The 24rd AIM International Workshop
Ohyama Memorial Hall, NIES
5-6 November 2018

Cobenefits and Tradeoffs of Combinations of GHGs, SLCPs and Air Pollutants Mitigation Measures
- Overview of S12 project -

Tatsuya HANAOKA

Center for Social and Environmental Systems
National Institute for Environmental Studies
Japan

AIM
ASIA-PACIFIC INTEGRATED MODEL

NIES JAPAN

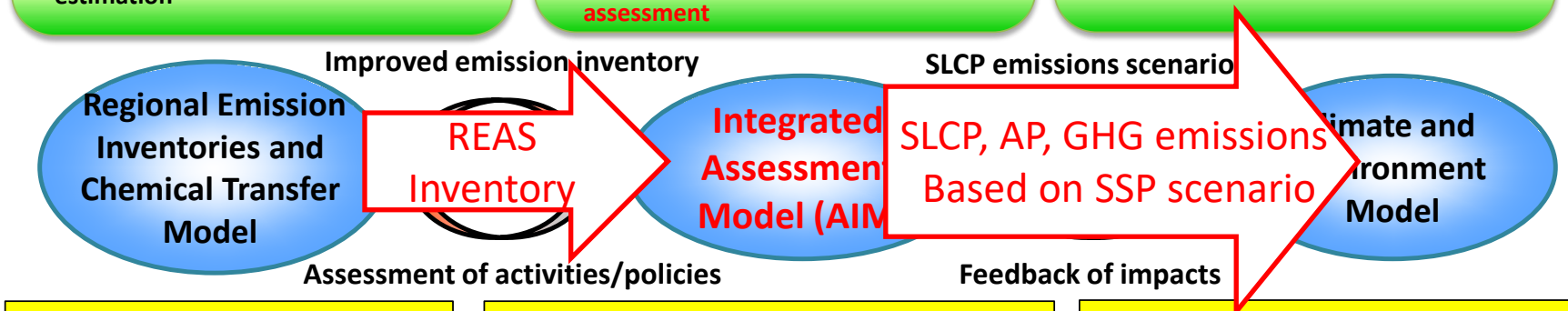
MOEJ-S12: Promotion of climate policies by assessing environmental impacts of SLCP and seeking LLGHG emission pathways (FY2014 – FY2018)

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

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

AIM ASIA-PACIFIC INTEGRATED MODEL NIES JAPAN

Today's Topics

For seeking to **balanced emissions pathways of GHGs, air pollutants, short-lived climate pollutants (SLCPs) while taking GHG mitigation actions for achieving 2 ℃ target**

1. Analyses on combinations of mitigation measures and characteristics of mitigation pathways in Global and Asia, from the viewpoints of both emissions and costs.

2. Simplified Web tool to analyze cobenefits and tradeoffs of mitigation technology combinations.

3. Detailed multi-regional analyses in Asian countries

Development of SLCP scenarios and Low-Carbon scenarios

- Considering major combinations of mitigation measures -

Ref : Reference scenario that future mitigation polices & technologies are in the current trends

EoPmid : **enhancing EoP diffusion both in developed & developing courtiers by 2050** for SO_2, NOx, BC, OC, $PM_{2.5}$, PM_{10}

EoPmax : **100 % end-of-pipe diffusion across the world by 2050** for SO_2, NOx, BC, OC, $PM_{2.5}$, PM_{10}

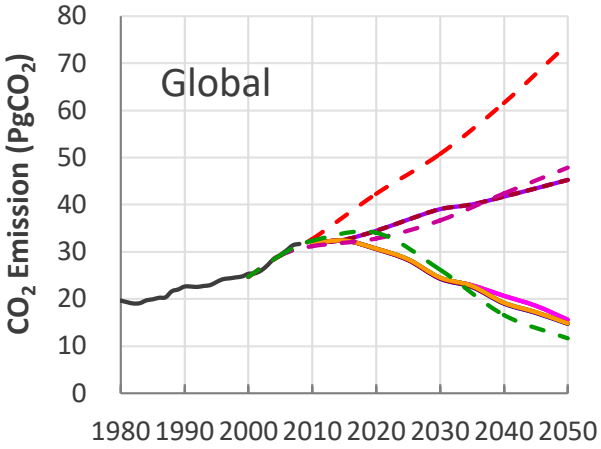
2D : Decarbonization mitigation measures toward 2℃ target. Carbon price in 2050 is 400US$/$tCO_2$

- ***CCS*** : in 2D scenario, especially **energy shift to coal & biomass power with CCS** rather than renewables
- ***RES*** : in 2D scenario, especially **energy shift to renewables** rather than fossil fuel with CCS
- ***BLD*** : in 2D scenario, especially enhancing **electrification in building sector across the world by 2050**
- ***TRT*** : in 2D scenario, especially enhancing **EV in passenger transport sector across the world by 2050**

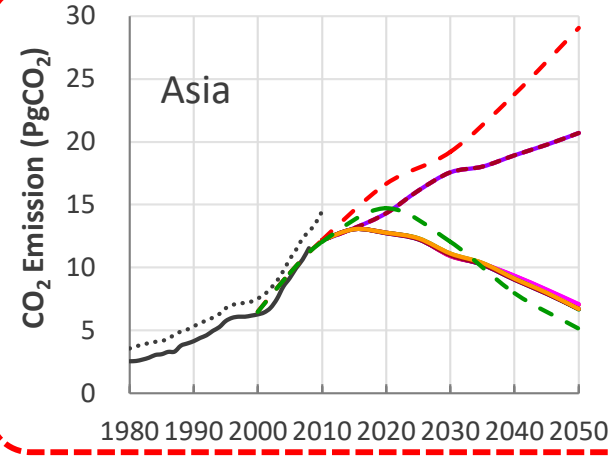
Scenario Group	Scenario code	Figure	Major combinations of mitigation measures on GHGs, air pollutants and SLCP					
			EoP enhancement (EoP)	2℃ target measures (2D)	CO_2 Enhancement (CCS)	Renewable enhancement (RES)	Electrification buildings (BLD)	Electrification transport (TRT)
Reference	Ref							
End-of-pipe only	EoPmid		Mid					
	EoPmax		Max					
2℃ target & End-of-pipe	2D-EoPmid-CCSBLD		Mid	✔	✔		✔	
	2D-EoPmax-CCSBLD		Max	✔	✔		✔	
	2D-EoPmid-RESTRT		Mid	✔		✔		✔
	2D-EoPmax-RESTRT		Max	✔		✔		✔
	2D-EoPmid-RESBLDTRT		Mid	✔		✔	✔	
	2D-EoPmax-RESBLDTRT		Max	✔		✔	✔	

