International Workshop on Air Quality in Asia
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24-26 June 2014

Co-benefits of reducing air-pollution in ASEAN by 2050 while achieving 2 ℃ global temperature limit target

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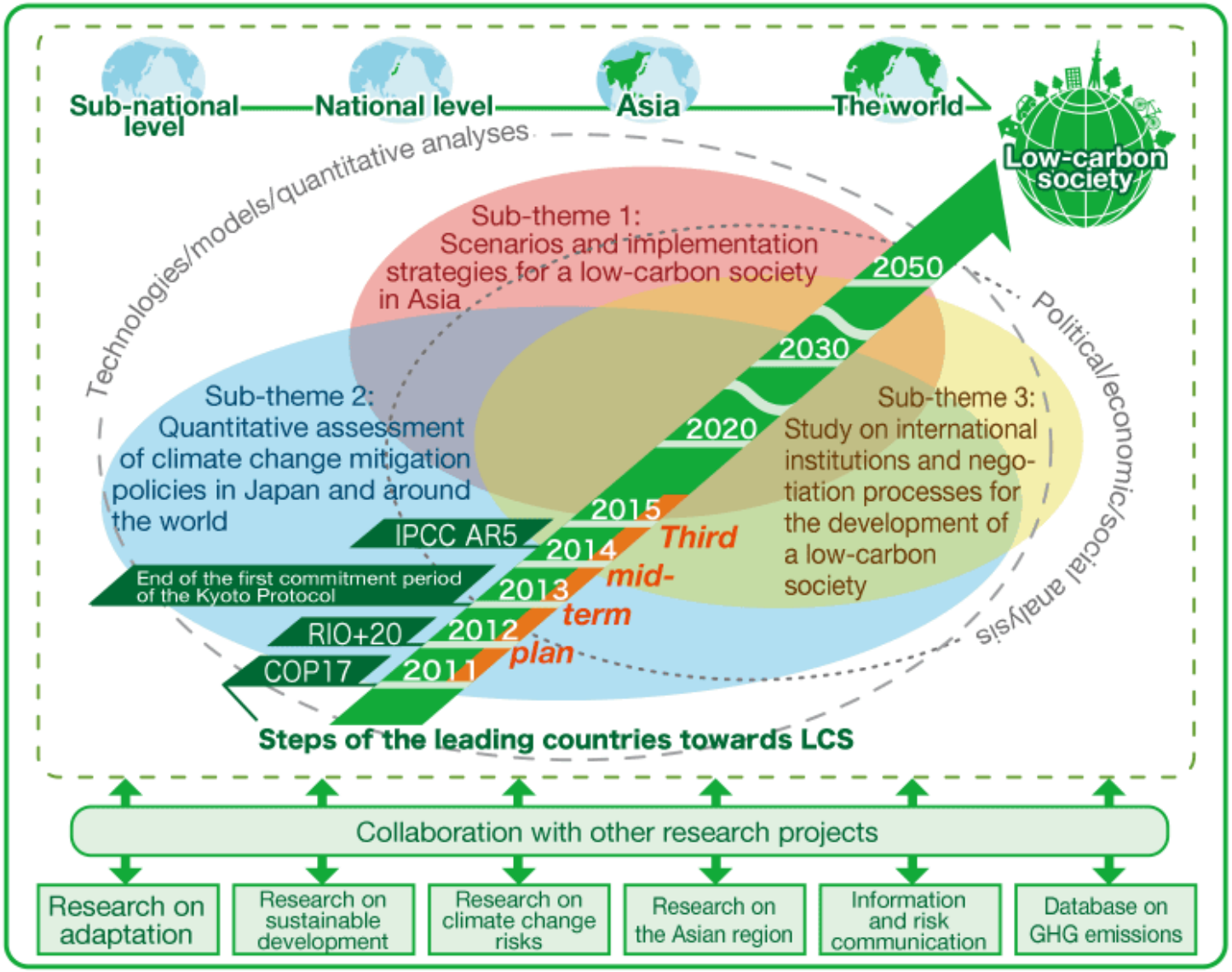
AIM
ASIA-PACIFIC INTEGRATED MODEL

NIES JAPAN

Topics

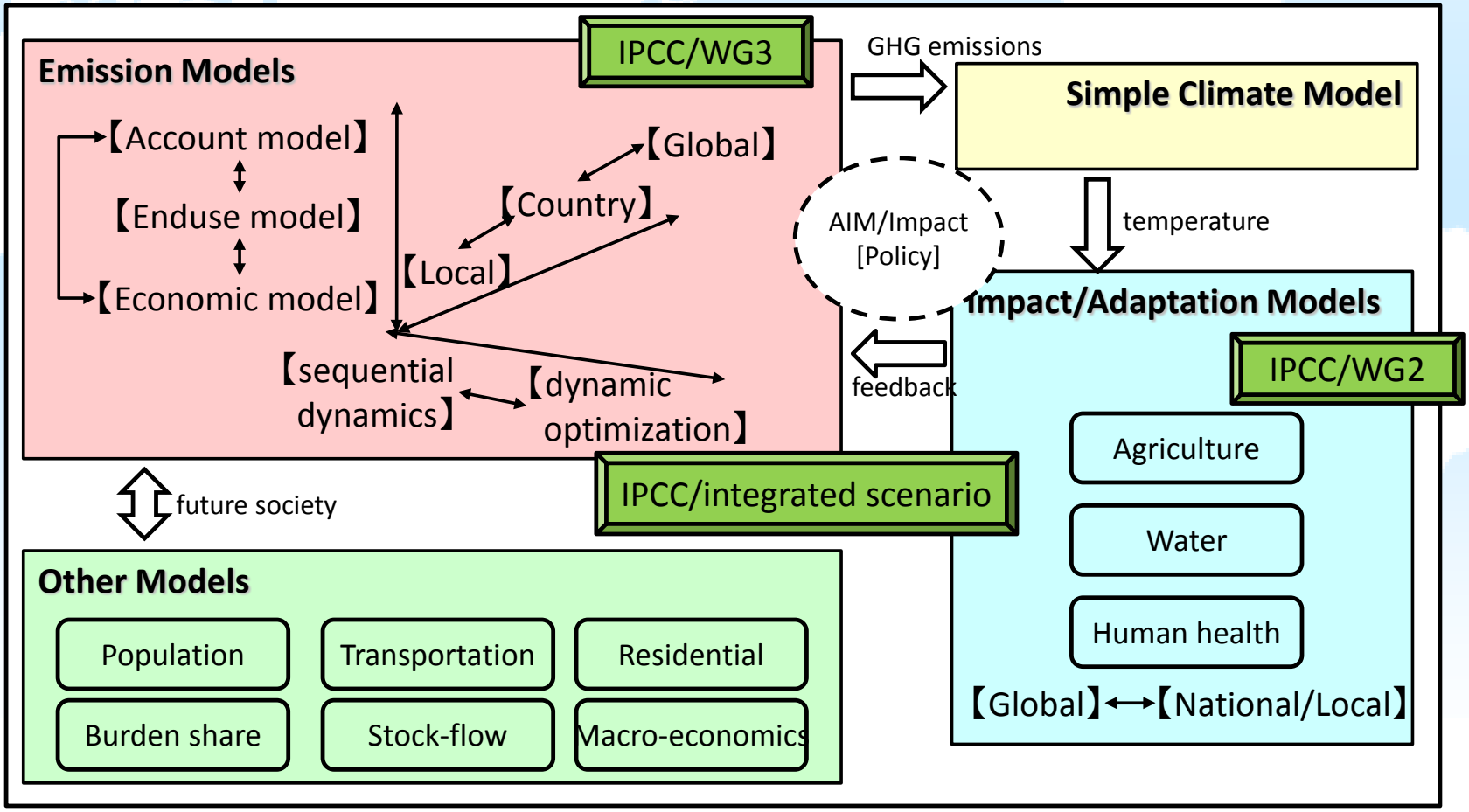
1. Introduction of AIM (Asia-pacific Integrated Model)
2. Role of the AIM models in S-12 project
3. Co-benefits of reducing air pollutants emissions in ASEAN while achieving 2 degree global temperature limit target

