



Greenhouse Gas Emissions Technical Mitigation Potentials and Costs in 2020

Mikiko Kainuma

National Institute for Environmental Studies

**2nd International Workshop on Sectoral Emission Reduction Potential
OECD Conference Centre Room CC7, Paris, France
22nd October 2008**

Key questions

- How much is mitigation potential by region and by sector in 2020?
- Is it enough to achieve emission targets?
- What kinds of barriers exist to prevent such potential into practice?
 - Financing
 - Acceptance (e.g. nuclear, CCS, bio-energy vs. food security and/or ecosystem preservation)
 - Lack of information
 - Lack of incentives/ability
- What kinds of policies are effective to support implementation of technologies?

Why difficult to estimate mitigation potentials ?

- Difficult to get information on technology vintages of the base year
- Difficult to assume characteristics of technologies in future
 - Performance
 - Cost
- Uncertainties of driving forces (e.g. population, GDP, energy price)
 - Economic situation
 - Level of activities caused by lifestyle, political situation, international relationships, etc.

Baseline assumption & technologies

Baseline assumption

Baseline is set as a technology frozen case, i.e. when the future share and energy efficiency of standard technologies are fixed at the same level as in the base year.

Mitigation technologies

This study is based on realistic and currently existing technologies, and future innovative technologies expected in 2020 are not taken into account.

Note1) For example, CCS is one of expected future innovative technologies that is likely to have large effect on mitigation measures. due to the lack of data availability, CCS is not taken into account as a mitigation measure in this study.

Note2) Effects of mitigation measures such as additional policies promoting modal shift, public-enlightment actions are not considered in this study.

Overview of this study

Mitigation potentials in this study are defined as follows:

Reduction amounts which are estimated by comparing the effect of introduction of new mitigation technologies in the target year, target region and target sector as compared to the effect of standard technologies fixed at the same level as in the base year

- ◆ **Target Regions : 23 geographical world regions**
- ◆ **Time Horizon : 2000 – 2020**
- ◆ **Target Gas : CO₂, CH₄, N₂O, HFCs, PFCs, SF₆**
- ◆ **Target Sectors : multiple sectors**
(Power generation / Industry / Residential and Commercial / Fugitive/
Transport / Agriculture / Waste / F-gas emissions sector)

Technology database

Energy Database

Mitigation potentials in 2020 are estimated at a 5%/year discount rate by using MAC (Marginal Abatement Cost) tool with detailed mitigation options database

Caveats of this study

The following points must be kept in mind while interpreting the results of this study:

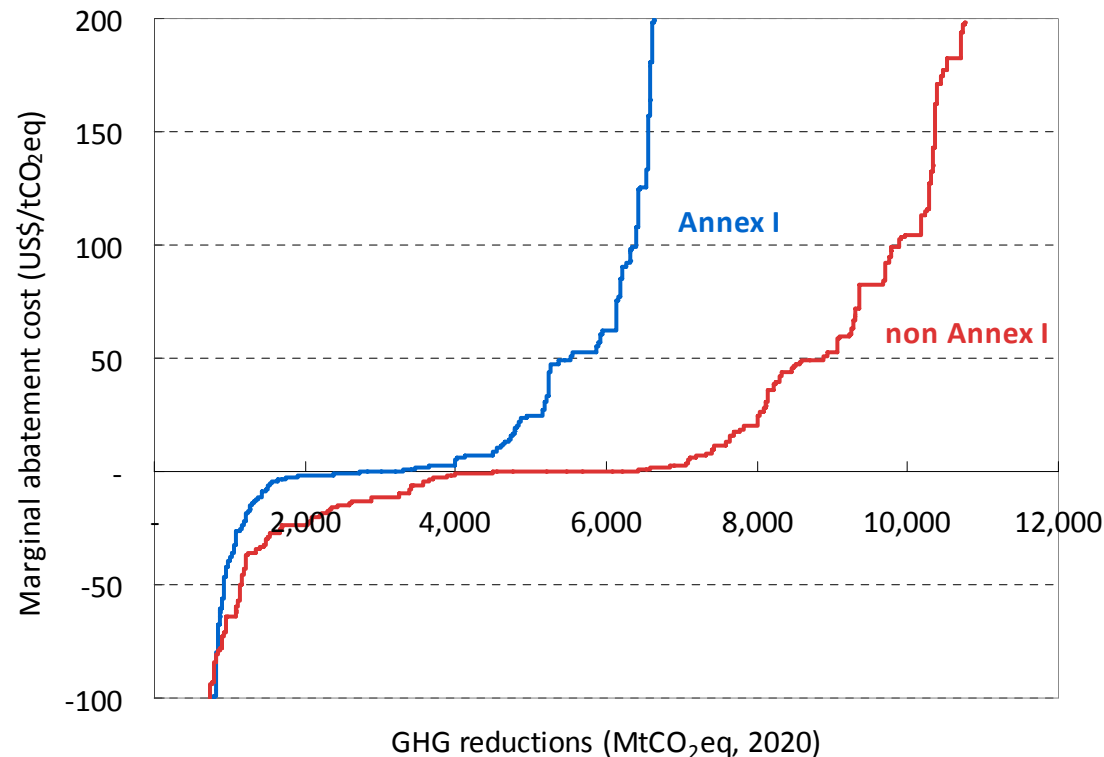
1) Possibility of more mitigation potentials

This study is based on realistic and currently existing technologies, and future innovative technologies expected in 2020 are not taken into account. Therefore, it may be possible to reduce more if innovative technologies become available in the future.

