The 20th AIM International Workshop
Ohyama Memorial Hall, NIES
23-24 January 2015

Overview of S-12-2 project and progresses in FY2014 - Assessing emissions of Long-Lived GHGs and Short-Lived Climate Pollutants in Asia -

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AIM
ASIA-PACIFIC INTEGRATED MODEL

NIES JAPAN

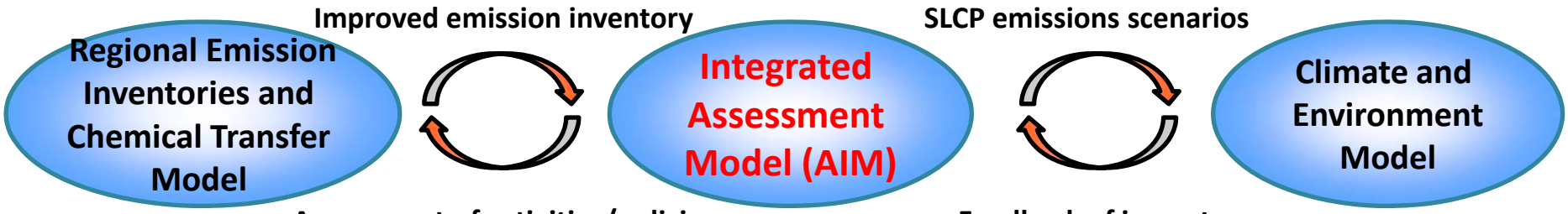
MOEJ-S12: Promotion of climate policies by assessing environmental impacts of SLCP and seeking LLGHG emissions pathways (FY2014-FY2018)

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



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	Stakeholders Policy makers	Society
Model improvement	System utilization	Information transmission

Experiment setup
Database development
Metric definitions

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

MDG・SDG・Future Earth

Regional strategy ↑↓ Global strategy

Challenges of S-12 Theme 2
led by NIES cooperating with MHIR and Kyoto Univ.

1. - To indicate **socio-economic scenarios considering climate change and environmental impacts** and

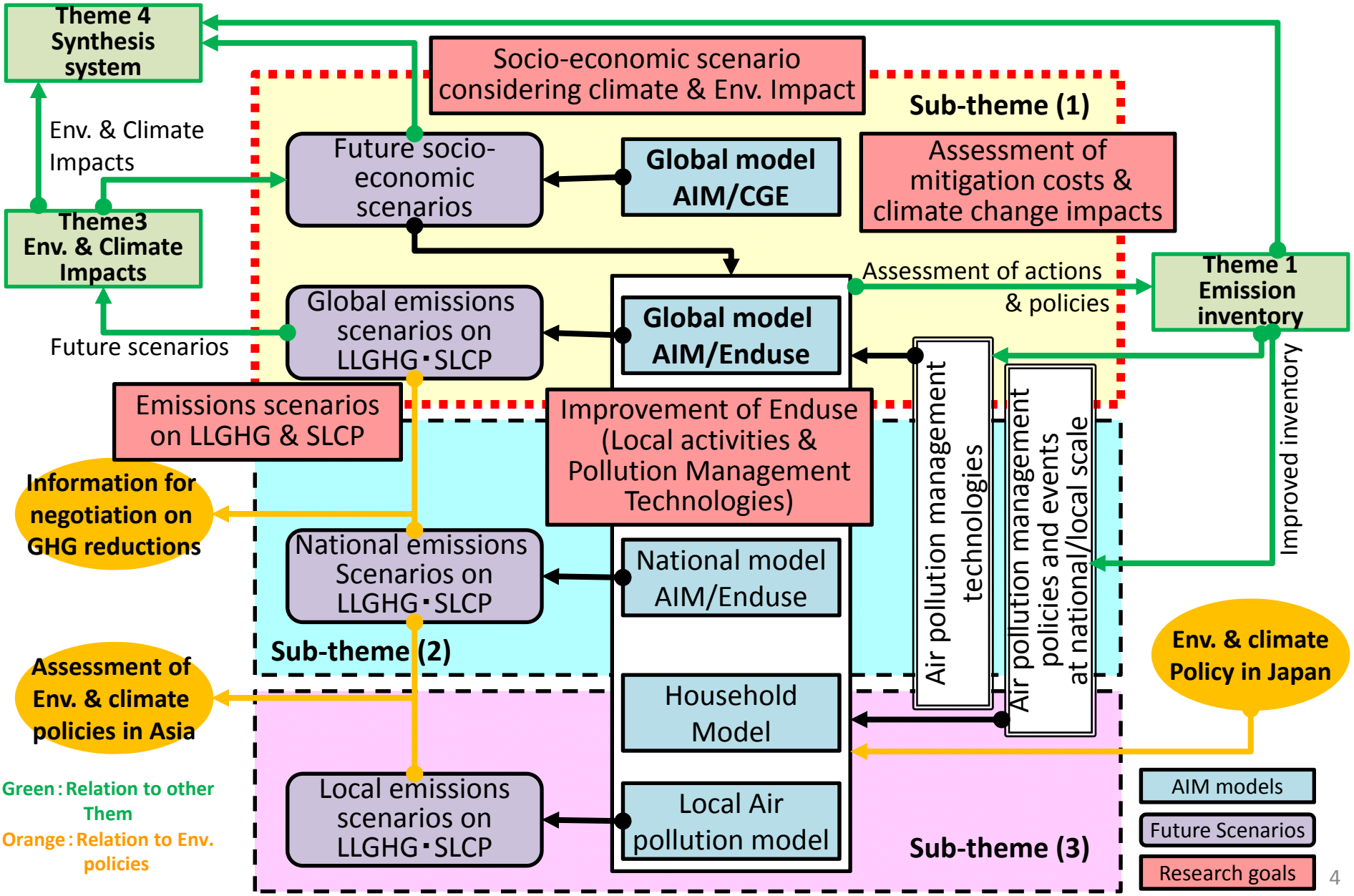
   - To present **emissions scenarios of Long-lived GHG(LLGHG) and Short lived Climate Pollutant (SLCP).**
   【global/national/local scales】

2. - To evaluate **co-benefits of LLGHG mitigation measures and SLCP reduction measures** and

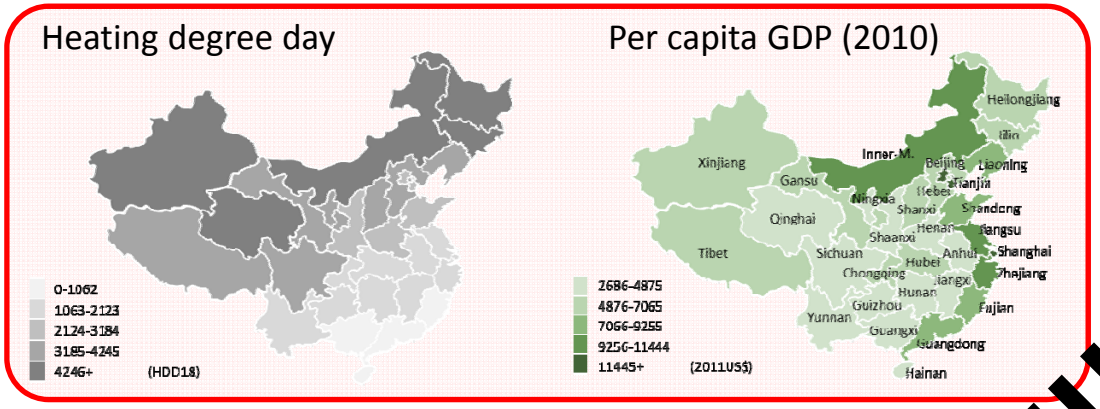
   - To analyze **regional characteristics in Asia**, in a manner consistent with long-term global scenarios such as achieving 2℃ global temperature change limit target and halving global GHG emissions by 2050.

   【national/regional scales in Asia】

S-12 Theme2: Improvement of Integrated Assessment Model and Quantification of Future Scenarios



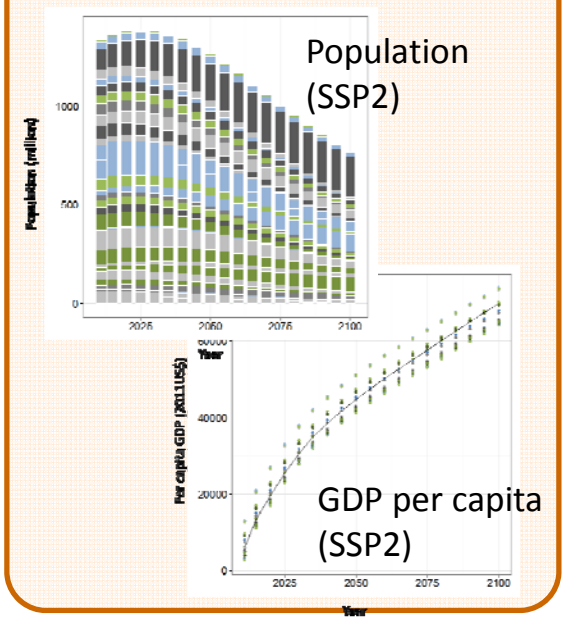
AIM/Enduse[China] at 31 provincial levels
service demands in the urban residential sector