Toward Low Carbon Society



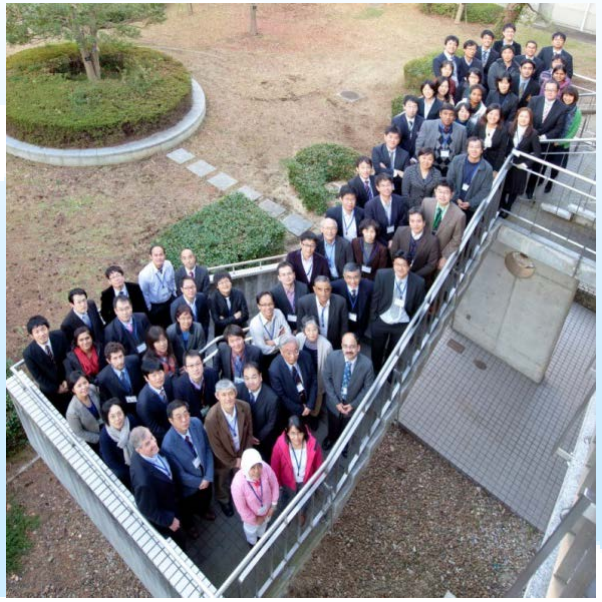
AIM (Asia-Pacific Integrated Model)

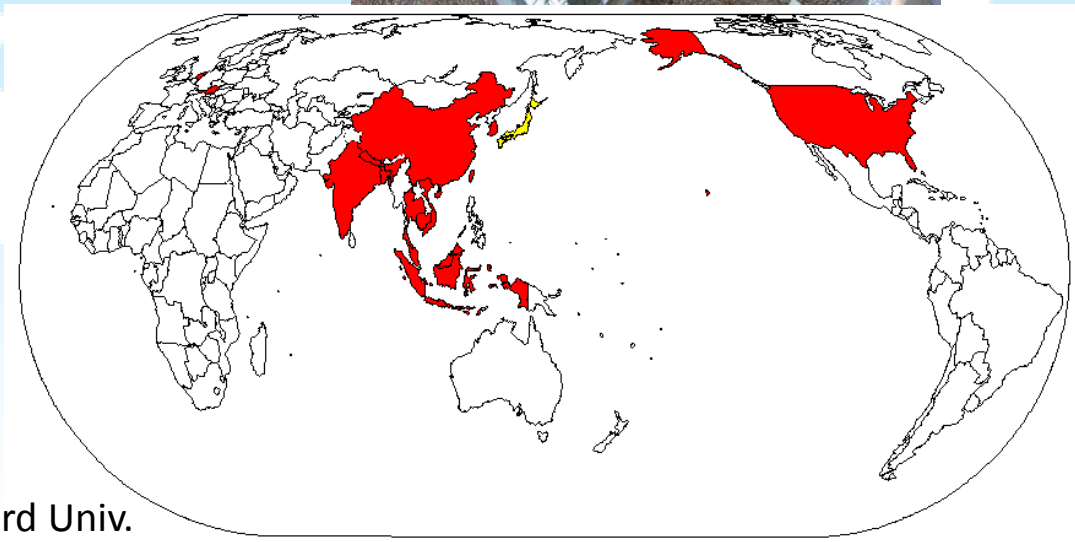
AIM is an integrated assessment model
-to assess mitigation measures to reduce GHG emissions
-to assess impact/adaptation to avoid severe climate change damages



AIM (Asia-pacific Integrated Model)
- International research network -

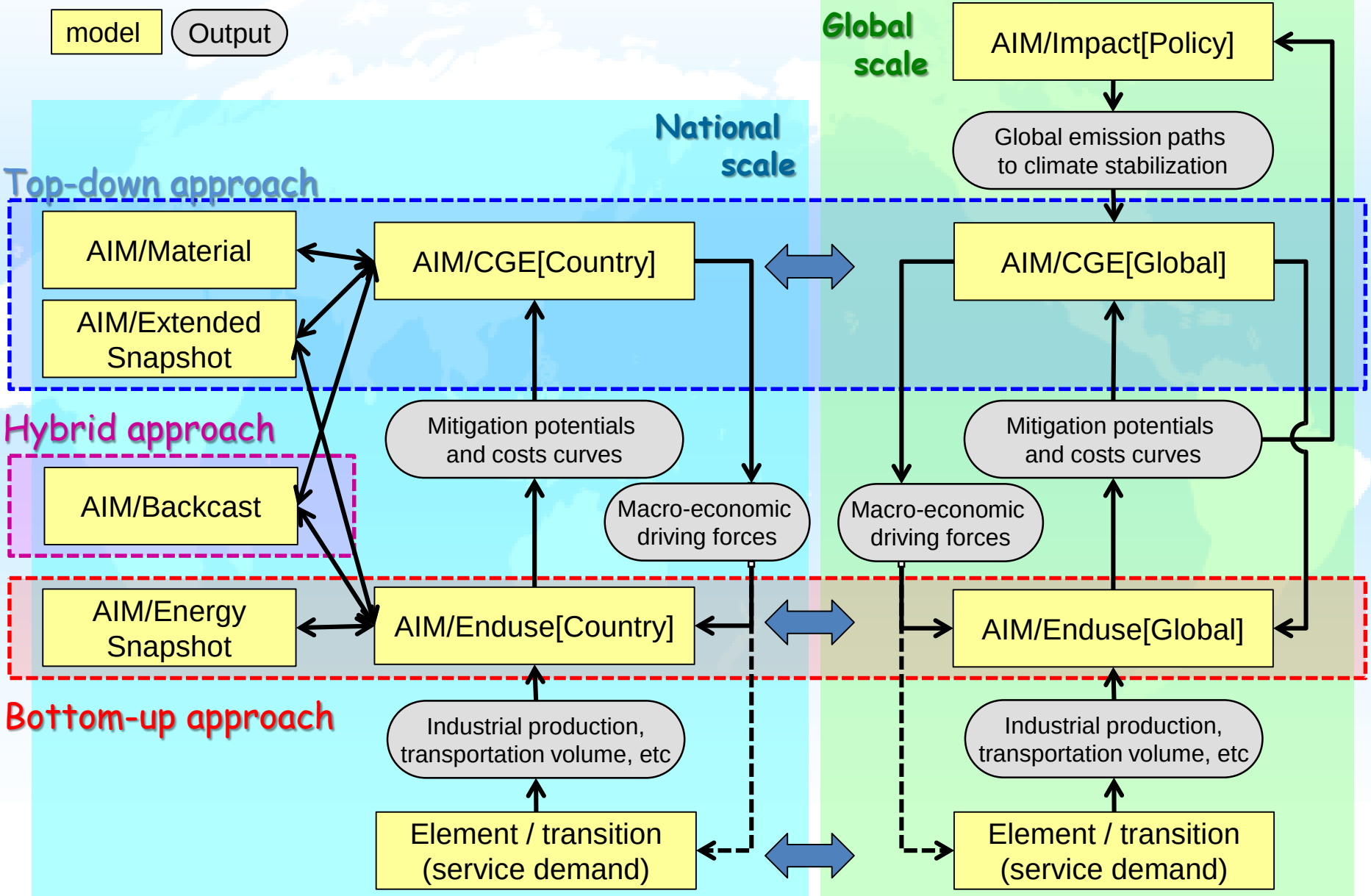
Japan	National Institute for Environmental Studies Kyoto University Mizuho Information Research Institute
China	Energy Research Institute, NDRC Institute of Geog. Sci. & Nat. Res. Research, CAS Institute of Env. & Sus. Dev. in Agri, CAAS Guangzhou Institute of Ene. Conversion, CAS
India	Indian Institute of Management, Ahmedabad School of Planning and Architecture, Bhopal
Korea	Seoul National Univ. Korea Environment Institute
Thailand	Asian Institute of Tech. Thammasat Univ. King Mongkut's Univ.
Malaysia	Univ. Tech. Malaysia
Indonesia	Bogor Agri. Univ. Bandung Institute of Tech.
Austria	IIASA
Netherlands	PBL
USA	Pacific Northwest National Lab. Energy Modeling Forum, Stanford Univ.





