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Co-benefits of reducing non-CO2 emissions in Asia by achieving 2 degree target pathways

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AIM
ASIA-PACIFIC INTEGRATED MODEL

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Topics

1. Overview of AIM/Enduse related activities.
2. Major outcome of AIM/Enduse[Global] in FY2012-FY2013
3. Discussion: Co-benefits of reducing air pollutants emissions in Asia by achieving 2 degree target pathways

Overview of AIM/Enduse related activities - model development and activities -

Scenarios for achieving GHG emission pathways consistent with the 2℃ target

Global scale

- ✓ Updating energy resource constraints and costs (especially, renewables).
- ✓ Analyzing future service demands transitions , appropriate to each regional/national characteristic.
- ✓ Expanding target sectors, target gases and target regions.
- ✓ Expanding time horizon from 2050 to 2100.
- ✓ Updating data in the base-year and in the socio-economic baseline
- ✓ Analyzing benefits of reducing GHGs, air pollutants and ODSs.

Today's topic and so on

National scale

- ✓ Breaking-up into province scale analyses
- ✓ Enhancing sufficient evidences and data at a national scale
- ✓ Analyzing service demands and discussing transitions toward LCS

Local scale

- ✓ Around 16,000 Large Point Sources data in 30 countries in Asia (Power, Steel, Cement, Petro-chemistry, Petroleum-refinery)
- ✓ Socio-economic data in area sources.

Next research topics for AIM/Enduse
- transition from IPCC AR4 to IPCC AR5 -

IPCC AR4

Three papers discussed **how to achieve 450 CO_2eq ppm concentration target which is equivalent to 2℃ global temperature limit above pre-industrial levels**

Policy makers in **COP15 paid attention to the 2℃ global temperature limit** above pre-industrial levels **in the Copenhagen Accord** in 2009

IPCC AR5

Various papers analysed **the role of negative CO_2 emissions for achieving GHG emission pathways consistent with the 2℃ target**

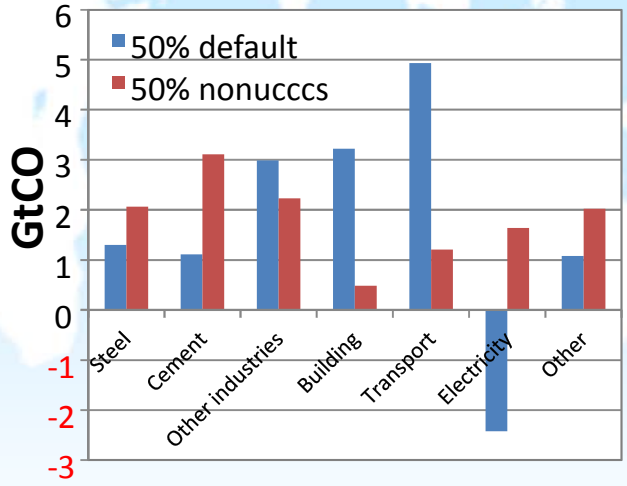
- Biomass energy with CCS (BECCS) is one of the essential technologies and it is **difficult to achieve the 2℃ target without BECCS**
- **Limitations and uncertainties of a large number of CCS and biomass**
- Energy efficiency improvement plays a key role. But the rate of change toward the 2℃ target is not in line with the current trends, much faster.

Next research topics are ・・・

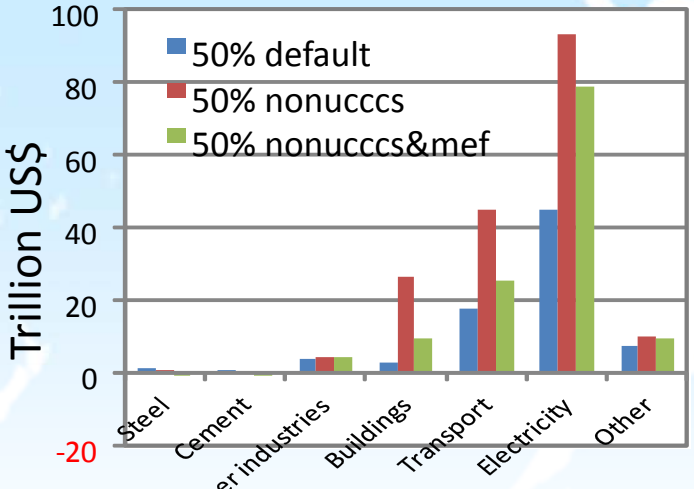
Major Outcome of AIM/Enduse[Global] from FY2012-2013

Scenario name	Description
50% default	Reducing global GHG emissions by 50% relative to the 1990.
50% nonucccs	Variant of 50% default scenario. **CCS is not available and no new nuclear power plants are built.**
50% nonucccs &mef	Variant of 50% default scenario. CCS is not available and no new nuclear power plants are built. Material efficiency is improved.

