CO_2 REDUCTION POTENTIALS IN THE TRANSPORT SECTOR BY MARGINAL ABATEMENT COST CURVES

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1. Introduction

Information regarding cost-effective greenhouse gas (GHG) emission reduction potentials in the sector level is significant for the success of the negotiations to promote sectoral approaches and set reduction targets for a specific sector. Especially, the transport sector needs to be curbed its emissions, as it contributes to 13% of GHG and 23% of global carbon dioxide (CO_2) emissions and is the fastest growing sector. This paper presents the percentage reduction potentials of CO_2 emissions in the transport sector in 2020 through marginal abatement cost (MAC) curves, compared to the emission levels of 1990 and 2005.

2. Marginal Abatement Cost Curves

Recently, MAC curves have become an efficient instrument to analyze potentials of GHG mitigation and impacts of the Kyoto Protocol and its emission trading (Klepper and Peterson, 2006). Also, the MAC curves can provide optimal emission reductions for countries which minimize total abatement cost for a given target (Ellerman and Decaux, 1998). However, to deal with sector-specific emission reductions, there was no previous study that provides sectoral MAC curves which have a large coverage of countries and regions. For instance, Ellerman and Decaux (1998) applied the EPPA Model to generate country-based MAC curves for 12 regions while Sue Wing (2004) developed a multi-sector computable general equilibrium (CGE) model which could generate sectoral MAC curves but only for the USA.

Thus, MAC curves by sector and by region for the year 2020 were first generated by the authors (Tippichai, Fukuda and Morisugi, 2009) through applying the AIM/CGE model which was developed by Professor Toshihiko Masui. The authors also introduced scenarios of the CO_2 emission reduction targets for the transport sector in 2020 for five key emitting developed countries. Based on the sectoral MAC curves plotted with absolute reductions, optimal CO_2 emission reductions and abatement costs in the transport sector for the countries were determined. However, in order to compare the reduction potentials among countries without taking into account of the size of the economy, the MAC curves with percentage reduction are essential. Also, this kind of the MAC curves can represent the reduction potential compared to the benchmark years.

3. CO_2 Reduction Potentials in the Transport Sector

The MAC curves for the transport sector in 2020 for 24 regions by plotting with absolute quantities and percentage of CO_2 emission reductions were first developed by the authors (Tippichai, 2010). In this paper, we focus on CO_2 reduction potentials in the transport sector in 2020 for 15 single countries (i.e., Australia, New Zealand, China, Japan, Korea, Indonesia, Thailand, India, Canada, USA, Mexico, Argentina, Brazil, Russia, and South Africa) and Western Europe (EU-15) and compare to the emission level of 1990 and 2005 which are currently used as the benchmark years to propose the mid-term reduction targets by developed countries. From the statistical data, these countries contributed to more than 80% of global CO_2 emissions in the transport sector in 1990 and 2005 (WRI, 2010).

Fig. 1 shows the MAC curves which are plotted by the absolute quantities of CO_2 emission reductions according to different CO_2 tax levels (i.e., 50, 100, 150 and 200 USD/tCO_2). It can be seen that for any equal tax level or marginal abatement cost, the emission reductions for the transport sector are most in USA and China, and least in New Zealand and Argentina. Further, in order to show the variations across countries without taking into account the size of the economy, the percentages of CO_2 emission reductions are plotted responding to the tax levels, as shown in Fig. 2. It was shown obviously that the range of emission reductions in percentages for countries is closer than plotting emission reductions in absolute quantities. Moreover, the ranks of emission reductions in percents for countries are not the same with the plotting emission reductions in absolute quantities. Brazil becomes the most efficient reductions of CO_2 emissions, in other words, Brazil has the least cost to reduce CO_2 emissions in the transport sector, followed by South Africa, Thailand, New Zealand, Indonesia, respectively. Meanwhile, Japan and EU-15 have the least efficient reductions of CO_2 emission reductions, in other words, they have the highest cost to reduce CO_2 emissions in the transport sector among the countries.

Figs. 3 and 4 show the percentage reductions of CO_2 emissions in the transport sector in 2020 compared to the emission level of 1990 and 2005, respectively. The percentage of reduction potentials of CO_2 emissions in the transport sector in 2020 compared to the 1990 level are higher than the percentage

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compared to the 2005 for most of the countries. In other words, the CO_2 emissions in the transport sector in 2005 of most of the countries were higher than the emission level in 1990. For the percentage reductions compared to the 1990 level, China and Thailand have the most efficient reductions while Japan, EU-15 and Russia have the least efficient reductions. For the percentage reductions compared to the 2005 level, India has the most efficient reductions while Japan and EU-15 have the least efficient reductions. Also, it should be noted that China has the most efficient reductions for lower CO_2 tax, below 25 USD/tCO_2, after that the emission reduction varies by the tax level slightly.