In addition, collaborating with **Vietnam, Cambodia, Bangladesh, Nepal, Taiwan**, ...

AIM family for mitigation analysis



The role of AIM models in the S-12 project

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MOEJ-S12: Promotion of climate policies by assessing environmental impacts of SLCP and seeking LLGHG emissions pathways (FY2014-FY2018)

Goal: To develop an integrated evaluation system for LLGHG and SLCP mitigation policy, by interconnecting emission inventory, integrated assessment models, and climate models.

Theme 1: Air quality change event analysis
- Analysis on regional AQ change
- Development of emission inventory
- Inversion algorithms of emission estimation

Theme 2: Integrated model and future scenarios
- Global socio-economic scenarios
- National & regional emissions scenarios
- Urban & household emissions AQ assessment

Theme 3: SLCP impacts on climate & environment
- Impact assessment of aerosols & GHG
- Assessment of health, agriculture, water cycle, sea level rise

Improved emission inventory

SLCP emissions scenarios

Regional Emission Inventories and Chemical Transfer Model ⇄ **Integrated Assessment Model (AIM)** ⇄ **Climate and Environment Model**

Assessment of activities/policies

Feedback of impacts

Chemical transfer model and emission inventory in Asia

AIM/Enduse model
Socio-economical & emissions scenario

Climate model, earth system model
Climate change impact & adaptation

Theme 4: Integrated operation system (Toolkits, data archive)

Science

Model improvement

Experiment setup
Database development
Metric definitions

Stakeholders
Policy makers

System utilization

CCAC, UNFCC, IPCC, EANET
Proposal and assessment of climate and air pollution policies

Society

Information transmission

MDG・SDG・Future Earth

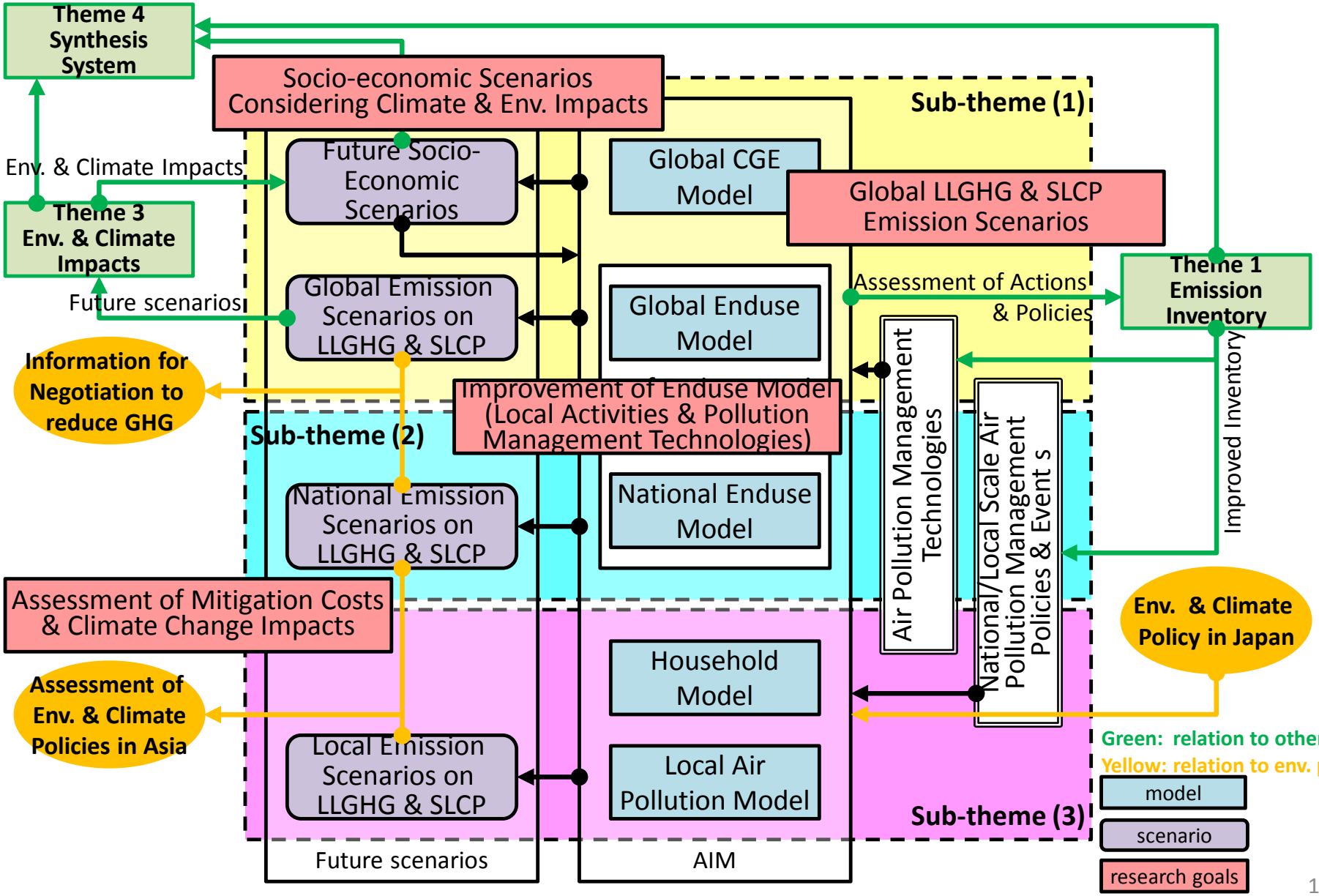
Regional strategy ⇅ **Global strategy**

Challenges of S-12 Theme 2

1. indicating socio-economic scenarios considering climate change and environmental impacts and emissions scenarios of Long-lived GHGs(LLGHG) and Short lived Climate Pollutants (SLCP).
【global/national/regional scales】

2. Evaluating co-benefits of LLGHG mitigation measures and SLCP reduction measures, and analyzing regional characteristics in detail, in a manner consistent with long-term global scenarios such as 2℃ target.
【national/regional scales in Asia】

Theme 2: Improvement of Integrated Assessment Model and Quantification of Future Scenarios



the AIM/Enduse[Global] model

- analysis at the global scale-

Co-benefits of reducing air pollutants emissions in ASEAN while achieving 2 degree global temperature limit target

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Background information
- 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
- 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.

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.

