International Institute for Applied Systems Analysis
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# Interactions between urban and rural air pollution in Asia, and the multiple development benefits of coordinated action

## IIASA-MOEJ activity – *Project A*

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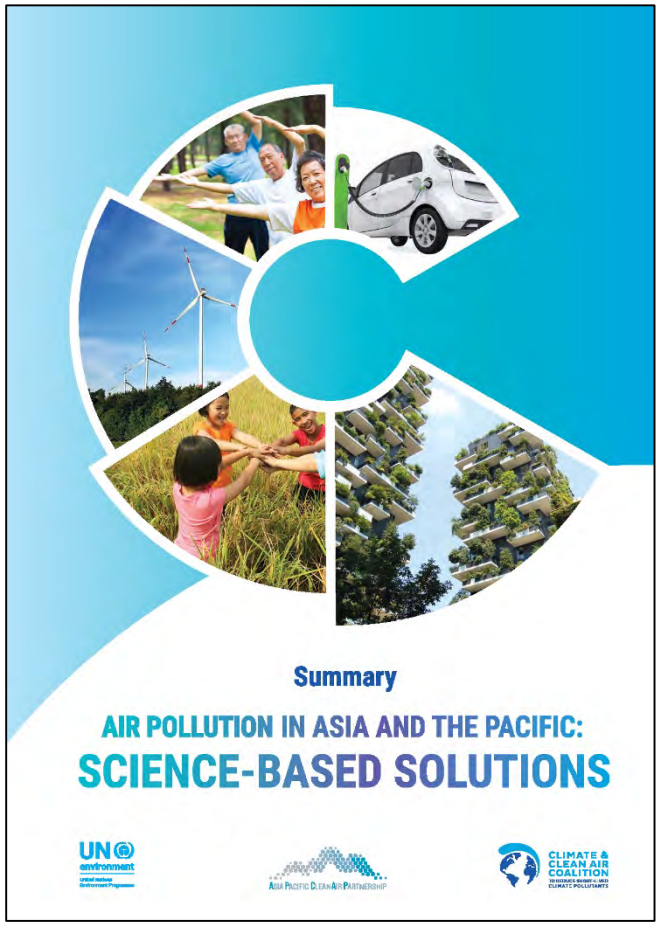
Pollution Management Group,
Energy, Climate and Environment program

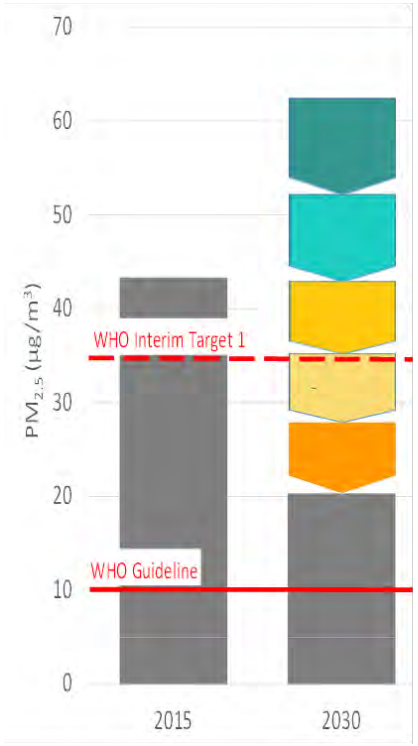
ACP/IIASA International Webinar, February 22, 2022

# Regional analysis of air pollution (2018)




MULTINATIONAL SCIENTIFIC COLLABORATION: Authors include from China (Beijing Normal University, Chinese Academy of Sciences, Tsinghua University), Japan (NIES, IGES), Korea (Konkuk University, Korea Environment Institute), and IIASA

Mean population exposure to PM2.5




| | Climate forcers $CO_2$ | $CH_4$ | BC | SDG benefits |
|---|---|---|---|---|
| *Current legislation* relative to 2015*) | *+16%* | *+17%* | *-24%* | |
| Conventional controls relative to 2030 baseline | 0% | 0% | -8% | |
| 'Next-stage' measures relative to 2030 baseline | 0% | -29% | -56% | |
| Development priority measures relative to 2030 baseline | -19% | -44% | -72% | |

# Regional and national analysis:
## ‘Clean Air Solutions for ASEAN’ *(in review)*

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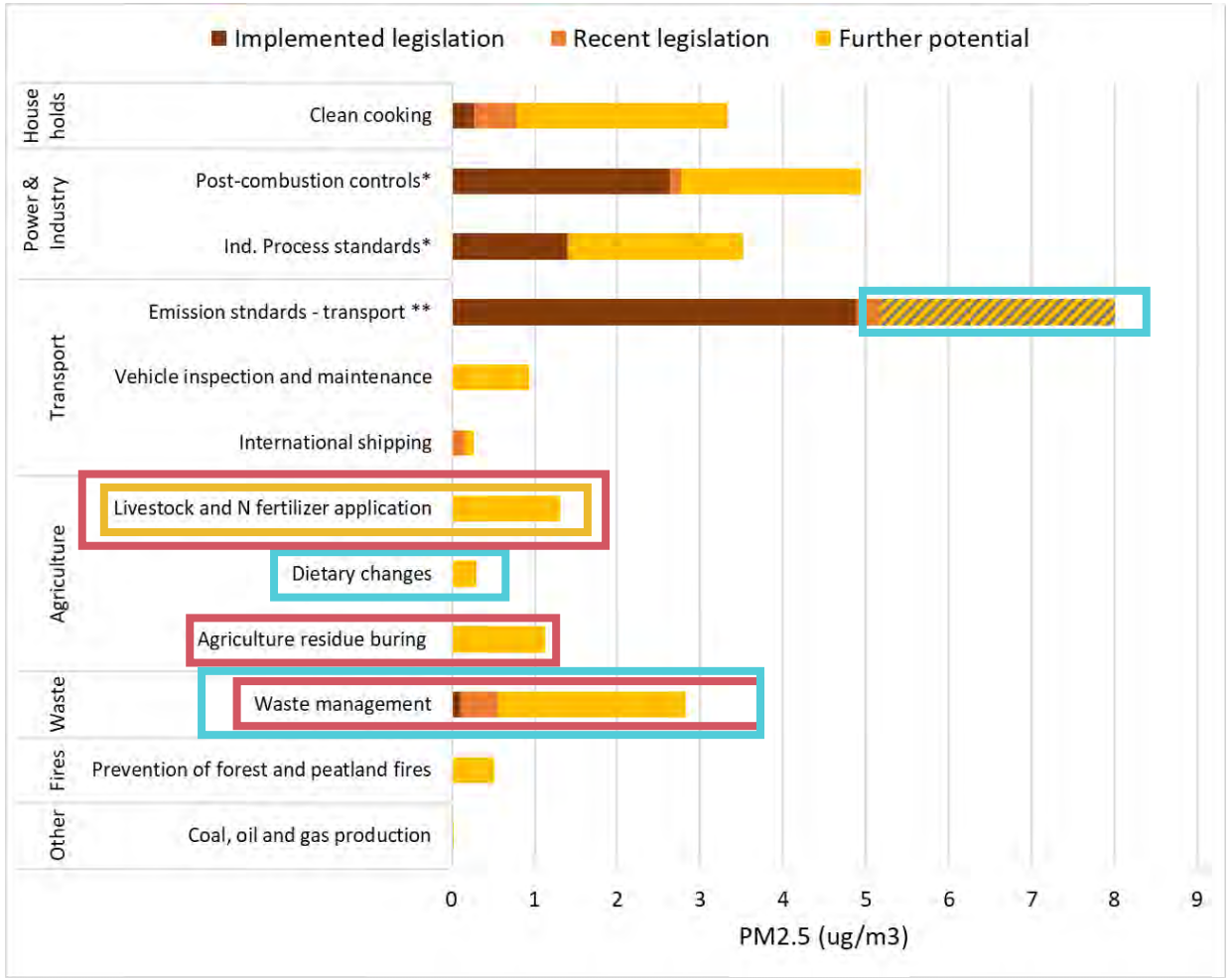
IGES
Institute for Global Environmental Strategies