- **The cost for achieving a 50% reduction target becomes high if nuclear and CCS are limited**, because additional investment for expensive technologies is required in order to compensate for emission increases in the steel, cement and power generation.



Sectoral breakdown of CO2 emission In 2050



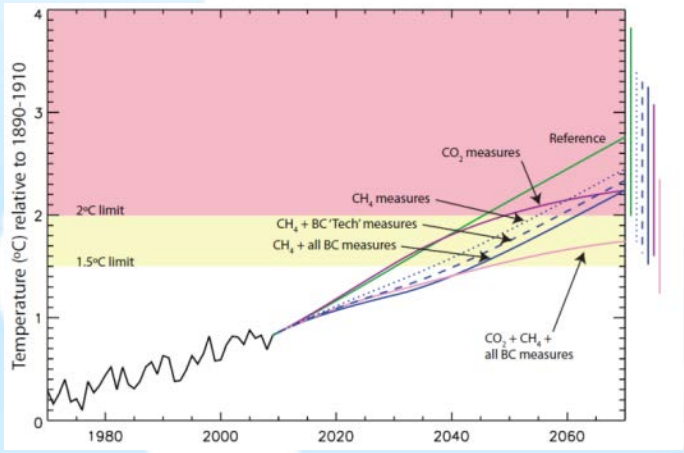
Additional cumulative investments from 2005 to 2050

Source)

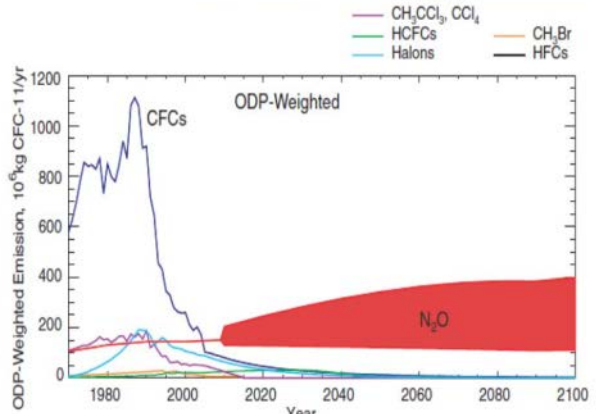
Akashi, O., Hanaoka, T., Masui, T. and Kainuma, M. (2013) Halving global GHG emissions by 2050 without depending on nuclear and CCS, Climate Change, DOI 10.1007/s10584-013-0942

Expansion of Enduse[Global]
(Preparation for S-12 project & EMF30, ect.)

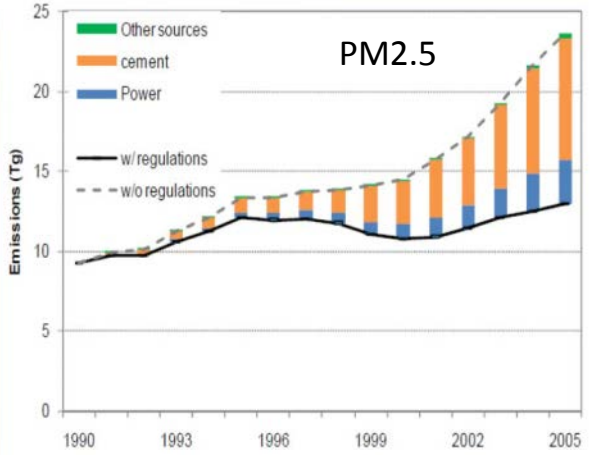
One of the missing discussions is **integrated analyses on ancillary benefits of reducing air pollutants, short-lived climate forces(SLCF), and ozone depleting substances(ODS), combined with GHG mitigations**, in the context of sustainable development.