Objective of this study

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**

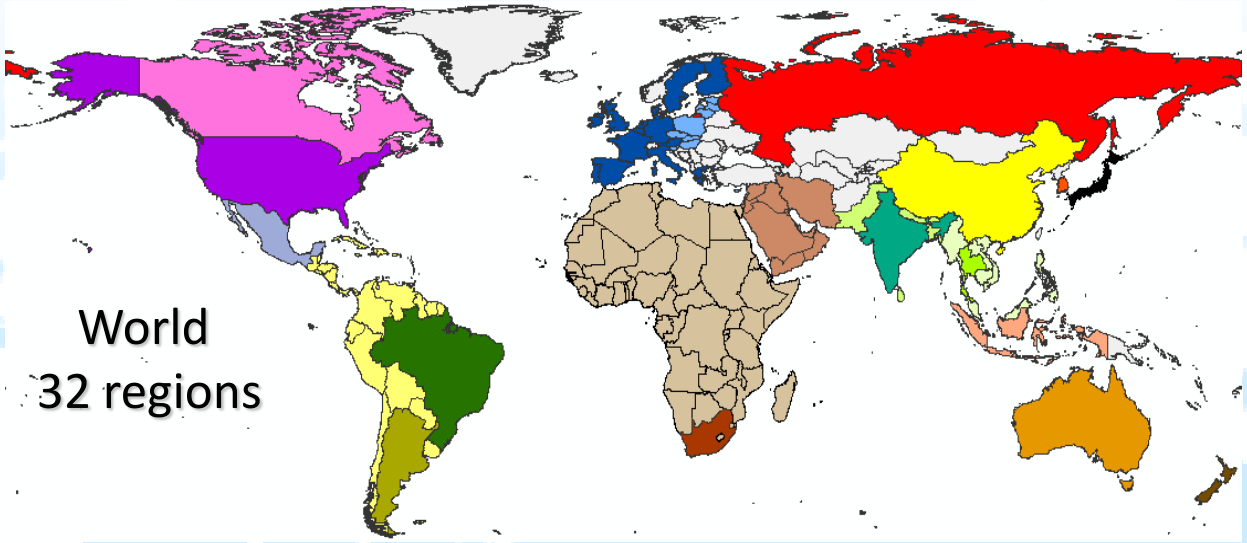
This study discusses co-benefits of reducing air-pollution **in ASEAN** by 2050, while achieving 2 degree temperature limit target

Characteristics of AIM/Enduse model

- Bottom-up type model with detailed technology selection framework with optimization
- Recursive dynamic model
- Assessing technological transition over time
- Analyzing effect of policies such as carbon/energy tax, subsidy, regulation and so on.
- Target Gas :CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, CFCs, HCFCs, SO_2, NOx, BC, etc
- Target Sectors : multiple sectors

  power generation sector, industry sector, residential sector, commercial sector, transport sector, agriculture sector, municipal solid waste sector, fugitive emissions sector, F-gas sector
  (each of these can be further disaggregated into sub-sectors)

Regional classification



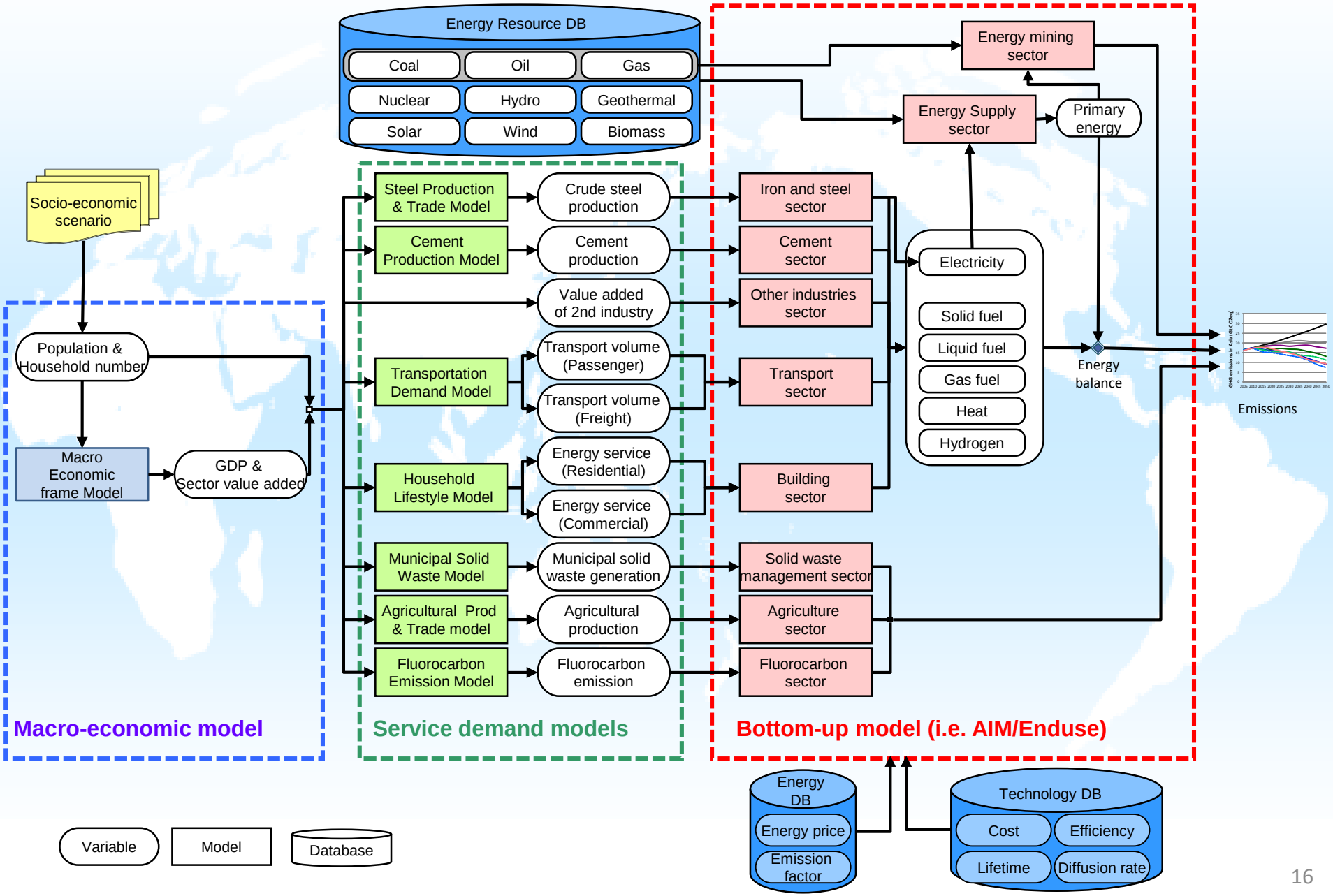
Annex I

OECD

JPN (Japan)	USA (United States)	CAN (Canada)	KOR (Korea)
AUS (Australia)	XE15 (Western EU-15)	TUR (Turkey)	MEX (Mexico)
NZL (New Zealand)	XE10 (Eastern EU-10)	XEWI (Other Western EU in Annex I)	BRA (Brazil)
RUS (Russia)	XE2 (Other EU-2)	XEEI (Other Eastern EU in Annex I)	ARG (Argentine)
CHN (China)	XSA (Other South Asia)	XENI (Other EU)	XLM (Other Latin America)
IND (India)	XEA (Other East Asia)	XCS (Central Asia)	ZAF (South Africa)
IDN (Indonesia)	XSE (Other South-East Asia)	XOC (Other Oceania)	XAF (Other Africa)
THA (Thailand)	MYS (Malaysia)	VNM (Viet Nam)	XME (Middle East)

