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Interactions between urban and rural air pollution in Asia, and the multiple development benefits of coordinated action

MOEJ-IIASA collaborative research activity

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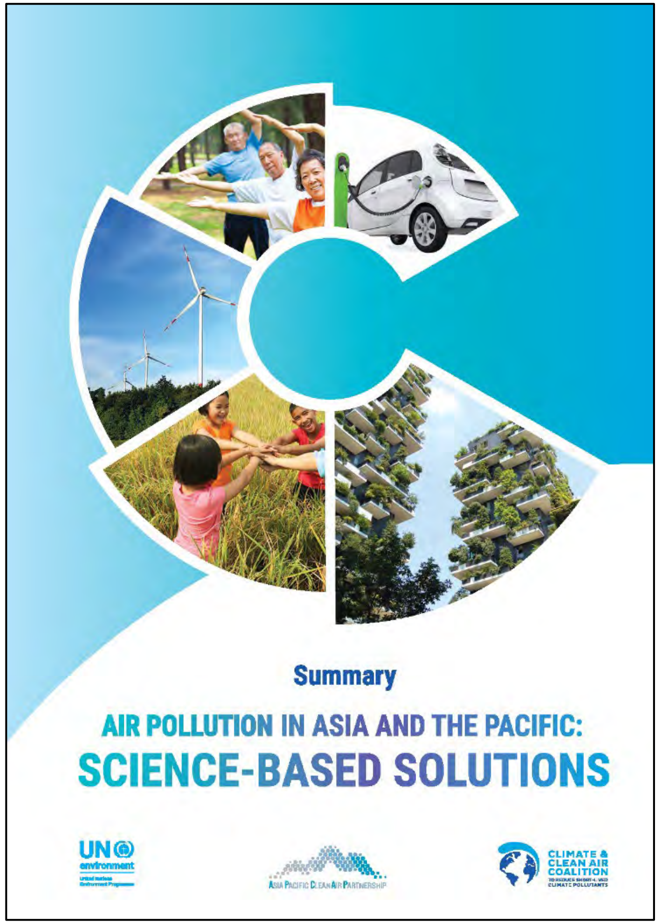
Strengthening the Science-Policy Interface for Clean Air and a Sustainable Future in Asia

19 December 2022

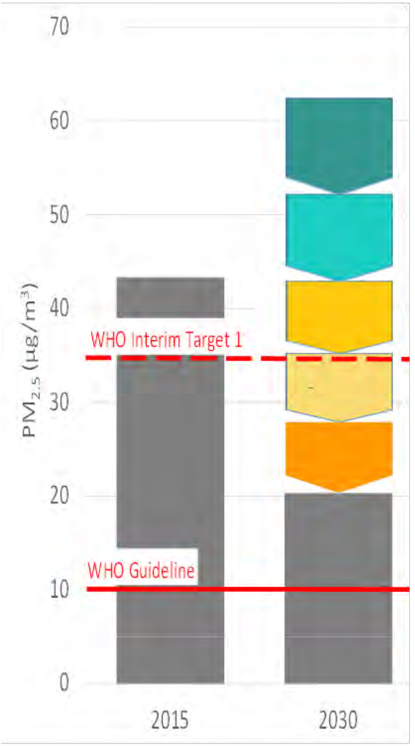
IIASA International Institute for Applied Systems Analysis
IGES Institute for Global Environmental Strategies
National Institute for Environmental Studies, Japan

Regional analysis of air pollution (2018)



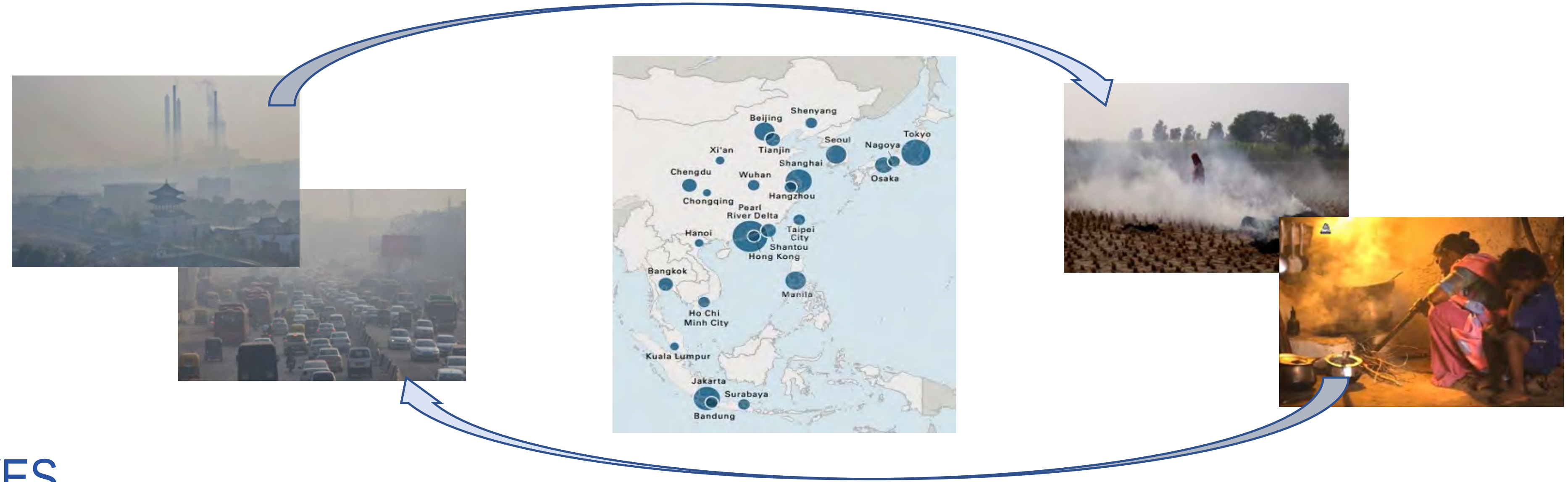
MULTINATIONAL SCIENTIFIC COLLABORATION: Authors include from China (Beijing Normal University, Chinese Academy of Sciences, Tsinghua University), Japan (NIES, IGES), Korea (Konkuk University, Korea Environment Institute), and IIASA