① CH4&BC are Short-lived climate forces
Source) UNEP/WMO 2011



② N2O is Ozone depleting substance
Source) Ravishankara, et al, (2009)



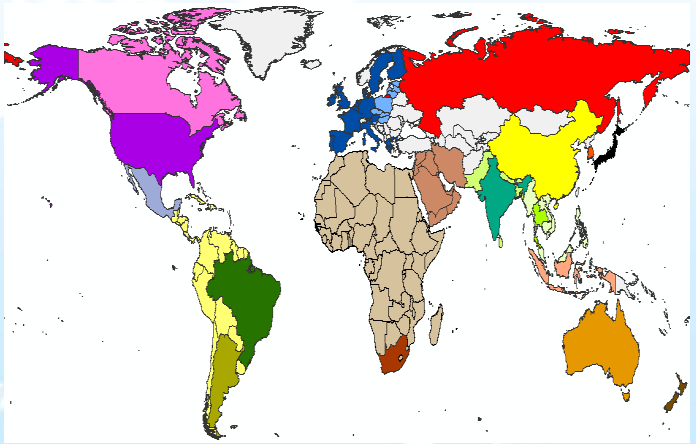
③ Air pollutants problems in China
Source) Lei et al (2011)

Objectives

1) Estimating **technological mitigation potentials and costs** of the Kyoto six GHGs to reduce 50 % global GHG emissions by 2050 **for achieving GHG emission pathways consistent with the 2℃ target in the long term**.
2) Assessing effects of **ancillary benefits of reducing air pollutants, SLCF, ODS** by achieving the 2℃ target, and analyzing its **attribution by sector and region**

Ongoing Development of Enduse[Global]

Term	Contents
Regions	World 32 regions
Time horizon	2005 – 2050
Sectors	Energy end-use: Industry, Residential, Service, Transport, Other Energy supply: Power generation, Heat generation, Coal transformation, Oil refinery, Gas transformation, Fuel mining Non-energy: Agriculture, Waste, Fluorocarbons



	CO2	CH4	N2O	HFC	PFC	SF6	CFC	HCFC	SO2	NOx	BC	OC	PM10	PM2.5	CO	NH3	NMV
Fuel combustion	✔	✔	✔						✔	✔	✻	✻	✻	✻	✻	✻	✻
Industrial process	✔	✔	✔	✔	✔	✔	✔	✔	✔		✻	✻	✻	✻	✻	✻	✻
Agriculture		✔	✔													✻	
Waste		✔															
Fuel mining		✔															
Others	✔	✔	✔													✻	✻

