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Emission Projections of GHGs and Air Pollutants in ASEAN: Toward the Global 2 ℃ Target

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ASIA-PACIFIC INTEGRATED MODEL

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Greenhouse Gases, Short-Lived Climate Pollutants(SLCPs) Air Pollutants

What are the situation in ASEAN among ASIA and the world?

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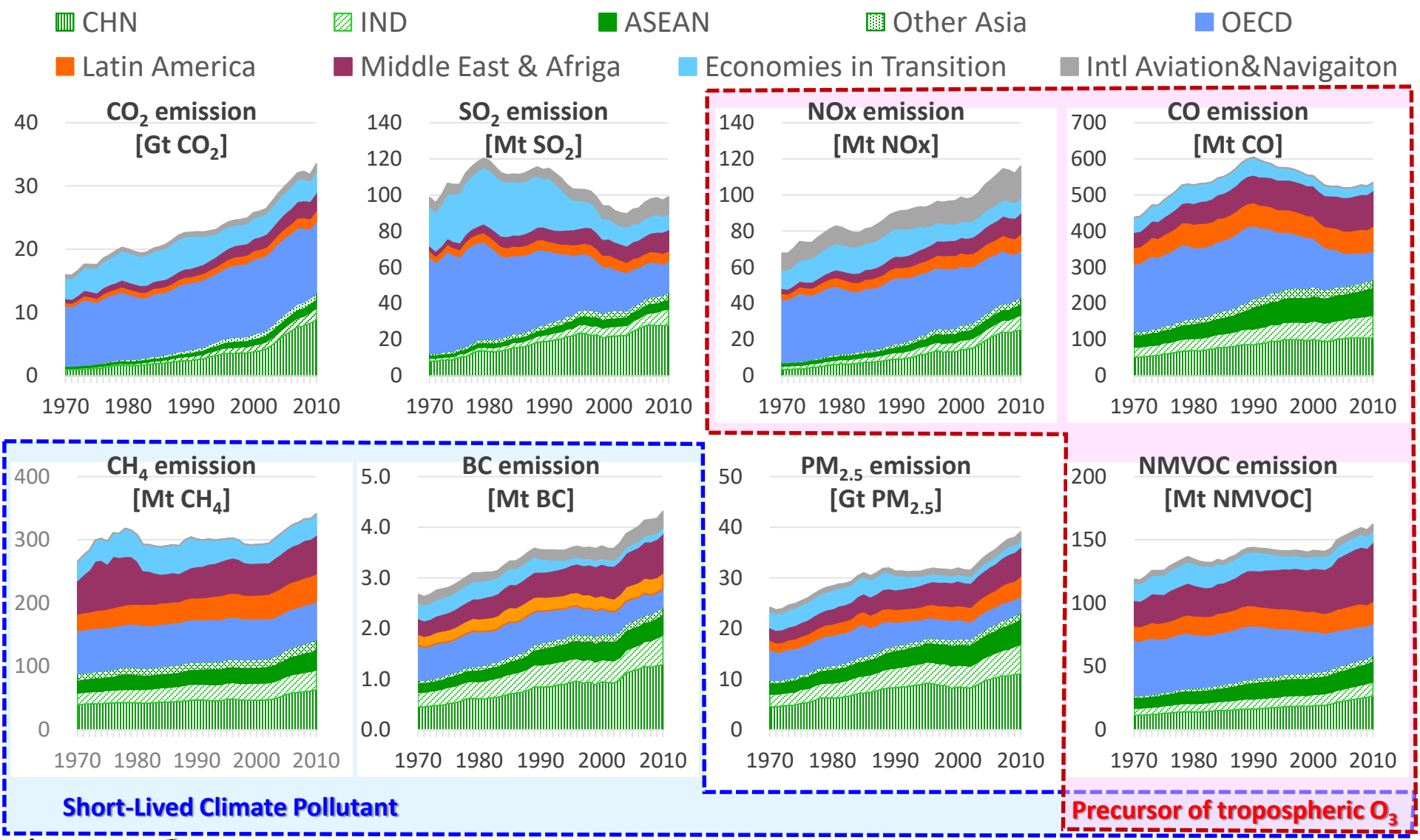
Global Anthropogenic Historical Emissions