Mean population exposure to PM2.5



	Climate forcers			SDG benefits
	CO_2	CH_4	BC	
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%	

Interactions between urban and rural air pollution in Asia (MOEJ-IIASA Project A)



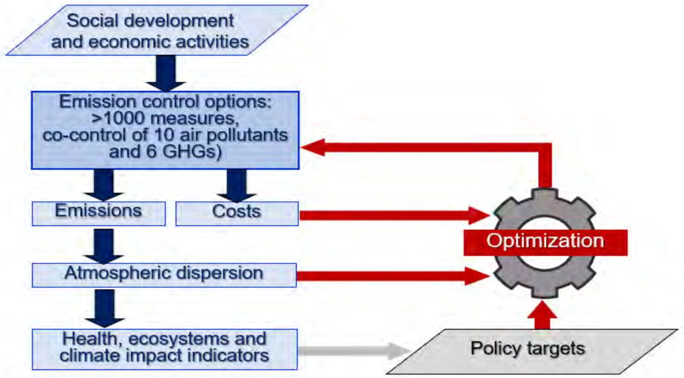
OBJECTIVES

- ✓ 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.

GAINS: A tool for a systematic assessment of the cost-effectiveness of emission control strategies

- **GAINS quantifies sectoral emission control potentials and costs**
  - for exogenous (governmental, international agencies) activity projections,
  - considering physical and economic interactions between pollutants.



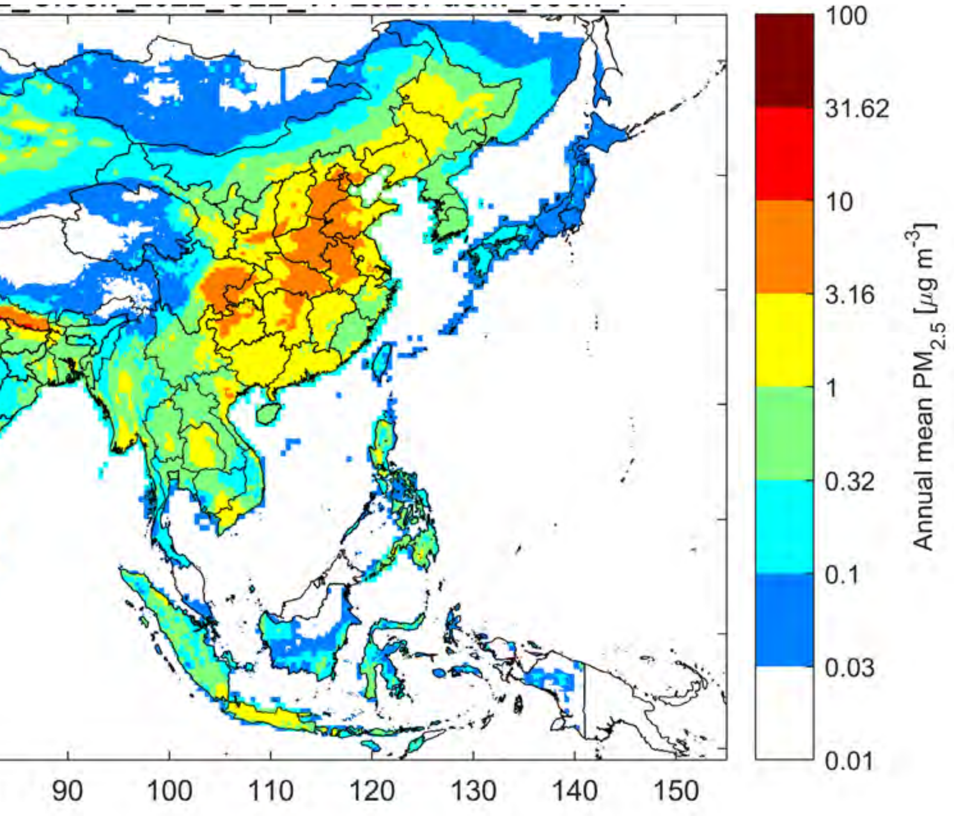
- **The model includes, i.a.:**
  - Several projections of emission drivers and representation of environmental policies
  - Characteristic of known emission sources (GHG and air pollutants)
  - Characteristic of available mitigation technologies (reduction efficiencies, costs, lifetime, co-control, application limits)
  - Health and ecosystem impact assessment

- **GAINS model capacity further developed, extending application across scales, i.a.:**
  - For secondary PM precursors (SO_2, NOx, NH_3, VOC): Spatial resolution 0.5° x 0.5°
  - For primary PM2.5: Grid to grid tracking:
    Spatial resolution 0.1° x 0.1°; Monthly results; For 4 different source sectors / vertical layers (can be mixed as needed)
  - Link to large scale Integrated Assessment Models (IAMs)