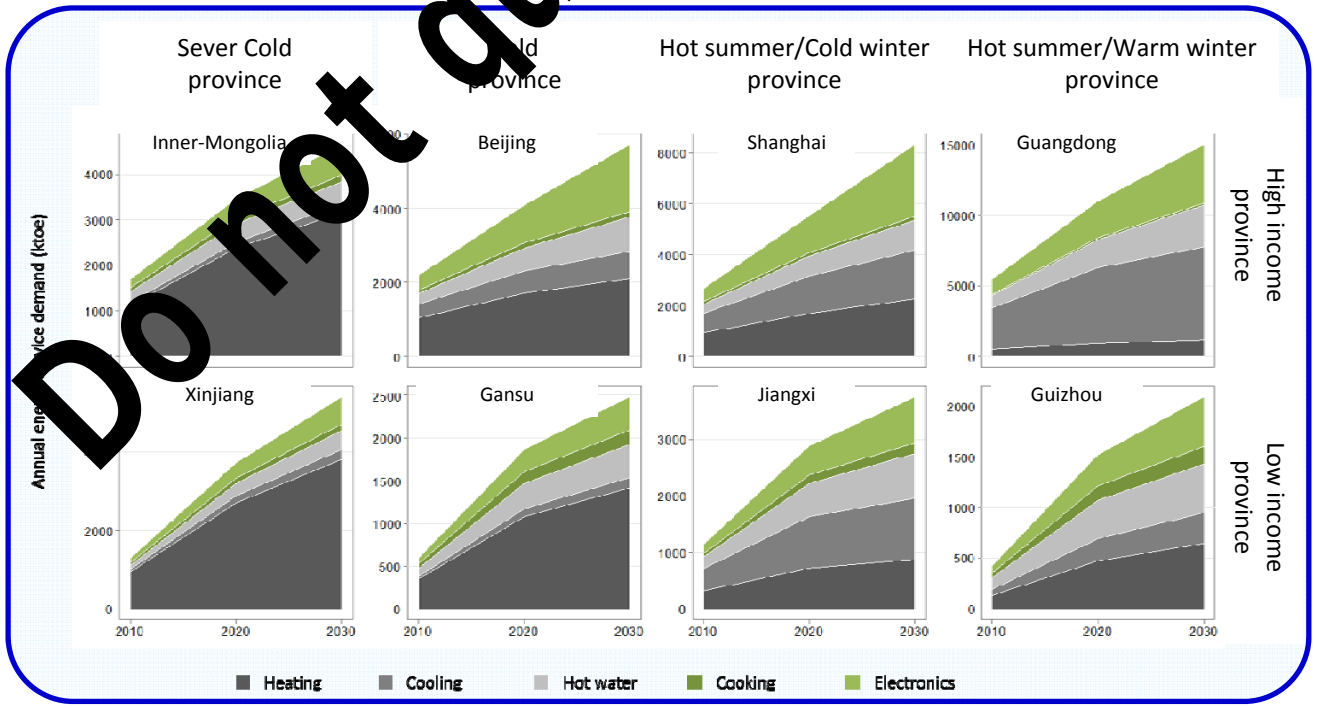


Important to consider provincial characteristics when estimating service demands in the residential sector in China

Left-top box : Regional characteristics
Left-bottom box : Socio-economic characteristics
Right-bottom box: Energy service demands

Downscaling national SSPs into provincial levels





Note) Dr. Xing's work. Under review in "Environmental Research Letters" , thus do not quote yet.

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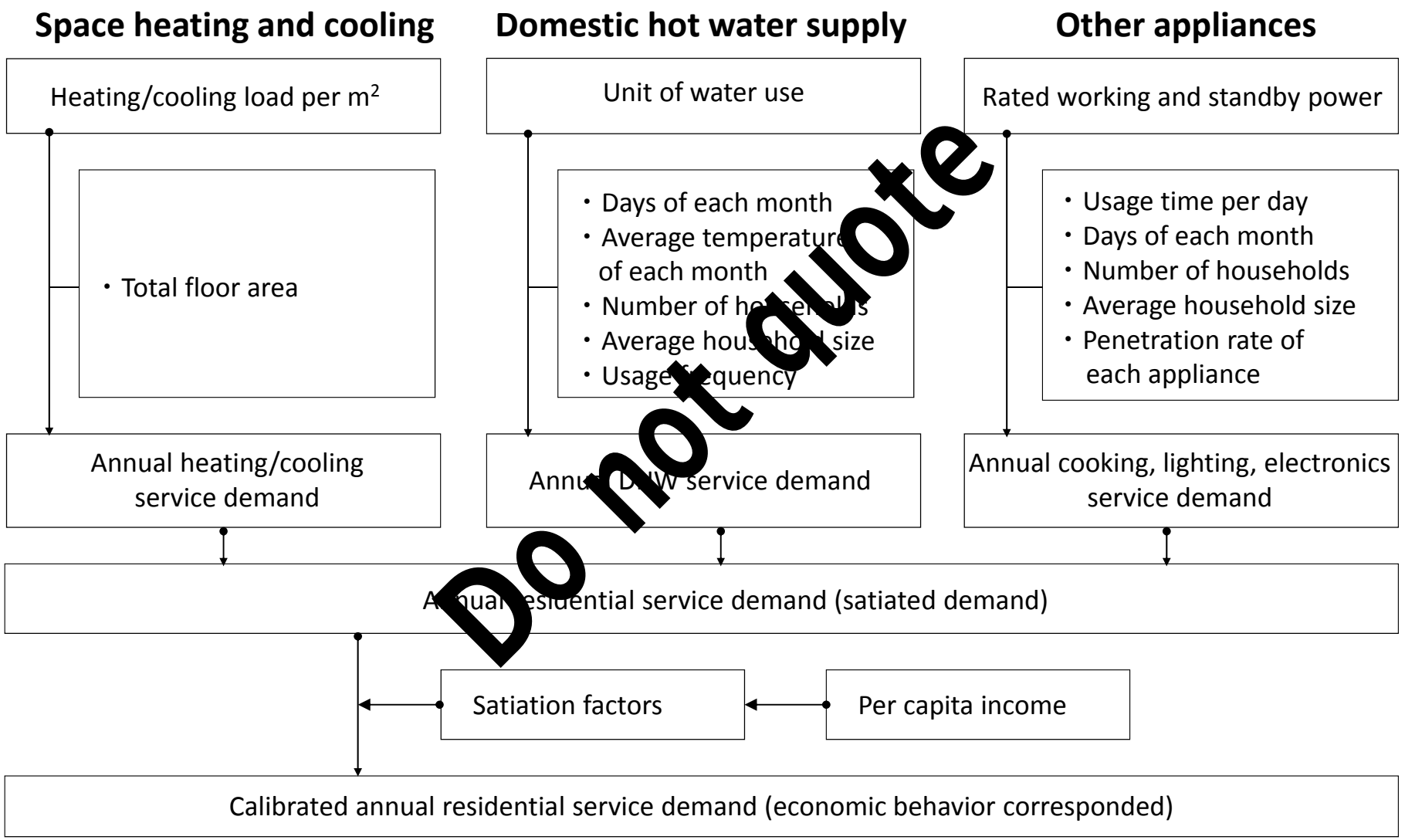

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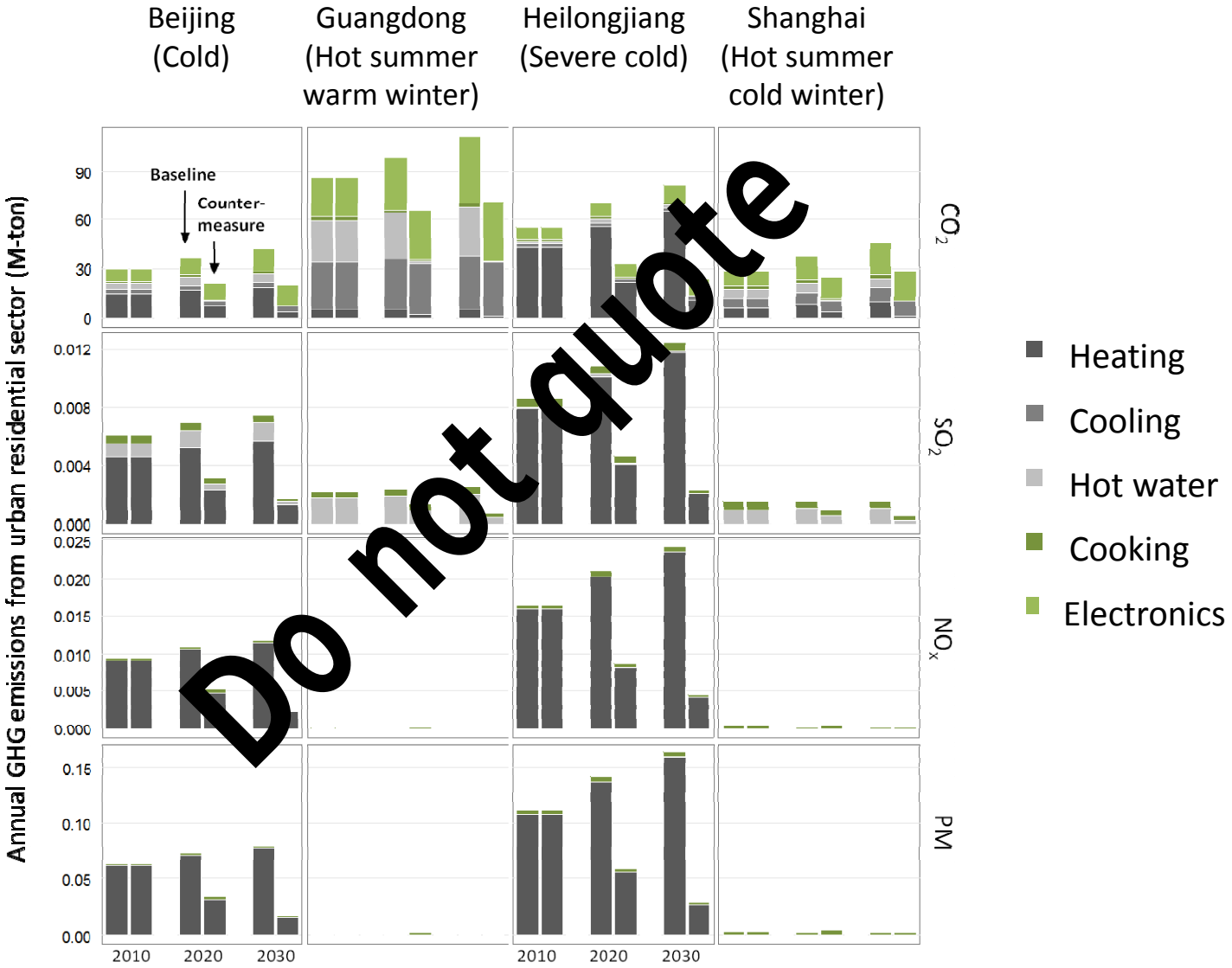