(Hanaoka, et al. paper in preparation)

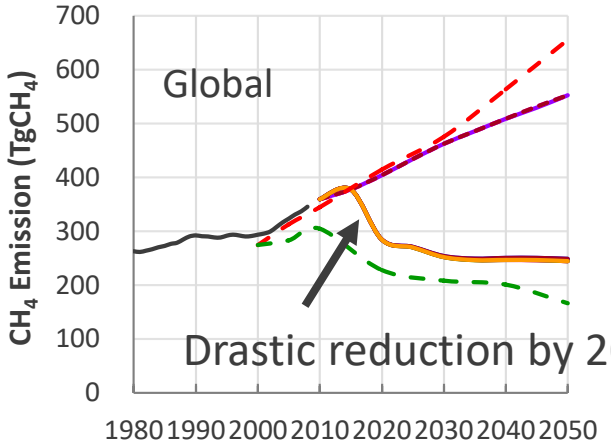
CO_2 & CH_4 emissions pathways in Global and Asia
- compared to emission inventory (EDGER, REAS) & emissions pathways of RCPs -



CO_2 emission level in 2050 achieving 2℃ is lower than the level in 1980s



CO_2 emission level in 2050 in Asia achieving 2℃ is similar to the level in 2000



CH_4 emission level in 2050 achieving 2℃ is similar to the level in 1980s

- There are various different combinations of decarbonization measures which can achieve the similar CO_2 emission pathways equivalent to 2 degree target
- Major emissions sources of CH_4 are agriculture, waste and fuel mining sectors. Thus, There is less effects of combinations of low-carbon and air pollutant measures

EDGER4.2 — REAS — Reference — RCP 8.5 — RCP 6.0 — RCP 2.6

2 ℃ target

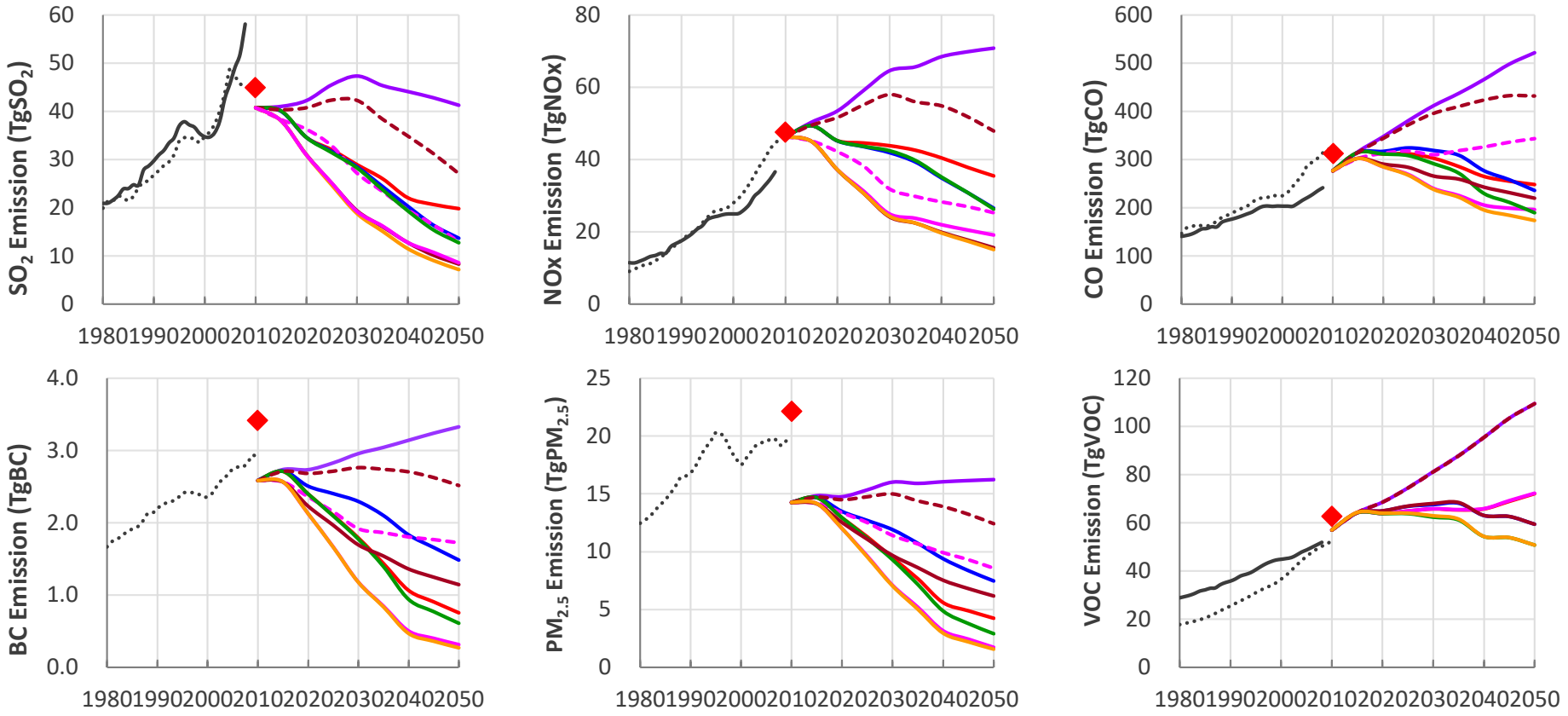
EoPmid — 2D-EoPmid-CCSBLD — 2D-EoPmid-RESTRT — 2D-EoPmid-RESBLDTRT

EoPmax — 2D-EoPmax-CCSBLD — 2D-EoPmax-RESTRT — 2D-EoPmax-RESBLDTRT

(Hanaoka, et al. paper in preparation)

SLCP and air pollutant emissions pathways in Asia

Emissions pathways of SLCPs and air pollutants are different due to combinations of low-carbon and end-of-pipe measures, even if CO_2 emission pathways equivalent to 2℃ are similar.