SEI Stockholm Environment Institute

CLIMATE & CLEAN AIR COALITION
TO REDUCE SHORT-LIVED CLIMATE POLLUTANTS

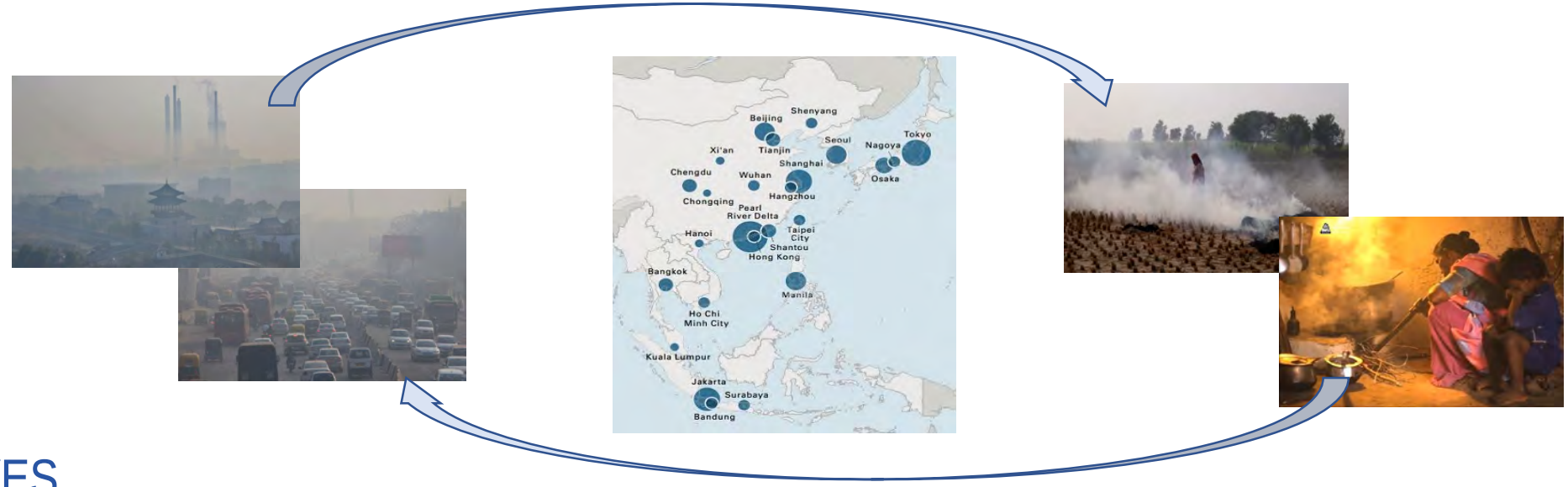



Nearly 40% of identified potential is associated with existing legislation – implementing existing solutions is critical!

Indicates maximum potential for either Euro VI equivalent vehicle emission standards or rapid electrification of vehicle fleet

Japan’s Circulating and Ecological Sphere (CES)

# Interactions between urban and rural air pollution in Asia (Project A)




## OBJECTIVES

- ✓ Reveal interdependencies between urban and rural air pollution in East Asia,
- ✓ Highlight the air quality and health benefits from regionally and internationally coordinated response action,
- ✓ Explore co-benefits for the various SDGs.,

Collaboration with scientific institutions/programs in Japan: JTCAP, EANET - comparison with newly available measurements, ACAP - emission inventories, NIES - comparisons of modeled source apportionments, IGES - the assessment of socio-economic aspects of emission control measures in cities and rural areas.

# Key tasks and progress

## Completed:

- Conduct source apportionments of PM2.5 for major cities, 2015-2018
- Source apportionment for 2030/2050 under current policies
- Determine potential for further air quality improvements in urban and rural areas

## Completion by May 2022

- Derive priority measures at different scales – links to *Solution Report* and recent ASEAN work

## Completion by July 2022

- Estimate benefits and their contributions to SDGs
- Synthesis, reporting and outreach

# Dispersion modelling method for this project

- Linear approximations of responses of ambient PM2.5 to changes in precursor emissions; computed with the EMEP CTM of the Norwegian Meteorological Institute
- 100 source regions in Asia, region to grid, based on 15% reduction runs
- Meteorological year: 2018

❑For secondary PM precursors ($SO_2$, $NO_x$, $NH_3$, VOC):

Spatial resolution $0.5^o$ x $0.5^o$

❑For primary PM2.5: Grid to grid tracking (“local fraction”)