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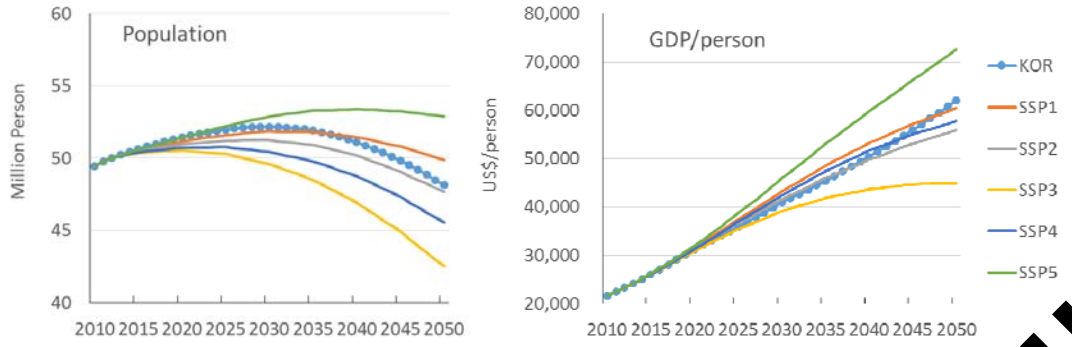
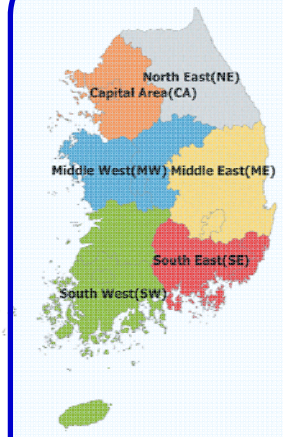
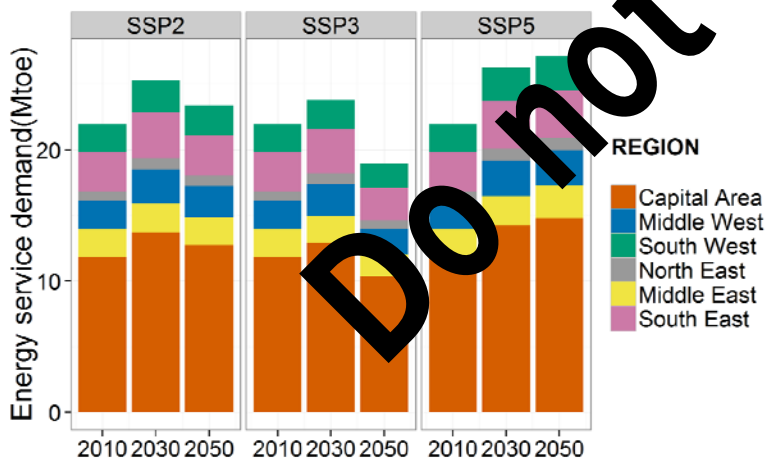
AIM/Enduse[Korea] in 6 mega-regions
service demands in the residential & power sectors

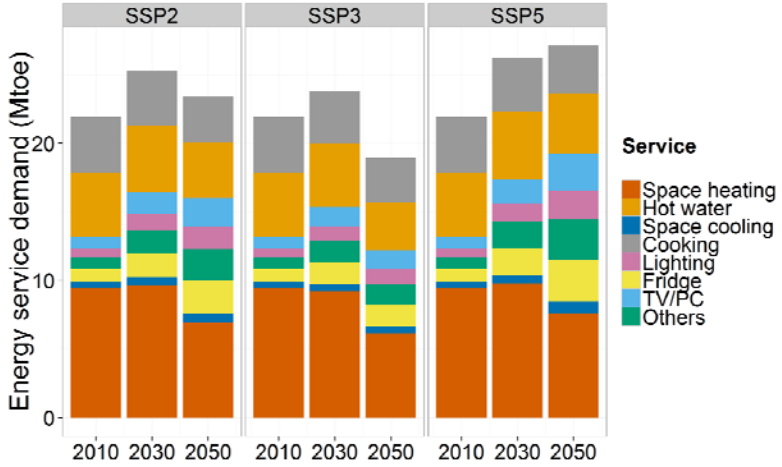


Korean Governmental outlook is in the range of SSP1 –SSP2, similar to SSP2

Left-top box : Socio-economic characteristics
Right-bottom box: Energy service demands







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AIM/Enduse[Korea] in 6 mega-regions
service demands in the residential & power sectors

Current energy service demand

$$RSD_{r,s,t} = EC_{r,s,t} \times EE_{r,s,t} \quad \textbf{Eq. 1}$$

$$EE_{r,s,t} = \frac{\sum_d stock_{r,d,t} \times EE_{r,d,t}}{\sum stock_{r,d,t}} \quad \textbf{Eq. 2}$$

Future energy service demand

$$RSD_{r,s,t} = Activity_{r,s,t} \times Intensity_{r,s,t} \quad \text{Eq. 3}$$

$Intensity_{r,s,t}$ = f(HDD, CDD, GDP, DP) Eq. 4

Where, RSD: Energy Service Demand, EC: Energy Consumption, EE: Energy Efficiency, DP: device penetration (r: Region, s: Service, e: Energy, d: Device)

	(1) HEATING	(2) HOTWATER	(3) COOLING	(4) LIGHTING	(5) COOKING	(6) FRIDGE	(7) ICT	(8) OTHERS	(9) air conditioner
HDD	0.125***	0.026*							
	(0.0194)	(0.00993)							
CDD			0.005*						
			(0.00288)						
AIRCON			2.783***						
			( )						
GDPPC				0.528***	-5.240***	1.091***	0.714***	0.436***	0.027***
				(0.046)	(0.636)	(0.0892)	(0.060)	(0.039)	(0.005)
cons	-118.3*	26.280	2.65	1.893*	177.000***	3.253	2.651*	1.578*	-0.013
	(46.19)	(23.64)	(0.491)	(0.850)	(12.13)	(1.701)	(1.146)	(0.746)	(0.101)
N	64	64	64	64	64	64	64	64	64
R-sq	0.739	0.665	0.872	0.848	0.822	0.865	0.829	0.903	0.569
adj. R-sq	0.650	0.551	0.825	0.796	0.761	0.820	0.771	0.870	0.422
(rsme)									

Standard errors in parentheses

* p<0.10 ** p<0.05 *** p<0.01

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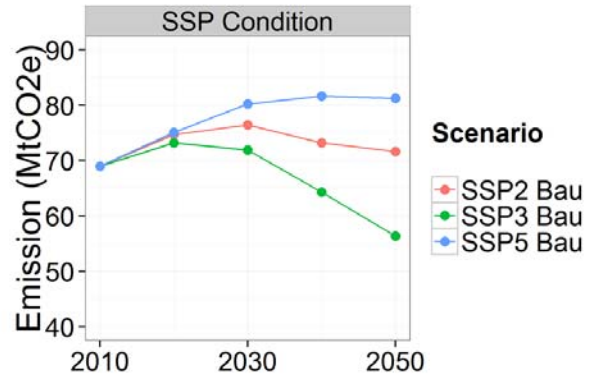
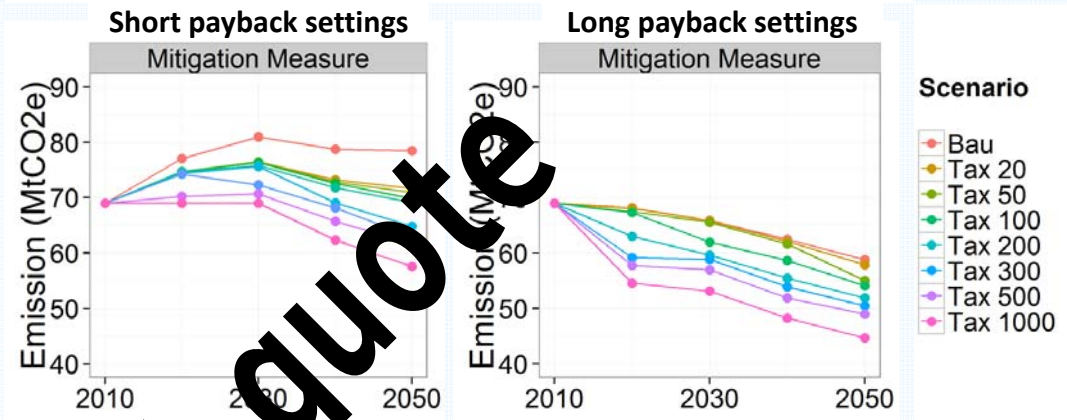
AIM/Enduse[Korea] in 6 mega-regions

emissions in the residential & power sectors

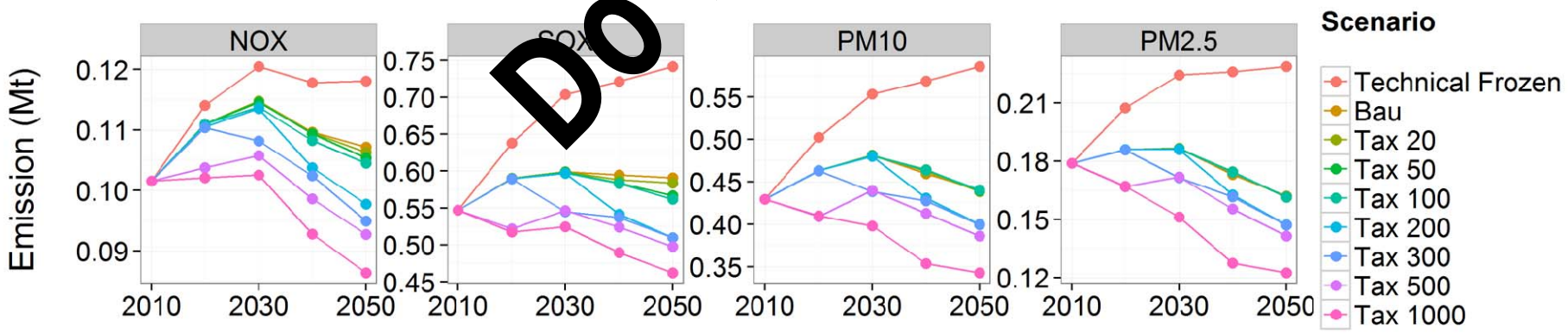
Impact of Socio-economic characteristics