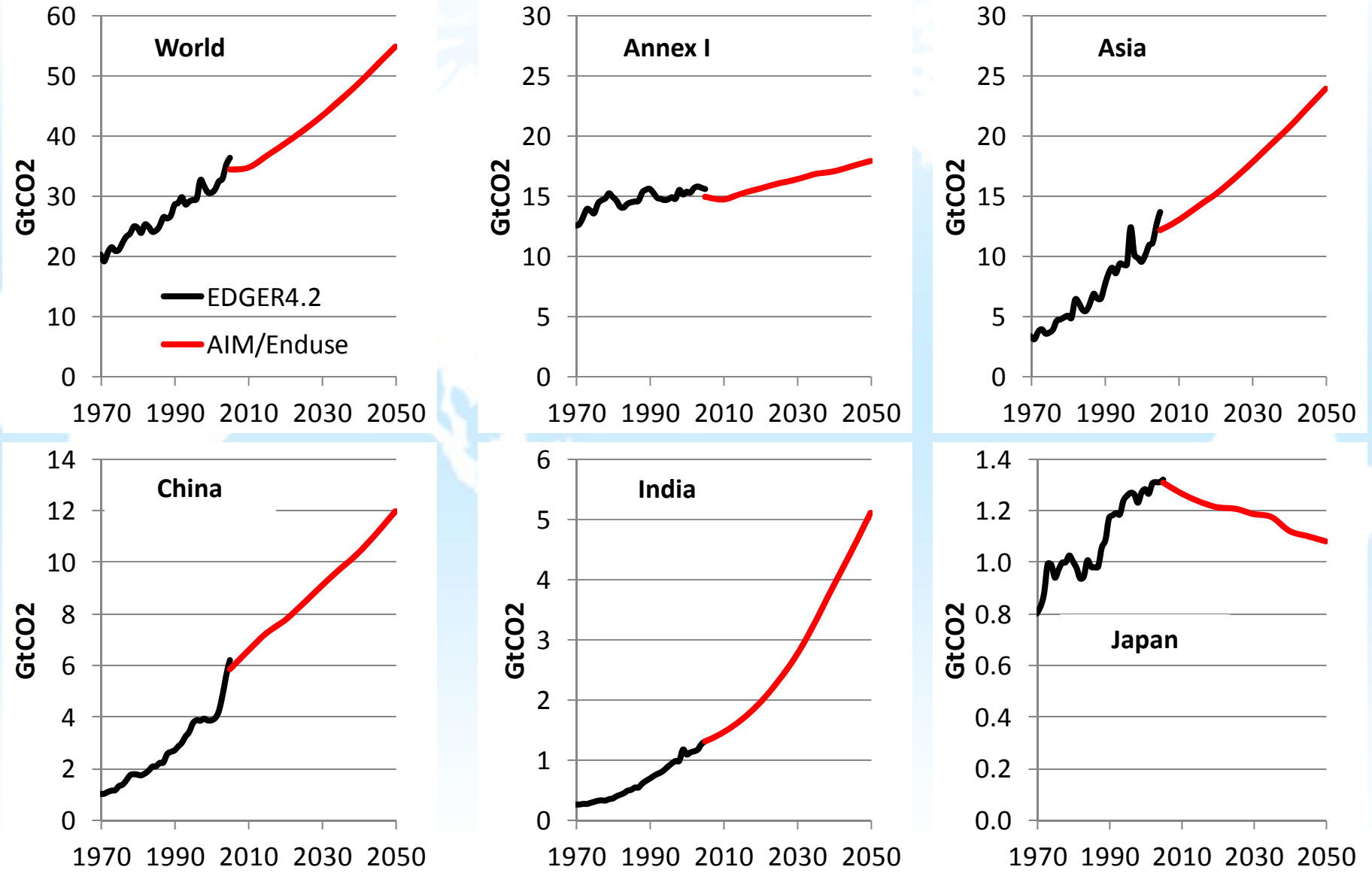
✔ : Updated

Today's topic

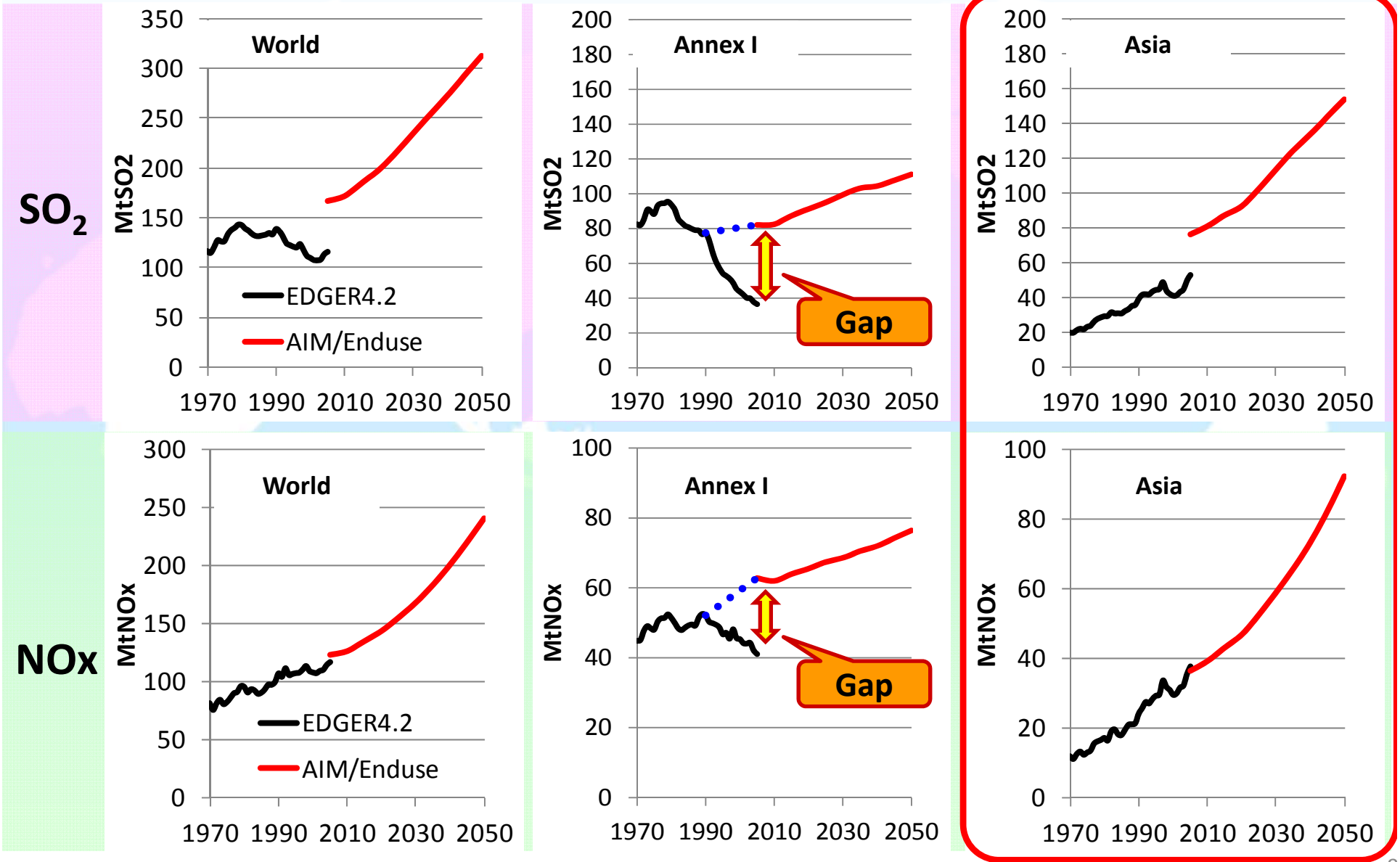
✻ : On-going updating

Emission factors are set by energy source, by sector and by region

CO_2 emissions in Baseline scenario
- from fuel combustion and industry -



SO_2 & NOx emissions in Baseline
- from fuel combustion and industry -



This study focuses on Asia

Mitigation scenario for achieving 2℃ target - carbon price settings -

The current useful references of carbon pricing such as:

- **EU-ETS carbon prices** fluctuated due to global economic change, and varied **around 15-30 EURO/tCO_2**.
- **The price of CER for CDM projects** also fluctuated **around 10-20 EURO/tCO_2**.
- Due to the economic recession, the carbon price has been on the decrease, **around 5 EURO/tCO_2**.