2) Possibility of over estimation

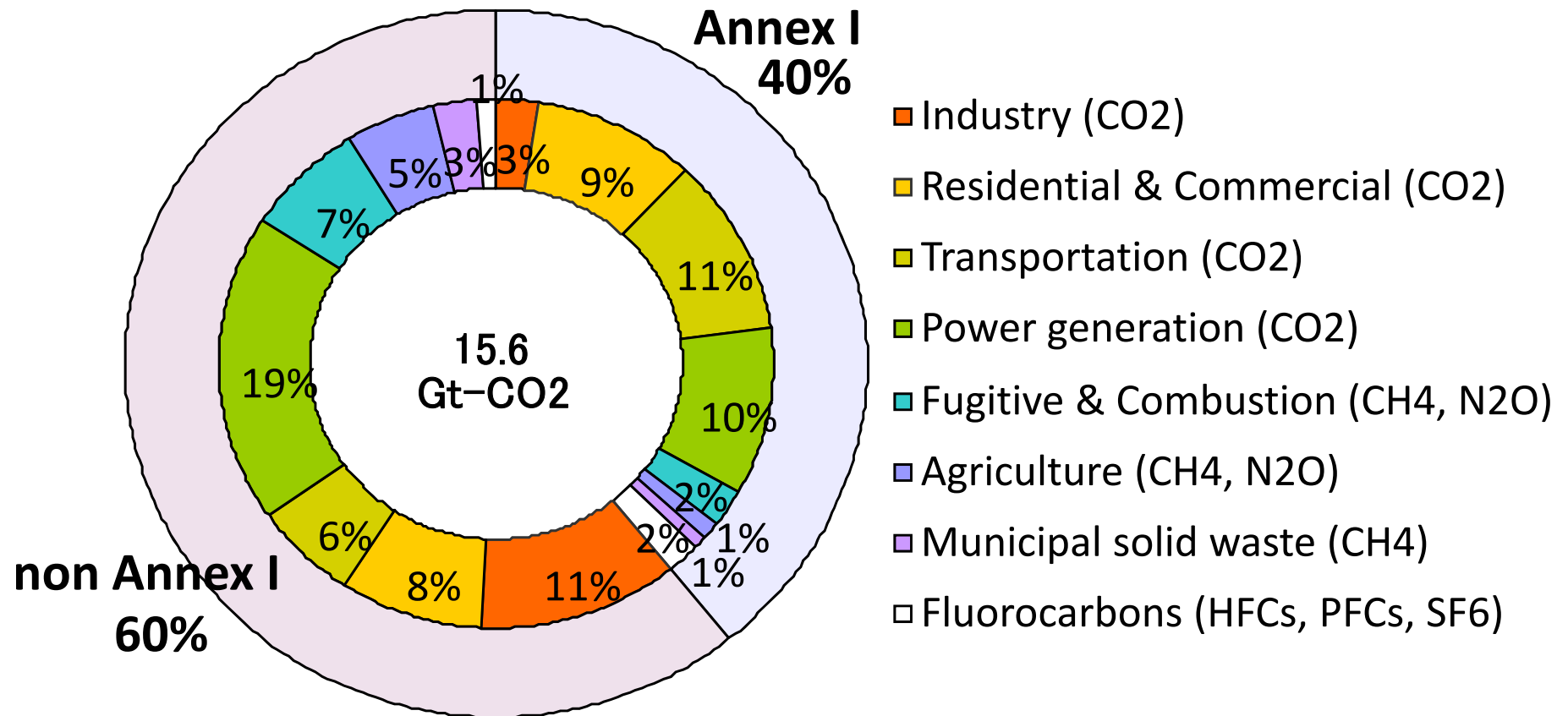
The baseline emissions in 2020 are estimated under the technology-frozen case which does not take into account changes in the industrial structure. Moreover, future service demands are exogenous parameters, thus changes in the industrial structure and service demands due to the effects of mitigation measures are not taken into account. Thus baseline emissions and mitigation potentials may be overestimated.

Marginal abatement cost curves in Annex I and Non-Annex I in 2020



- **Mitigation potentials in 2020 are estimated as 15.6 GtCO₂ eq globally and 6.1 GtCO₂ eq and 9.5 GtCO₂ eq under 100 US\$/tCO₂ marginal abatement cost in 2020 in Annex I and Non-Annex I regions respectively.**
- **There are larger mitigation potentials for cost-effective measures in Non-Annex I. Thus international cooperation in technology transfers and financial assistance to developing countries may play an important role in achieving GHG mitigation.**

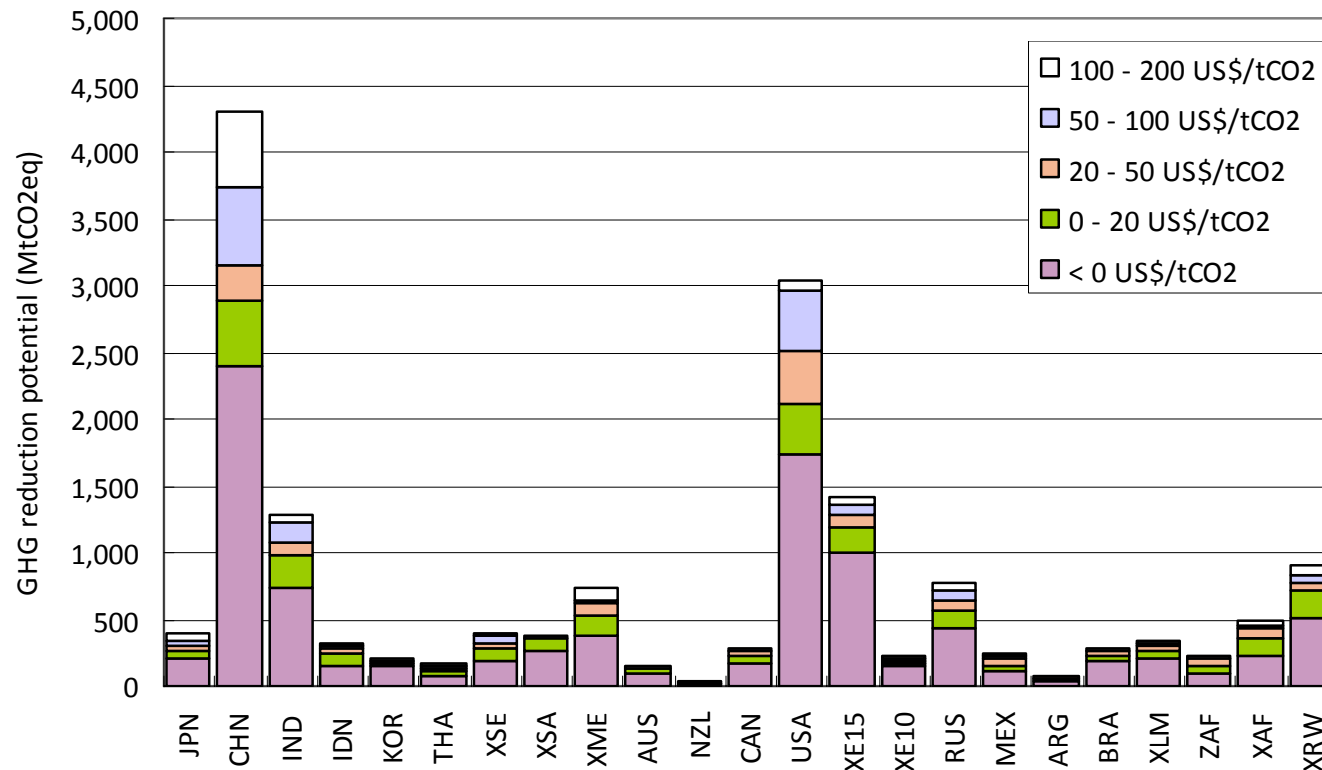
Ratio of sector-wise mitigation potentials in Annex I and Non-Annex I in 2020



- Large mitigation potentials are identified in the power generation and industry sectors due to the use of low energy-efficient technologies in Non-Annex I regions. These sectors account for about 40~50% of the total potential.
- Mitigation potentials in Non-Annex I account for about 60% of the total.