Impact of mitigation actions and payback time settings



Co-benefits of implementing CO2 mitigation actions (in short payback time technology selections)



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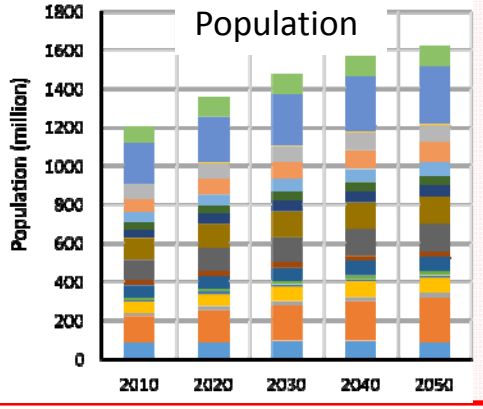
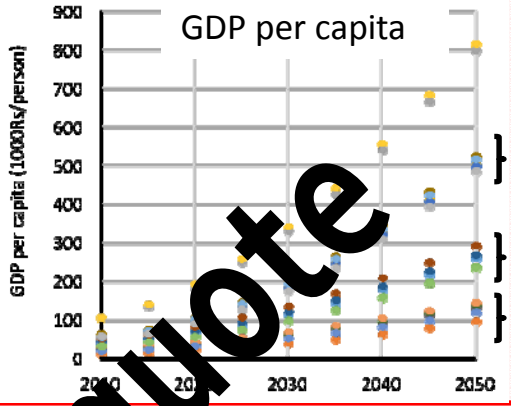
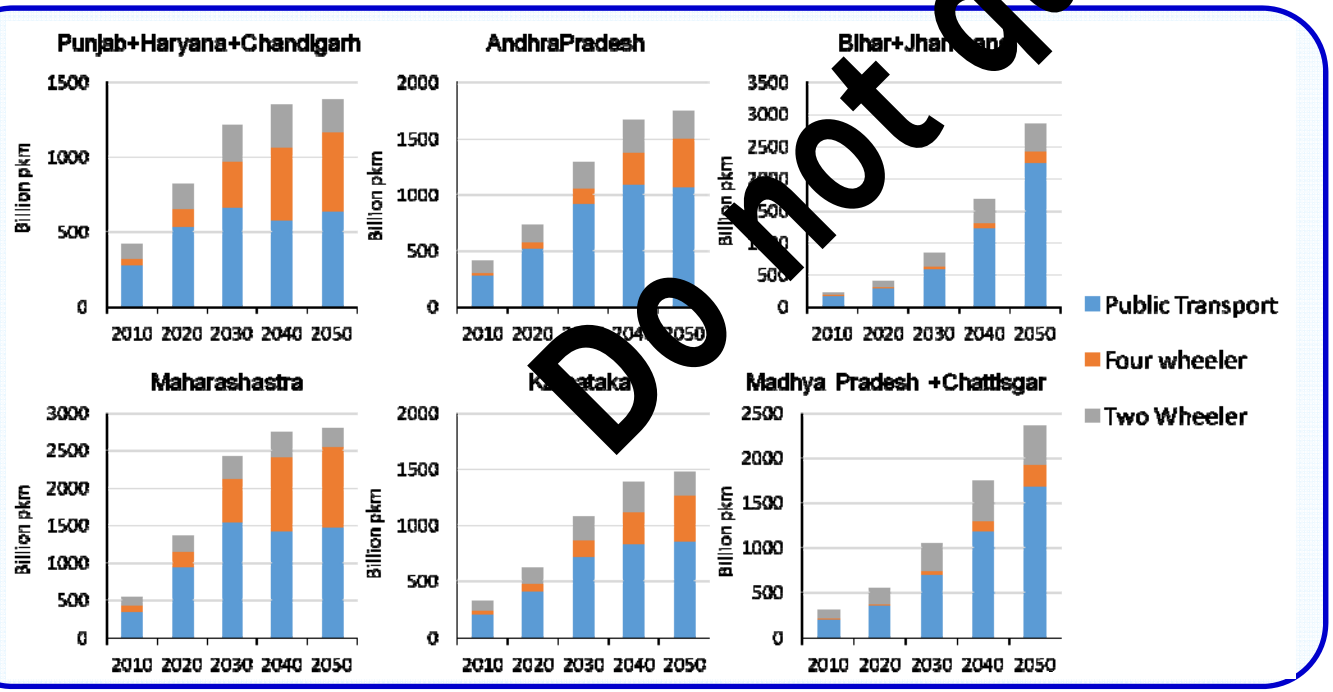
AIM/Enduse[India] in 18 aggregated states
service demands in passenger road transport sector



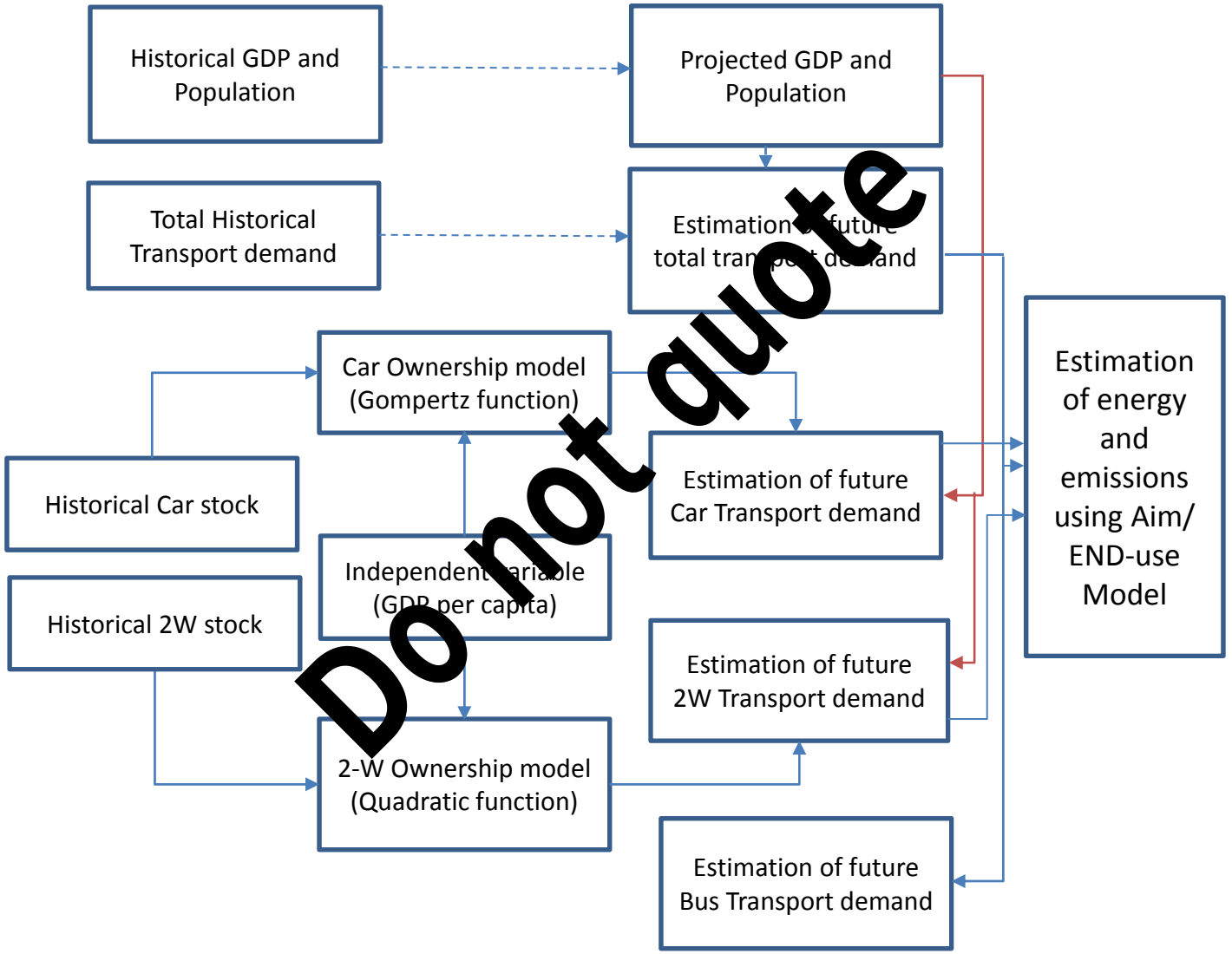




Top box :
Socio-economic characteristics
Bottom box:
Energy service demands

Note) Dr. Mittal's work. Will Submit to "Environmental Research Letters" , thus do not quote yet

AIM/Enduse[India] in 18 aggregated states
service demands in passenger road transport sector