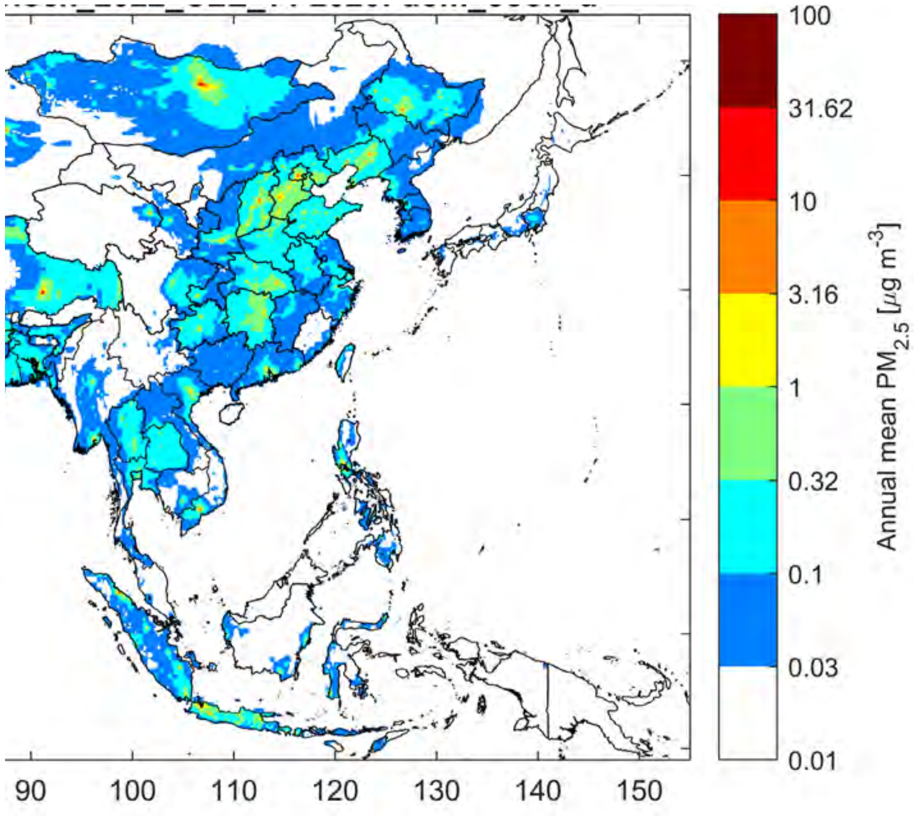
- ***What is yet inadequately represented in the modelling?***
  - Implementation barriers
  - Non-technical measures
  - Cost of inaction
  - …