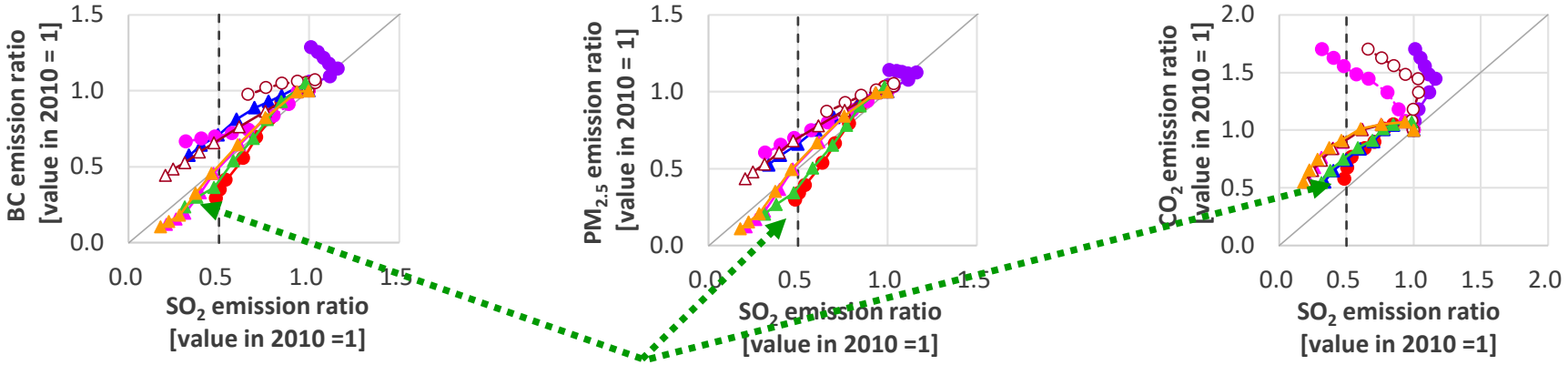


(Hanaoka, et al. paper in preparation)

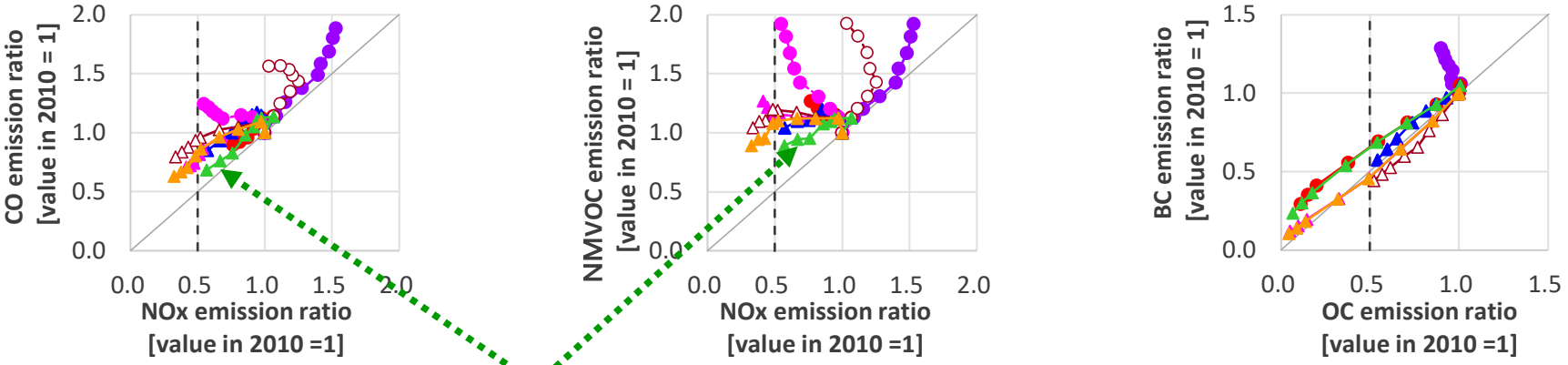
Diagnosis of reduction directions in Asia

- Considering warming effects, cooling effects and environmental impacts -

2D-EoPmid-RESBLDTRT is an recommended SLCP scenario for attaining 2 degree target controlling CH_4 & tropospheric O_3



Considering balanced reductions of BC, $PM_{2.5}$, SO_2 and CO_2, for reducing health effects at the same time of reducing climate effects by CO_2, SO_2



By reducing NOx, CO, NMVOC at the same time, it is possible to mitigate "tropospheric O_3 generation" and "increasing CH_4 concentration"

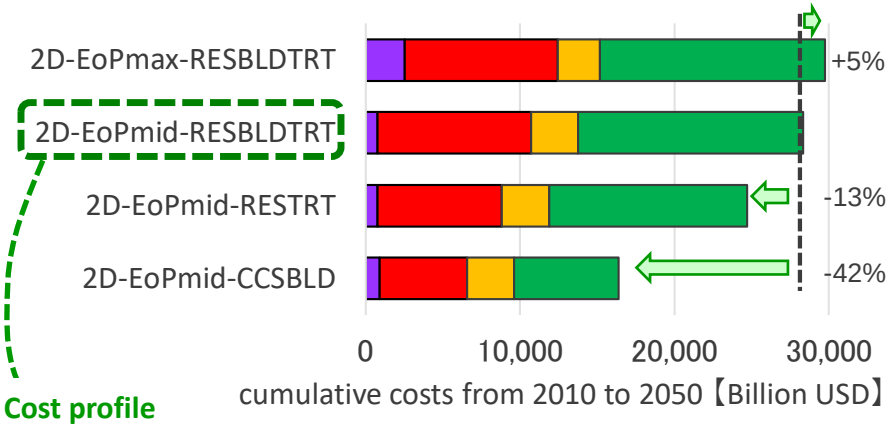
Refrefence
EoPmid
EoPmax
2D-EoPmid-CCSBLD
2D-EoPmax-CCSBLD
2D-EoPmid-RESTRT
2D-EoPmax-RESTRT
2D-EoPmid-RESBLDTRT
2D-EoPmax-RESBLDTRT

(Hanaoka, et al. paper in preparation)

AIM ASIA-PACIFIC INTEGRATED MODEL NIES JAPAN

Evaluation of Cumulative cost up to 2050 in China and India

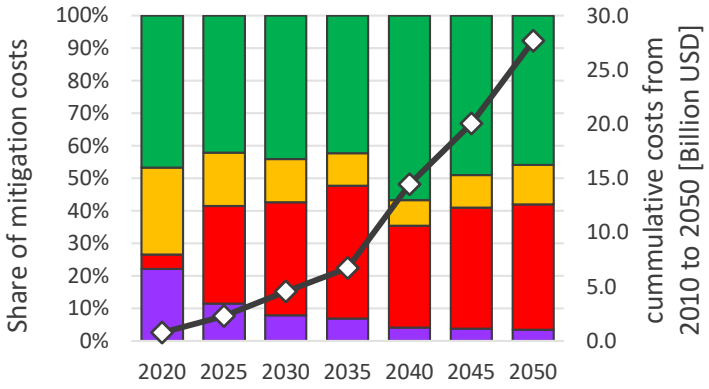
- Low Carbon Mitigation costs and End-of-Pipe costs -



Cumulative costs of all mitigation measures are around 28 trillion US$, and the share of End-of-Pipe measures costs account for only 3%, in 2D-EoPmid-RESBLDTRT scenario.