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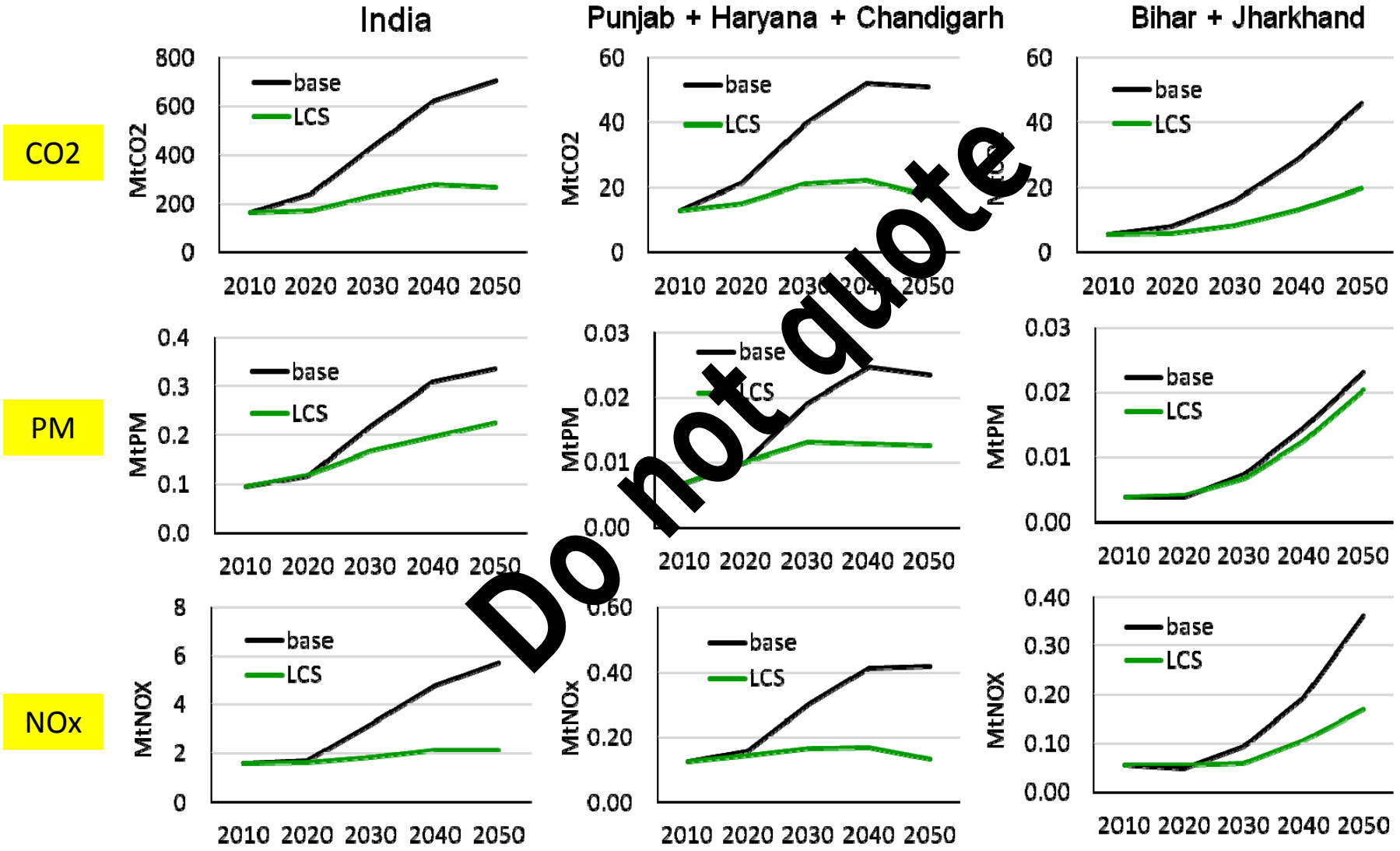

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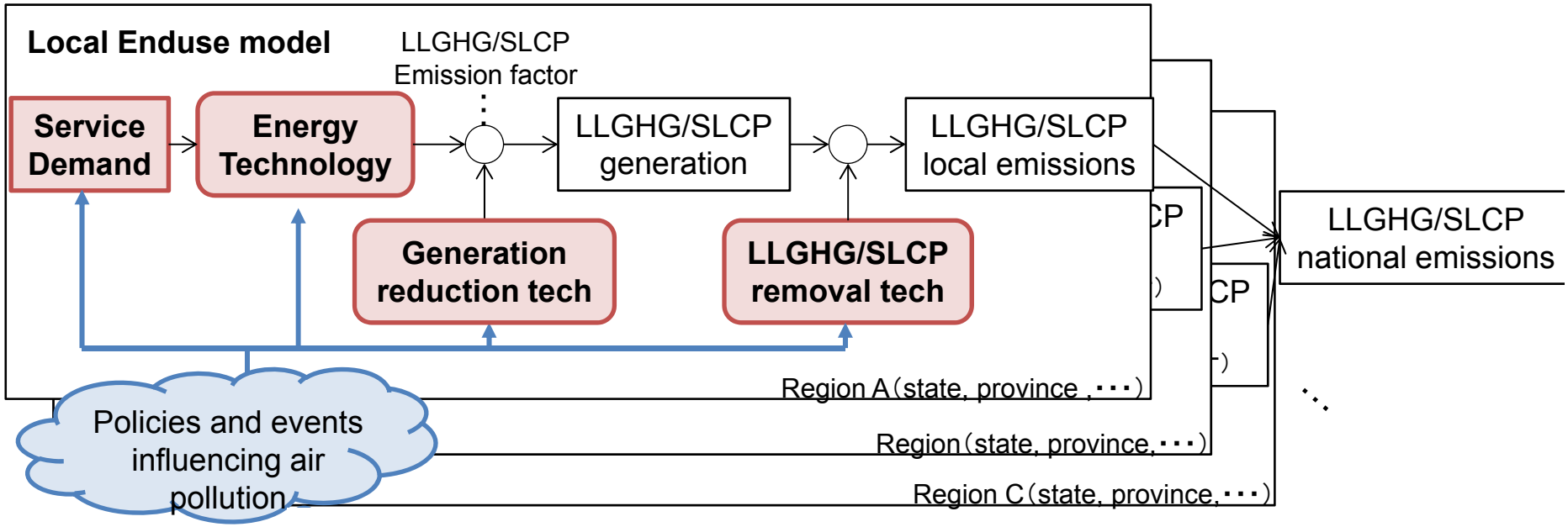
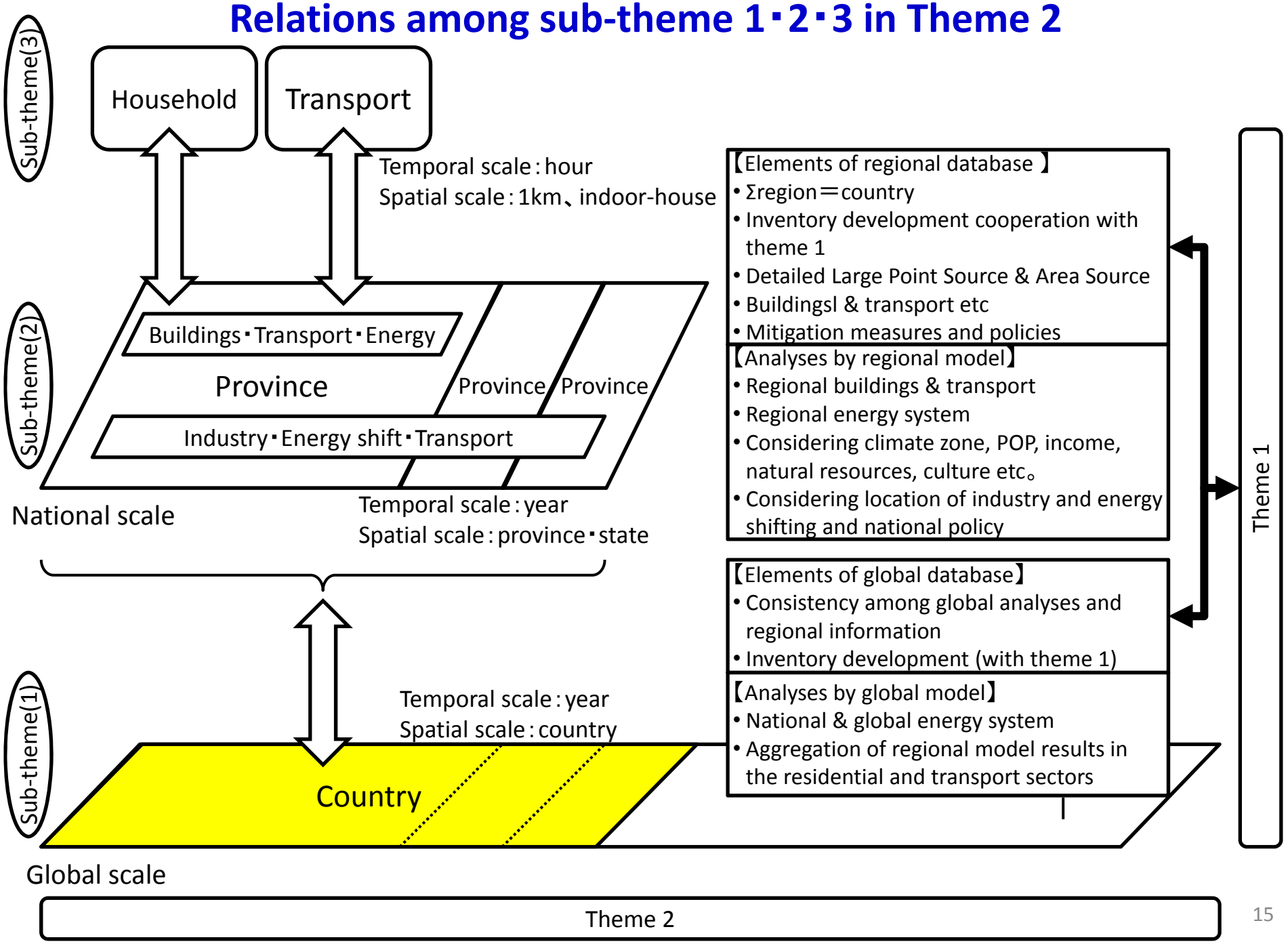
Extending ESS tool and updating various data in China and India