ASEAN

Relations of AIM/Enduse model and element models



Results of future emissions scenarios up to 2050

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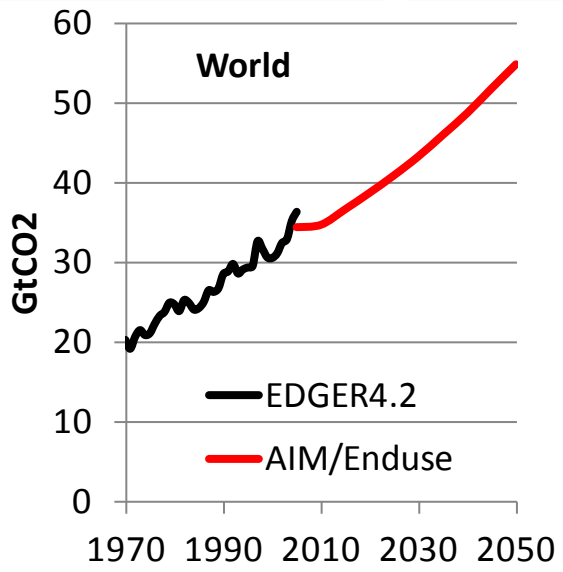
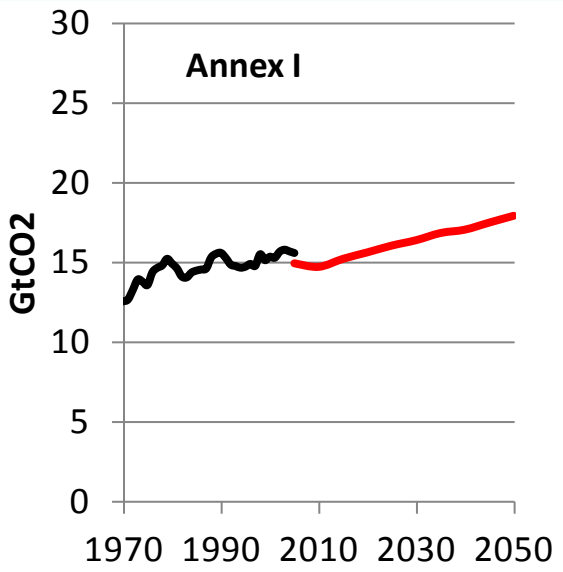
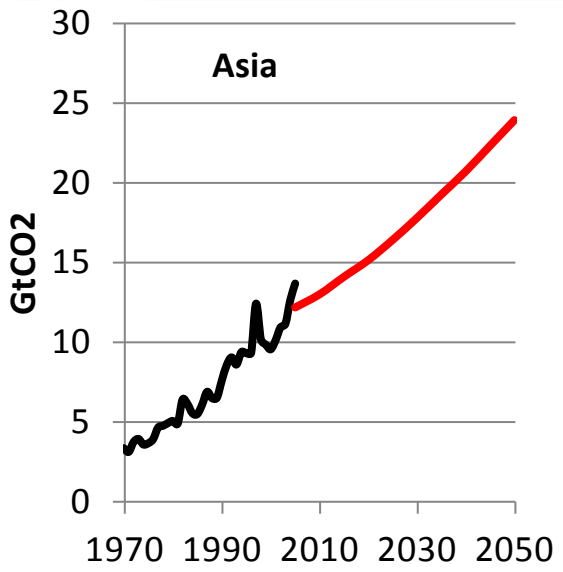
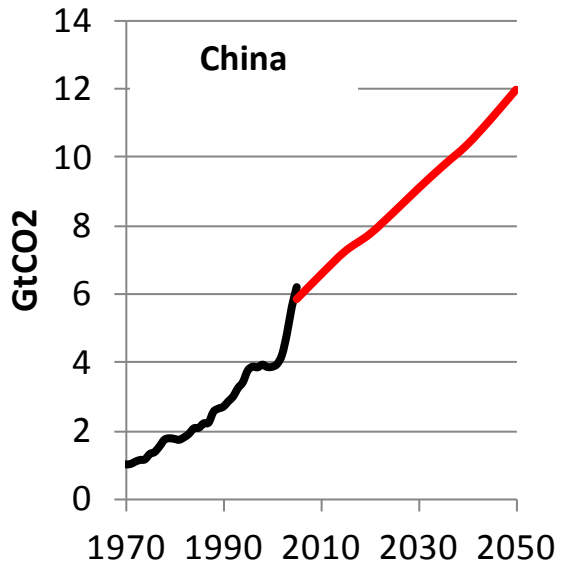
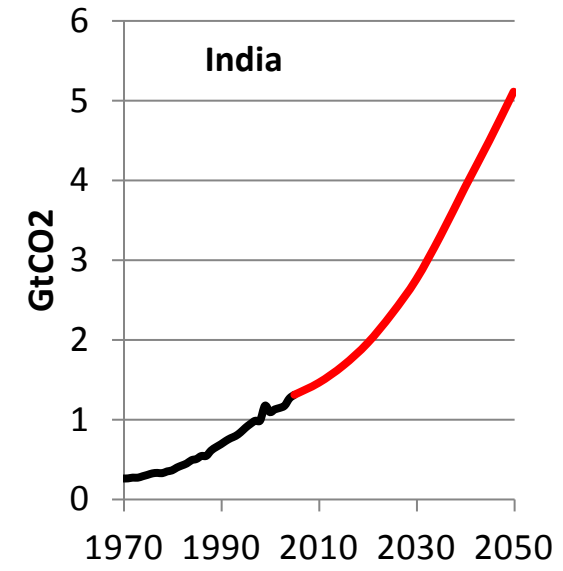
CO_2 emissions in Baseline scenario
- from fuel combustion and industry -