Cost profile

2D-EoPmid-RESBLDTRT scenario



Low carbon measures (transport, residential, commercial & others)

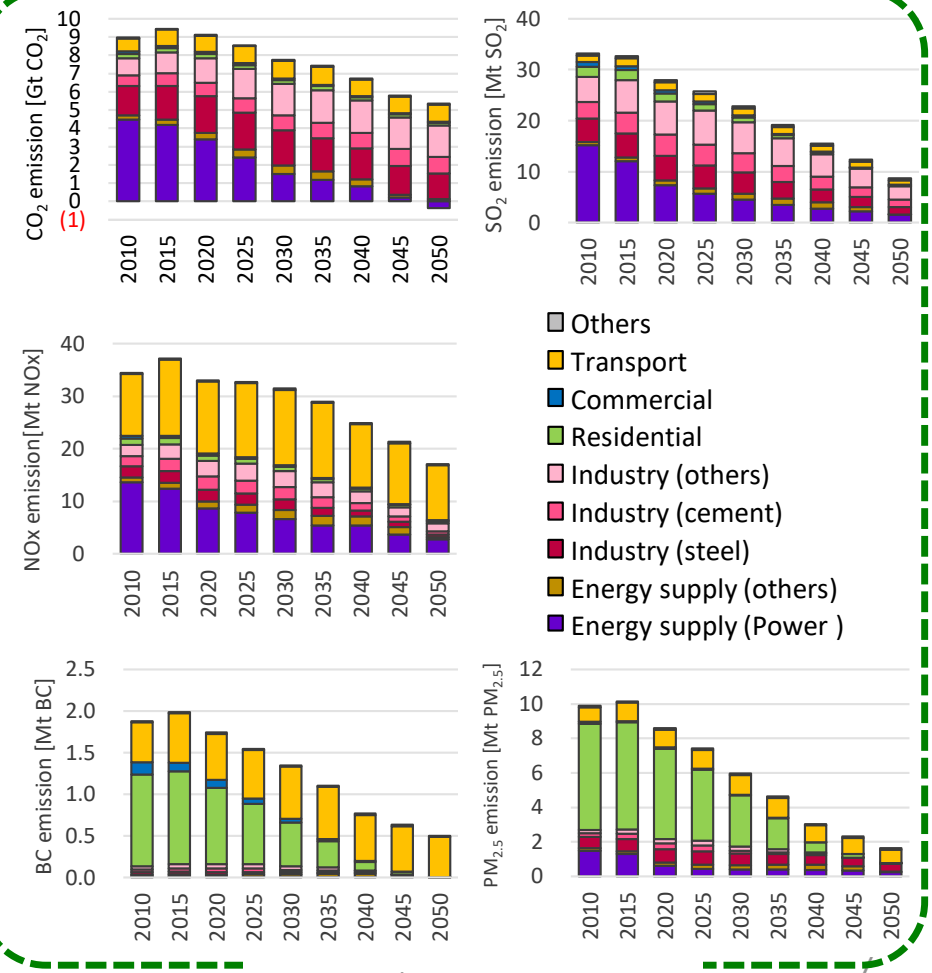
Low carbon measures (industry)

Low carbon measures (power)

End-of-pipe measures (power & industry)

Cumulative costs

Emission profile



2D-EoPmid-RESBLDTRT scenario

(Hanaoka, et al. paper in preparation)

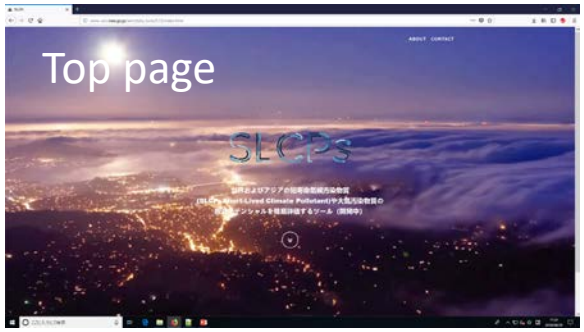
AIM ASIA-PACIFIC INTEGRATED MODEL NIES JAPAN

Technology Combinations and Emission Reductions Analysis Tool
- based on AIM/Enduse[Global] model -

http://www-iam.nies.go.jp/aim/data_tools/S12/

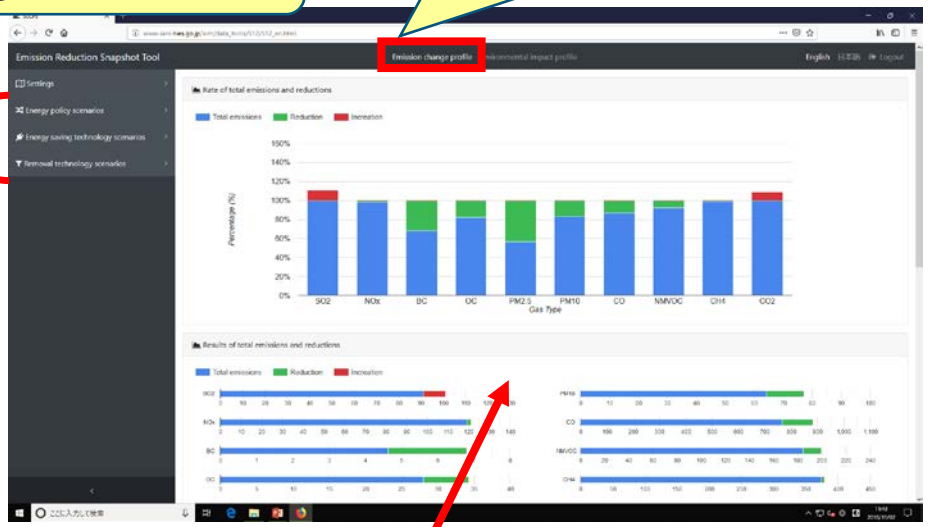
ID : aim
PWD: S12_aim_nies

Please **DO NOT disclose ID and PWD yet**, because it is under development. We are going to release in the early December. If any suggestions, **please send feedback comments by November 23** to Hanaoka (hanaoka@nies.go.jp)