- ✓ **Data collections necessary for developing Enduse model and ESS tool**
  - **Regional population, regional GDP, industry structures, material products, transport volumes, energy consumptions, energy prices, etc**
  - **Energy efficiency, removal device efficiency, penetration rate, initial and operation costs, etc, by region and country**
  - **Emission factors by energy type, by sector and by region**
- ✓ **Extending Energy Snapshot tool which can estimate LLGHG/SLCP emissions trends covering all major sectors in the macro viewpoint**

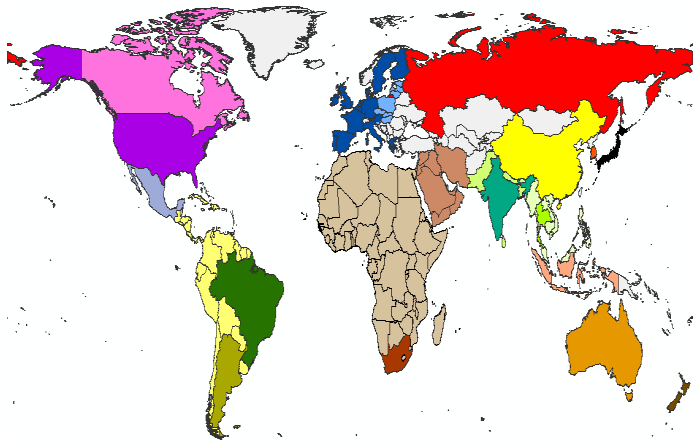
Source) by MHIR

Relations among sub-theme 1・2・3 in Theme 2



Updating AIM/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

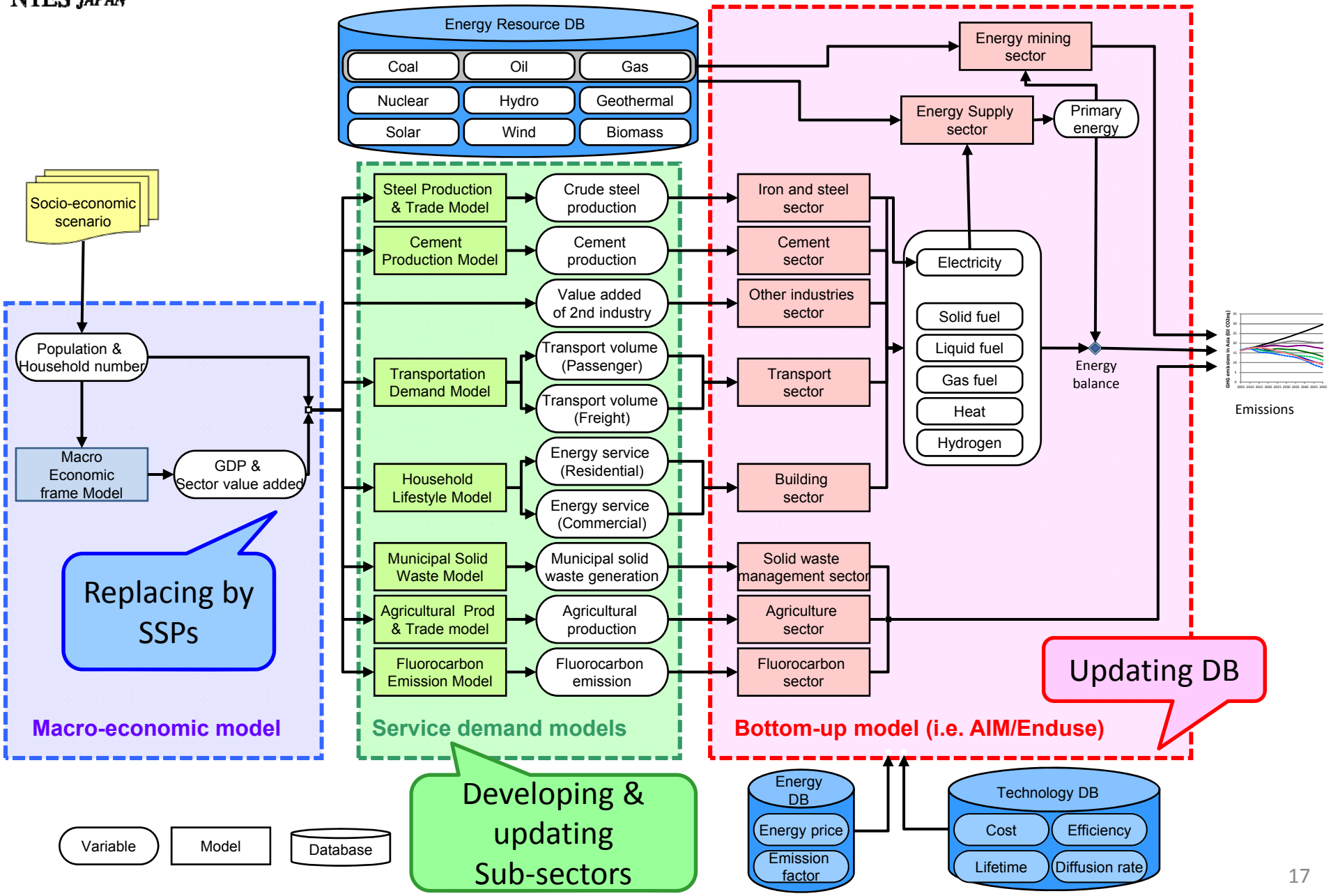


	CO2	CH4	N2O	HFC	PFC	SF6	CFC	HCFC	SO2	NOx	BC	OC	PM10	PM2.5	CO	NH3	NMV
Fuel combustion	✔	✔	✔						✔	✔	✔	✻	✔	✔	✻	✻	✻
Industrial process	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✻	✔	✔	✻	✻	✻
Agriculture		✔	✔													✻	
Waste		✔															
Fuel mining		✔															
Others	✔	✔	✔													✻	✻

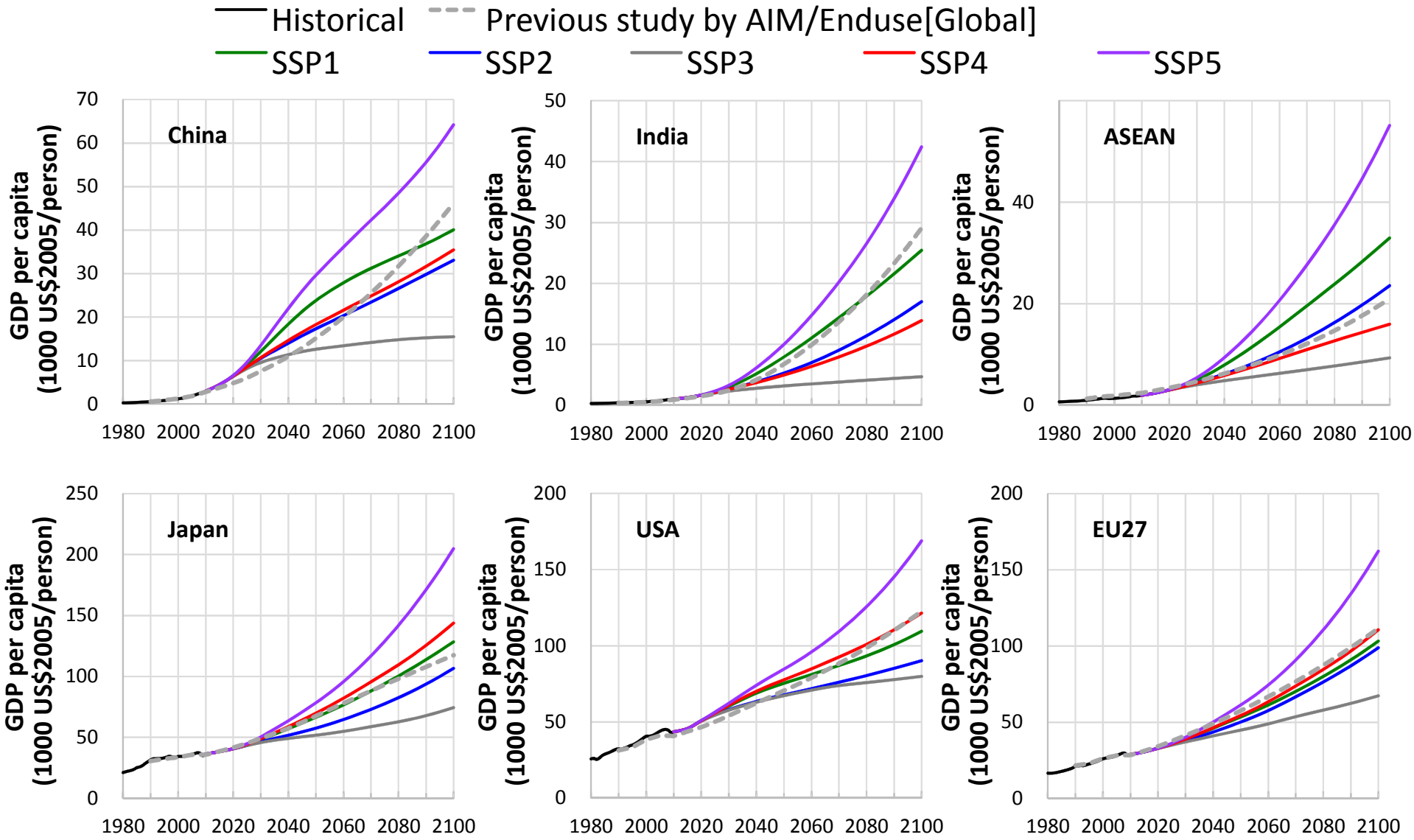
✔ : Updated & elaborating　　✻ : On-going updating