Region-wise mitigation potentials in 2020 for different cost categories

Mitigation potentials from 0 to 200 US\$/tCO₂ at a 5%/year discount

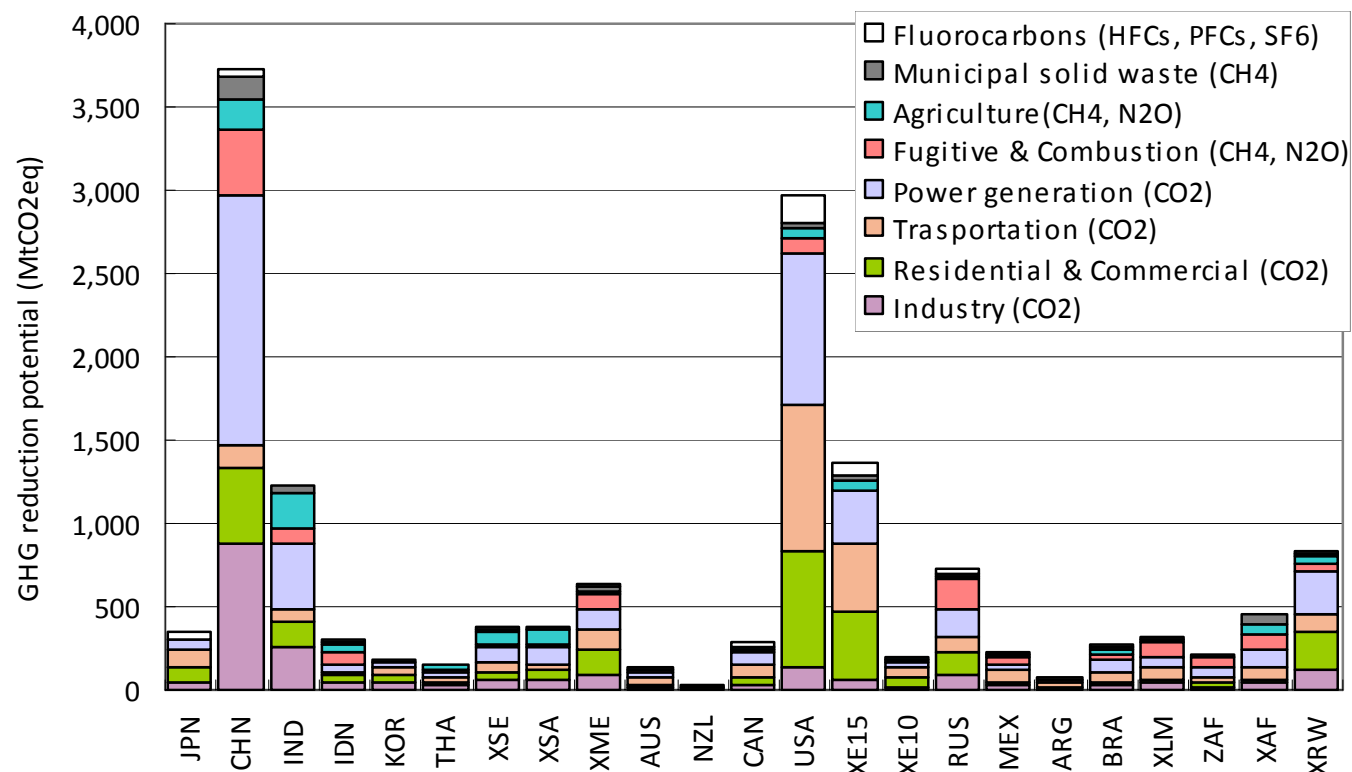


JPN	Japan
CHN	China
IND	India
IDN	Indonesia
KOR	Korea
THA	Thailand
XSE	Other South-east Asia
XSA	Other South Asia
XME	Middle East
AUS	Australia
NZL	New Zealand
CAN	Canada
USA	USA
XE15	Western Europe(15)
XE10	Eastern Europe(10)
RUS	Russia
ARG	Argentina
BRZ	Brazil
MEX	Mexico
XLM	Other Latin America
ZAF	South Africa
XAF	Other Africa
XRW	Rest of the World

- **China, US, India, Western Europe and Russia are five major regions with large mitigation potentials, accounting for approximately 60% of the total mitigation potential in the world. Ten major regions account for approximately 75%.**
- **It is important to think carefully about the meaning of the no-regret (i.e. 0US\$/tCO₂ eq.) case . Even if it is no-regret, such options cannot be introduced without imposing initial costs.**