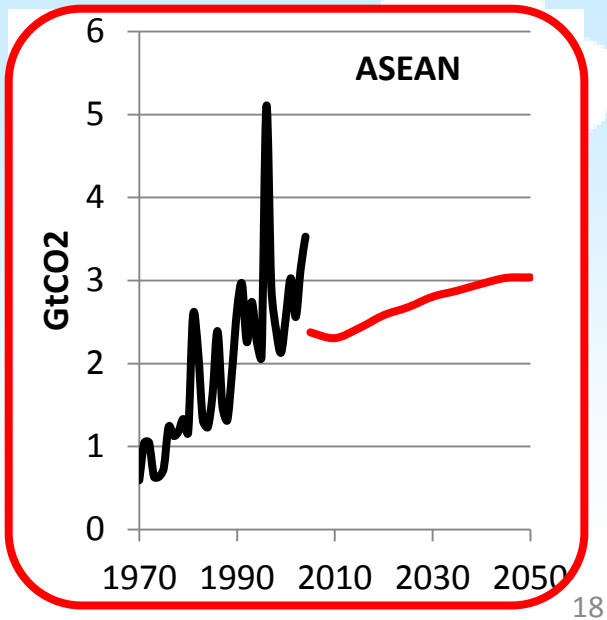




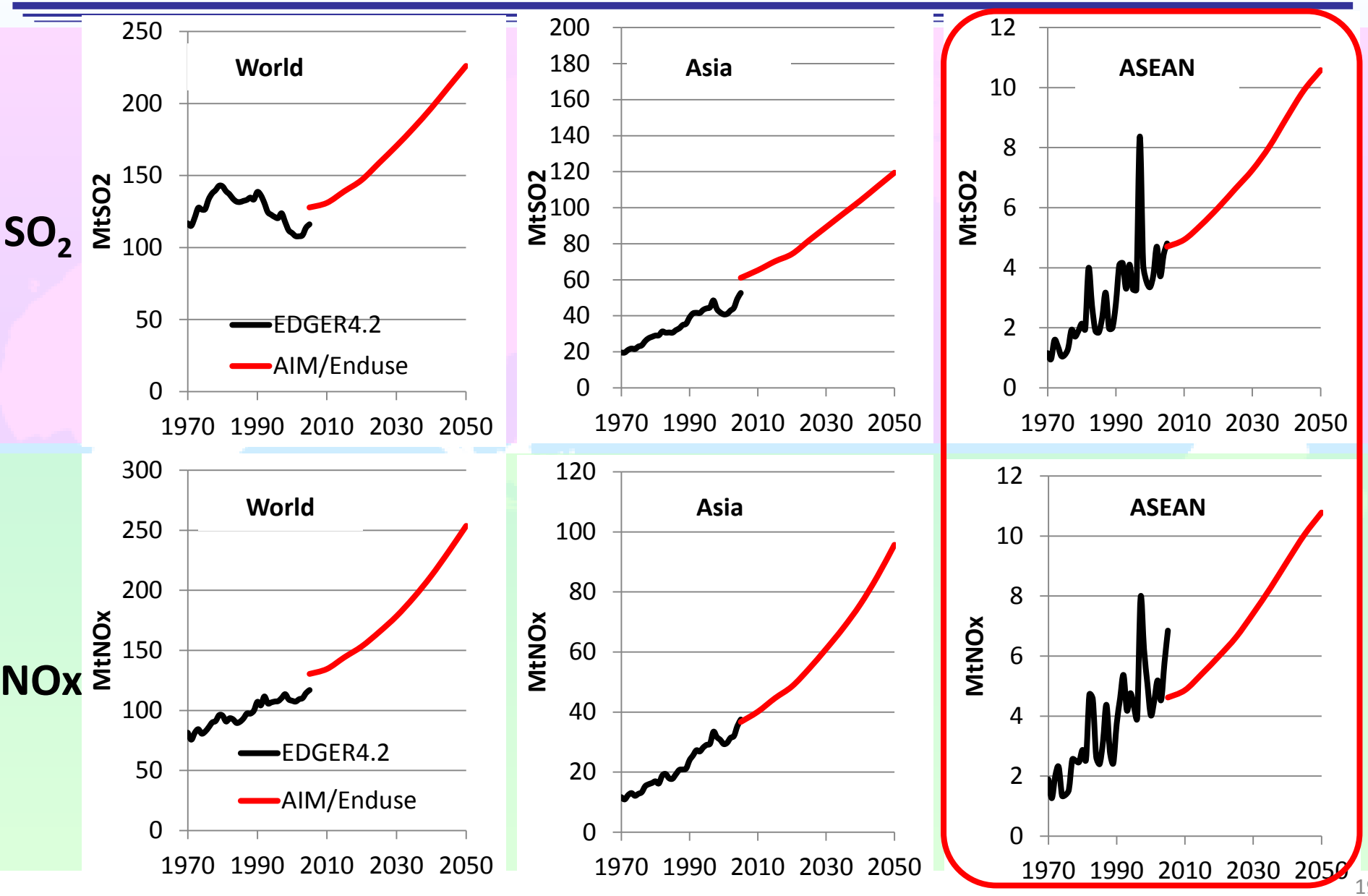








SO_2 & NOx emissions in Baseline
- from fuel combustion and industry -



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

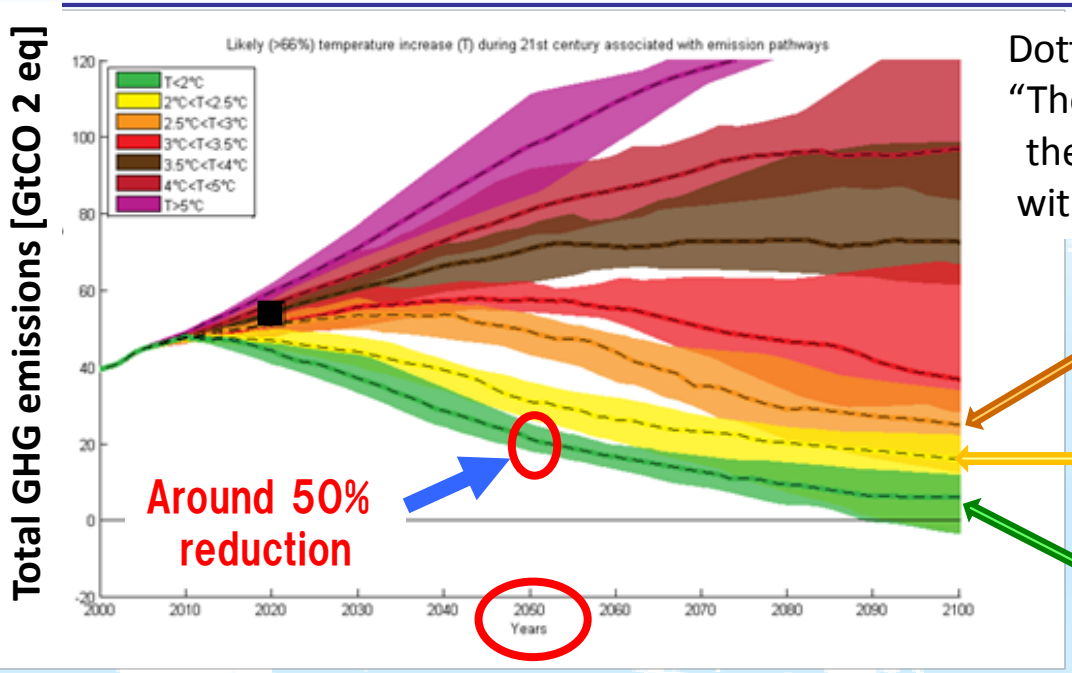
The current useful references of carbon pricing such as:

- **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
Reference	0	0	0	0	0
T50	**3.75**	**12.5**	**25**	**37.5**	**50**
T100	7.5	25	50	75	100
T200	**15**	**50**	**100**	**150**	**200**
T400	30	100	200	300	400

Global GHG emissions constraint scenario

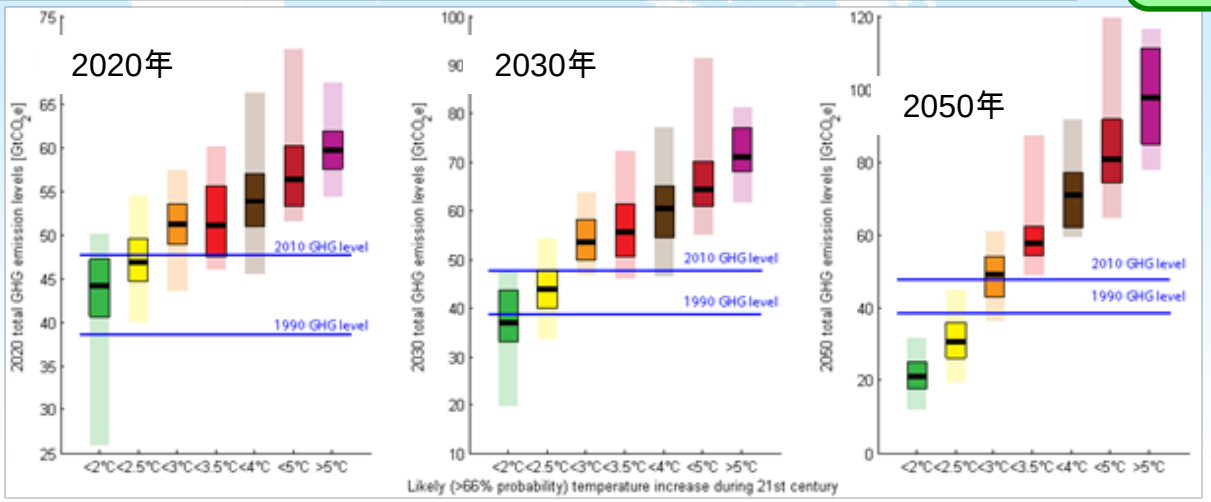


Dotted lines show
"The median global GHG emissions pathway in the range of global GHG emissions pathways with a "likely" probability (greater than 66%)"