4. Concluding Remarks

This paper presented the percentage reduction potentials of CO_2 emissions in the transport sector in 2020 through MAC curves, compared to the emission levels of 1990 and 2005. Based on the MAC curves for the transport sector compared to different benchmark years, it was seen that the country that has the most efficient reductions will change according to benchmark years, while Japan and EU-15 have the least efficient reductions for all cases. Therefore, it can be concluded that the selection of the benchmark year is important for setting the reduction target. Moreover, it can be said that this information about CO_2 reduction potentials in the sector level will be very informative and accelerate the negotiation to promote the sectoral approach and allocate reduction targets for the transport sector for the post-Kyoto Protocol.

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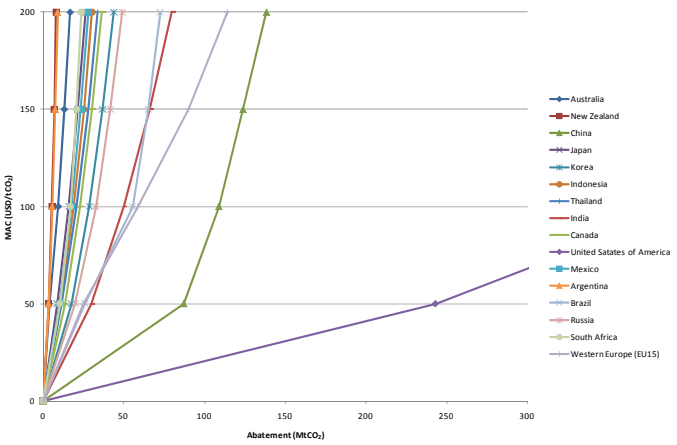

Fig. 1 MAC curves for the transport sector in 2020

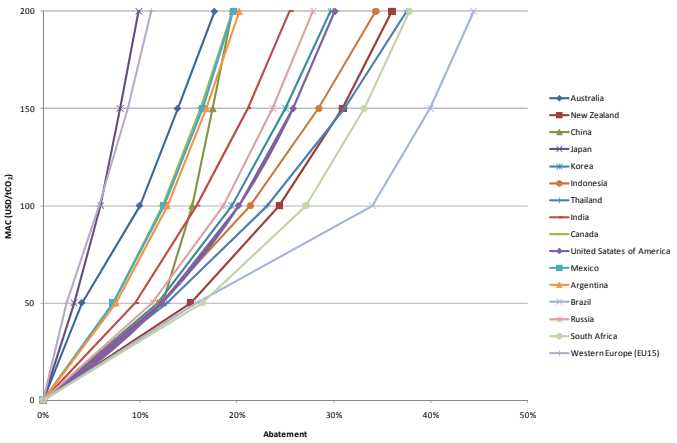

Fig. 2 Percentage of CO_2 reductions in the transport sector in 2020

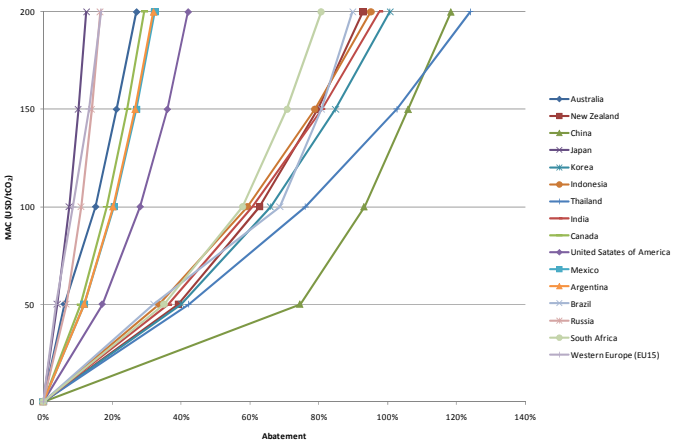

Fig. 3 Percentage of CO_2 reductions compared to 1990 level

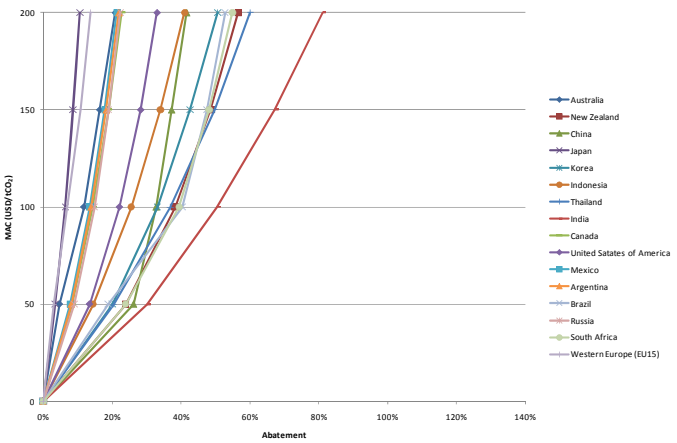

Fig. 4 Percentage of CO_2 reductions compared to 2005 level