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

AIM/Enduse[Global] and element models

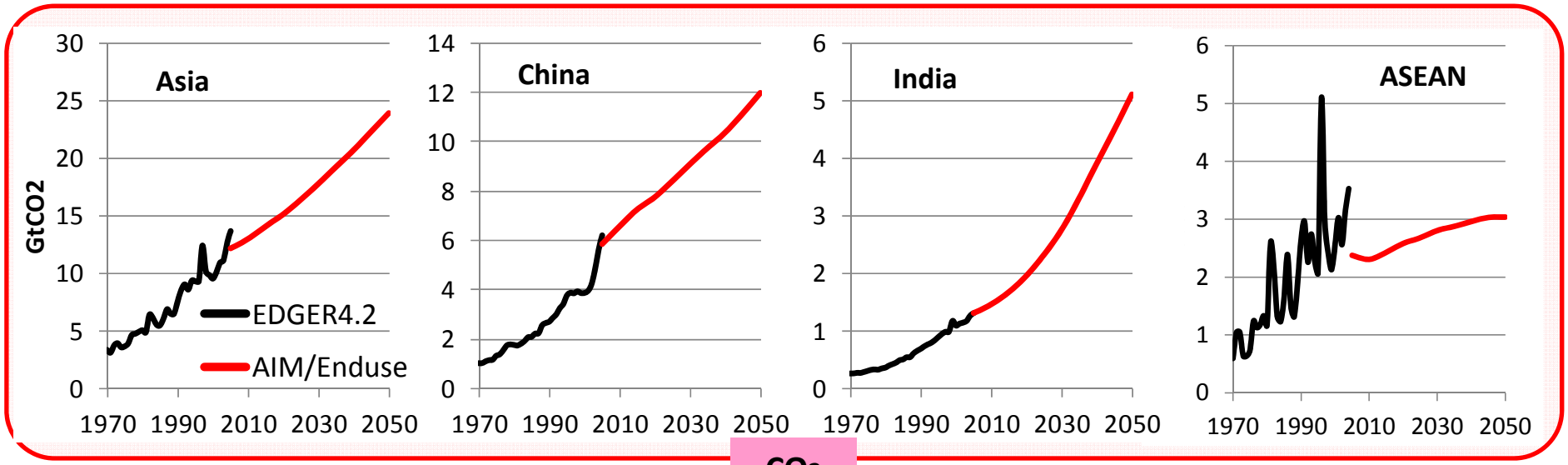


Considering Shared Socioeconomic Pathways for estimating future service demands



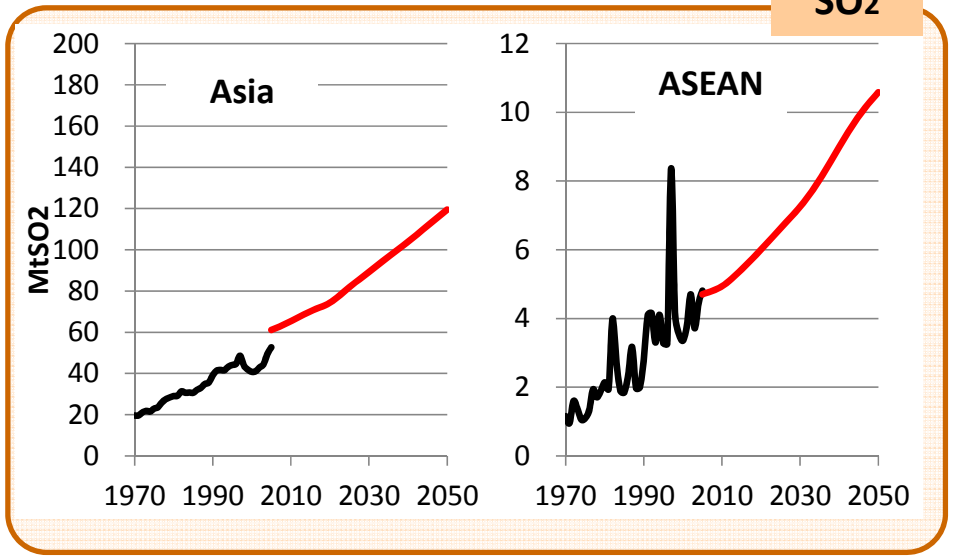
AIM/Enduse[Global] in global 32 regions

Baseline emissions from fuel combustion & industry in Asia

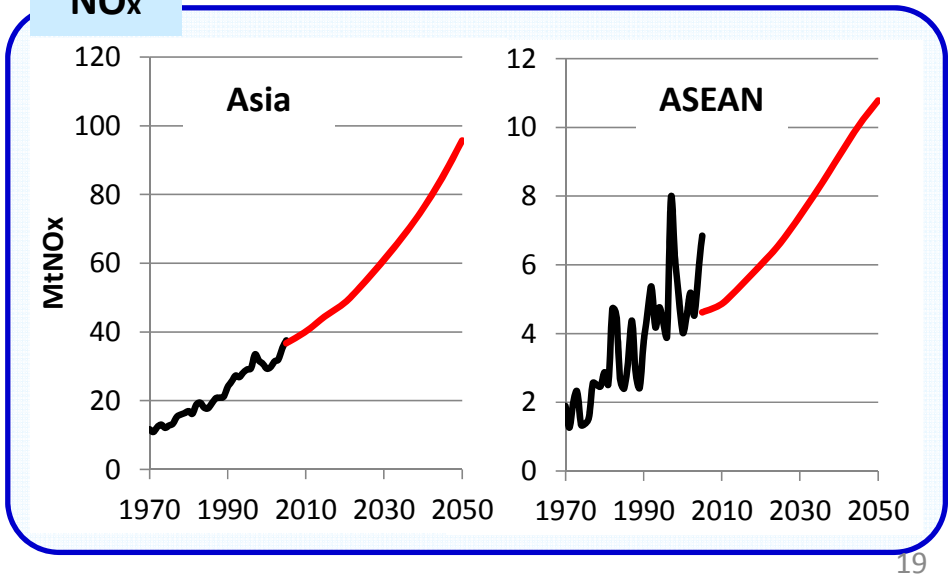


CO_2

SO_2



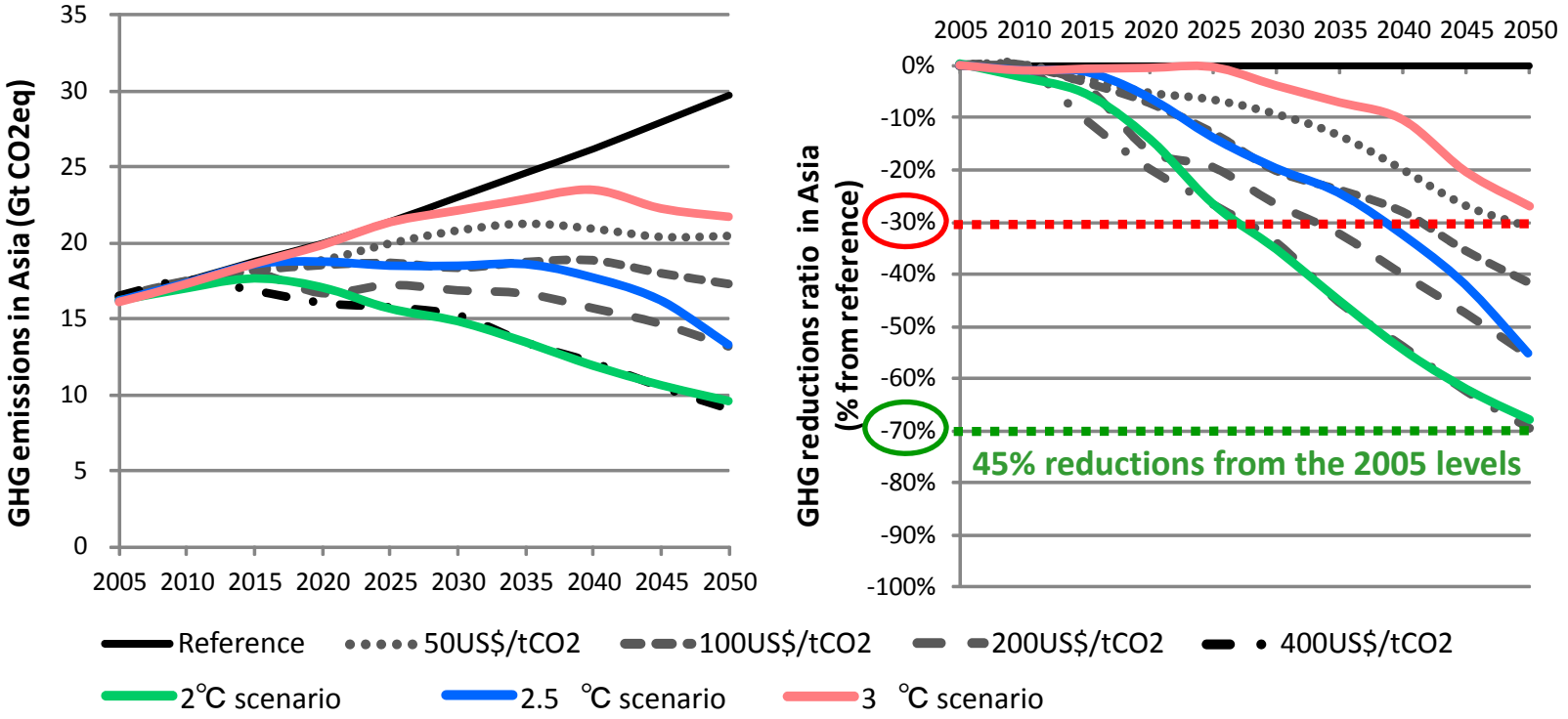
NO_x



6 GHGs emissions pathways in Asia and comparison with 2 ℃ target pathways

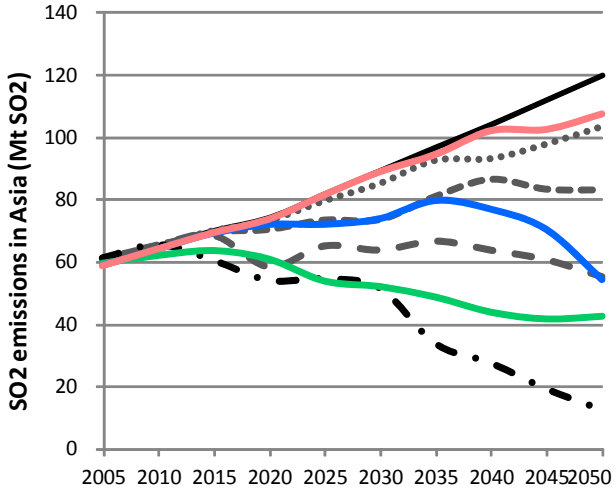
- Emissions constraints of achieving 2℃-3℃ were calculated based on UNEP Gap Report
- Future global economy-wide carbon prices scenarios (US$/$tCO_2$)