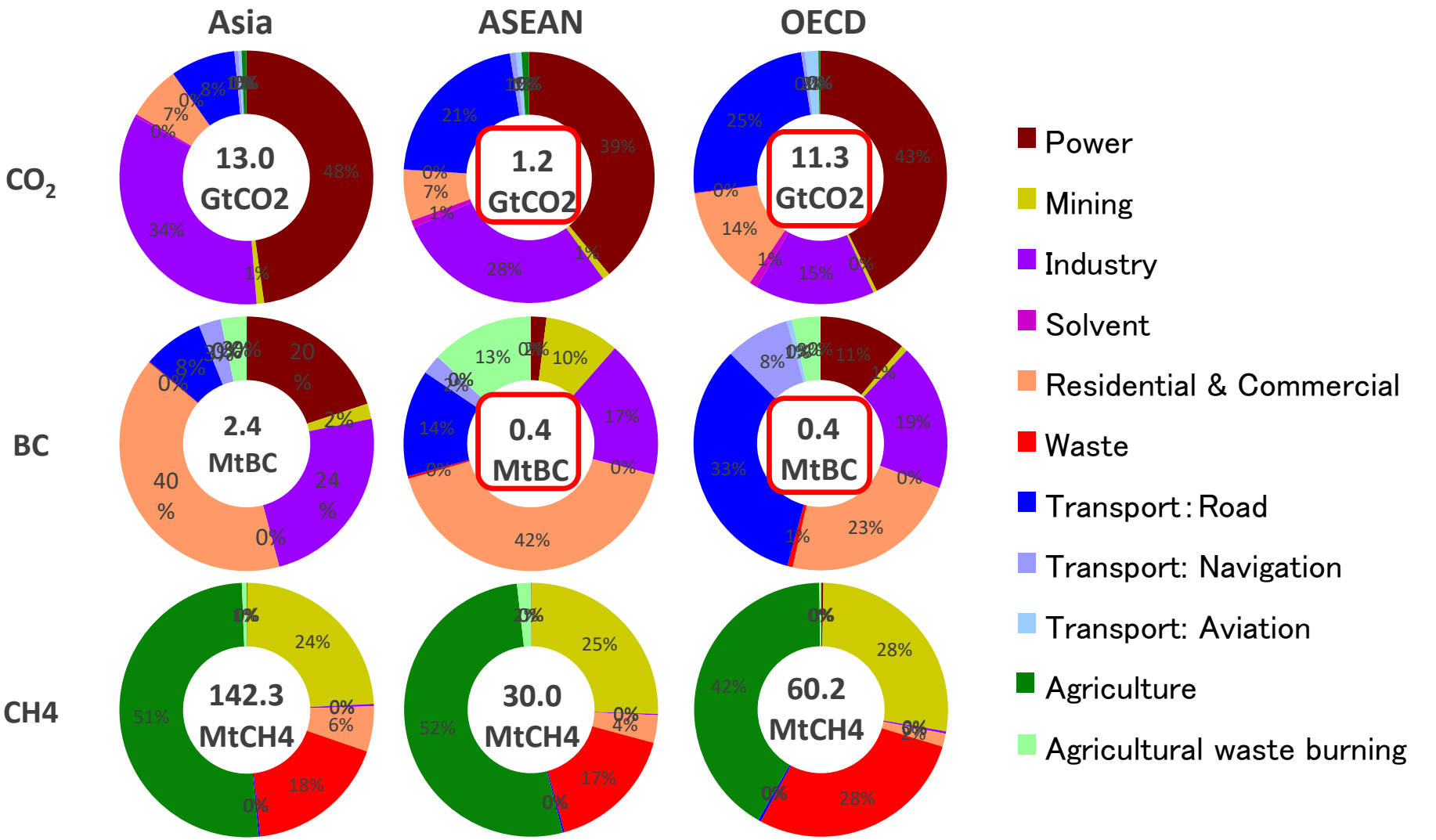
SLCPs and air pollutants emissions from South-east and South Asia has been on the increase



Source) made by author from EDGER 4.3.2

Sectoral Anthropogenic Emissions in 2010 : Asia, ASEAN, OECD

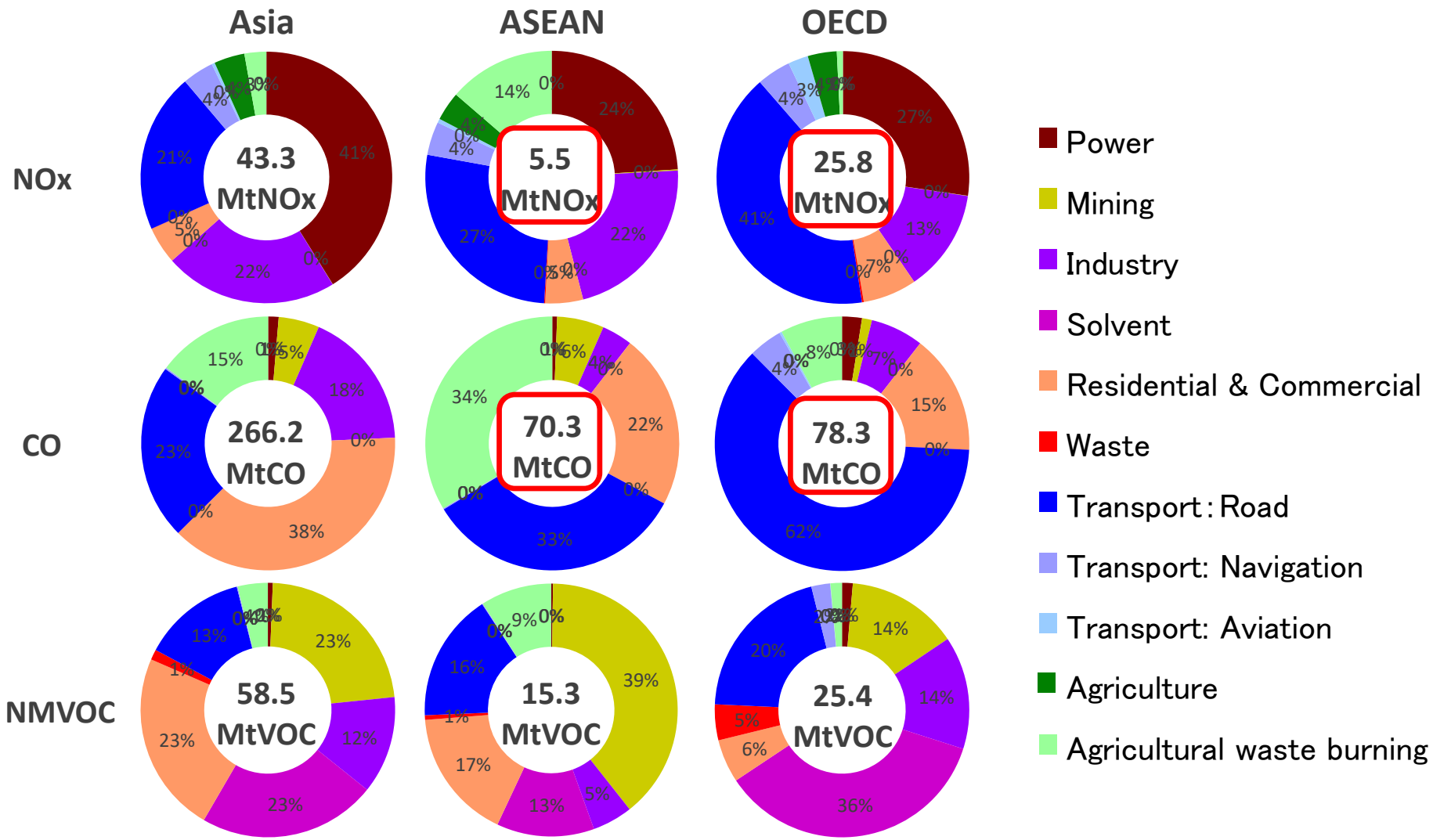
- Emission features between ASIA & OECD are different. (i.e. major emissions sources are different)
- Characteristics of ASEAN are in between ASIA and OECD.