Sector-wise mitigation potentials in 2020

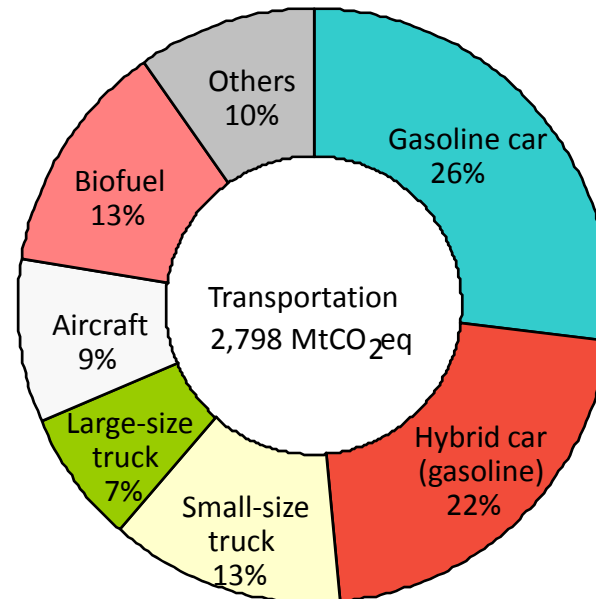
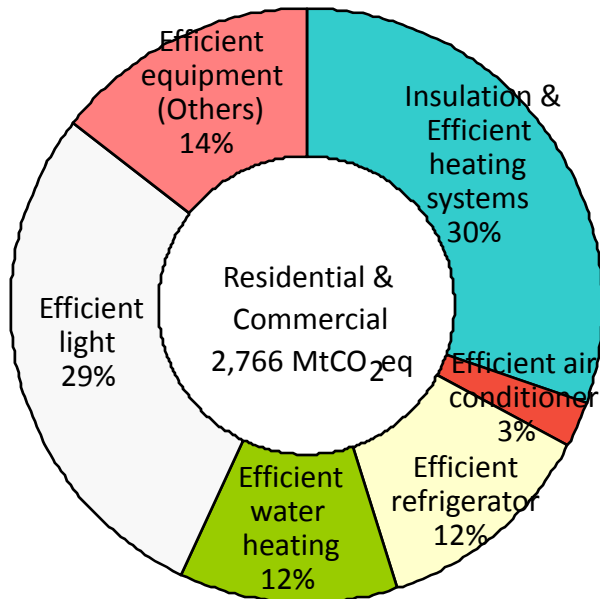
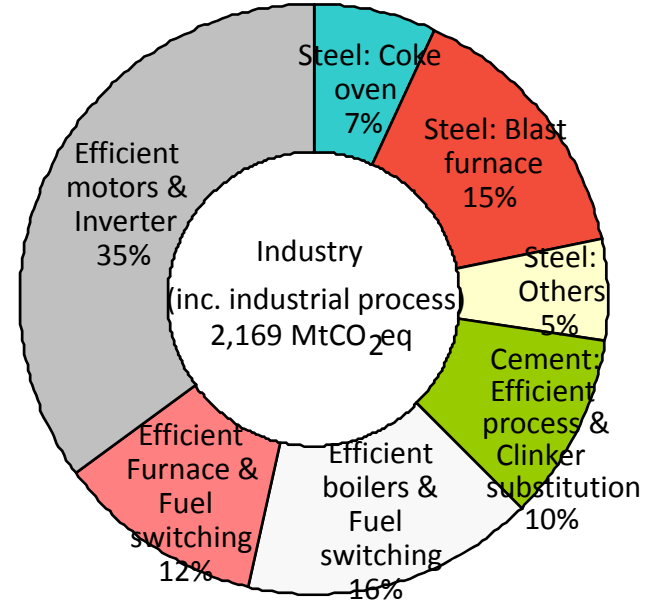
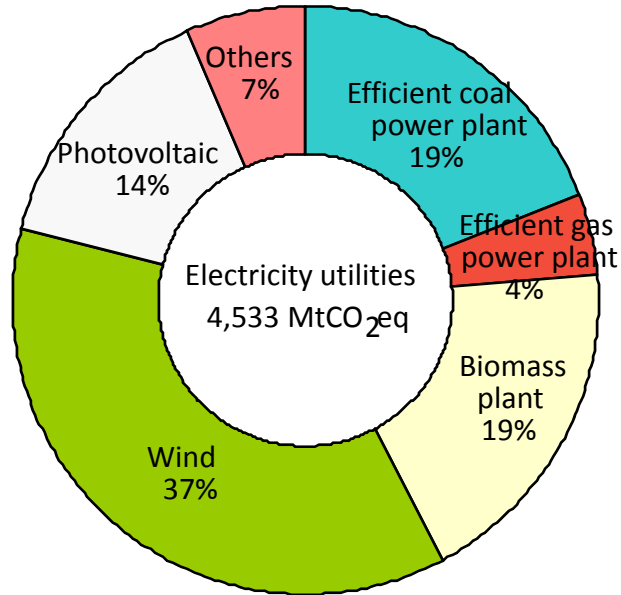
mitigation potentials under 100 US\$/tCO₂ at a 5%/year discount rate



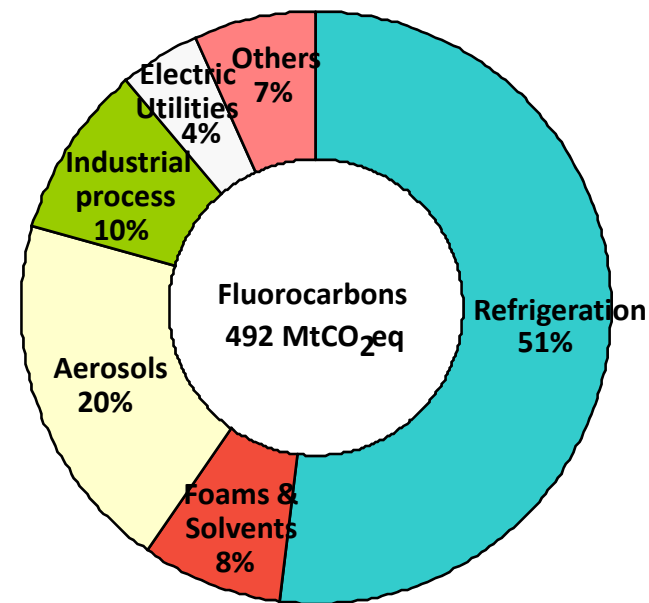
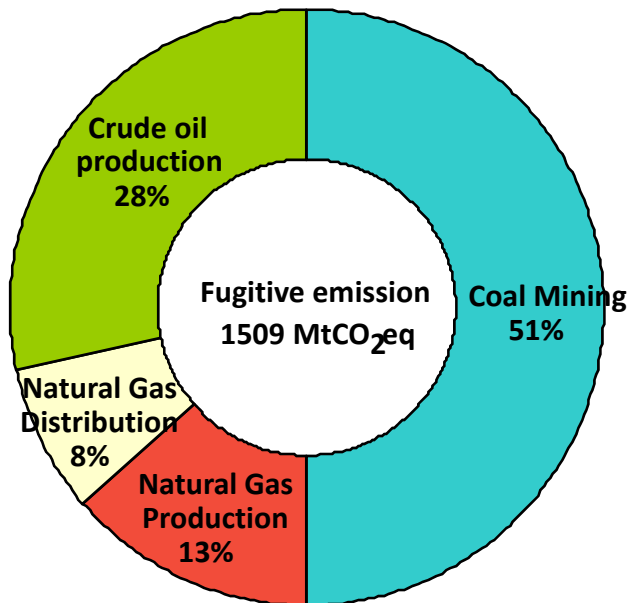
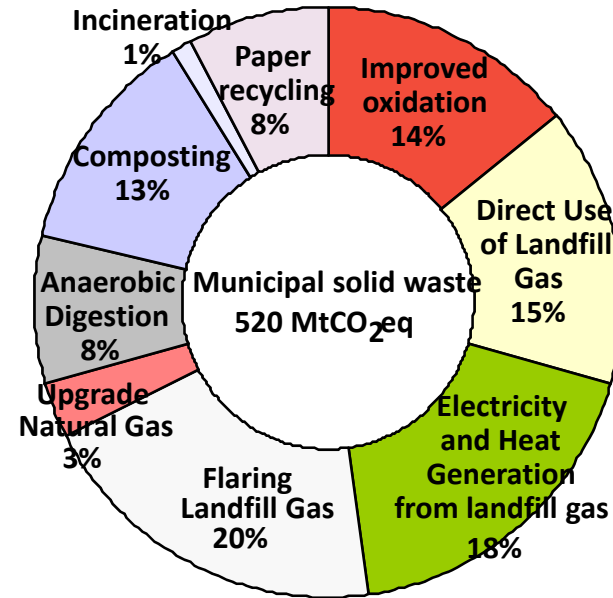
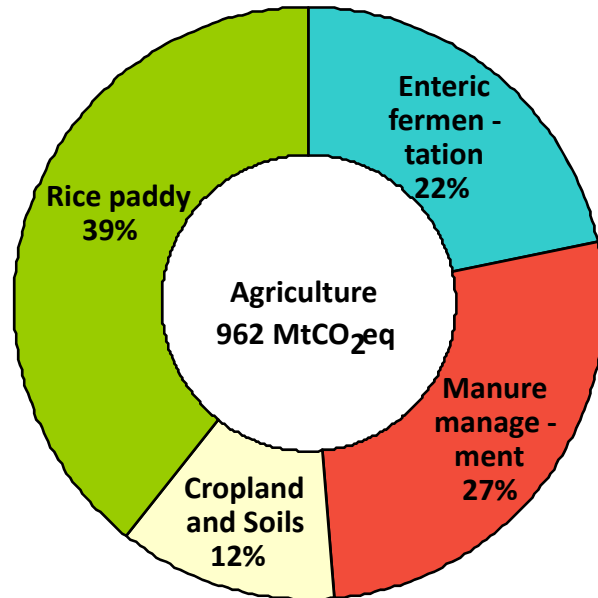
JPN	Japan
CHN	China
IND	India
IDN	Indonesia
KOR	Korea
THA	Thailand
XSE	Other South-east Asia
XSA	Other South Asia
XME	Middle East
AUS	Australia
NZL	New Zealand
CAN	Canada
USA	USA
XE15	Western Europe(15)
XE10	Eastern Europe(10)
RUS	Russia
ARG	Argentina
BRZ	Brazil
MEX	Mexico
XLM	Other Latin America
ZAF	South Africa
XAF	Other Africa
XRW	Rest of the World