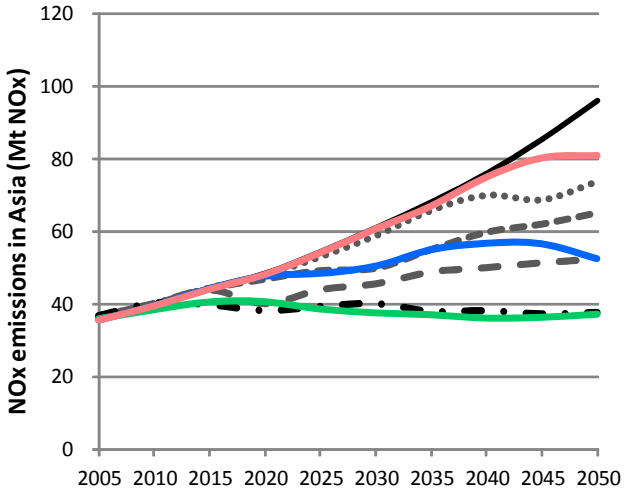
Scenario name	2013	2020	2030	2040	2050
Reference	0	0	0	0	0
50 US$/tCO2	**3.75**	**12.5**	**25**	**37.5**	**50**
100 US$/tCO2	7.5	25	50	75	100
200 US$/tCO2	**15**	**50**	**100**	**150**	**200**
400 US$/tCO2	30	100	200	300	400

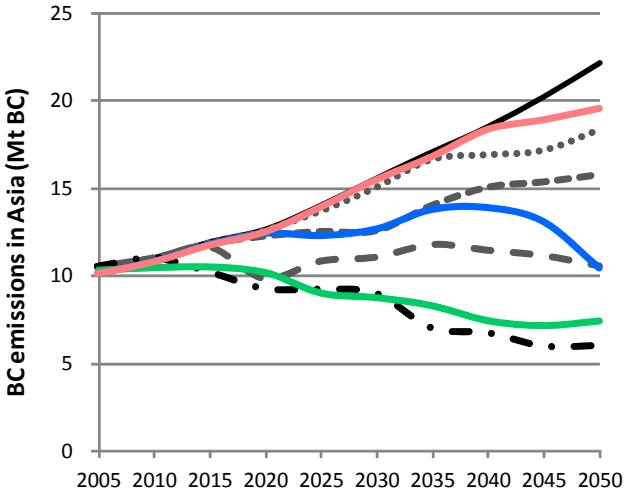


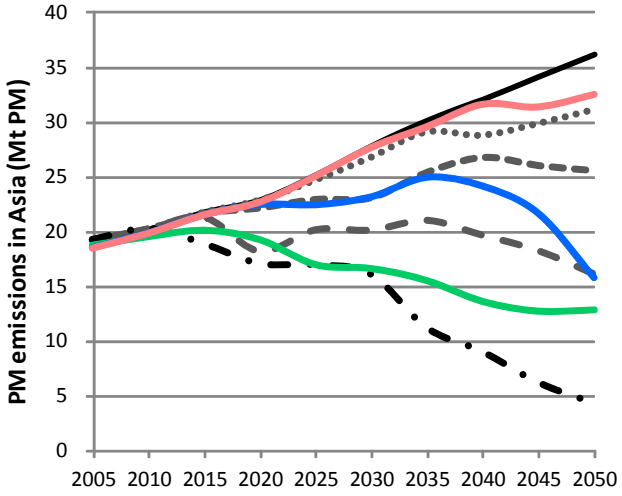
Source) modified from Hanaoka et al, Environmental Pollution (2014)

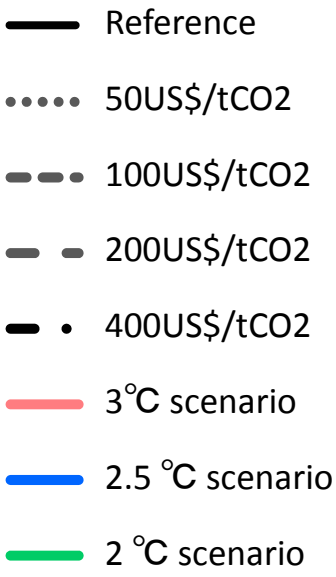
SLCP & Air pollutants emissions in Asia
- Cobenefits of implementing CO2 mitigation policies-







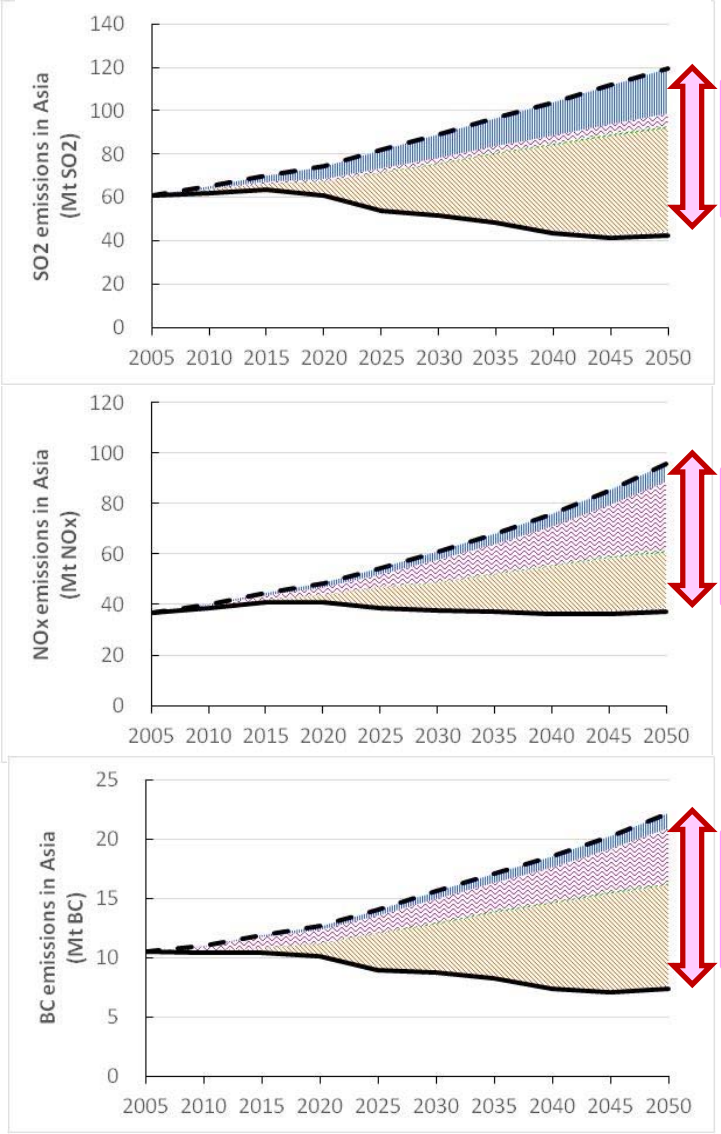




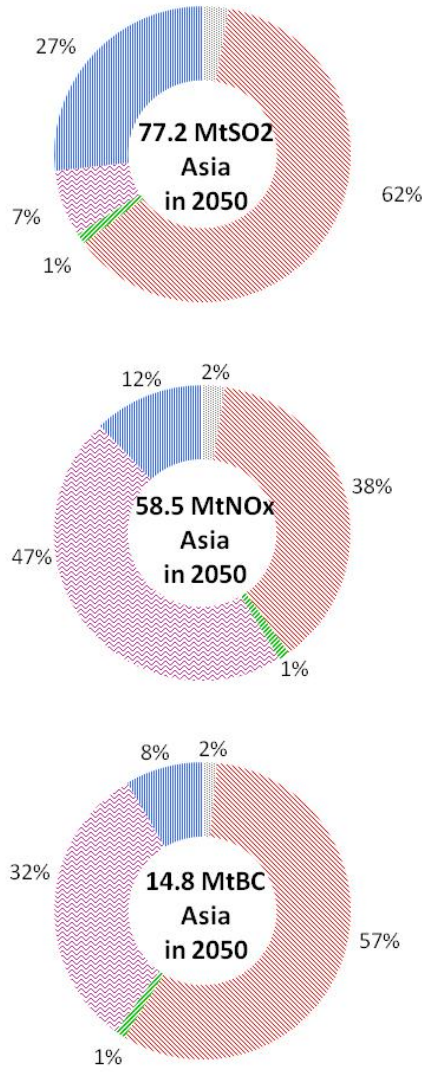
Source) modified from Hanaoka et al, Environmental Pollution (2014)

SLCP & Air pollutants reduction potentials in Asia
- Cobenefits of implementing CO2 mitigation policies-

Emissions pathway & reduction potentials



Reduction potentials in 2050



Features of reduction potentials are different by energy type, by gas type and by sector

- Reference scenario
- 2℃ scenario
- Industry
- Transport
- Residential & Commercial
- Energy supply
- Others

Source) modified from Hanaoka et al, Environmental Pollution (2014)

Timing is important!

Thank you for your attention!

Contact: hanaoka@nies.go.jp