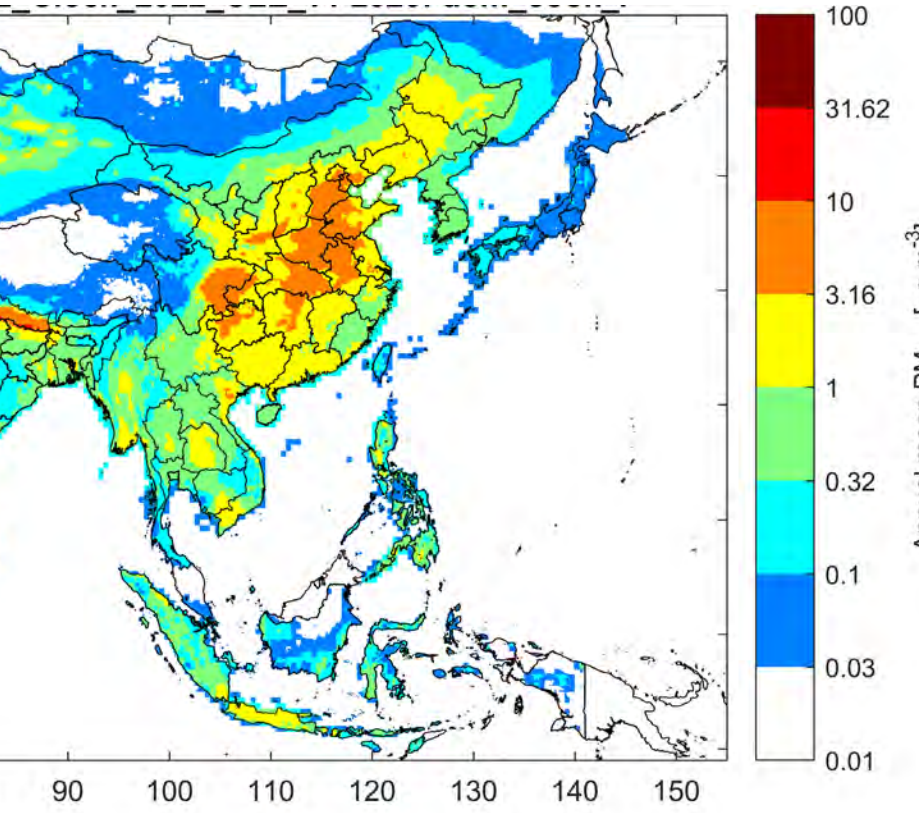
Spatial resolution $0.1^o$ x $0.1^o$

Monthly results

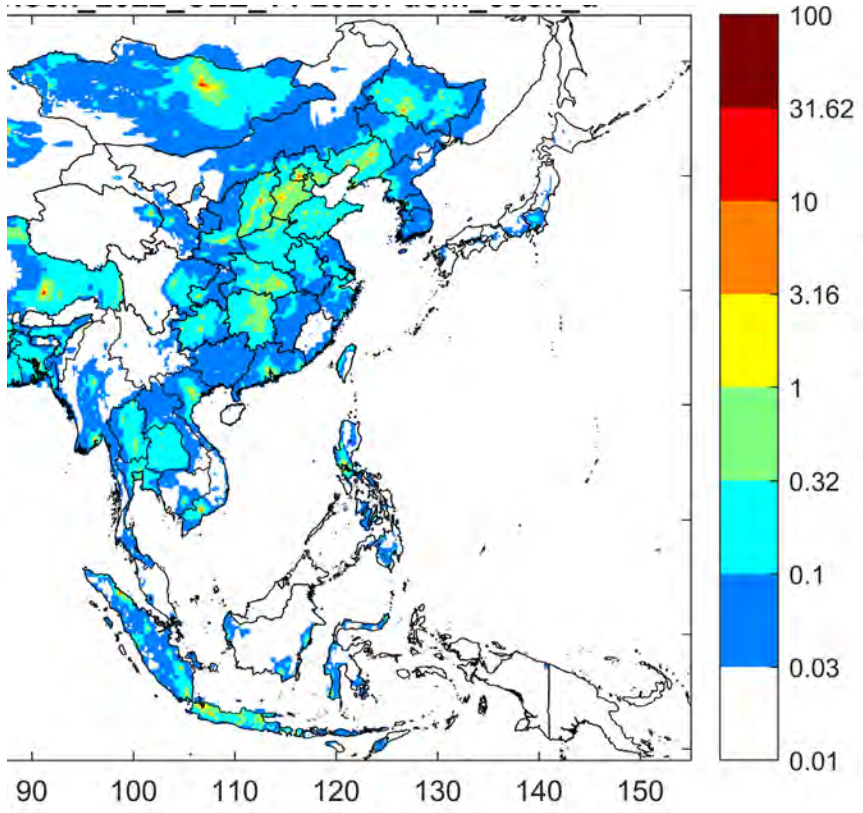
For 4 different source sectors / vertical layers (can be mixed as needed)

# Selected examples of source contributions to PM2.5

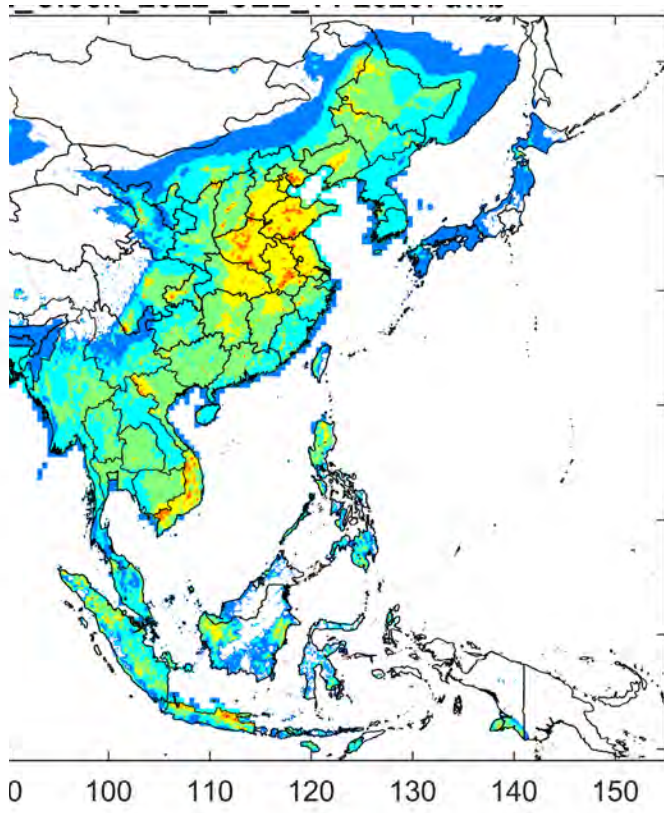
Cooking – rural




Cooking – urban




Agri waste burning



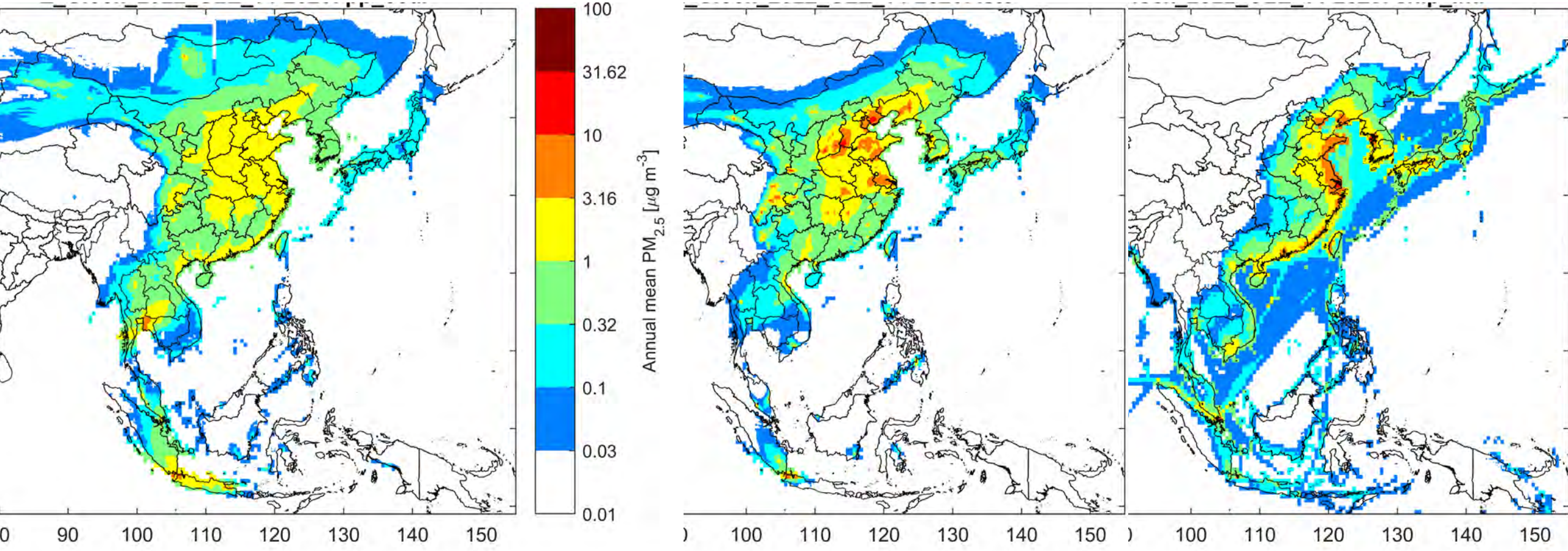

*Source:* GAINS model (IIASA)