Source) made by author from EDGER 4.3.2

Sectoral Anthropogenic Emissions in 2010 : Asia, ASEAN, OECD

- To reduce tropospheric O_3, **combinations of mitigation measures are necessary but complicated**
- Reduction measures on transport sector is primary important, next building sector, and next ???

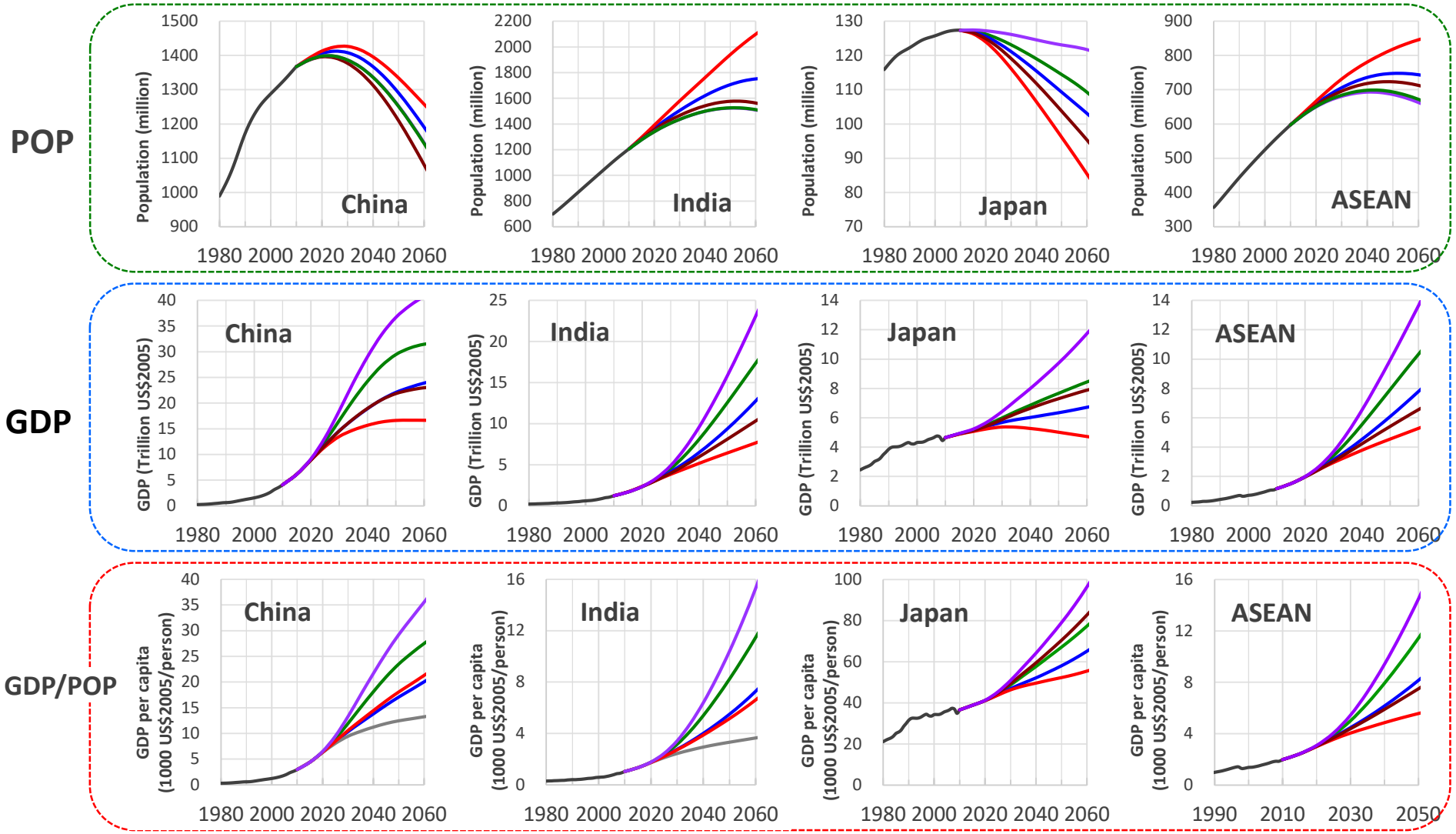


Source) made by author from EDGER 4.3.2

Socio-economic: historical trend and future projections in Asia

Characteristics of socio-economic dynamics are different depending on countries & scenarios

South-east and South Asia has been rapidly increasing, following the past China.