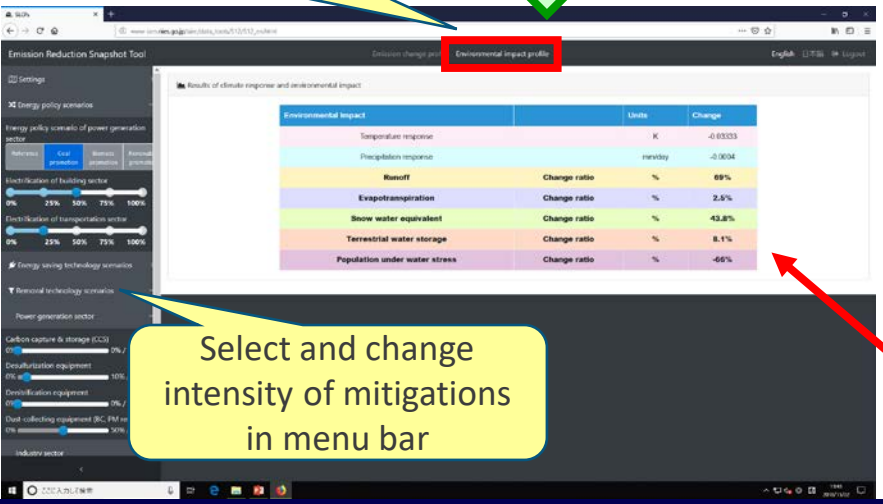


Mitigation options are summarized in three key categories in menu bar

Select “Emission changes profile”



Select “Environmental Impact profile”



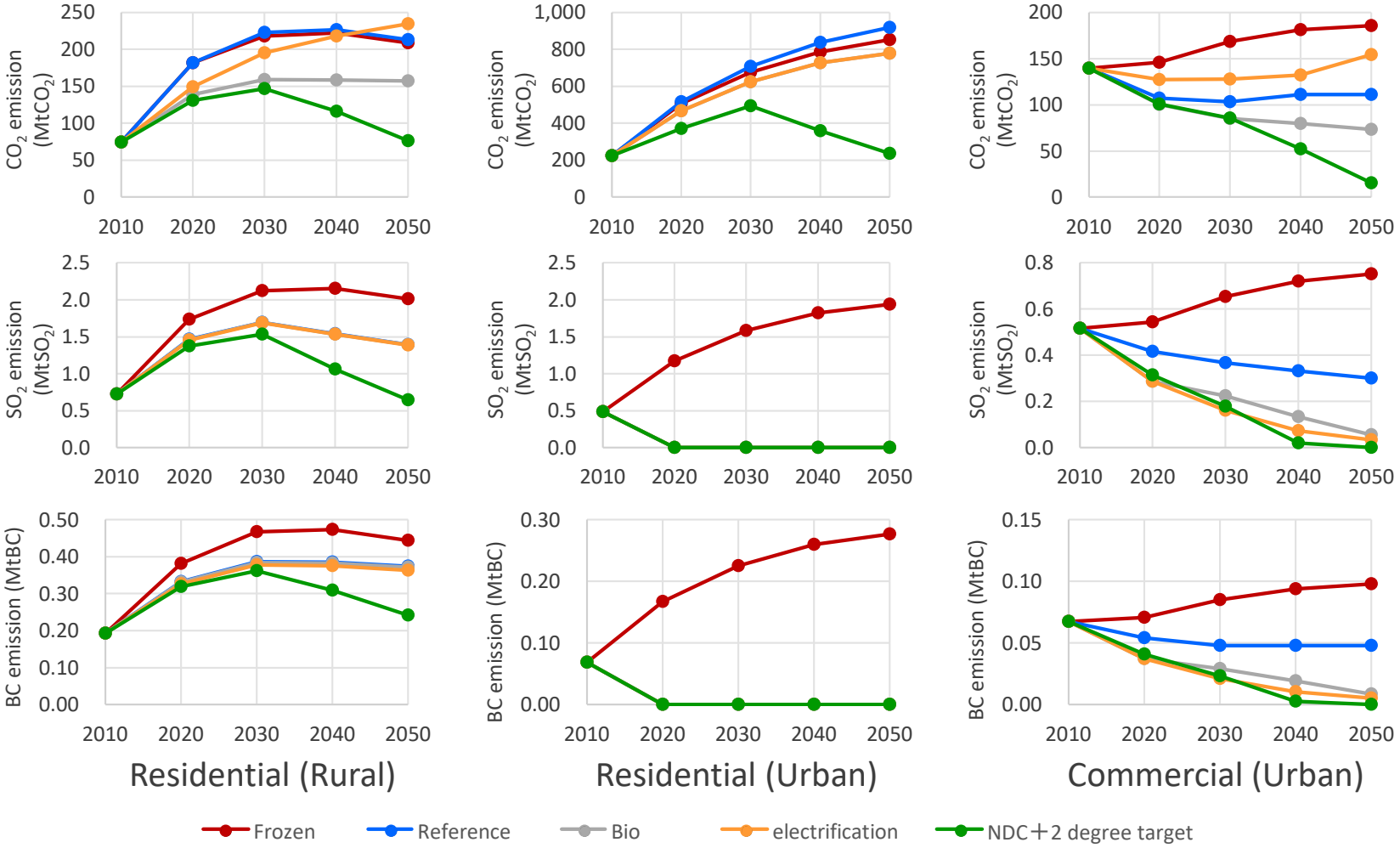
Select and change intensity of mitigations in menu bar

You can see emission changes by gas-type and environmental impact changes by impact-type, if you change combinations of mitigation measures and their intensity in the menu bar