# Selected examples of source contributions to PM2.5

Coal power plants

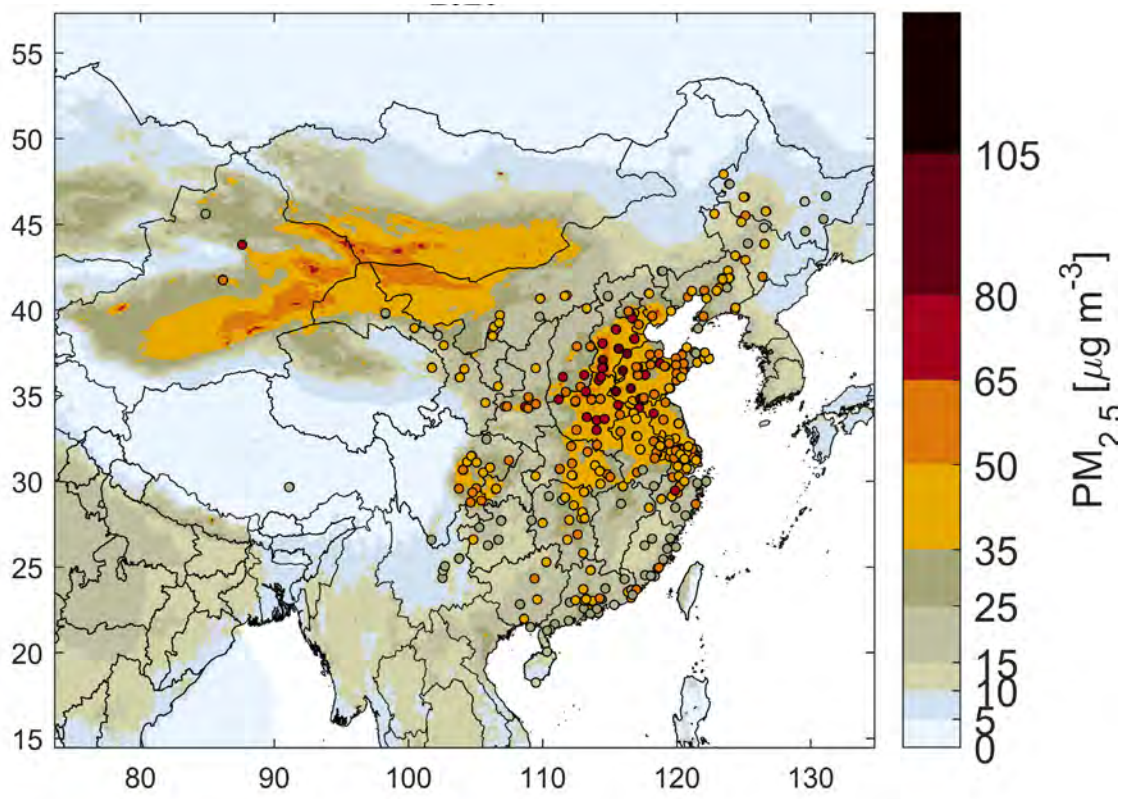
Iron and steel

International shipping

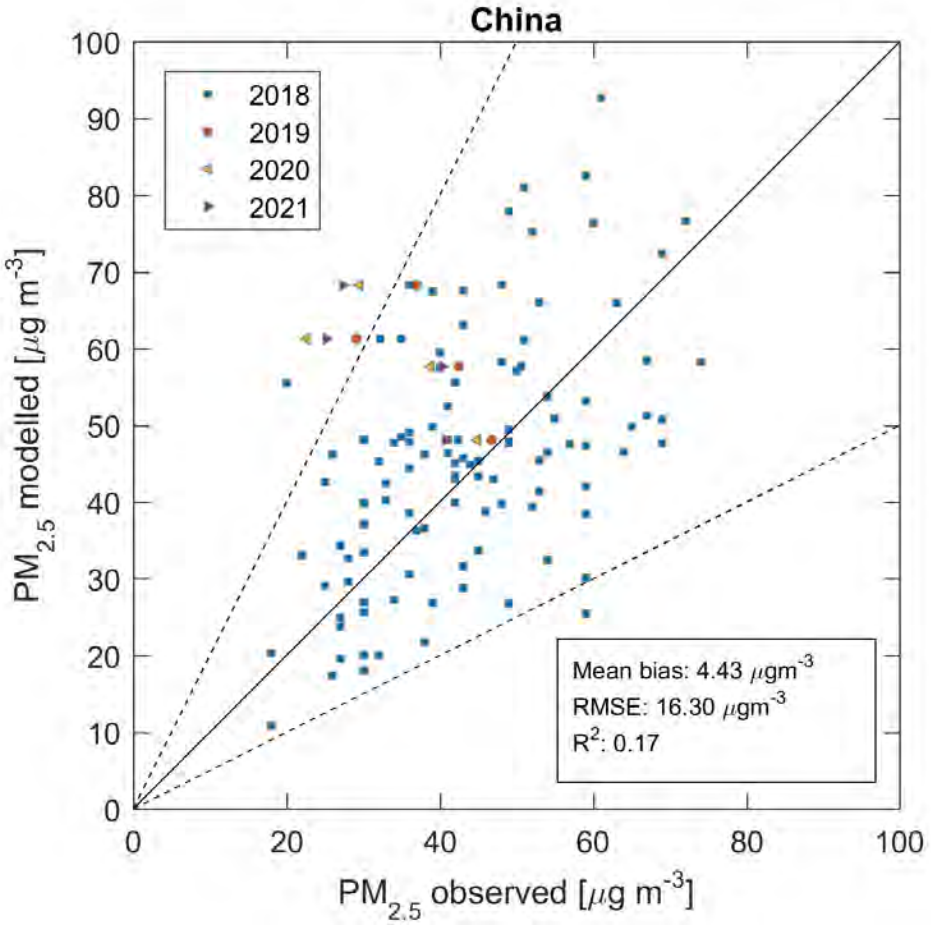



*Source:* GAINS model (IIASA)

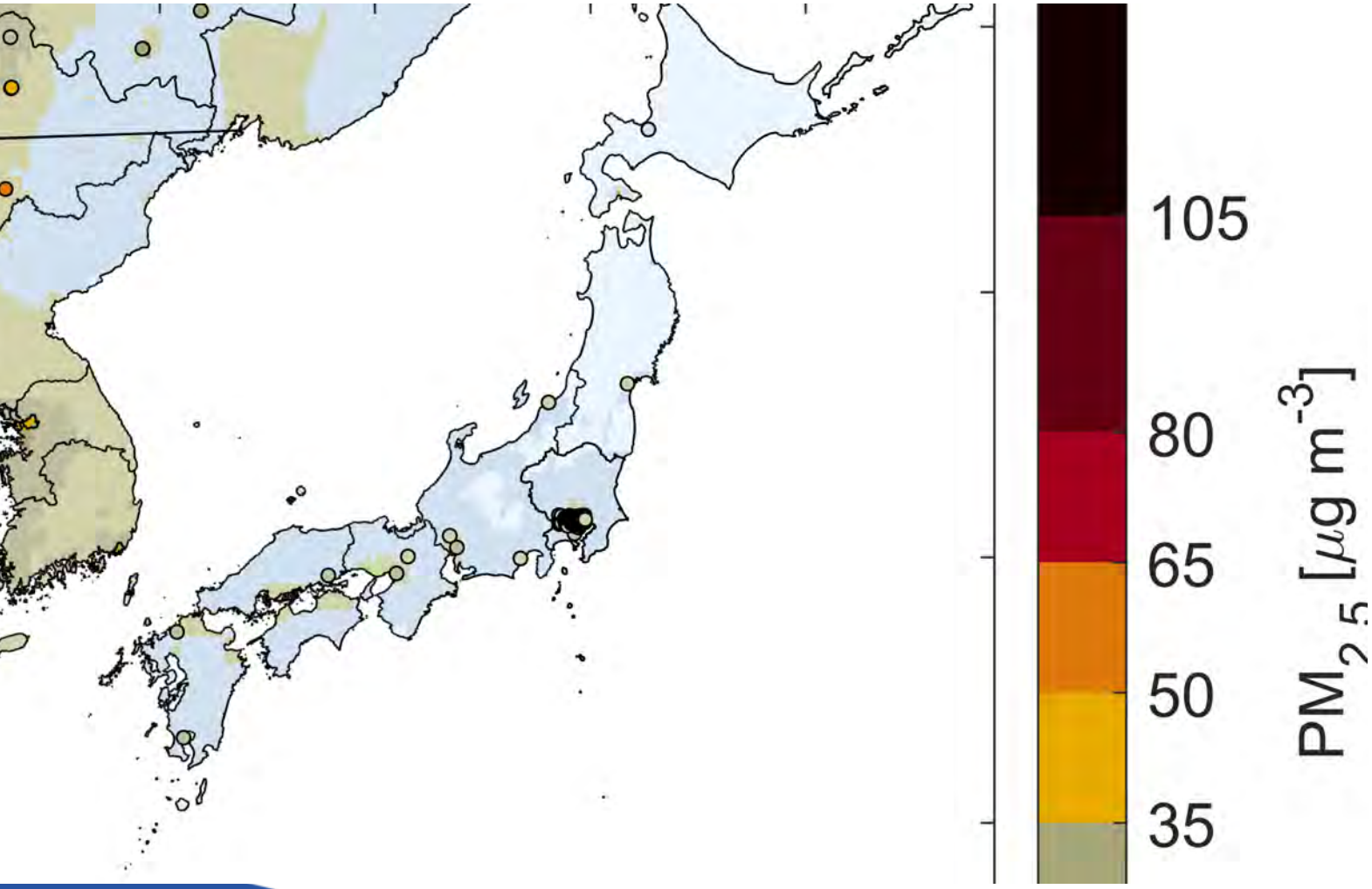
# Validation: Ambient $PM_{2.5}$ for 2019