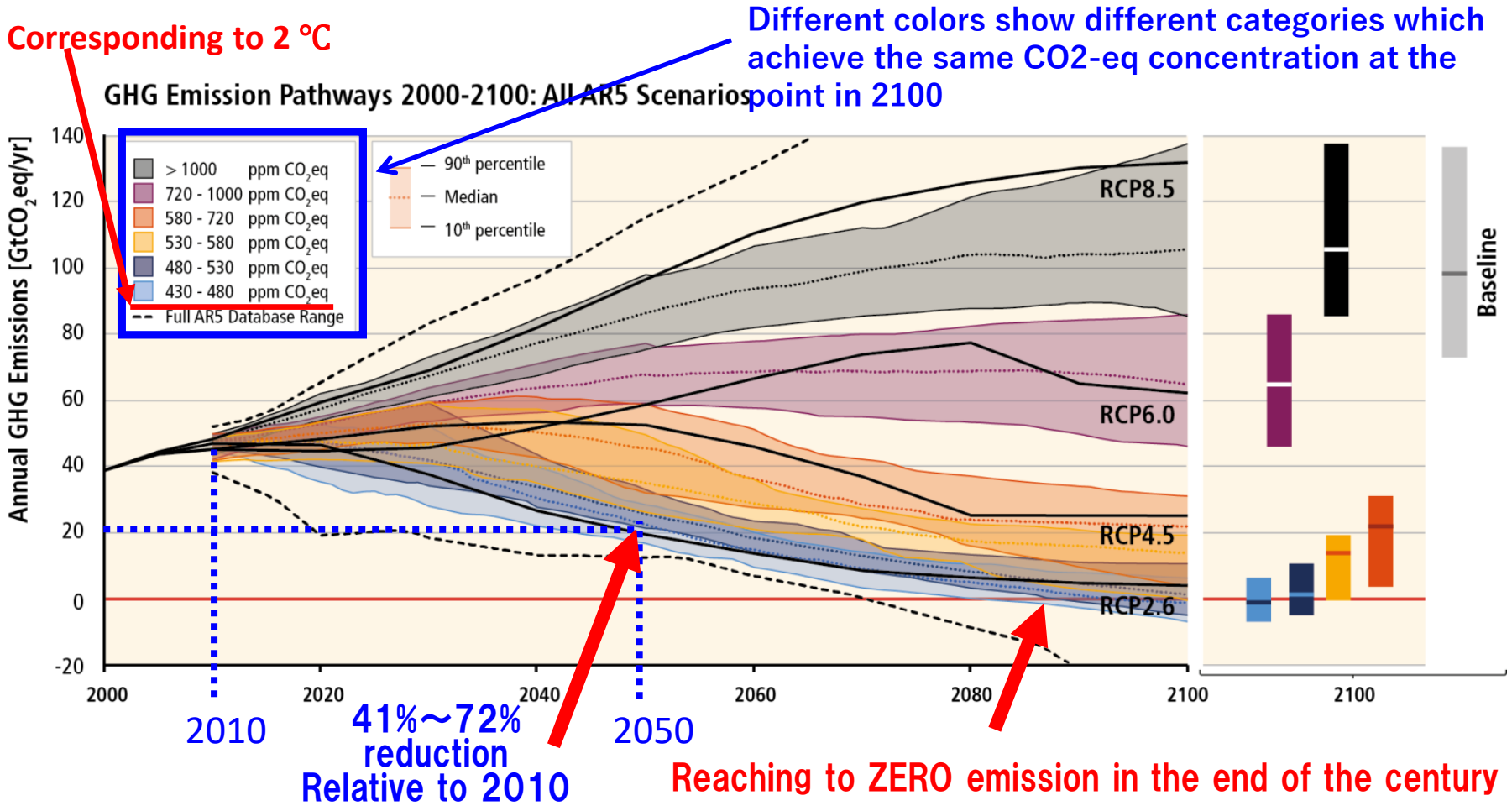


Greenhouse Gases, Short-Lived Climate Pollutants(SLCPs) Air Pollutants

How much we need to reduce?
What are Science-Policy agenda?

Meaning of Stay Below 2 ℃
IPCC AR5 WG3(2014) Chapter 6 Assessing Transformation Pathways

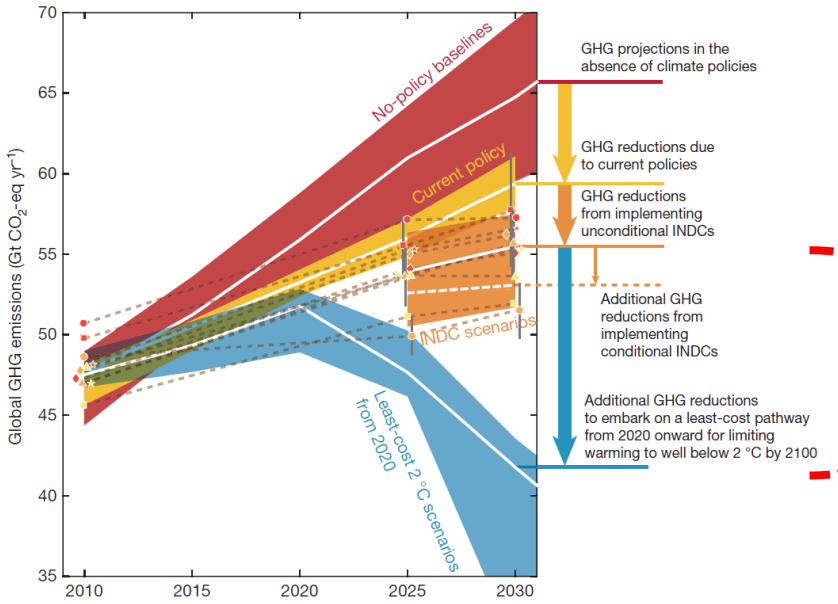
- Without more mitigation, **global mean surface temperature might increase by 3.7 – 4.8℃** by 2100.
- To stay below 2℃, **the range of GHG emissions are roughly between 30-50 Gt CO_2eq in 2030.**
- To stay below 2℃, **41–72% reductions by 2050 compared to the 2010 level** are required.