Selected examples of source contributions to $PM_{2.5}$

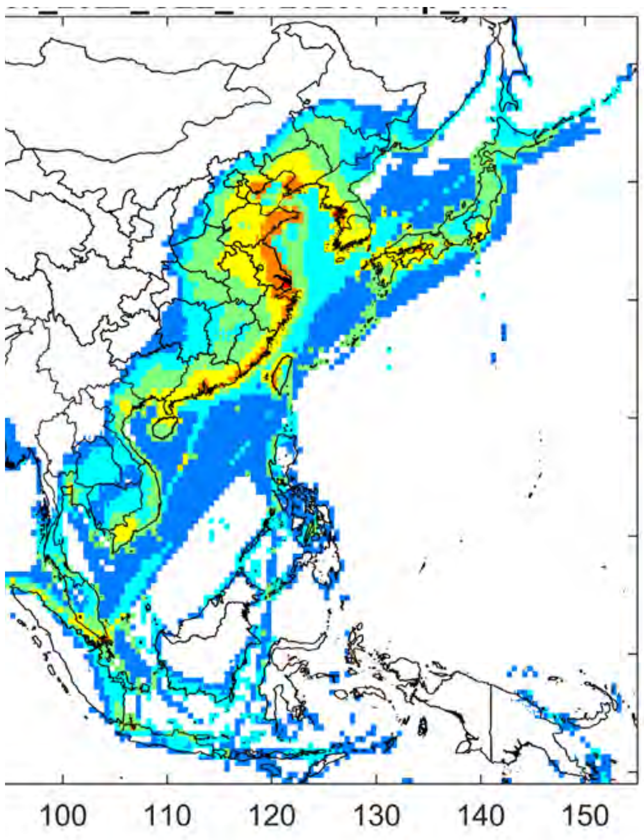
Cooking/heating – rural



Cooking/heeating – urban

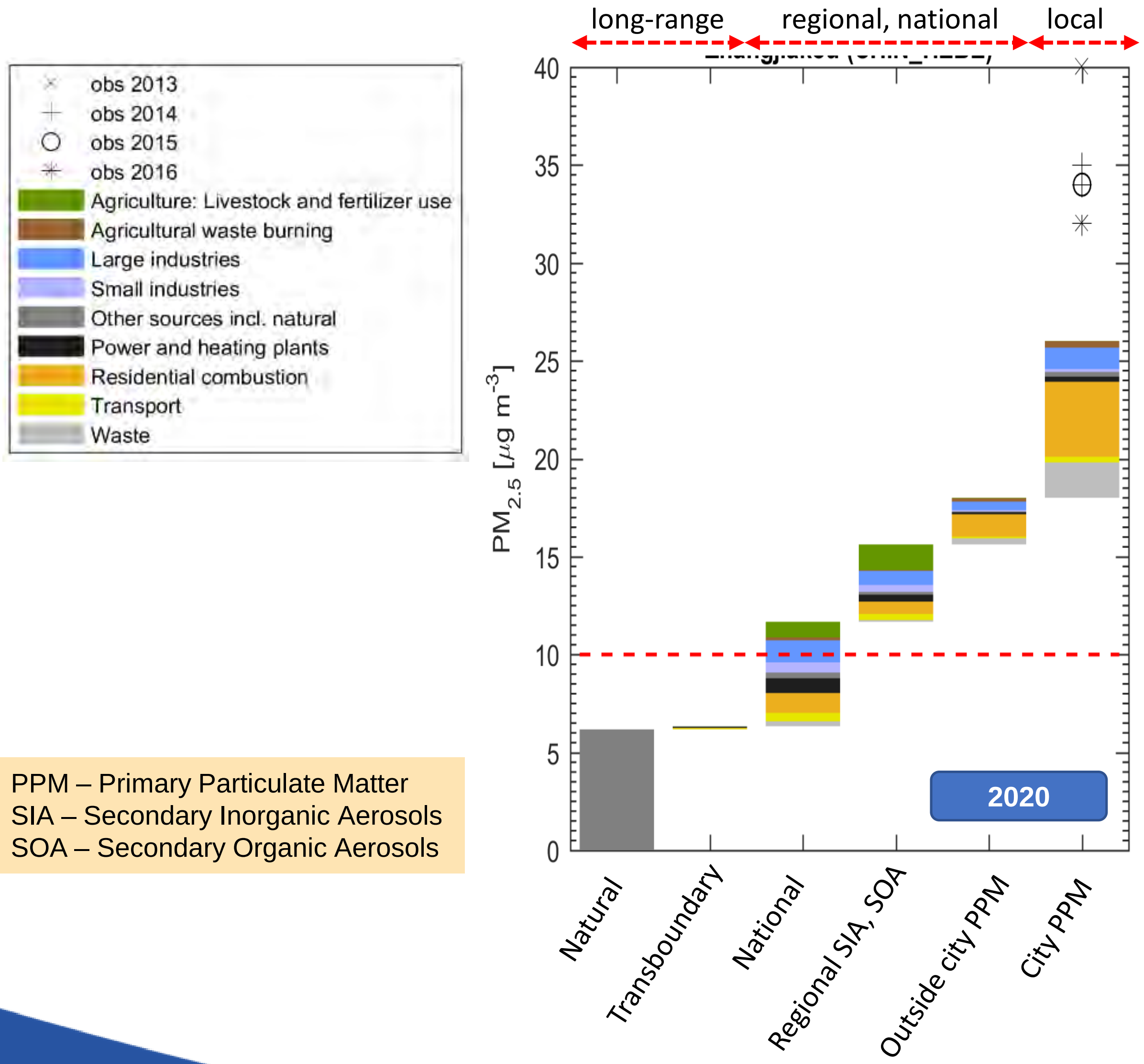


International shipping



Source: GAINS model (IIASA)

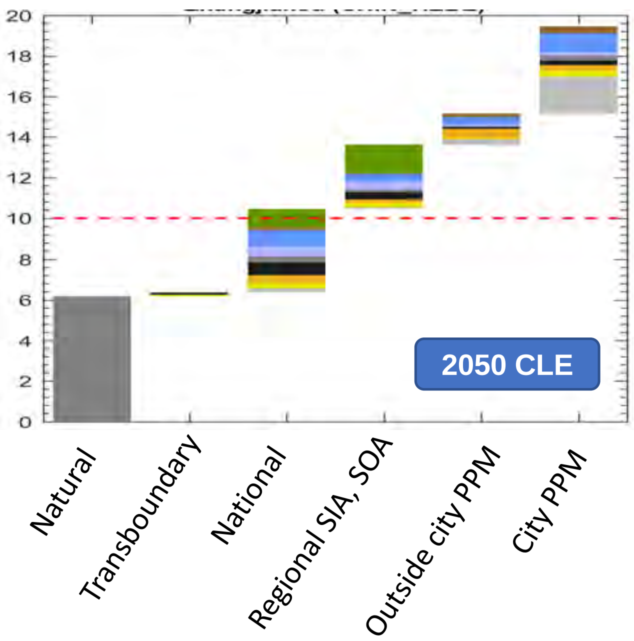
$PM_{2.5}$ Source apportionment for Zhangjiakou, China



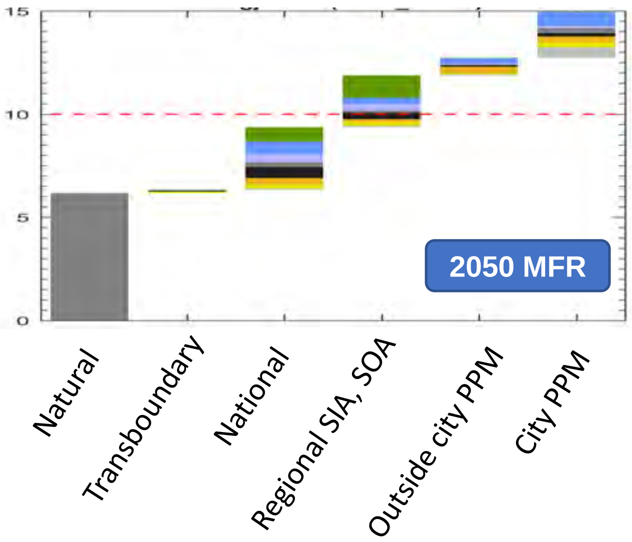
PPM – Primary Particulate Matter
SIA – Secondary Inorganic Aerosols
SOA – Secondary Organic Aerosols