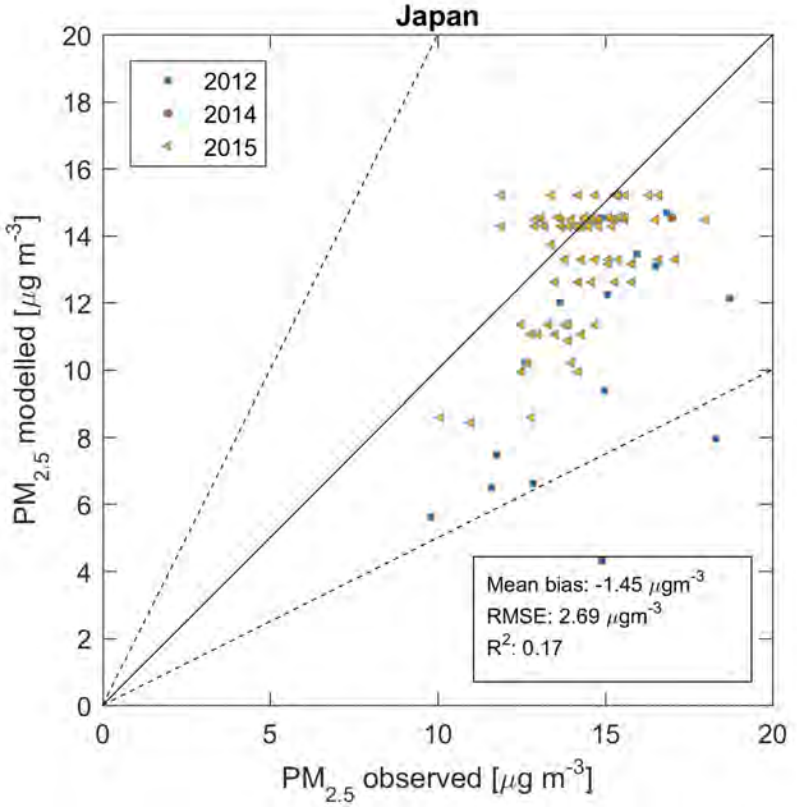



Comparison to observations for China (statistical yearbook)