- IEA (2010) reported carbon price is at **175 US$/$tCO_2$ in the 450 ppmv scenario**.

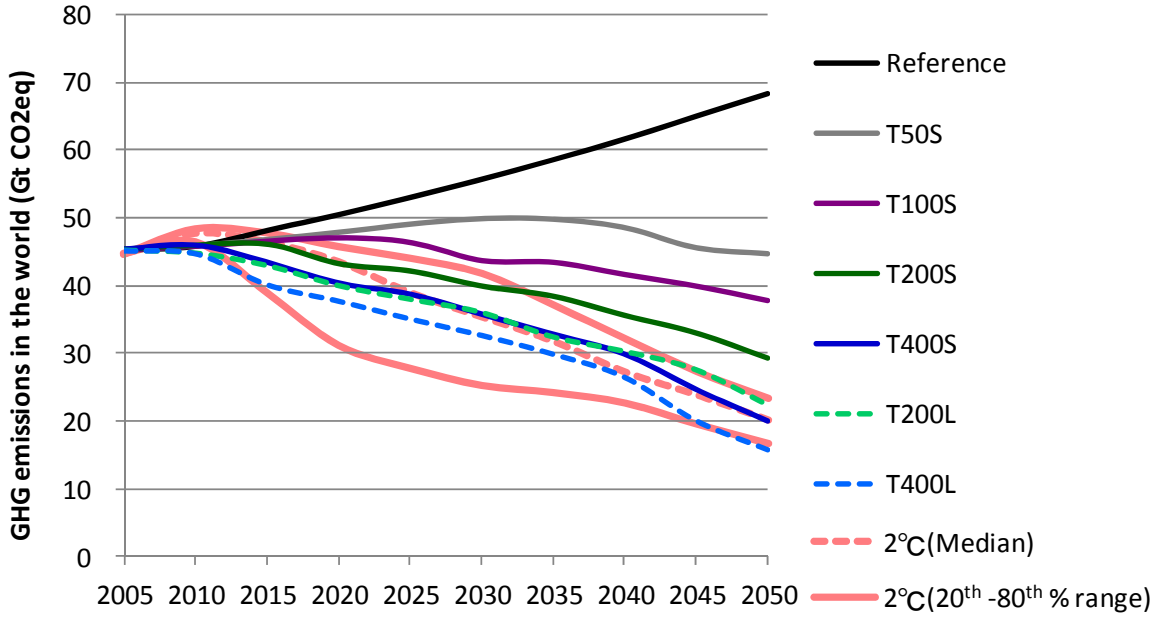
Future global economy-wide carbon prices scenarios (US$/$tCO_2$)

Scenario name	2013	2020	2030	2040	2050	Payback time
Baseline	0	0	0	0	0	Short
T50S	**3.75**	**12.5**	**25**	**37.5**	**50**	**Short**
T100S	7.5	25	50	75	100	Short
T200S	**15**	**50**	**100**	**150**	**200**	**Short**
T200L	15	50	100	150	200	Long
T400S	30	100	200	300	400	Short
T400L	30	100	200	300	400	Long

Global GHG emissions pathways and comparison with 2 ℃ target pathways

The global GHG emissions pathways by AIM/Enduse[Global] are compared with the emissions pathways consistent with the 2℃ target scenarios.