Source) IPCC AR5 WG3 (2014), Figure SPM.4

Comparison of NDCs and Paris Agreement Climate Proposals

- Even if **the NDCs** collectively lower GHGs emissions compared to where current policies stand, but still imply a median warming of **2.6–3.1 ℃ by 2100**
- **Emission gaps between the INDCs and 2℃ median pathway** are **14 Gt CO2eq by the unconditional INDCs, 11 Gt CO_2eq by the conditional INDCs, in 2030**



Source) Rogelj, J. et al (2016) Nature

Submitted (Intended) Nationally Determined Contributions by UNFCCC nations are not enough for achieving the 2℃ target

In 2030
Around 11-14 GtCO_2eq emission GAP

note) CO_2emission in Asia in 2010 = around 10GtCO_2
CO_2emission in OECD in 2010 = around12GtCO_2

For achieving 2 degree target, it is important to accelerate Low Carbon measures and SLCP measures

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Research Questions

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Q1：How can we fill the Gap between NDCs and 2 degree target in Asia and ASEAN?

Q2: What kinds of advantage and disadvantage, from the view points of air pollutants and SLCPs reduction, when considering deep decarbonization?

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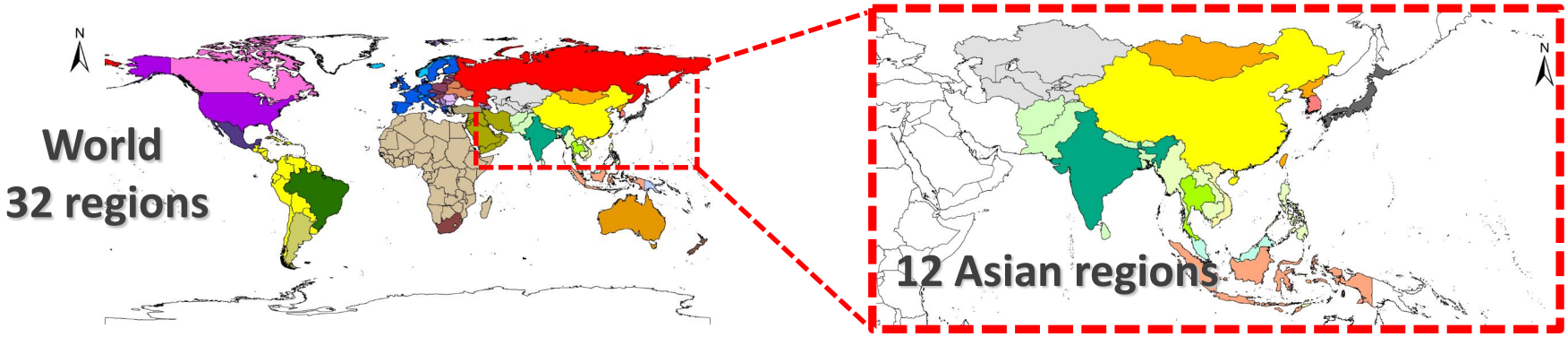
AIM/Enduse[Global] – Major characteristics

- Bottom-up type model with detailed technology selection framework with optimizing the total system cost, assessing technological transition
- Recursive dynamic model (=Calculating year by year)
- Analyzing effects of policies such as carbon/energy tax, subsidy, regulation and so on.



	CO_2	CH_4	N_2O	SO_2	NOx	BC	OC	PM_{10}	$PM_{2.5}$	CO	NMVOC	NH_3	HFCs	PFCs	SF6	CFCs	HCFCs
Energy supply	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔					
Fuel mining		✔									✔						
Industry	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Transport	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔					
Building	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔					
Waste		✔	✔								✔						
Agriculture		✔	✔									✔					
Others	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔					

Note1) ✔ shows the coverage of target gases in the model

Note2) Within the same gas-type,

- ✔ shows most major emitting sector
- ✔ shows 2nd major emitting sectors
- ✔ shows relatively emitting sectors
- ✔ shows minor sectors