Exploring nZEB scenario in 31 provinces in China

- Development of AIM/Enduse in rural & urban in the residential and commercial -

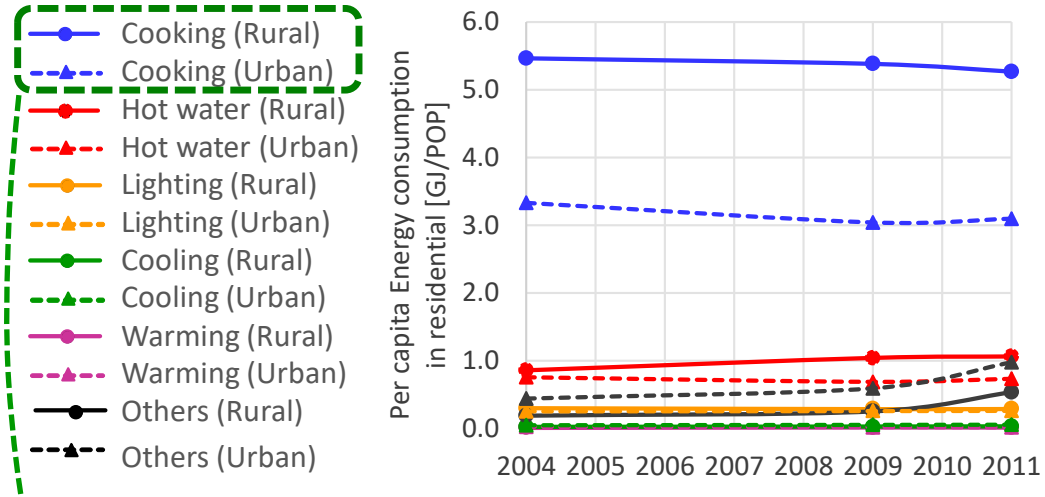
- Energy characteristics in rural and urban, and in large and small province are different
- It is important to carefully consider constraints such as its **inertia and energy transition**.
- There are **some constraints especially in rural** for drastic reductions of CO_2, SO_2, BC etc.



(Xing, et al. paper in preparation)

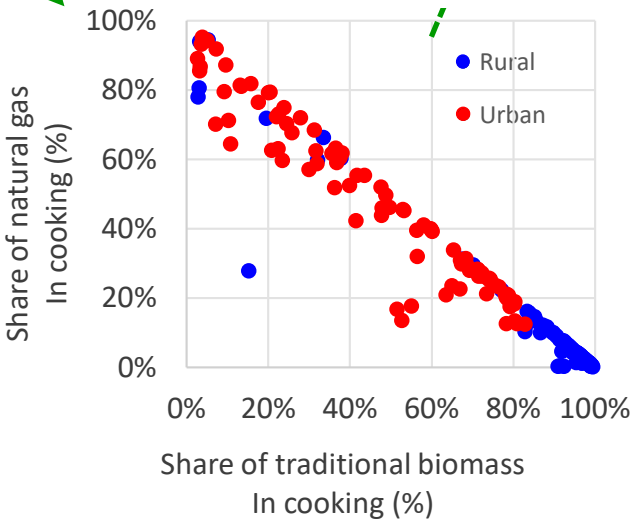
Energy Balance and Service Demands in 35 States in India

- Development of energy service demand model in rural & urban in residential -

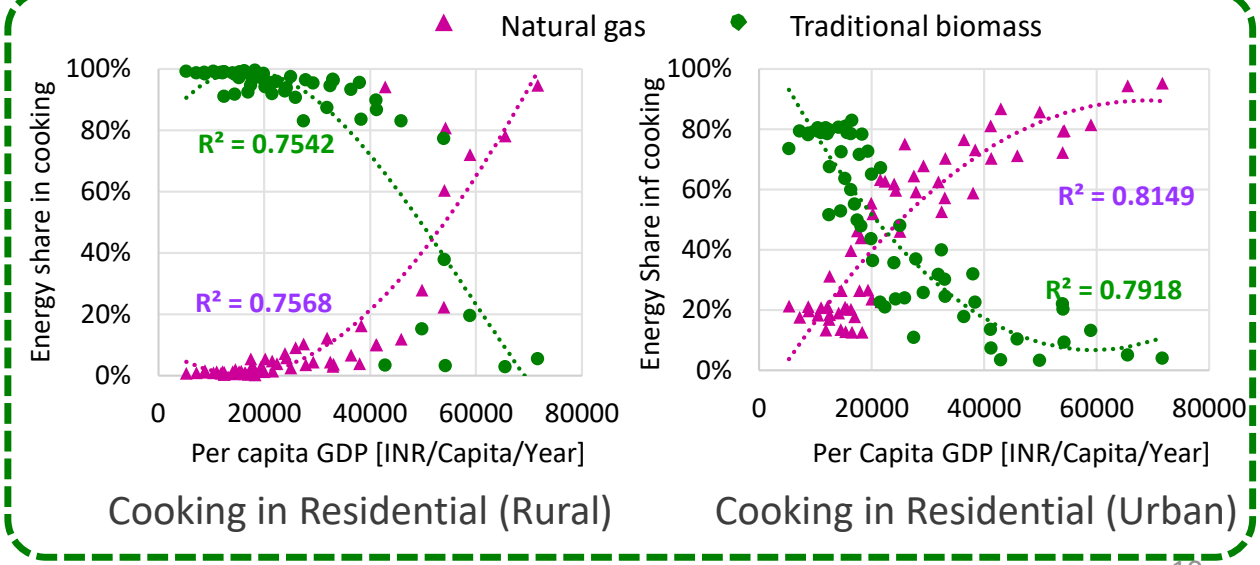


- There is no Energy Balance Table (EBAL) in residential sector in 35 states. Thus, we created state-wise EBAL.
- Cooking is the most energy consuming service in residential sector in India.
- Clear energy transition trend, but different characteristic in rural and urban.
- By considering major characteristics, we developed new methodology to estimate future energy service demands

Energy profile → **Relations with Economic development**



Relations between energy profile and economic development

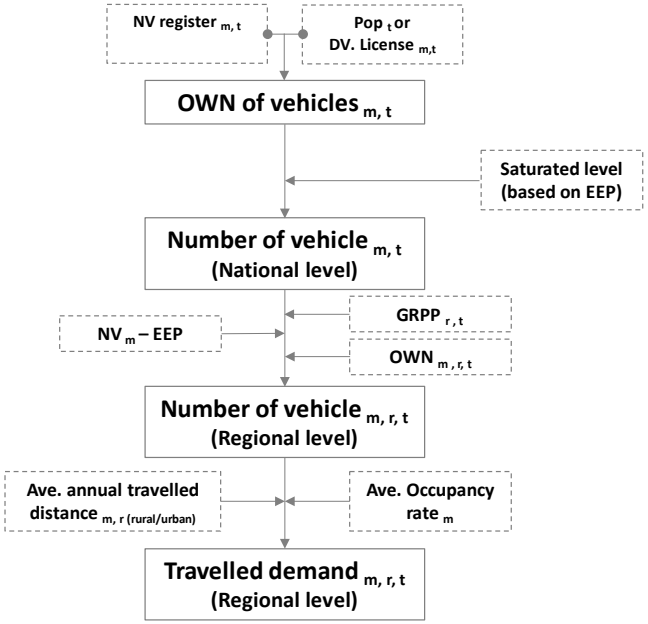


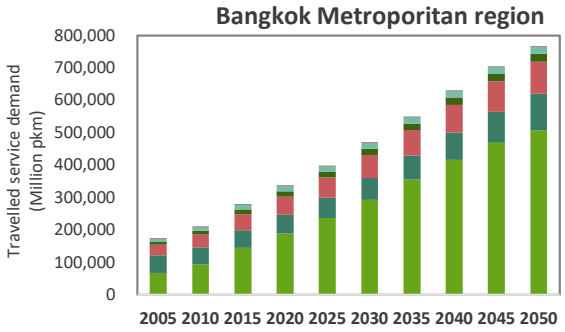
(Yawale, et al. paper in preparation)