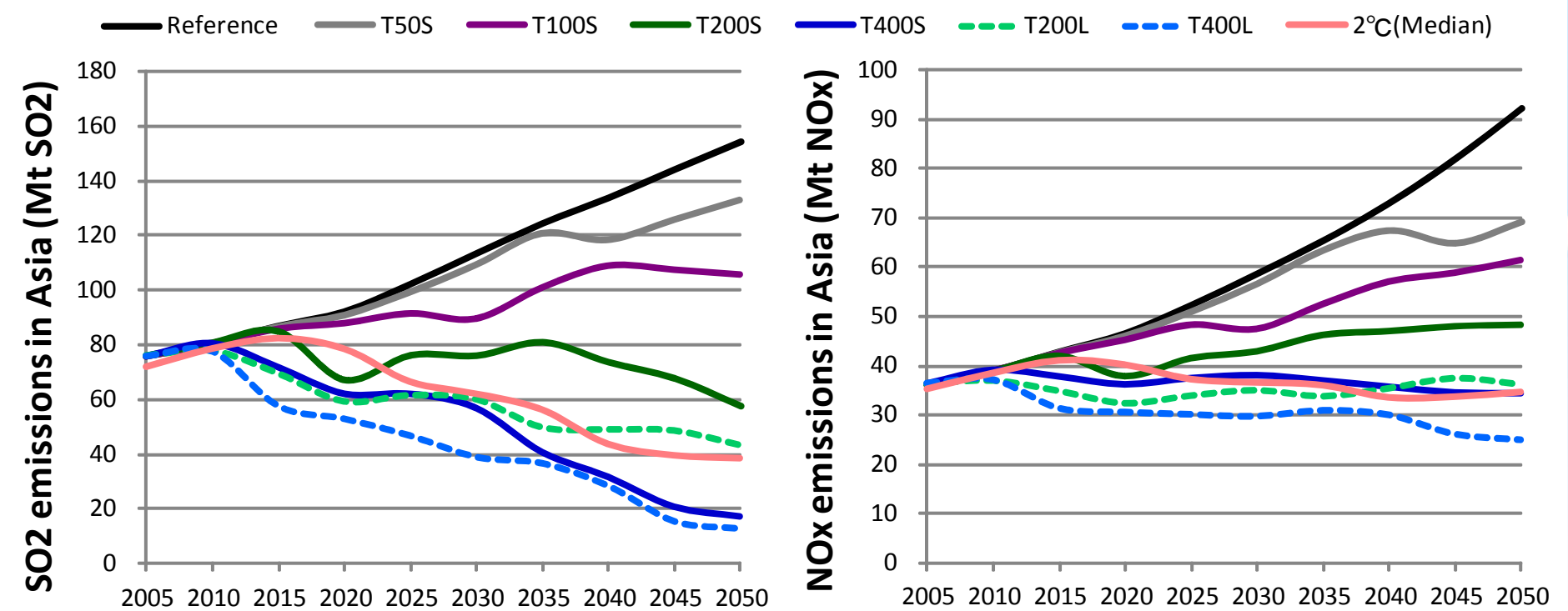
- Transitions toward the 2℃ target are not in line with the current trend.
- It requires high carbon price around **400 US$/tCO$_2$ in 2050 (T400S scenario)**, which is necessary to consider various strategies to promote mitigation actions.
- But, in long payback case, even **200 US$/tCO$_2$ in 2050 (T200L scenario)** can achieve pathways of 2℃ target scenarios.



Note) Emissions pathways consistent with 2℃ target scenarios with a likely probability (greater than 66%)
Sources are Rogelj, J. et al., (2011), UNEP The Emission Gap Report (2012)

SO_2 & NOx emissions pathways in Asia
- Cobenefits of implementing CO2 mitigation policies-

- In order to focus on cobenefits of reducing air pollutants by introducing GHG mitigation measures, **air pollutant removal devices are not considered**
- In T400S scenario, **SO_2 and NOx emissions in Asia will be decreased largely as cobenefits** of achieving the GHG emissions pathways of 2℃ target scenarios.