# Initial validation for 2019; WHO, AirNow



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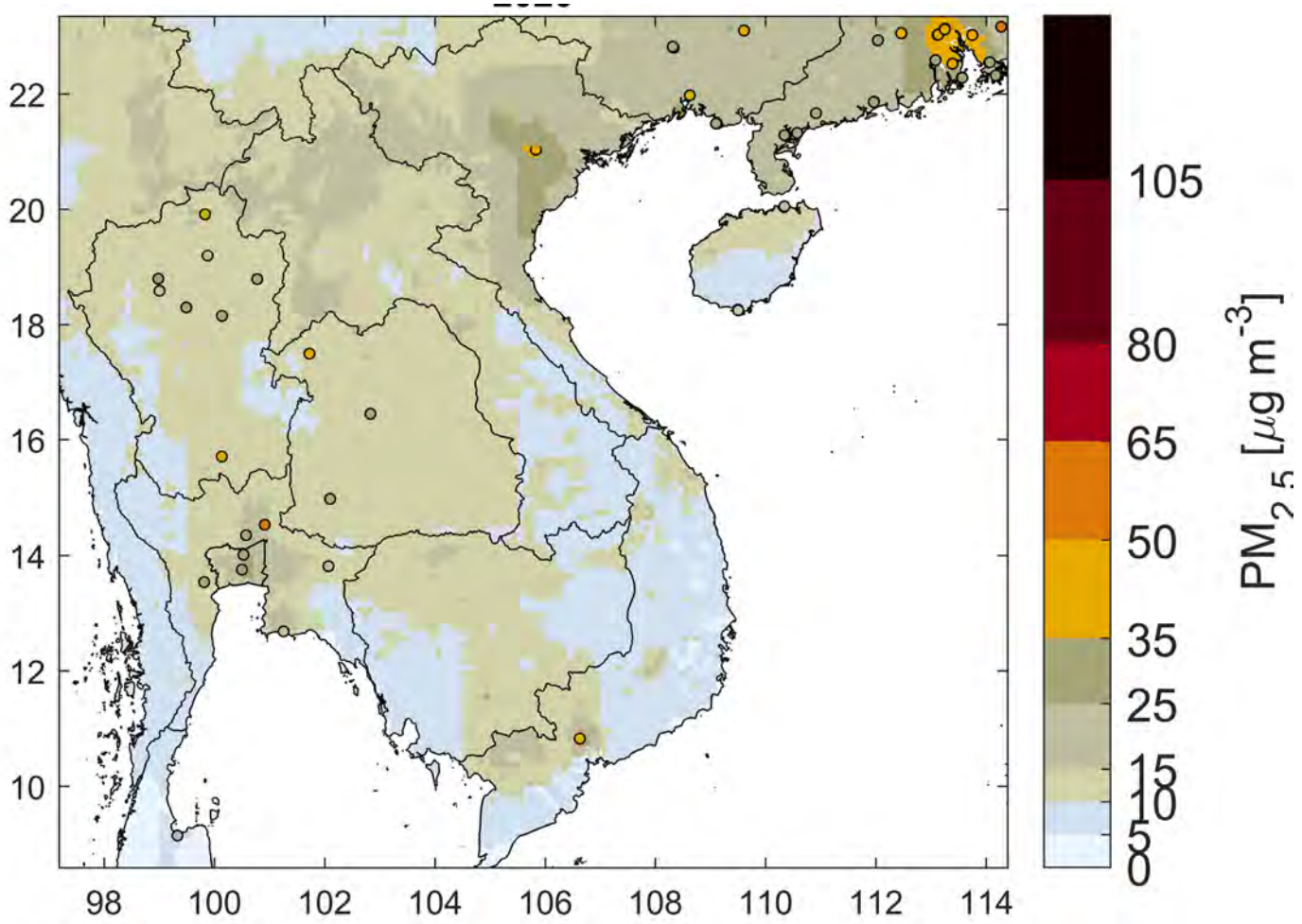
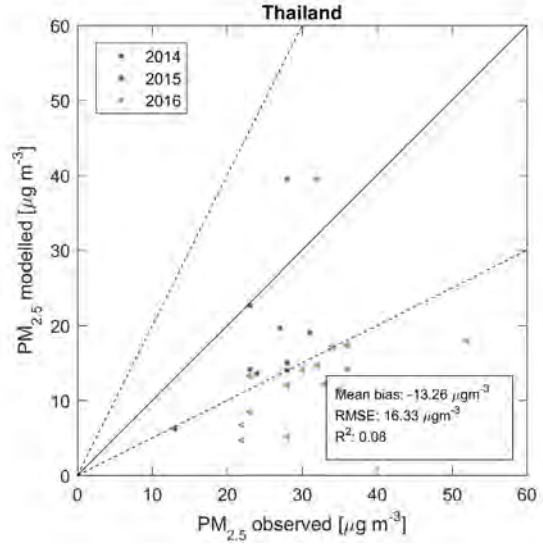
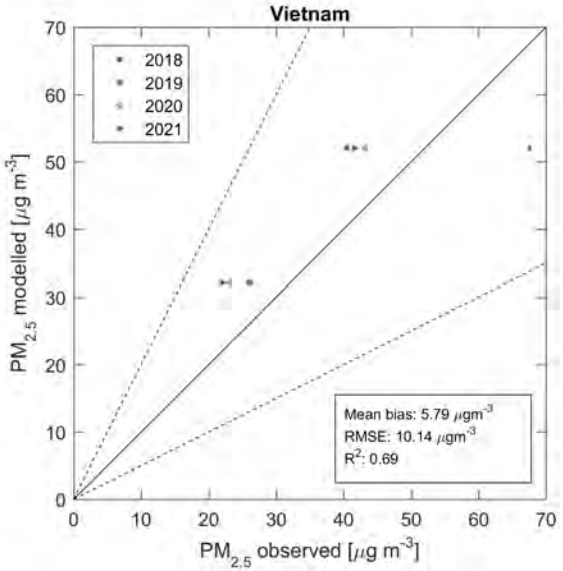
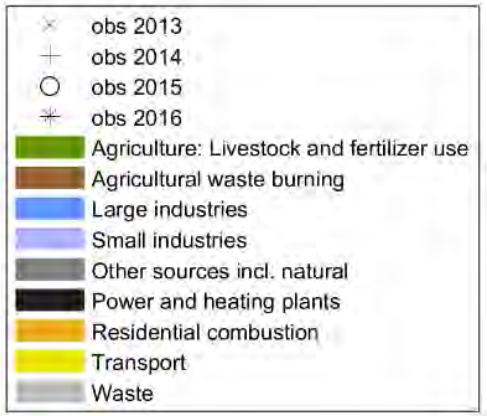
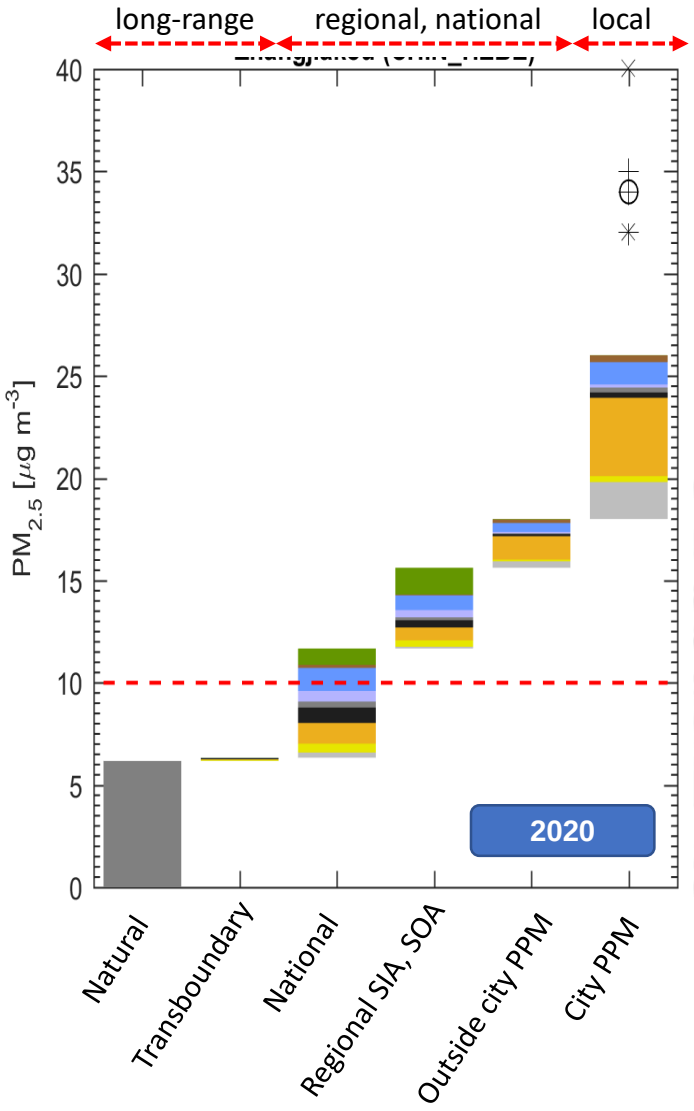


# PM2.5 Source apportionment for Zhangjiakou, China

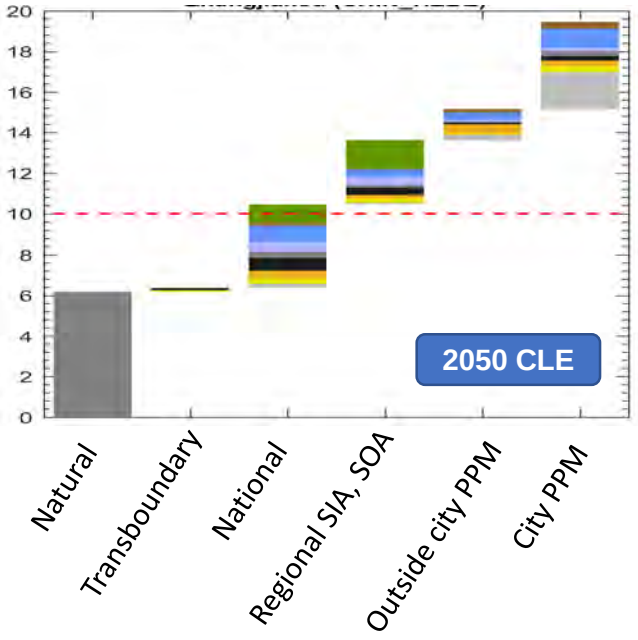



Current policies promise to bring down PM2.5 concentrations within the national standard by:

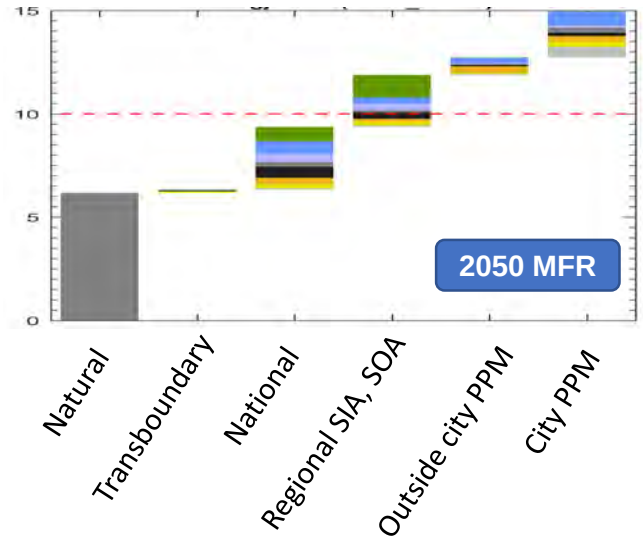
- keeping industrial sources in check
- addressing household cooking and heating sources

Mitigation of local sources essential



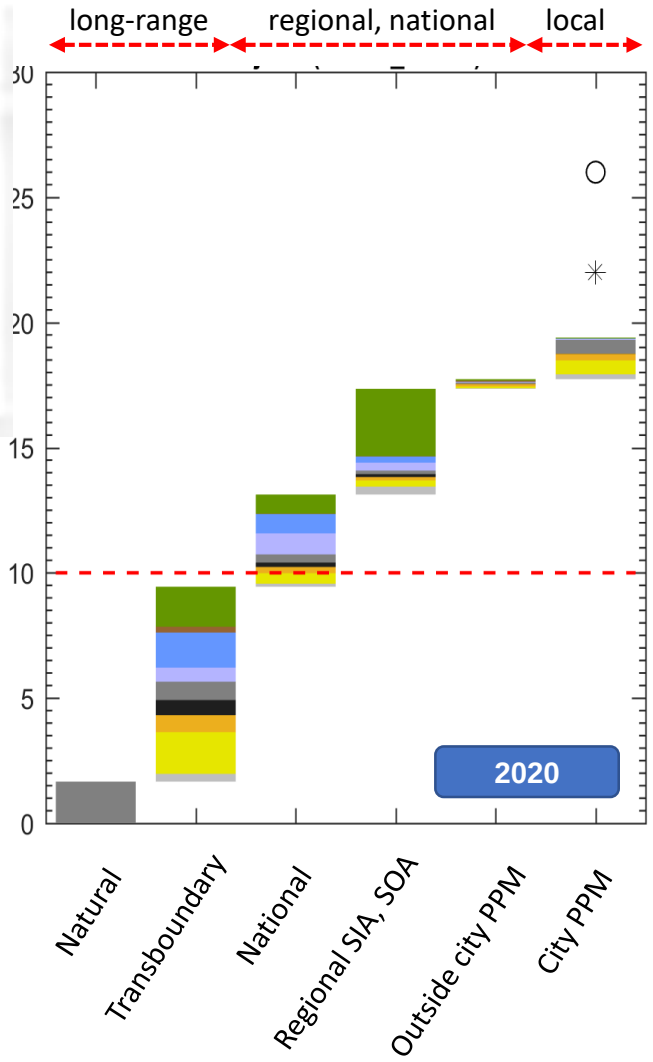

Rather limited further mitigation potential, mostly:

- Local sources (waste, transport)
- Regional sources in agriculture

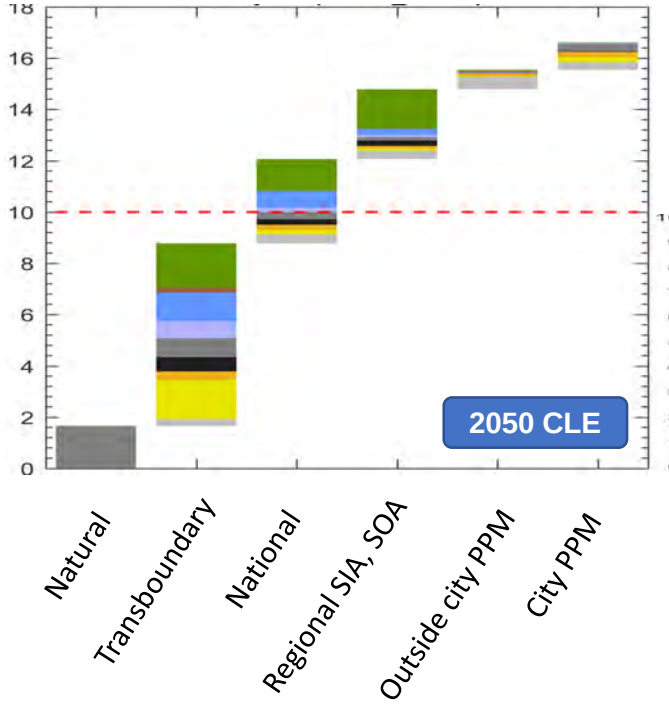



PPM – Primary Particulate Matter
SIA – Secondary Inorganic Aerosols
SOA – Secondary Organic Aerosols

# PM2.5 Source apportionment for Daejeon, Korea

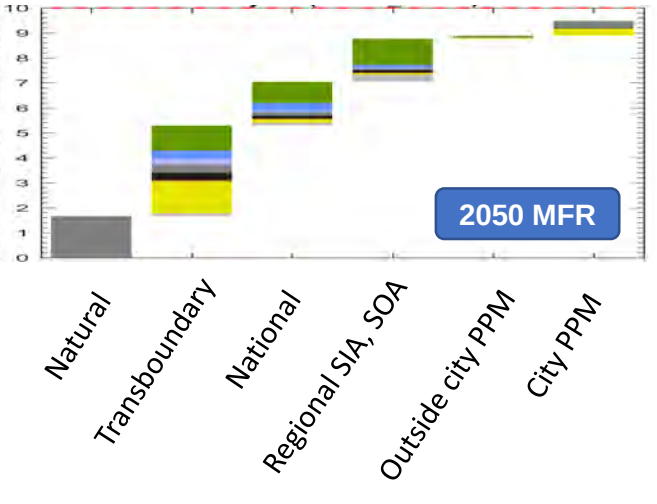




Current policies provide only a small reduction of PM2.5 concentrations but guard against increase with economic growth. Transboundary component remains fairly constant too; role of agriculture increases




Available mitigation potential allows to reach the WHO air quality guidelines:

- Large contribution from transboundary sources
- Agriculture becomes even more important and further mitigation would require structural or behavioral changes