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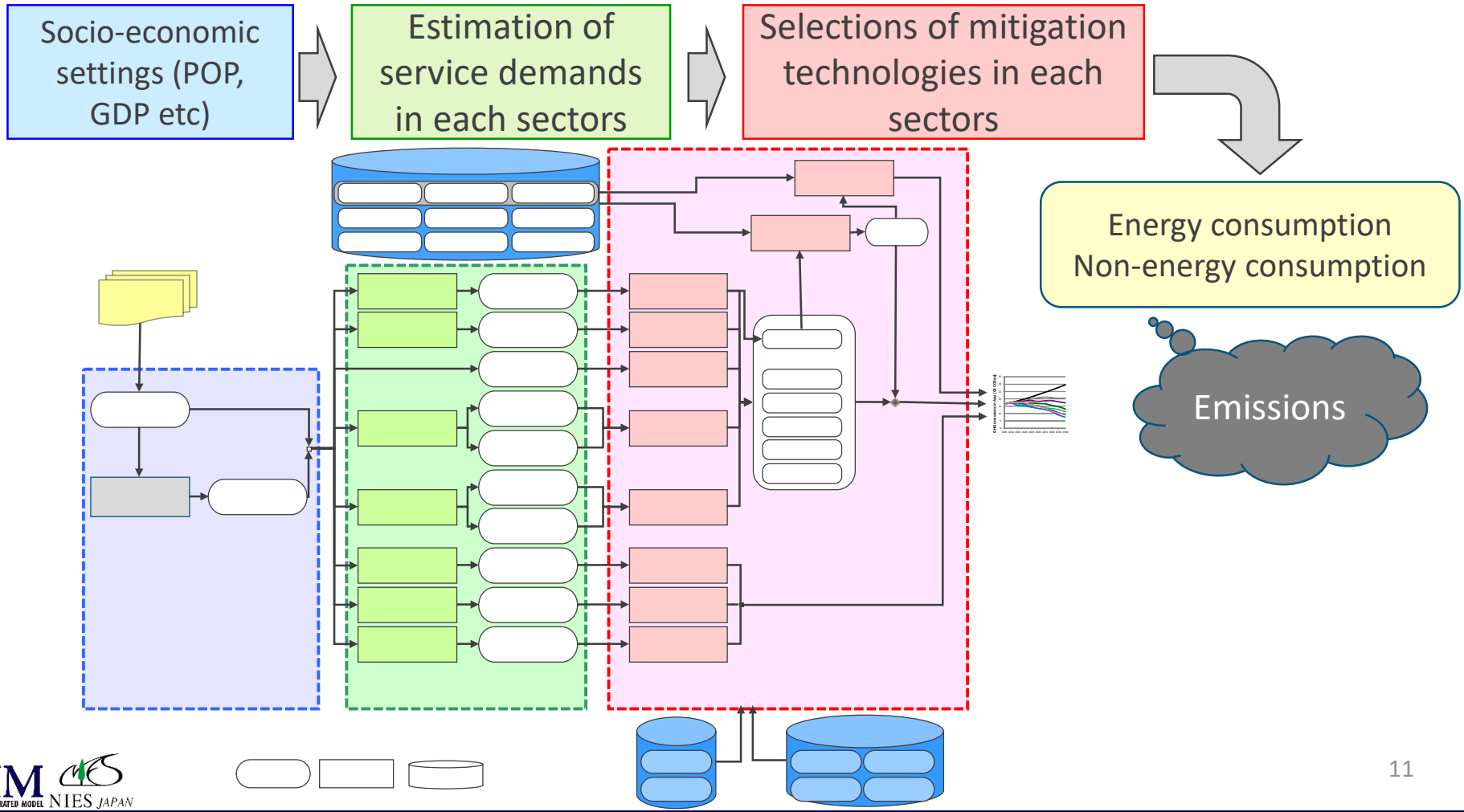
Overview of Bottom-up type methodology : AIM/Endues model

This analysis consists of three parts;

1) setting future socio-economic growths,
2) estimating future service demands of each demand sector by using service demand models,
3) analyzing combinations of mitigation options by using a technology bottom-up model



Overview of mitigation measures

Around 200 - 300 mitigation measures are set in the AIM/Enuse model. Mitigation measures are selected depending on policy push and regulation, carbon pricing, subsidy.

Four major groups of 200 – 300 mitigation measures on GHG and air pollutants

① End-of-pipe mitigation measures ⇦ Effective for reducing (a) specific gas(es)

- ✓ **desulfurization equipment [=SO_2 reduction],**
- ✓ **denitrification equipment [=NOx reduciton],**
- ✓ **dust-collecting equipment [=BC, PM reduction],**
- ✓ **fertilization management in agriculture [=N_2O reduciton],**
- ✓ **manure management [=CH_4, N_2O reduction],**
- ✓ **waste management [=CH_4 reduction]**

② Improvement of quality of fuels ⇦ Effective for reducing a specific gas

- ✓ **shifting from high sulfur-content fuel to low-sulfur content fuel [=SO_2 reduction]**