- In China and India with high economic growth, mitigation measures in industry and power generation sectors are significant. In developing countries, it is also effective to reduce emissions from agriculture and waste sectors.
- In developed countries, it is important to undertake measures in the industry and power generation sectors, but potentials in transport, residential and commercial sectors are also large.

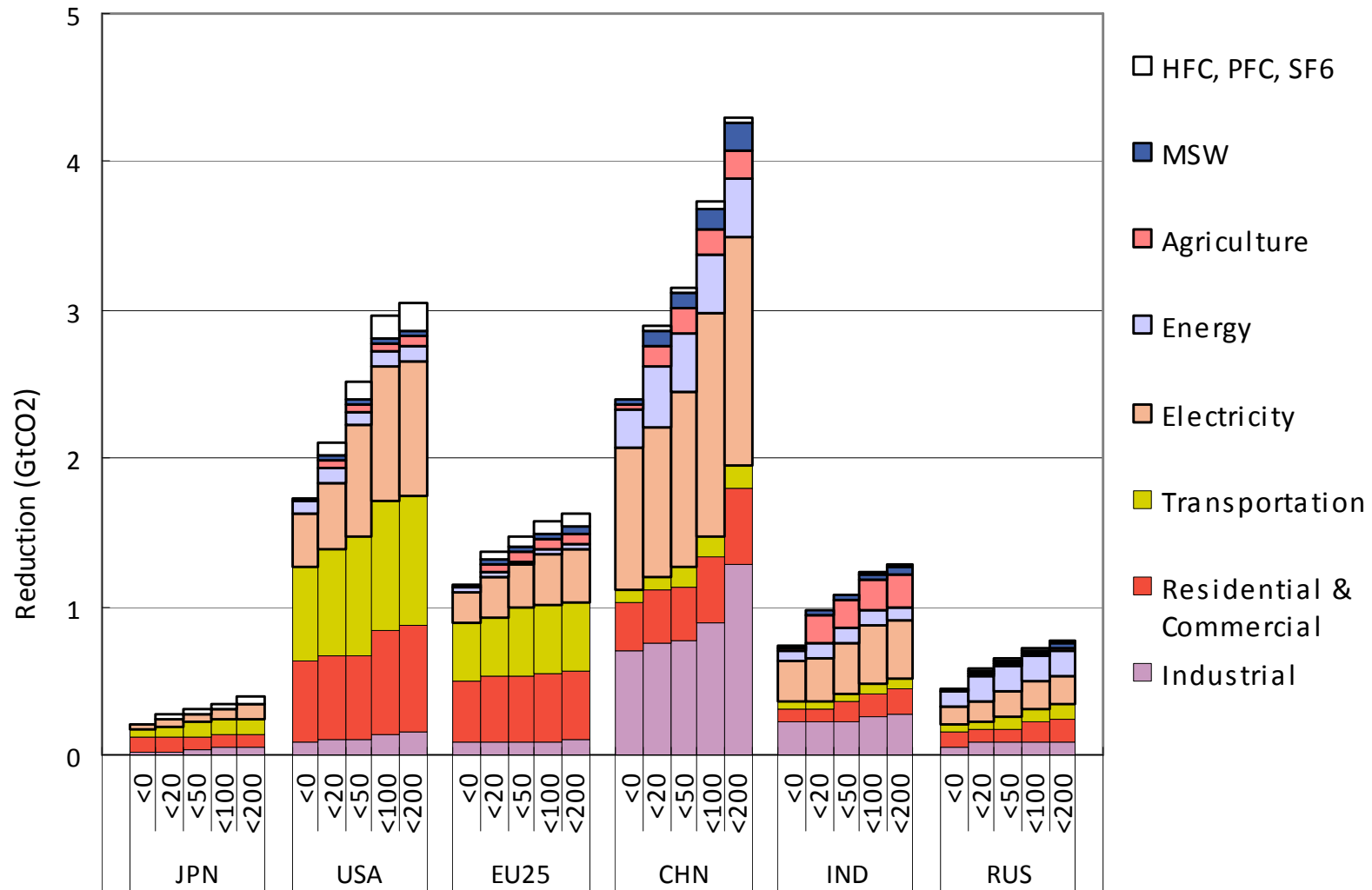
Major Mitigation Option



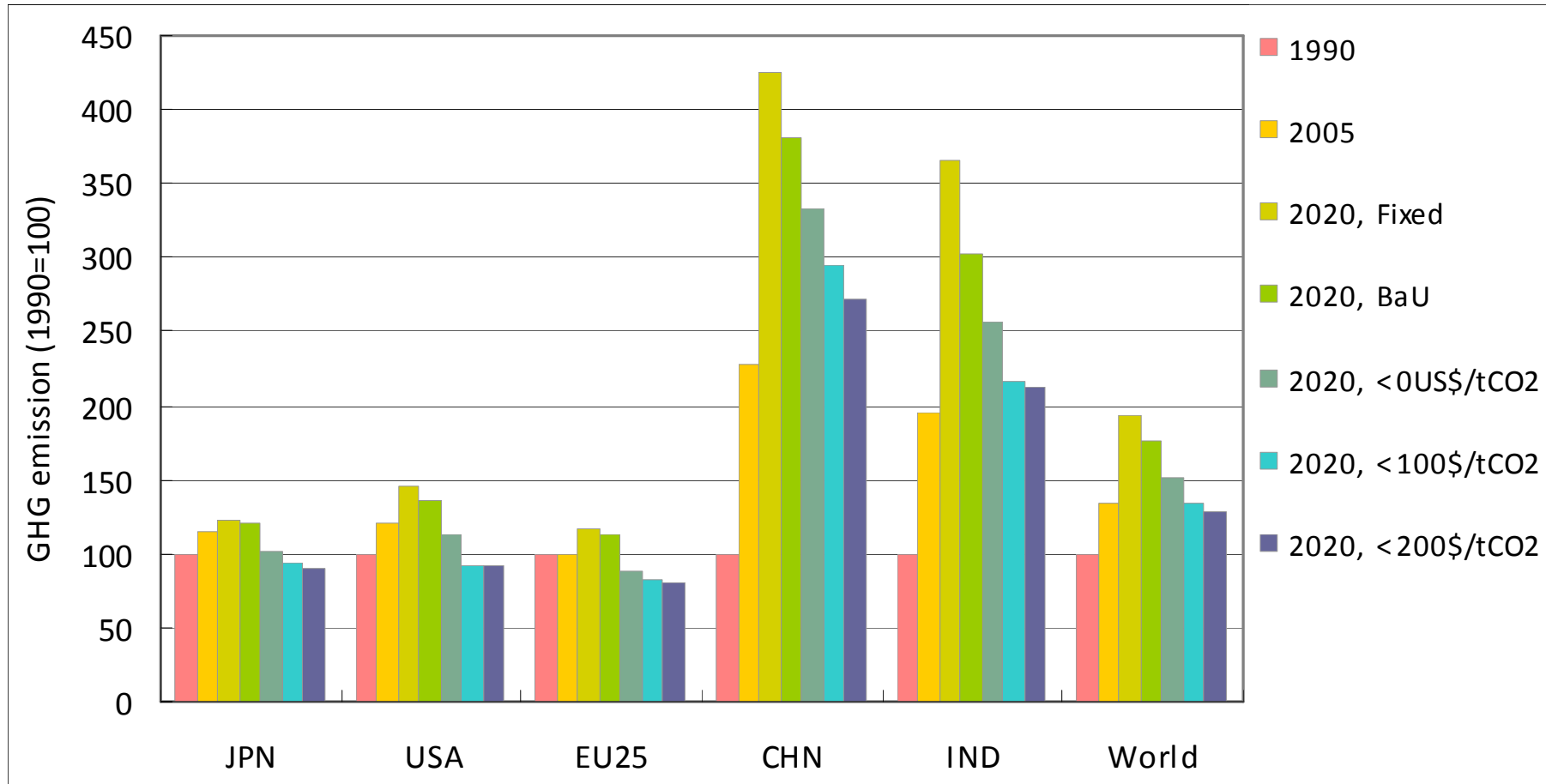
Major Mitigation Option



Sector-wise potentials in major countries and regions for different cost categories



Emission in 2020 for different cost categories



- **In this study, mitigation potentials are estimated compared to the technology-frozen case. However, if we define a certain BaU not the technology-frozen case, then the results of mitigation potentials become different, especially under the no-regret case.**

GHG Emissions in major countries & regions