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

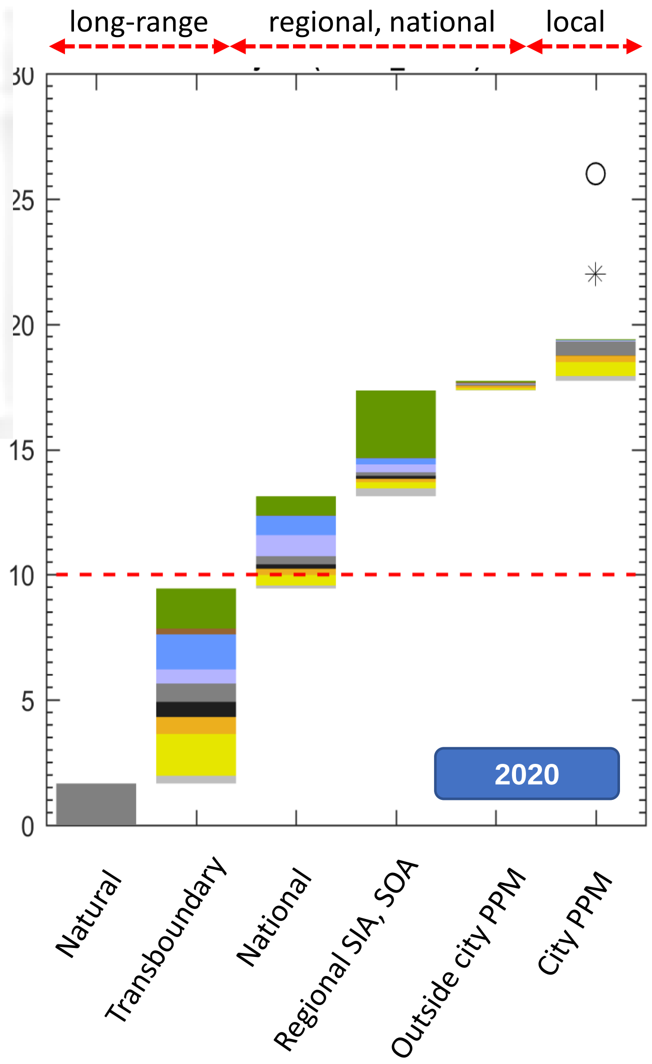
Mitigation of local sources essential



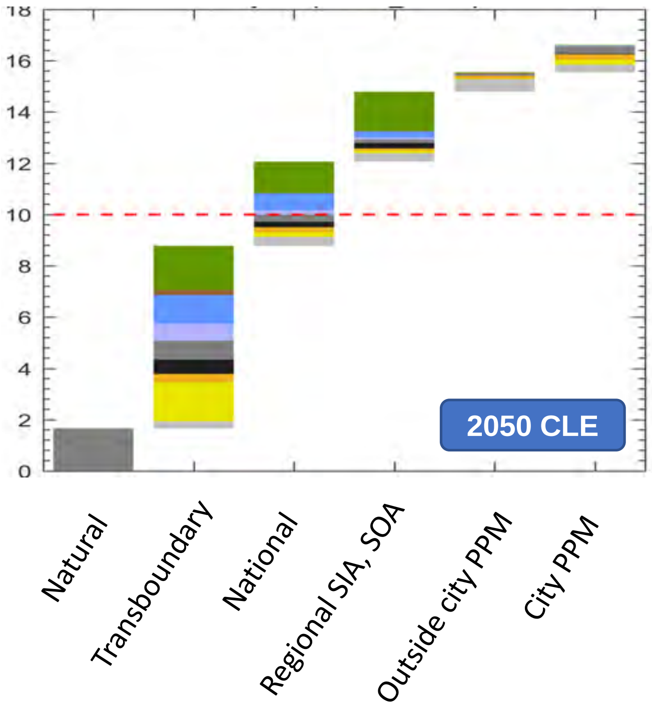
Rather limited further mitigation potential, mostly:
- Local sources (waste, transport)
- Regional sources in agriculture



PM$_{2.5}$ Source apportionment for Daejeon, Korea

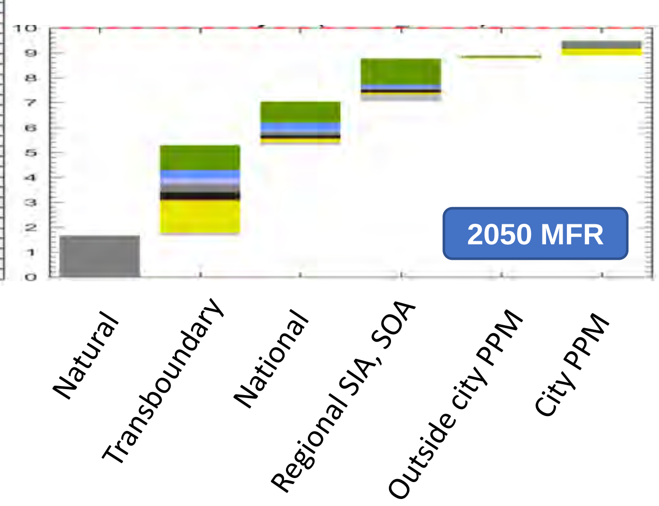


Current policies provide only a small reduction of PM2.5 concentrations but guard against increase with economic growth. Transboundary component remains fairly constant too; role of agriculture increases



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



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Regional and national analysis:

‘Clean Air Solutions for ASEAN’ *(expected publication mid 2023)*

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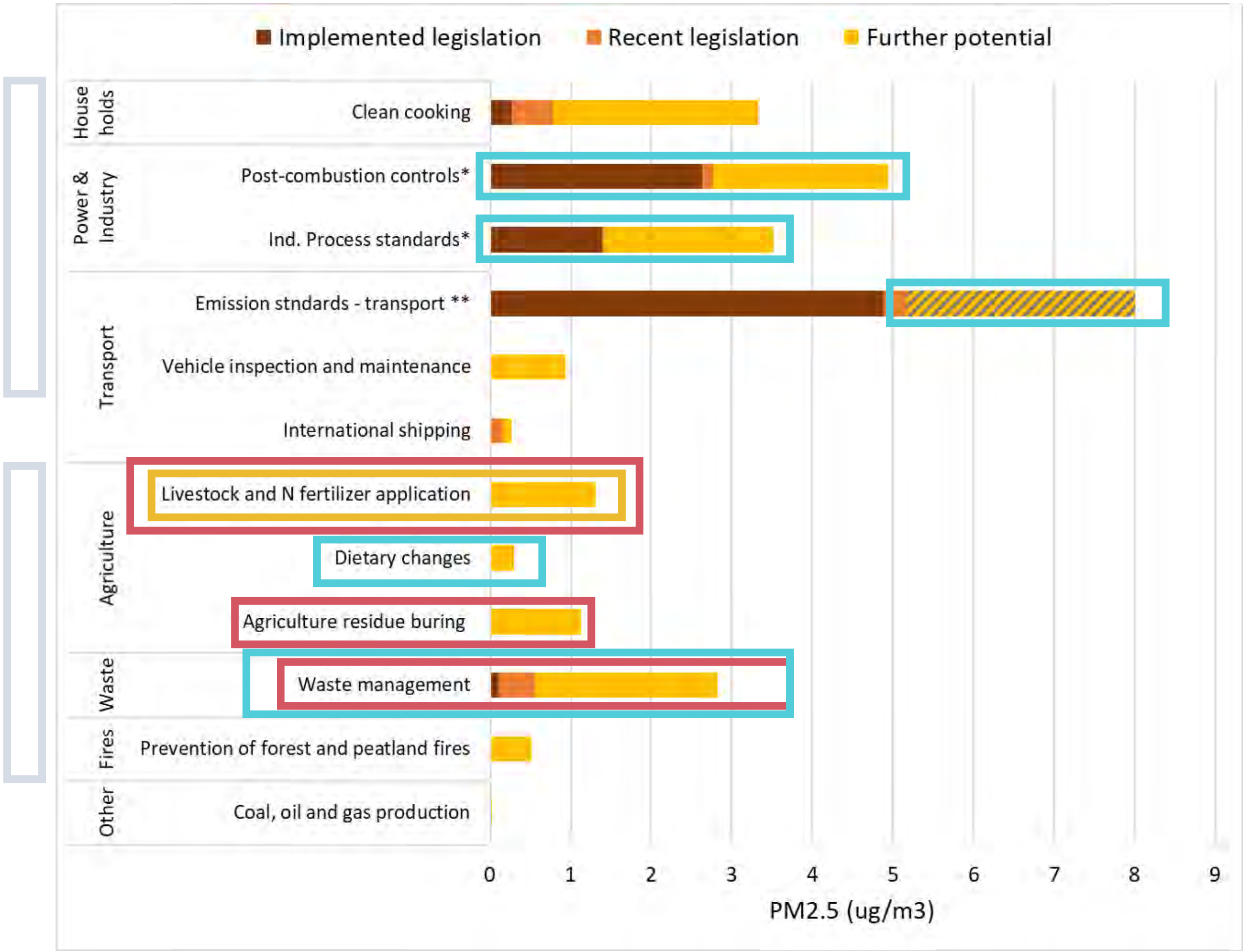
IGES Institute for Global Environmental Strategies