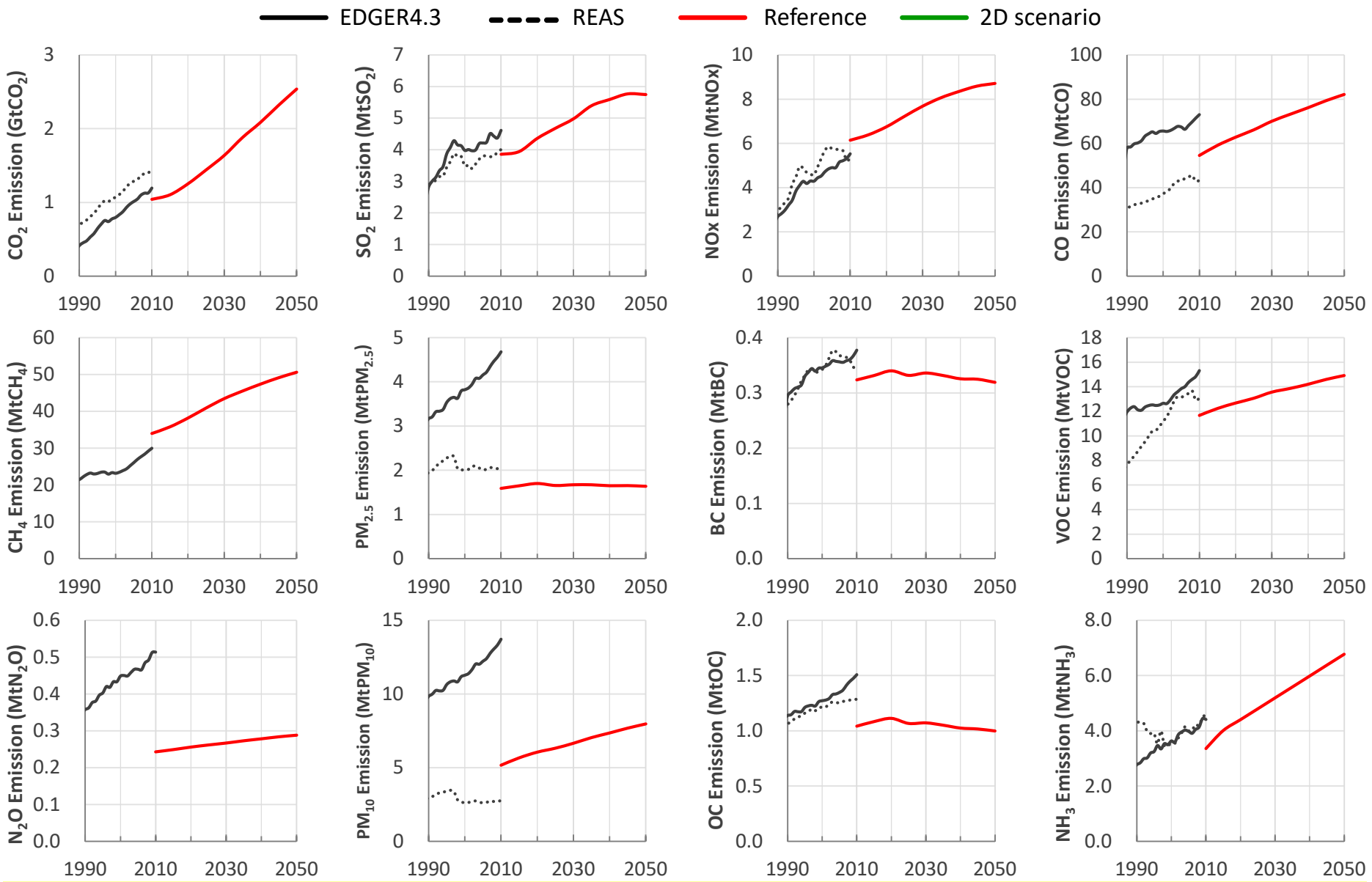
③ Improvement of energy efficiency ⇦ Effective for reducing multiple gases

- ✓ **high-energy efficient technologies and reduction of energy [=CO_2・APs・ BC reduction],**
- ✓ **Low-carbon power supply and electrification in demand side [=CO_2・APs・ BC reduction]**

④ Drastic energy shifting ⇦ Effective for reducing multiple gases

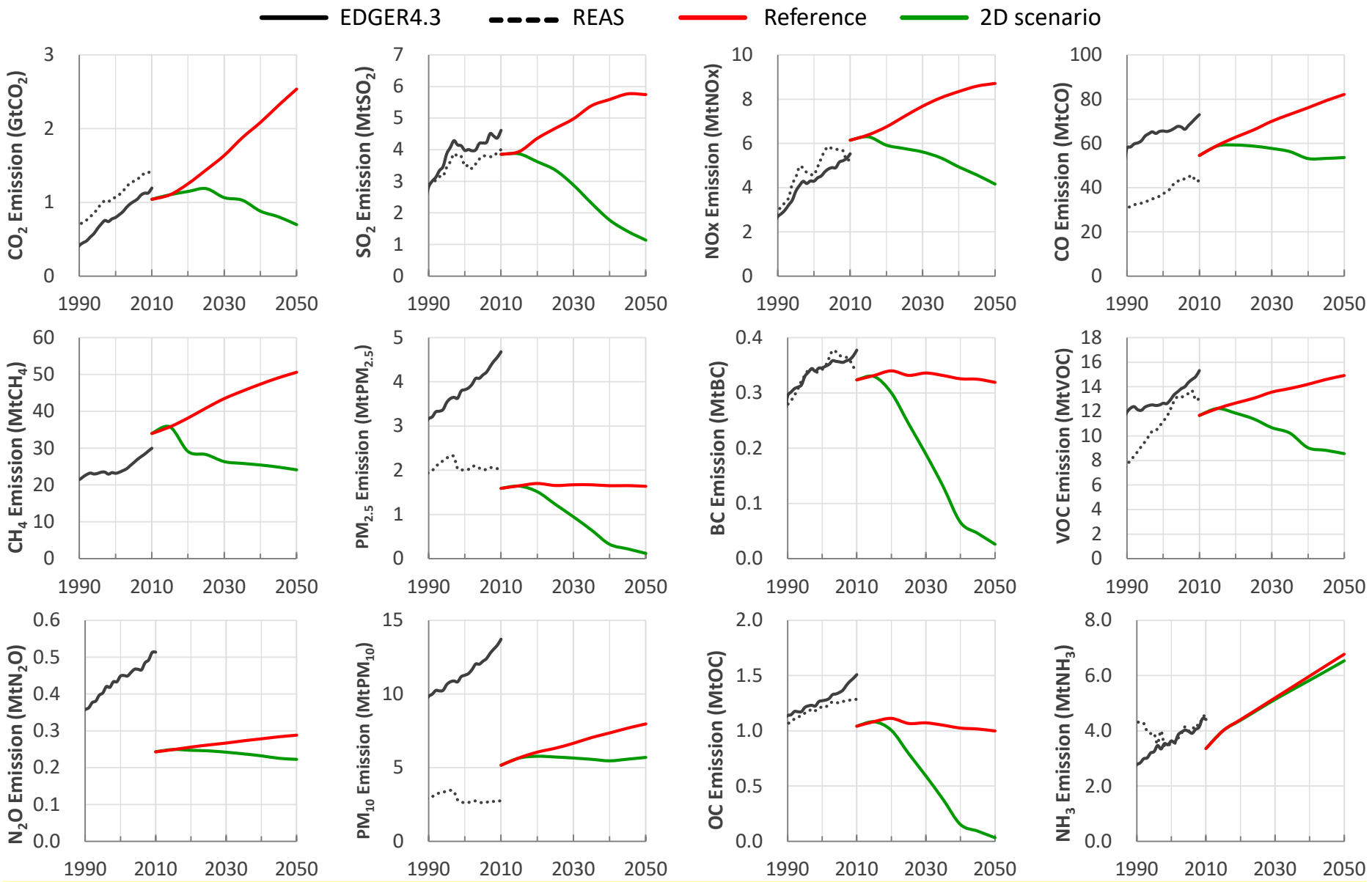
- ✓ **shifting from coal to renewables or natural gas [=CO_2・APs・ BC reduction],**
- ✓ **diffusion of hydrogen-fuel from renewables [=CO_2・APs・ BC reduction]**