PPM – Primary Particulate Matter
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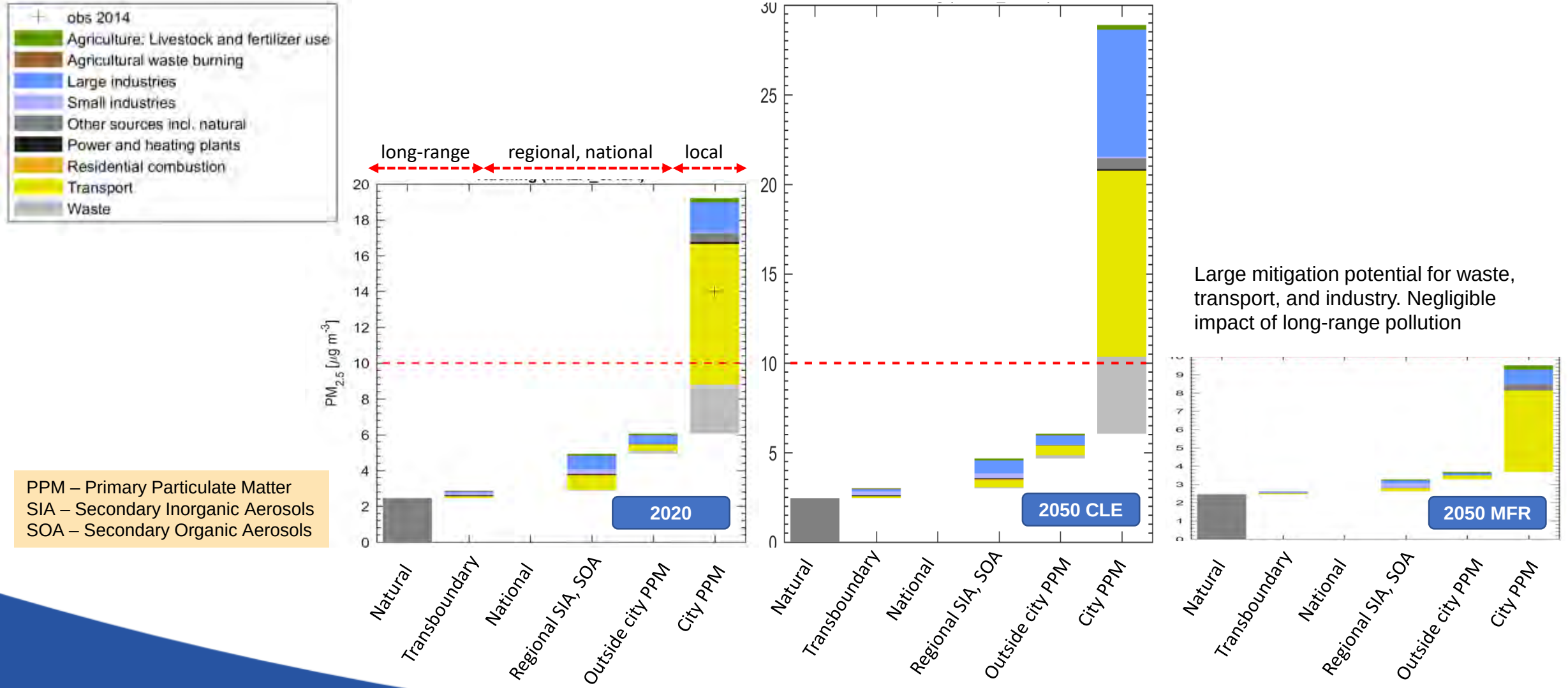
# PM2.5 Source apportionment for Kuching, Malaysia

Current policies provide are not able to prevent increase in PM2.5 concentrations with strong growth of local primary sources: transport and large scale ind activities




Large mitigation potential for waste, transport, and industry. Negligible impact of long-range pollution

PPM – Primary Particulate Matter
SIA – Secondary Inorganic Aerosols
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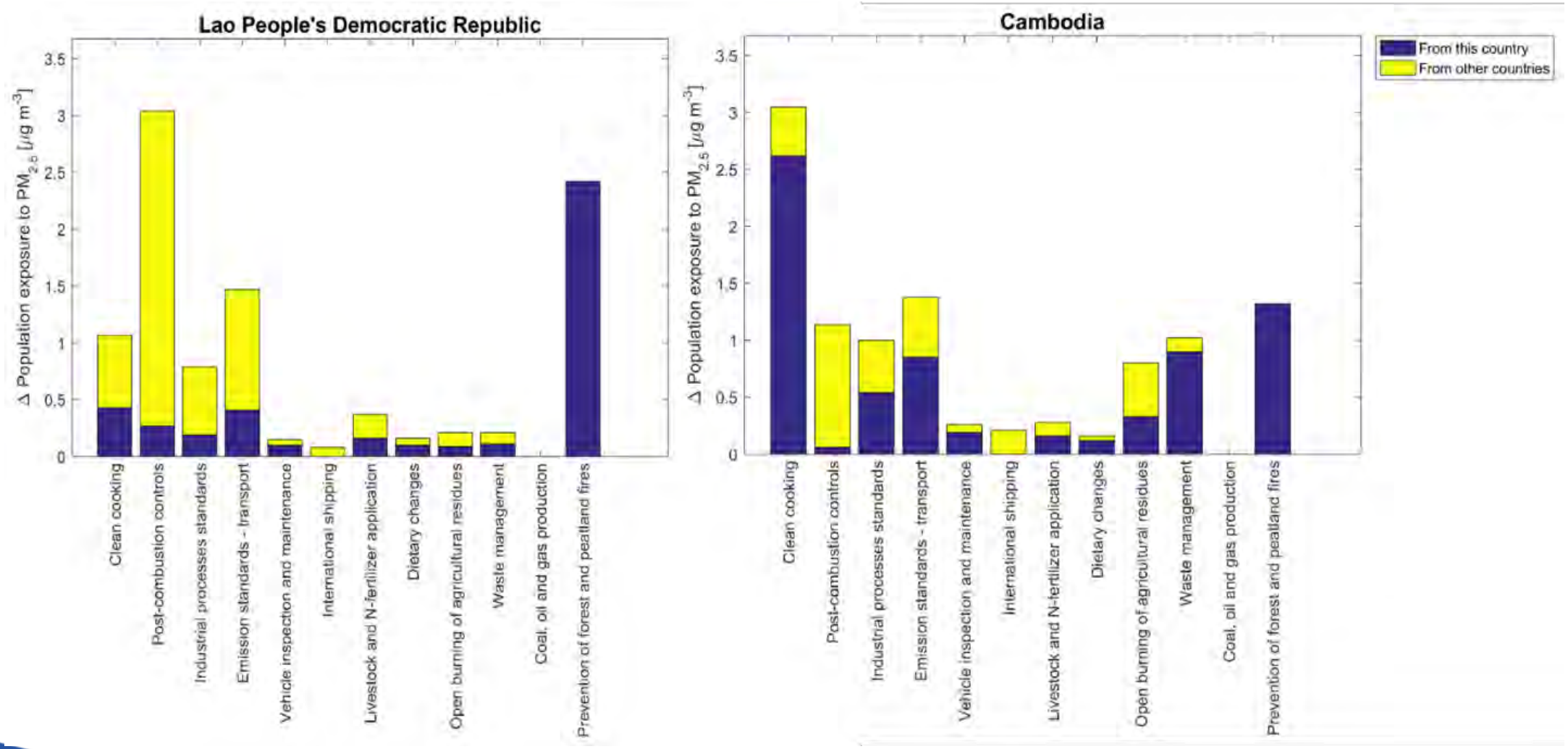
# Impact on pop-weighted exposure to PM2.5 in 2030 from implementation of priority solutions and contribution from local and transboundary sources (example for two ASEAN countries)




*Source:* GAINS model (IIASA); Clean Air Solutions for ASEAN (*in review*)

# Further Tasks within this project

Extending dataset of measurements and including available (even seasonal) speciated data sets to improve robustness of results and final policy relevant messages

Determine potential for further air quality improvements in urban and rural areas (align with measures in *Solution Report* and *Clean Air Solutions for ASEAN)*

**May 2022**

Implement potentials from IEA Sustainable Development + Healthy Diet scenario + N efficiency
Derive priority measures and their potentials for AQ improvements
- for each city/country
- over the whole model domain (including long-range transport)

Estimate benefits and their contributions to SDGs

**Summer 2022**

Quantification of SDG benefits
Multi-level governance structures, distribution of responsibilities, etc. – *Jointly with IGES*
Implementation aspects, multi-stakeholder strategies, etc. – *Jointly with IGES*

Synthesis, reporting and outreach

**Summer 2022 & beyond**