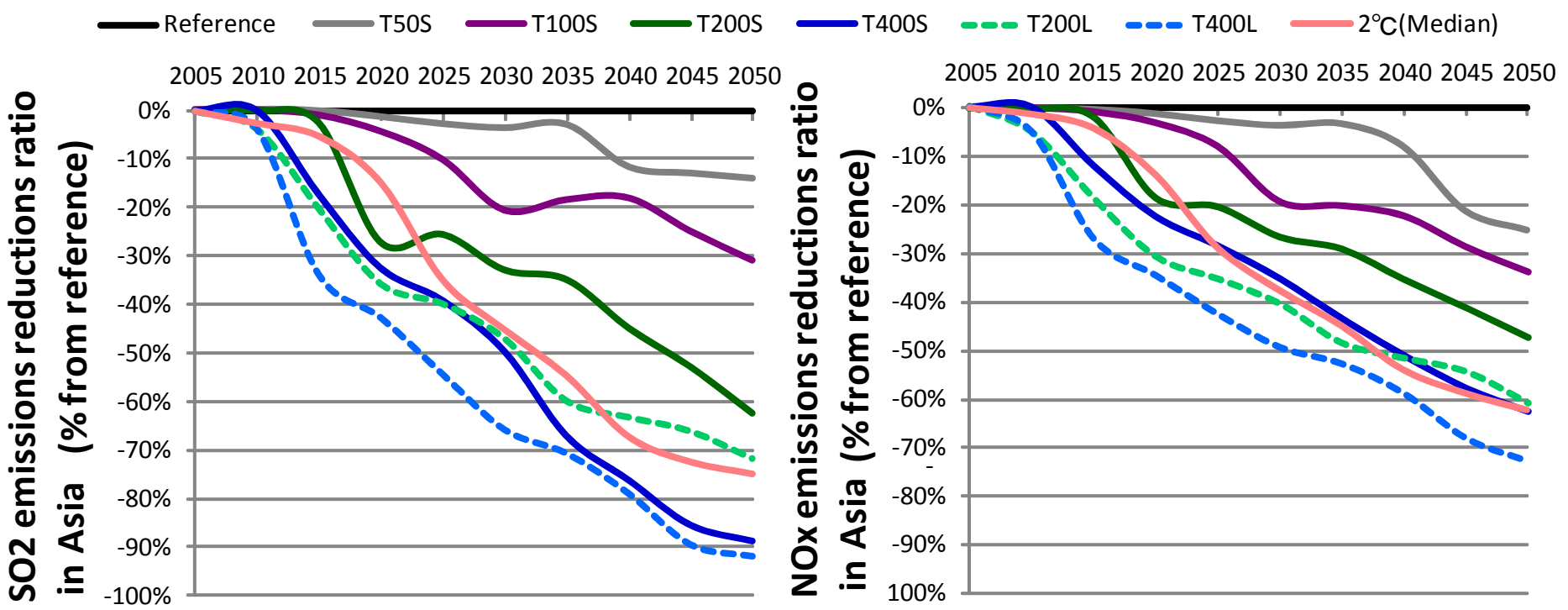
Showing such cobenefits may help to overcome various barriers for achieving LCS?

SO_2 & NOx emissions reduction ratio
- Cobenefits of implementing CO_2 mitigation policies-

- In **T400S scenario, SO_2 emissions in Asia in 2050** are largely reduced
  - At 136.4 Mt SO_2 which correspond to **89% reductions from baseline**.