Baseline Anthropogenic Emissions Scenario in ASEAN



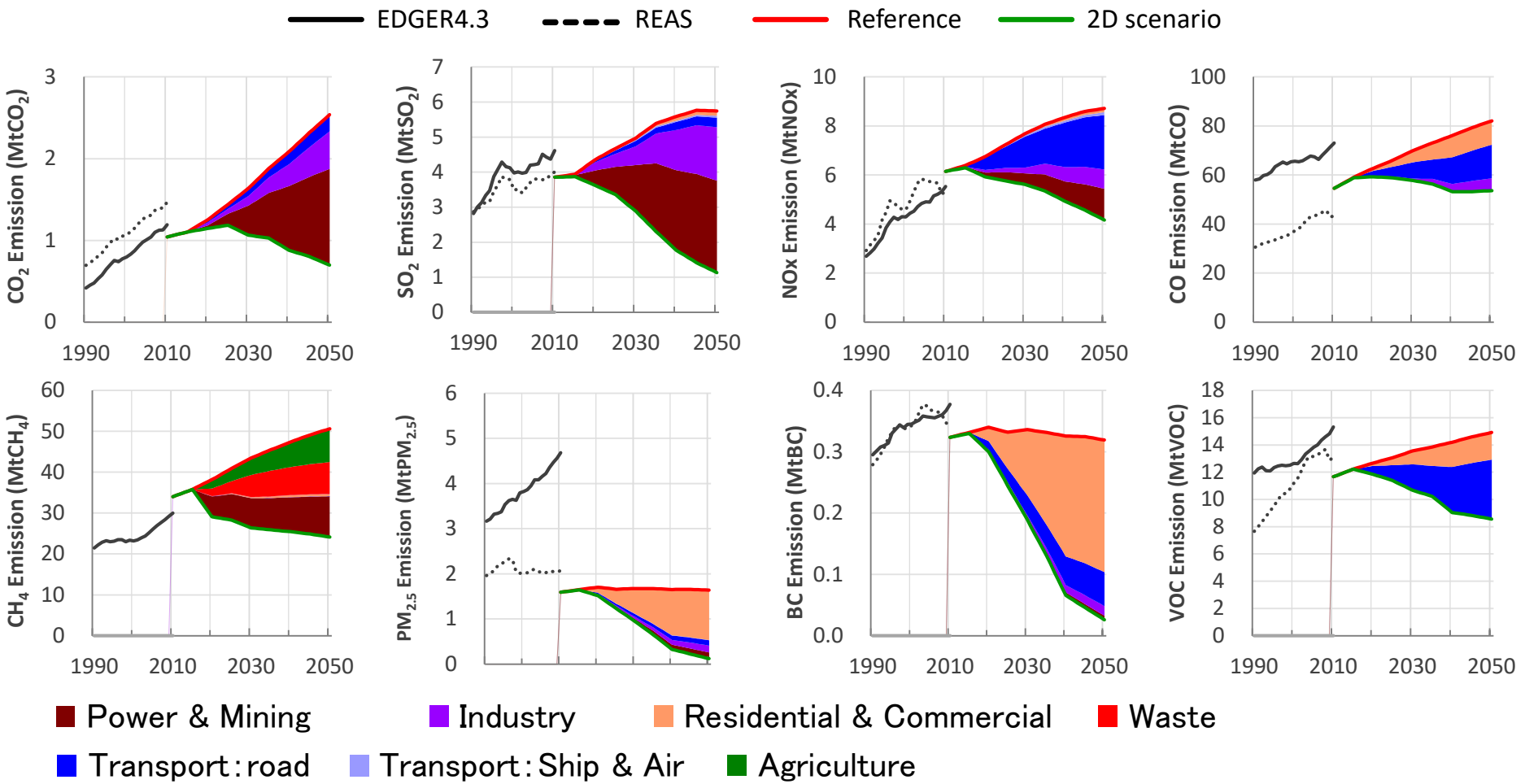
1) Uncertainty of PM emissions is large, 2) emissions related to non-energy are necessary to be calibrated

2 ℃ Mitigation Scenario in ASEAN



Deep decarbonization measures have multiple effect for reducing large amount of air pollutants & SLCPs

2 ℃ Mitigation Scenario in ASEAN



- Major mitigation sectors are different by gas, i.e. combination of multi-sector measures are important.
- Caveats are that 1) emissions from natural sources are out of scope, 2) technology database in this model does not consider some innovative technologies and non-energy related technologies due to the lack of information about cost, efficiency, etc.

Acknowledgment

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