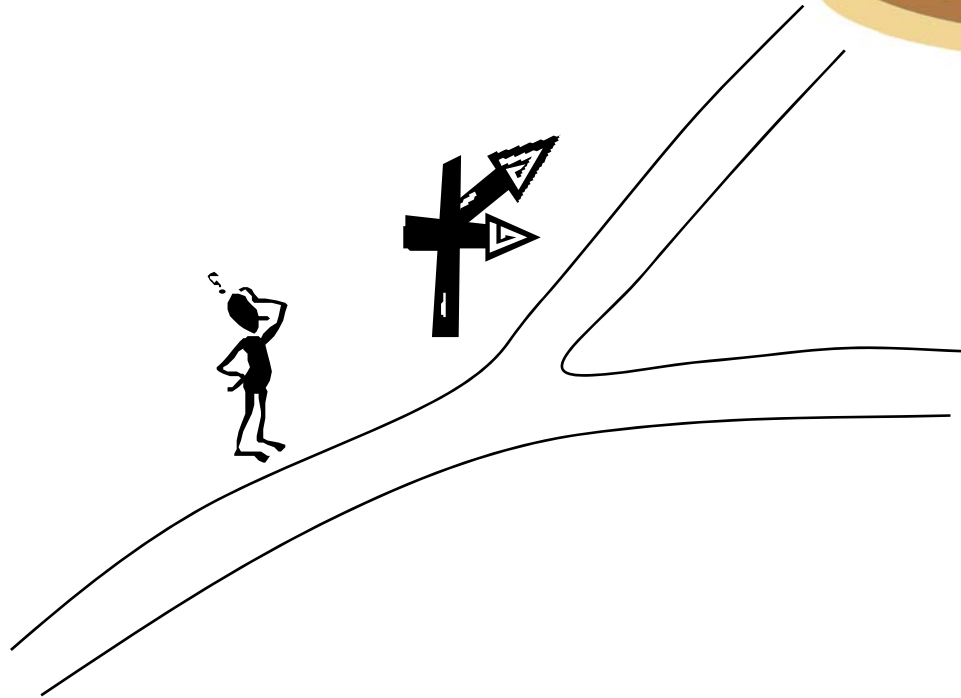
Unit: GtCO₂ eq

				2020 (Mitigation)					
	1990	2005	2020 (Frozen)	< 100 \$/tCO ₂	vs 1990	vs 2005	< 200 \$/tCO ₂	vs 1990	vs 2005
Japan	1.25	1.41	1.53	1.13~ 1.18	-9% ~ -5%	-19% ~ -16%	1.11~ 1.14	-11% ~ -9%	-21% ~ -19%
US	6.33	7.28	8.92	5.84~ 5.96	-8% ~ -6%	-20% ~ -18%	5.77~ 5.88	-9% ~ -7%	-21% ~ -19%
EU25	5.09	4.98	5.80	4.14~ 4.22	-19% ~ -17%	-17% ~ -15%	4.10~ 4.17	-20% ~ -18%	-18% ~ -16%
China	3.74	7.53	12.78	8.76~ 8.91	134% ~ 138%	16% ~ 18%	8.22~ 8.33	120% ~ 123%	9% ~ 11%
India	1.48	2.38	3.55	2.36~ 2.40	59% ~ 61%	-1% ~ 1%	2.31~ 2.35	55% ~ 58%	-3% ~ -1%
Russia	3.07	2.21	2.80	2.05~ 2.07	-33% ~ -32%	-7% ~ -6%	2.00~ 2.02	-35% ~ -34%	-9% ~ -8%
Annex I	16.89	17.31	20.84	14.49~ 14.77	-14% ~ -13%	-16% ~ -15%	14.27~ 14.52	-15% ~ -14%	-18% ~ -16%
Non Annex I	16.32	25.02	36.15	26.43~ 26.77	62% ~ 64%	6% ~ 7%	25.45~ 25.77	56% ~ 58%	2% ~ 3%
Global	33.86	43.29	58.25	42.00~ 42.62	24% ~ 26%	-3% ~ -2%	40.80~ 41.37	20% ~ 22%	-6% ~ -4%