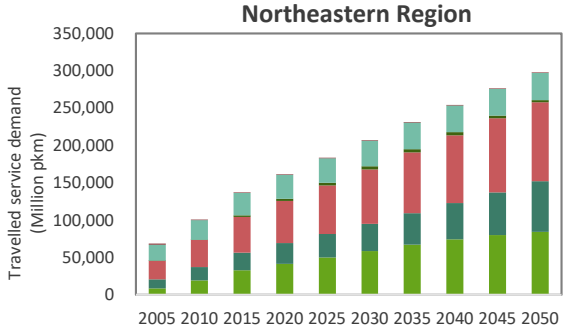
Regional Road Passenger Transport Volume in Thailand

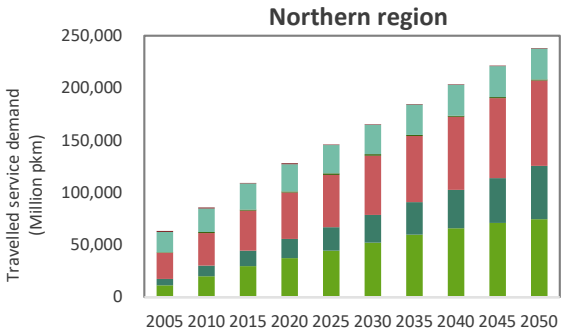
- Development of passenger transport model considering Thai's Policy Target -

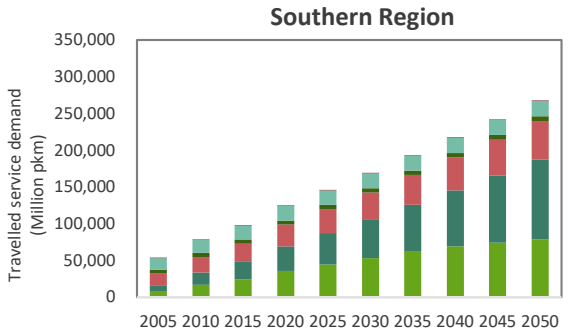
- For estimating future transport volume in detail to consider region-wise and mode-wise characteristics, we developed regional road transport model by using non-linear function.

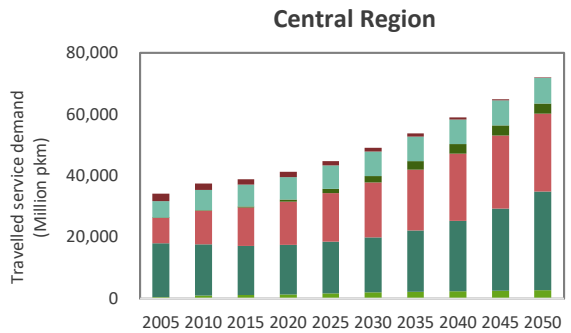


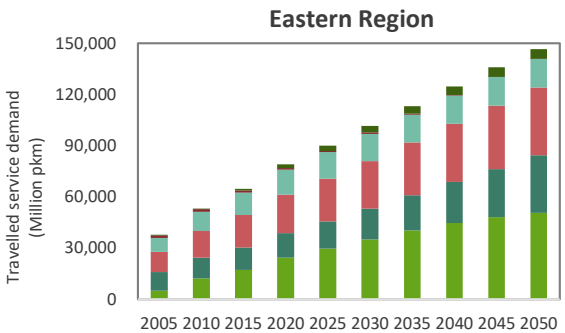


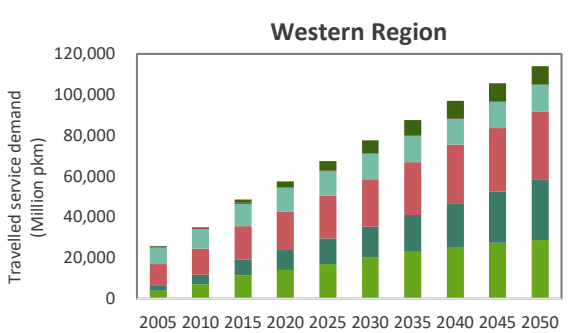








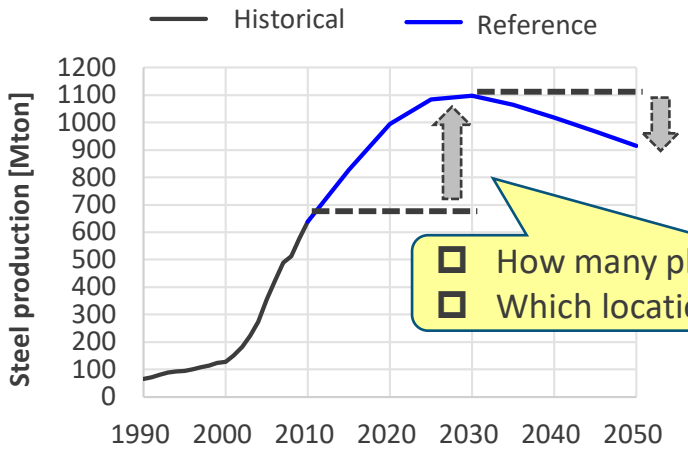




Tuk Tuk | Motorcycle | Taxi | Pick up | Bus | Sedan

(Cheewaphongphan, et al. paper in preparation)