SEI Stockholm Environment Institute

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



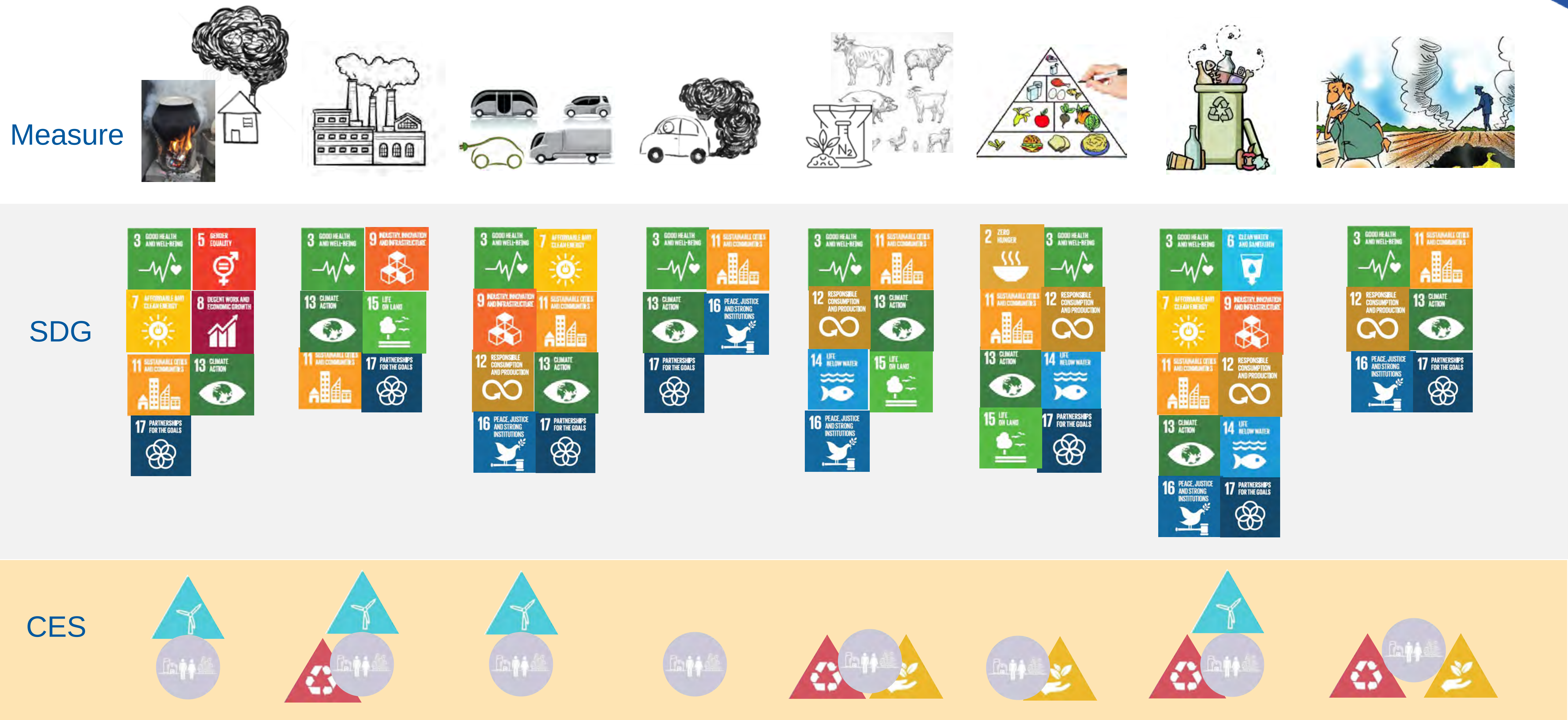
Nearly 40% of identified potential is associated with existing legislation – implementing existing solutions is critical!

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

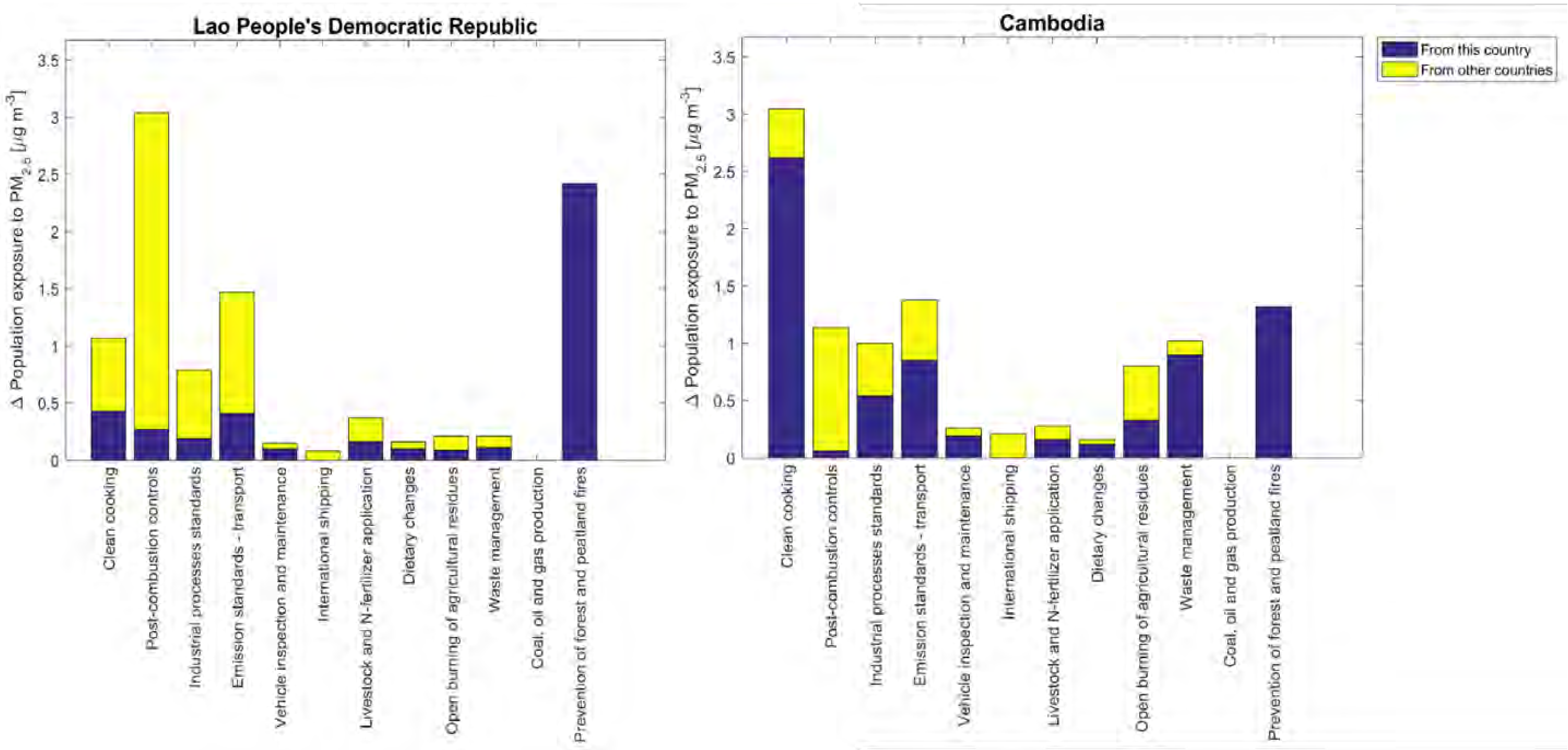
Japan’s Circulating and Ecological Sphere (CES)