Key findings

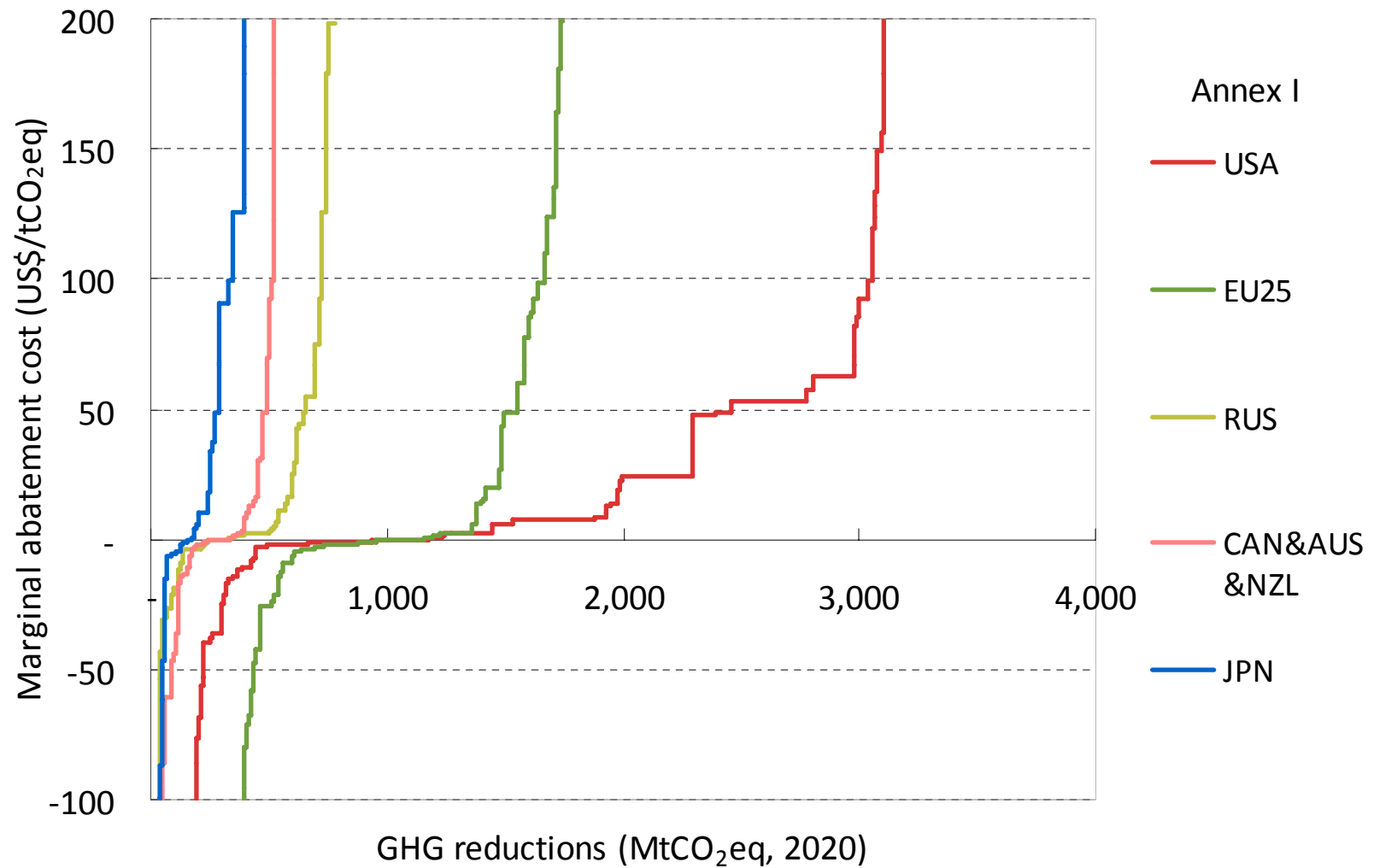
- **China, US, India, Western Europe and Russia are five major regions where there are large mitigation potentials, and account for about 60% of the total mitigation potential, and top ten major regions account for about 75 %.**
- **Large mitigation potentials exist in power generation and industry due to the use of low energy-efficient technologies especially in Non-Annex I countries, and these sectors account for approximately 40% of total global mitigation potential.**
- **There is a much larger potential for cost-effective measures in developing countries, therefore international cooperation such as technology transfer and financial assistance to developing countries will play an important role.**
- **Early actions are effective to achieve mitigation targets.**

Timing is important!