of staying below 3 degree compared to pre-industrial levels

of staying below 2.5 degree compared to pre-industrial levels

of staying below 2 degree compared to pre-industrial levels

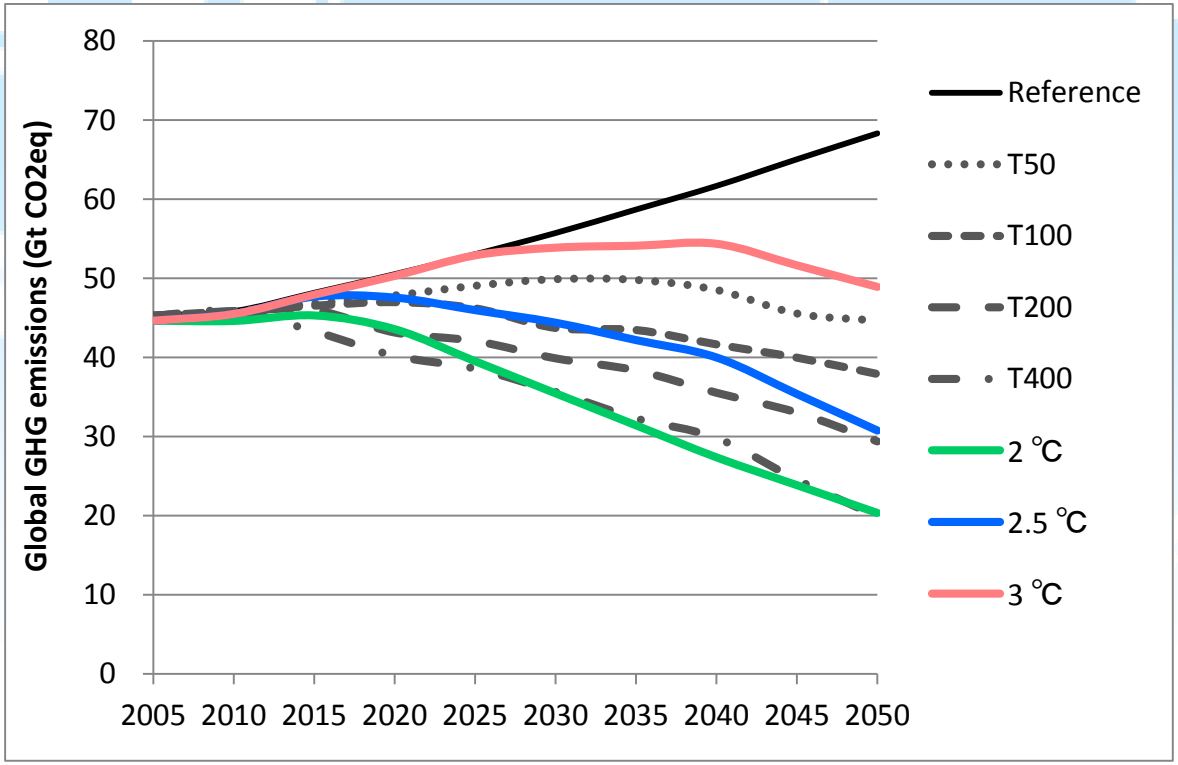


Sources）Rogelj, J. et al., (2011), UNEP The Emission Gap Report (2012)

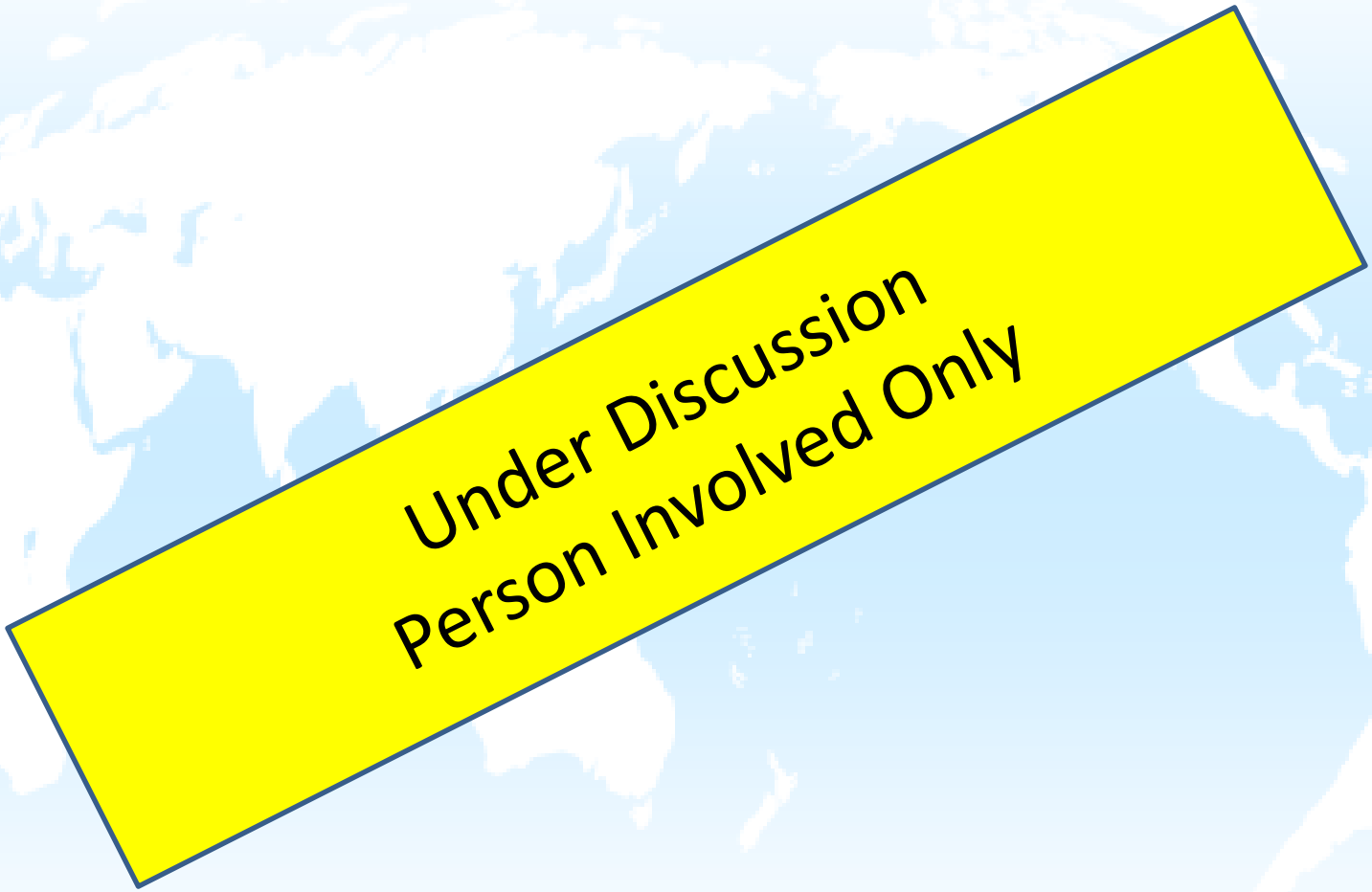
Global GHG emissions pathways and comparison with 2 ℃ target pathways

