Air Quality Improvement (SAMAQI)' implemented in 2005. The plan was to improve the air quality in the SMA to the level of those in the developed countries by conducting total air pollution load management, supplying low emission vehicles, retrofitting existing vehicles to reduce emissions, strengthening controls on VOCs from exhausts, and other preventive measures (KMOE, 2011b). The total budget for the plan will be about 5.2 billion USD by 2012.

The planned reductions in the emissions of major pollutants; NOx, SOx, PM10 (particulate matter with an aerodynamic diameter less than or equal to 10 μm) and VOCs, were 49, 58, 55 and 64% of the estimated emitted amount up to 2014, respectively (KMOE,

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2005b). To accomplish this goal, the projects to convert on-road vehicles to low emission vehicles, increase the deployment of low emission diesel vehicles and reduce exhaust gas emissions were introduced to manage the emissions from vehicles. In addition, to control VOCs, which are mainly emitted from area sources, reductions in the use of solvents and environmentally-friendly paints were introduced. Also, to reduce and manage the emissions from industrial facilities, a project to support the installation of low NOx burners was introduced, and the Cap-and-Trade System for the air pollutants in the SMA (the SMA CATS) was started in July 2007 (KMOE, 2011b). A facility is defined as an entity that emits air pollutants and/or GHGs.

However, the SMA CATS, which will be described in section 2, has demonstrated limited success due to the limited buyers and sellers, as well as limited tradable species in the system, although the object of the SMA CATS was to provide the facilities with added flexibility in meeting the required reductions in their emissions while lowering the cost of compliance. The numbers of trades have increased since the first trade in 2008, but are still small. Also, the amount of NOx traded was small, and the trading price is decreasing. Thus, more attractive ways to drive active participation of facilities to trade will be needed; therefore, methods for the flexible operation of the SMA CATS should be studied.

In addition to pursuing improved air quality, links with climate change are also important since most facilities simultaneously co-emit air pollutants and greenhouse gases (GHGs). The GHGs emissions in Korea were 588 $MtCO_2e$ and the SMA's GHG emissions were 171 $MtCO_2e$ in 2009. Reducing and managing GHGs are outstanding problems. Therefore, the Korean Government announced a GHG reduction target for 2020 which was a 30% reduction compared to the 2020 Business As Usual emissions at the UNFCCC COP 15 meeting (Conference Of Parties 15), held in Copenhagen in 2009. Also, the Korean Government is actively driving the "low-carbon, green growth" strategy as a new vision to guide the nation's long-term development (FALCGG, 2011).

The Korean Government has operated the Korea Voluntary Emission Reduction (KVER) program as one of the devices for managing GHGs (KEMCO, 2010). Since Korea is not an Annex I party to the Kyoto protocol, the facilities in Korea are under no obligation to reduce GHGs, either internationally or domestically, so no allowance based cap and trade scheme for GHGs exists in Korea. Companies are in favor of the KVER program, because it offers a project-based credit, which is a kind of economic incentive.

Previous studies have shown that implementing integrated measures, which address both air pollutants and GHGs emissions, is essential to achieve the necessary air quality improvements and prepare for future agreements on climate change for Korea (Chae, 2010; IDI, 2010; KMOE, 2007). And the Korean Government has established the GHG-CAPSS (Clean Air Policy Support System) which is the data-base system to estimate the national emission data for air pollutants (SOx, NOx, PM10, etc.) and greenhouse gases (CO_2, N_2O, and CH_4) (KMOE, 2011a).

Integrated management is considered a cost-effective mechanism to reduce the impact of air pollutants on ecosystems, human health and the risks associated with climate change, especially when GHGs and air pollutants are co-generated by the combustion of fossil fuels (Syri et al., 2001; Barker et al., 2010). According to Alcamoa et al. (2002), climate policies could have a major indirect effect on the costs of controlling regional air pollution. Previous co-benefit studies have shown that GHG mitigation policies had a positive effect on the regional air quality (van Vuuren et al., 2006; Rypdal et al., 2007; Williams, 2007; Bollen et al., 2010; Chae, 2010).

In this study, for the purpose of the more flexible operation of the SMA CATS two options; (1) to link the SMA CATS with the KVER Program, and (2) to extend the System by extending the tradable species and participants, and introducing a project-based certification mechanism for pollutants reduction have been suggested and discussed.

2. The Cap-and-Trade System for the air pollutants in the Seoul Metropolitan area

The SMA CATS is one of the main policies to reduce and manage the emissions from facilities within the SMA. It has been executed for class 1 facilities. Among the class 1 facilities, the facility emitting 30 t or more NOx per year, or 20 t or more SOx per year since July 2007 were selected as the target facility. It has been expanded to class 2 or 3 facilities emitting 4 t or more NOx, or 4 t or more SOx since July 2009. The classification criteria for facilities with total amount of pollutants emitted are shown in Table 1. The target pollutants for estimating the amounts emitted are TSP, SO_2 and NOx, which are emitted from most facilities (CACA, 2011). The total amount of pollutants emitted is estimated using the maximum amount of fuel usage or the facility's capacity.

The established cap was not very stringent for the 1st compliance year, but the cap on the SMA CATS has become more stringent. The cap will be linearly reduced down to the level with the best available technology being applied in the 5th compliance year (KMOE, 2005a). The total cap for the 1st compliance year to the whole facilities of the same category was the average of the emission amounts during the latest 5 years, but the cap to each facility was distributed using the activity level of each facility. The allowances are free-granted and banking is permitted but not borrowing. If a facility emits more than the annual allocated amount, the facility will be fined and the emission allowance for the next year will be reduced accordingly (CACA, 2011; KMOE, 2005a).

Each facility may determine its own most cost-effective approach for reducing emissions, including purchasing emission credits from other facilities that have reduced emissions below their target levels. However, the SMA CATS has limitations because of the limitation of the buyers and sellers which should be one of the targeted facilities. Also, the tradable species are limited, as only SOx and NOx can be traded with no inter-species trading allowed. The number of trades has increased after the first trade in 2008, with 18, 19 and 77 trades in 2008, 2009 and 2010, respectively. However, the traded amount of NOx was highest in 2008, and has decreased thereafter. The amounts traded were 894, 326 and 574 t in 2008, 2009 and 2010, respectively as shown in Table 2 (KMOE, 2010). The trading price has also decreased from $0.30 in 2008, to $0.12 in 2009, and finally to $0.09 per kg in 2010, which was quite a low price compared to those for NOx and SOx in the RECLAIM (REgional CLean Air Incentives Market); the market program for reducing air pollution in the South Coast AQMD (Air Quality Management District), USA. The trading prices in 2009 via RECLAIM were $125 per kg for NOx and $37 per kg for SOx. Table 3 shows that the trading price has increased in RECLAIM since 1994 (AQMD, 2010). Even the lowest price for the NOx or SOx in the mid 1990s was about $15 per kg.

Table 1
Classification criteria for facilities with total amount of pollutants emitted.

Classification	Emitted total amount of pollutants annually
Class 1	Facilities emitted 80 t or more
Class 2	Facilities emitted 20 t or more and less than 80 t
Class 3	Facilities emitted 10 t or more and less than 20 t
Class 4	Facilities emitted 2 t or more and less than 10 t
Class 5	Facilities not included in the class 1–4

Source: SAMAQI (2011).