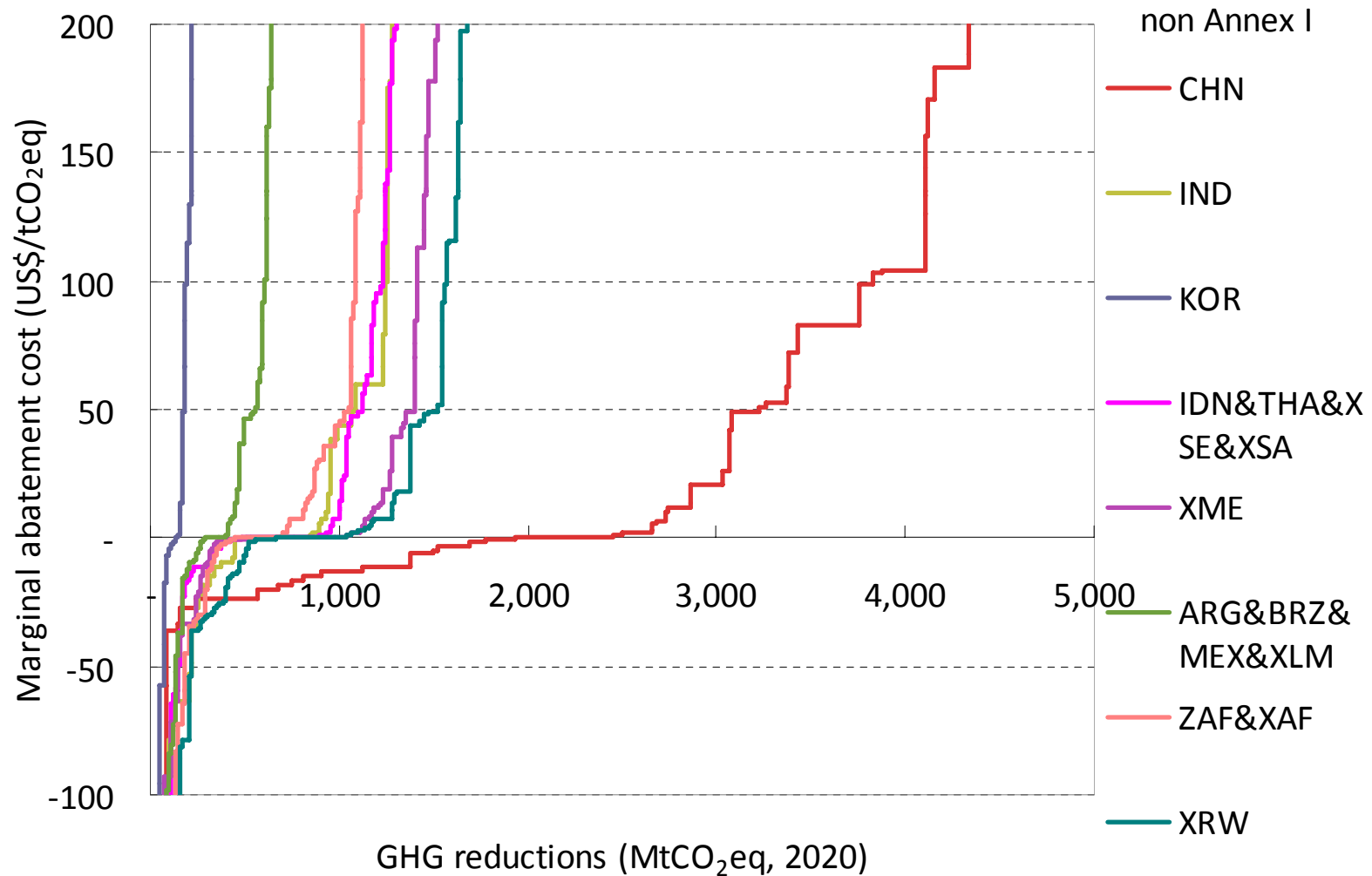


Thank you for your attention!

Regional MAC curves - Annex I nations -

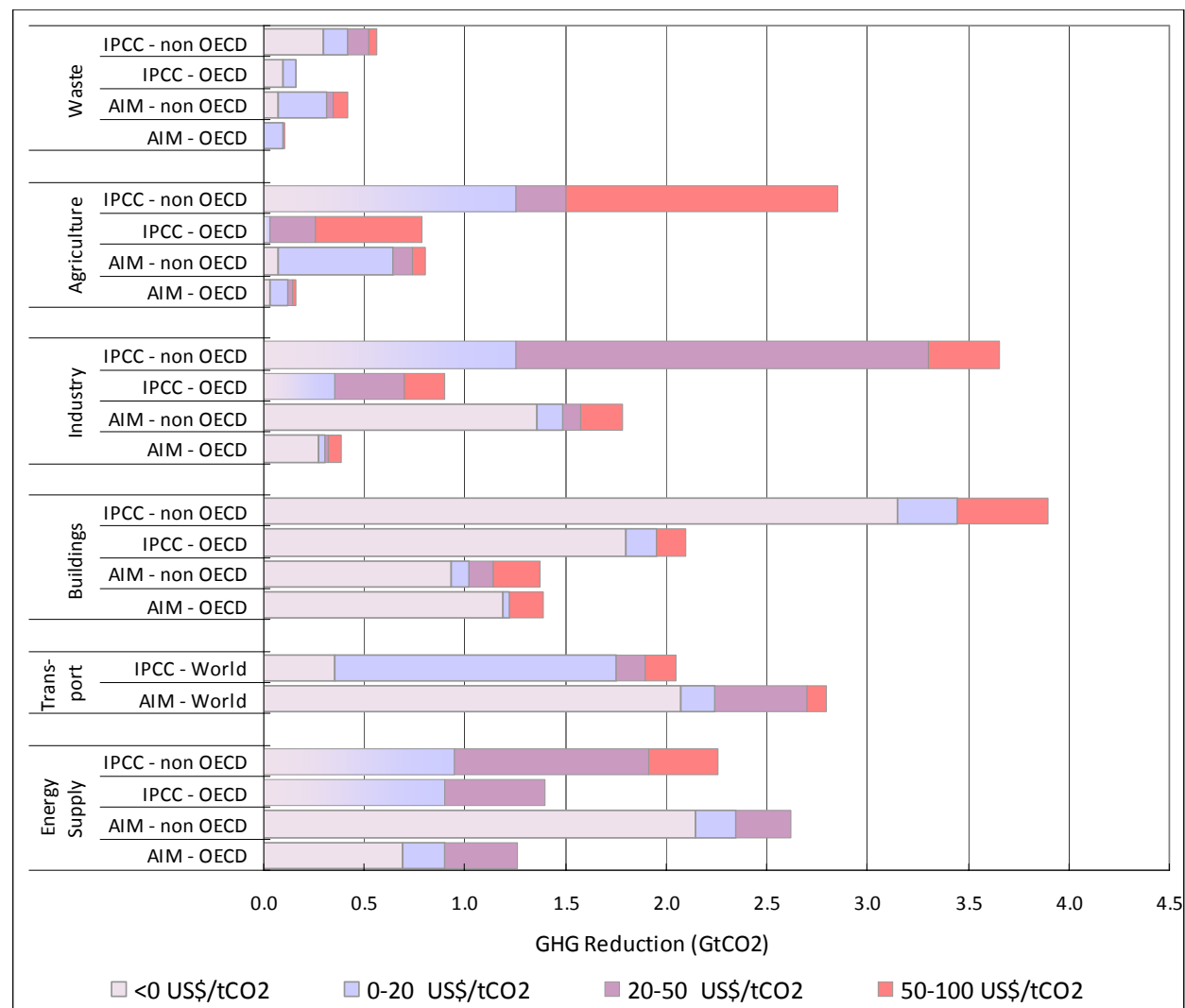


Regional MAC curves - Non Annex I nations -



Comparison with the IPCC AR4

mitigation potentials under 100US\$/t-CO₂



➤ **This study shows results for 2020, but results in IPCC AR4 are for 2030.**