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

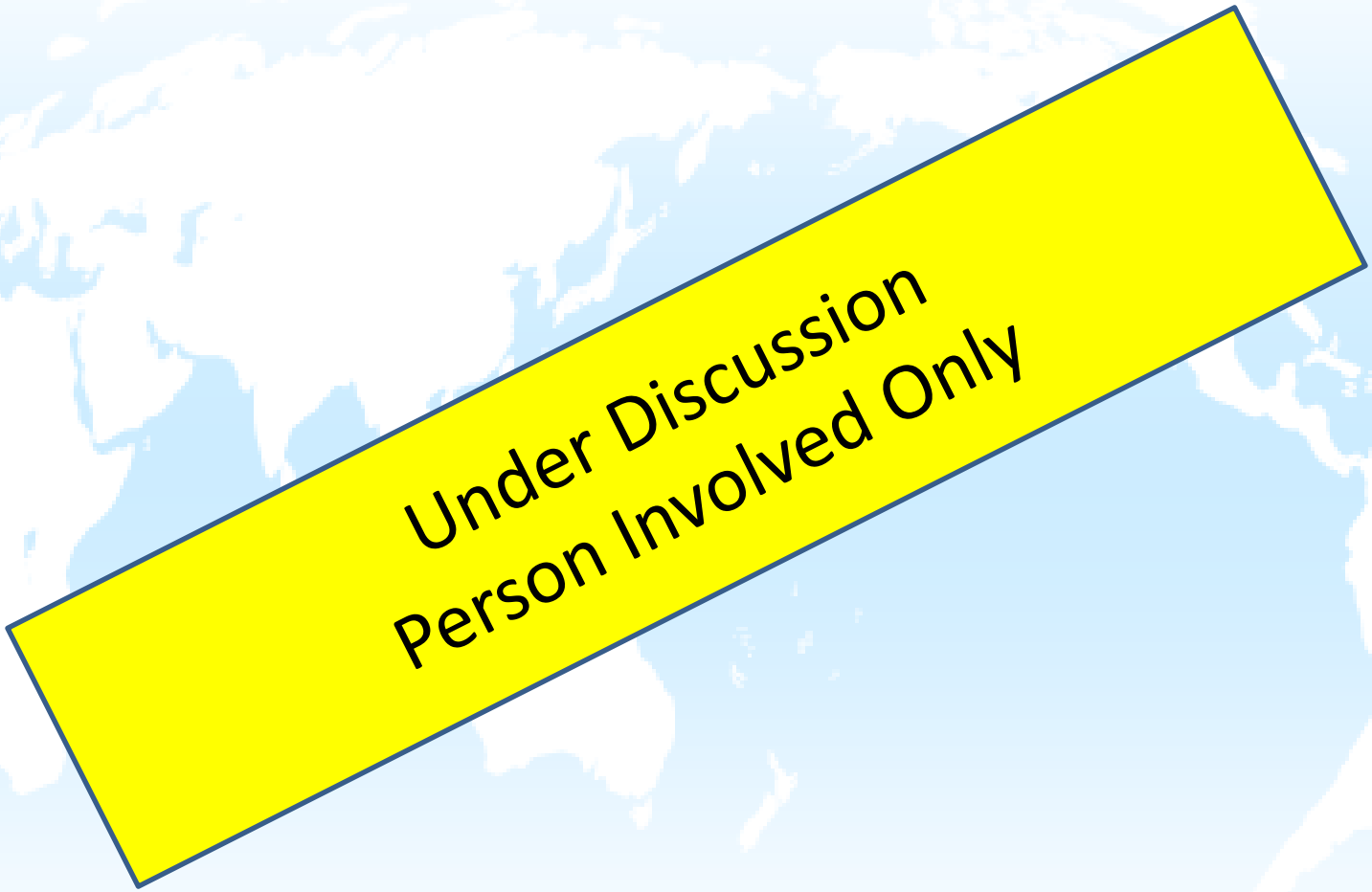
- Transitions toward the 2℃ target are not in line with the current trend.
- T400 scenario can only achieve the 2℃ target scenario.
- It requires high carbon price around **400 US$/tCO$_2$ in 2050 (T400 scenario)**, which is necessary to consider comprehensive strategies to promote mitigation technologies to achieve the maximum potentials of energy savings.



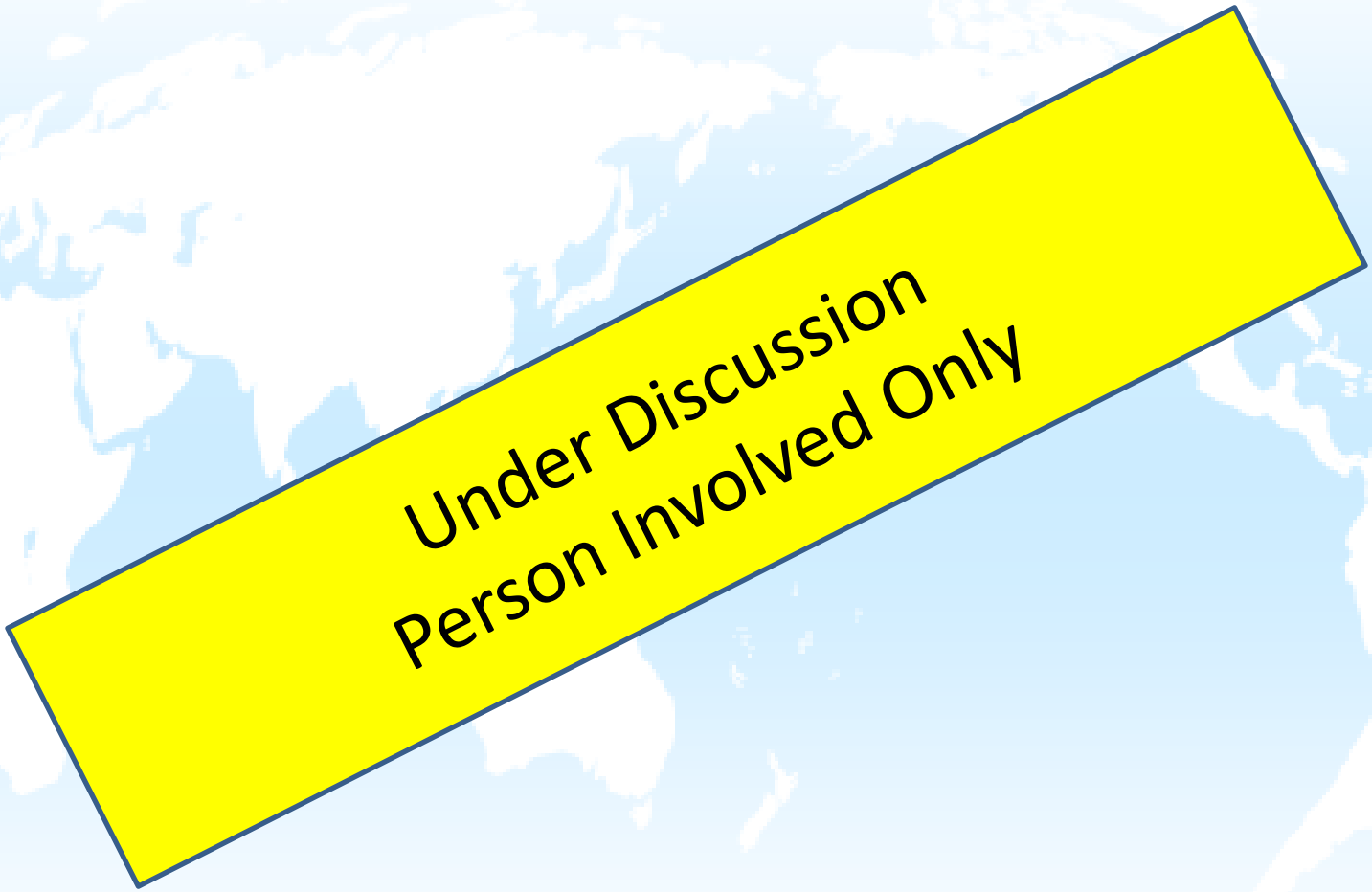
GHG emissions pathways in ASEAN and comparison with 2 ℃ target pathways



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



BC & PM emissions pathways in ASEAN
- Cobenefits of implementing CO2 mitigation policies-



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 air pollutant 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 the energy supply sector largely contribute to reducing GHGs as well as SO_2 in ASEAN. 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.