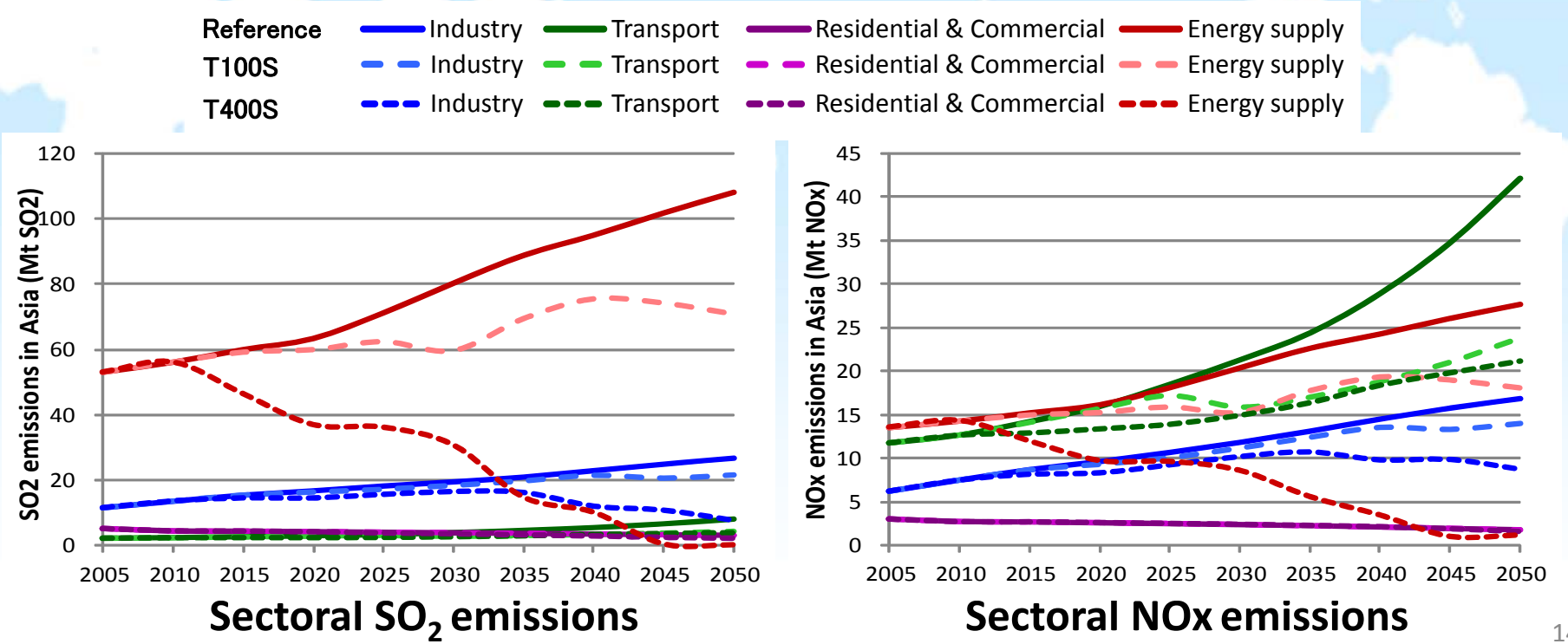
  (at 58.6 Mt SO_2 which correspond to **77% reductions from the levels in 2005.**)
- In **T400S scenario, NOx emissions in Asia in 2050** are largely reduced
  - at 57.8 Mt SO_2 which correspond to **63% reductions from baseline**.

  (at 2.0 Mt SO_2 which correspond to **5% reductions from the levels in 2005.**)



Sectoral SO_2 & NOx emissions in Asia
- Cobenefits of implementing CO2 mitigation policies-

- Large amounts of SO_2 are emitted from the **energy supply sector**. Thus, **the shifting from high-carbon fossil fuels to less-carbon intensive fuels or renewables energies largely contributes to reduce SO_2 emissions** as well as GHGs emissions .
- NOx are mainly emitted from **energy supply, industry and transport sectors**. The shift from vehicle with gasoline or diesel to efficient vehicles such as hybrid vehicle and electric vehicle will occur; however, **there are certain economic barriers to introduction of such efficient vehicles even in the high carbon tax scenario in Asia**.



Sectoral SO_2 emissions **Sectoral NOx emissions**

Conclusion

- Mitigation measures of energy efficiency improvement on the demand side and the shift to less-or non-carbon energies on the supply side play important roles in reducing CO_2 emissions as well as increasing cobenefits of SO_2 and NOx emissions reductions.
- 400 US$/t$CO_2$ carbon tax scenario can achieve pathways in the range of 2℃ target scenarios and global emissions of GHGs, SO_2 and NOx are largely reduced around 60-90% compared to baseline in 2050.
- Energy shift in energy supply sector largely contribute to reducing GHGs as well as SO_2 in Asia. However, NOx are derived from transport as well as energy supply, and there are limitations to shifting from fuel vehicles to Hybrid, plug-in Hybrid, electric vehicles in developing countries.
- One caveat is that, to focus on cobenefits of reducing air pollutants by introducing GHG mitigation measures, air pollutant removal devices are not considered.