*) Includes also energy-efficiency measures; **) Further potential represents approximation for reduction due to more stringent standards or rapid electrification, although the result will be different depending on target year

Multiple benefits of selected example measures across several policy domains

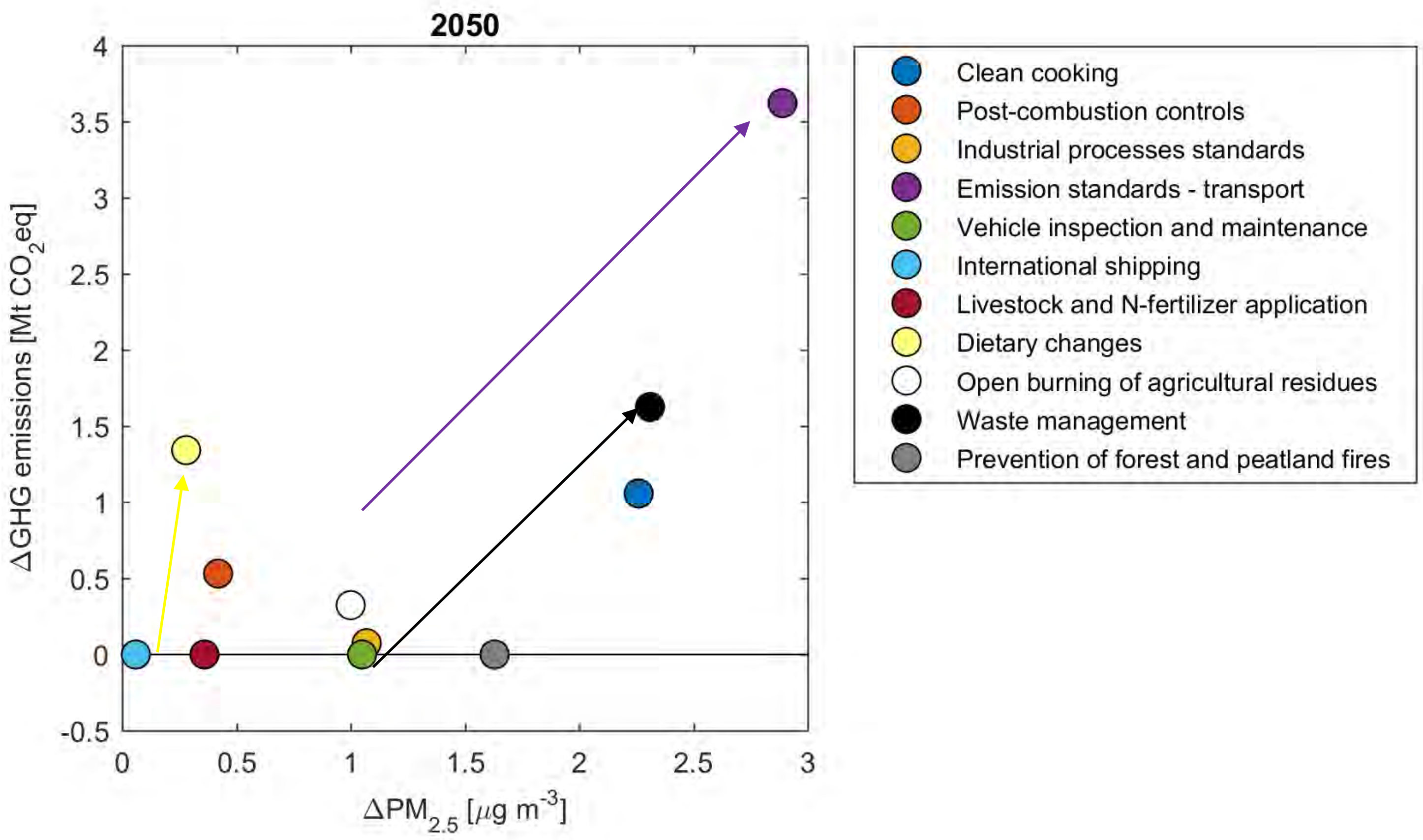


Impact on pop-weighted exposure to $PM_{2.5}$ in 2030 from implementation of priority solutions and contribution from local and transboundary sources (example for two countries)



Source: GAINS model (IIASA); Clean Air Solutions for ASEAN (2023)

Co-benefits of measures for GHG emission reductions:
Example for Cambodia



- Several measures also reduce GHG emissions
- Some have GHG emission 'penalties' in the short run
- In the longer run (2050), co-benefits are larger, and no 'penalties' were identified

Summary and further steps

- Tools developed to:
  - Assess the interactions between urban/rural air pollution, and
  - Design and evaluate packages of measures to harvest multiple benefits of coordinated action

- These can support policies to develop coordinated local and regional action (near- and long-term planning)

- Multiple studies support implementation of particular policies/measures but the actual implementation is often slow

- New methods are being developed to better assess, i.e.:
  - Barriers for implementation and ways to overcome them,
  - Costs of inaction

- These can be used to enhance the integrated modelling analysis, considering local circumstances and indicating costs and benefits of overcoming barriers and delivering multiple benefits
  => more robust and realistic models => more efficient science-policy dialog