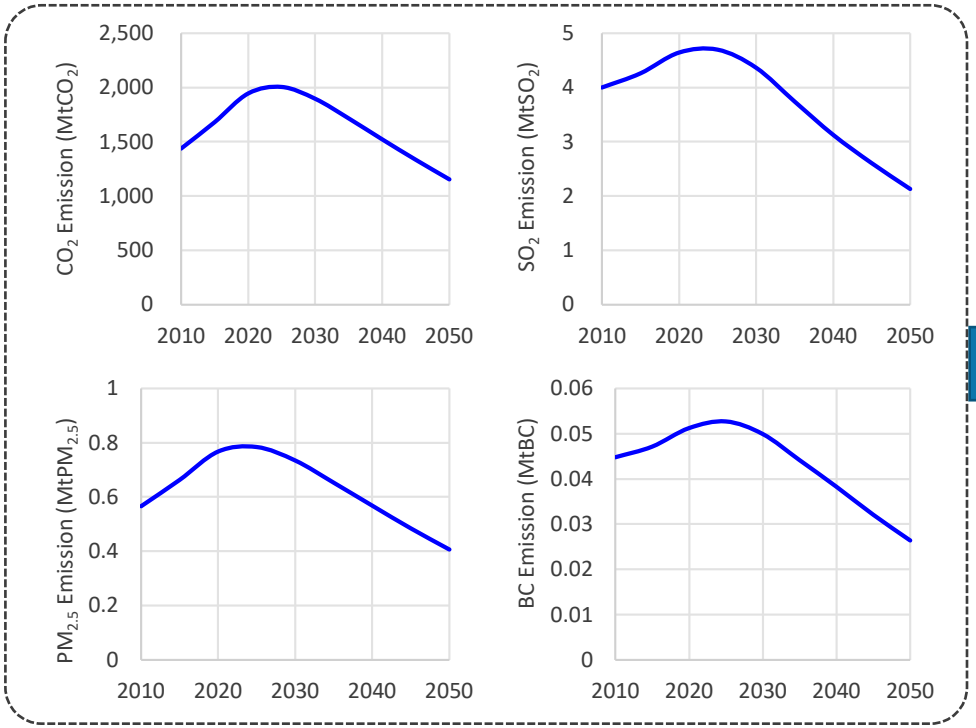
Algorism of Scrap & Build Steel Plant and Location Determination in China
- Development emission downscale model considering LPS (Large Point Source) -



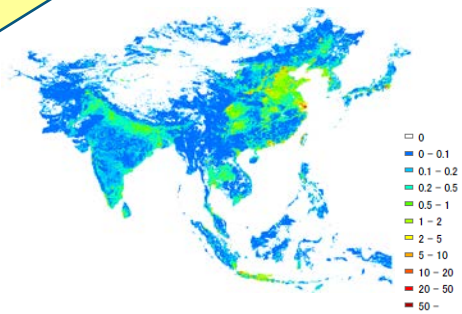
- How many plants we need to close down?
- Which plants we need to scrap-and-build?

- How many plants we need to build?
- Which location we build new plants?

AIM/Enduse

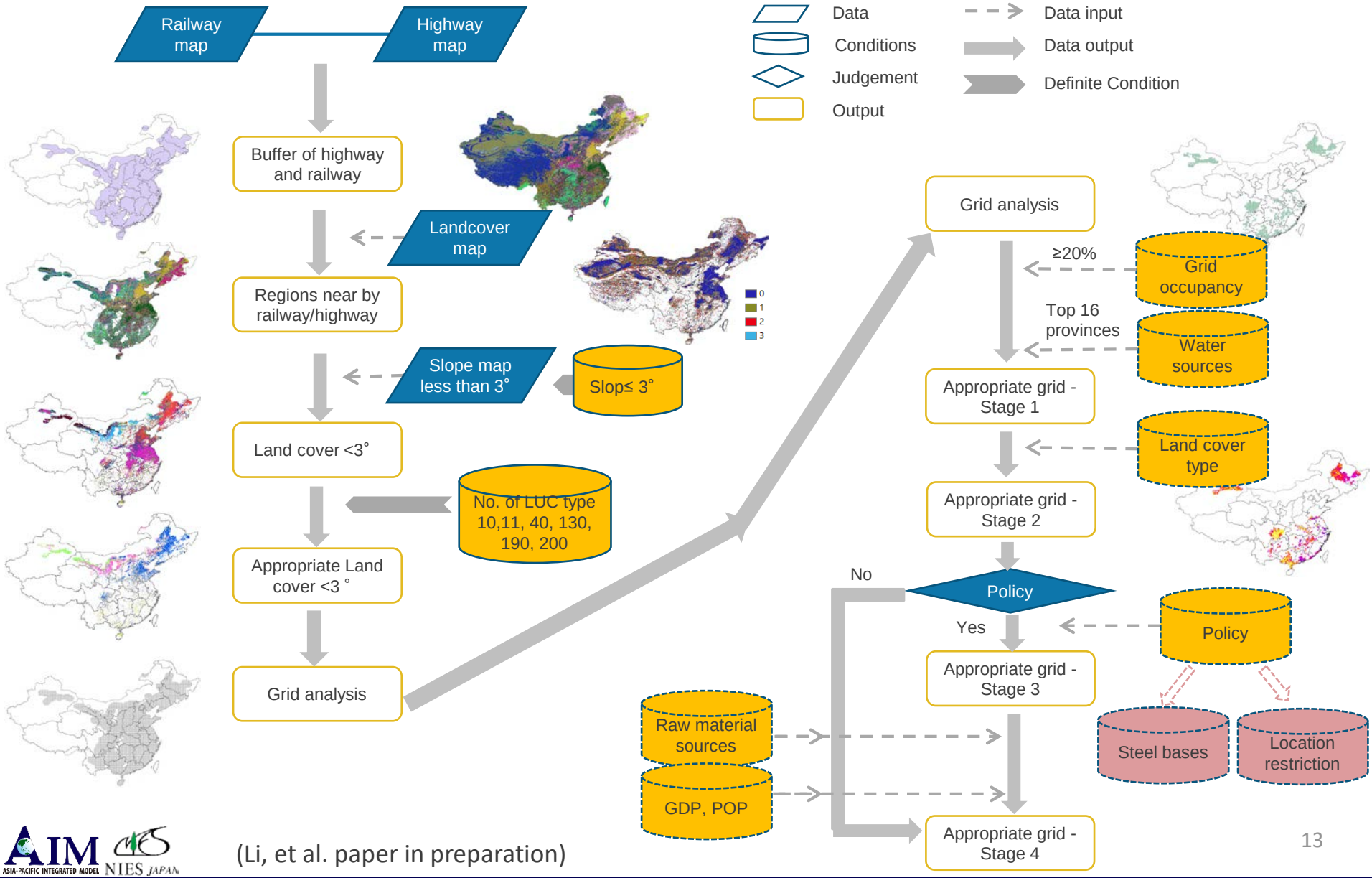


How to allocate emissions



AIM ASIA-PACIFIC INTEGRATED MODEL NIES JAPAN

Algorism of Scrap & Build Steel Plant and Location Determination in China
- Development emission downscale model considering LPS (Large Point Source) -



(Li, et al. paper in preparation)

ご清聴ありがとうございました

Thank you for your attention