International Institute for Applied Systems Analysis
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Modelling future mercury emission control scenarios in GAINS

An update

Flora Brocza (brocza@iiasa.ac.at)
Peter Rafaj (rafaj@iiasa.ac.at)

International Institute for Applied Systems Analysis (IIASA)
http://gains.iiasa.ac.at/

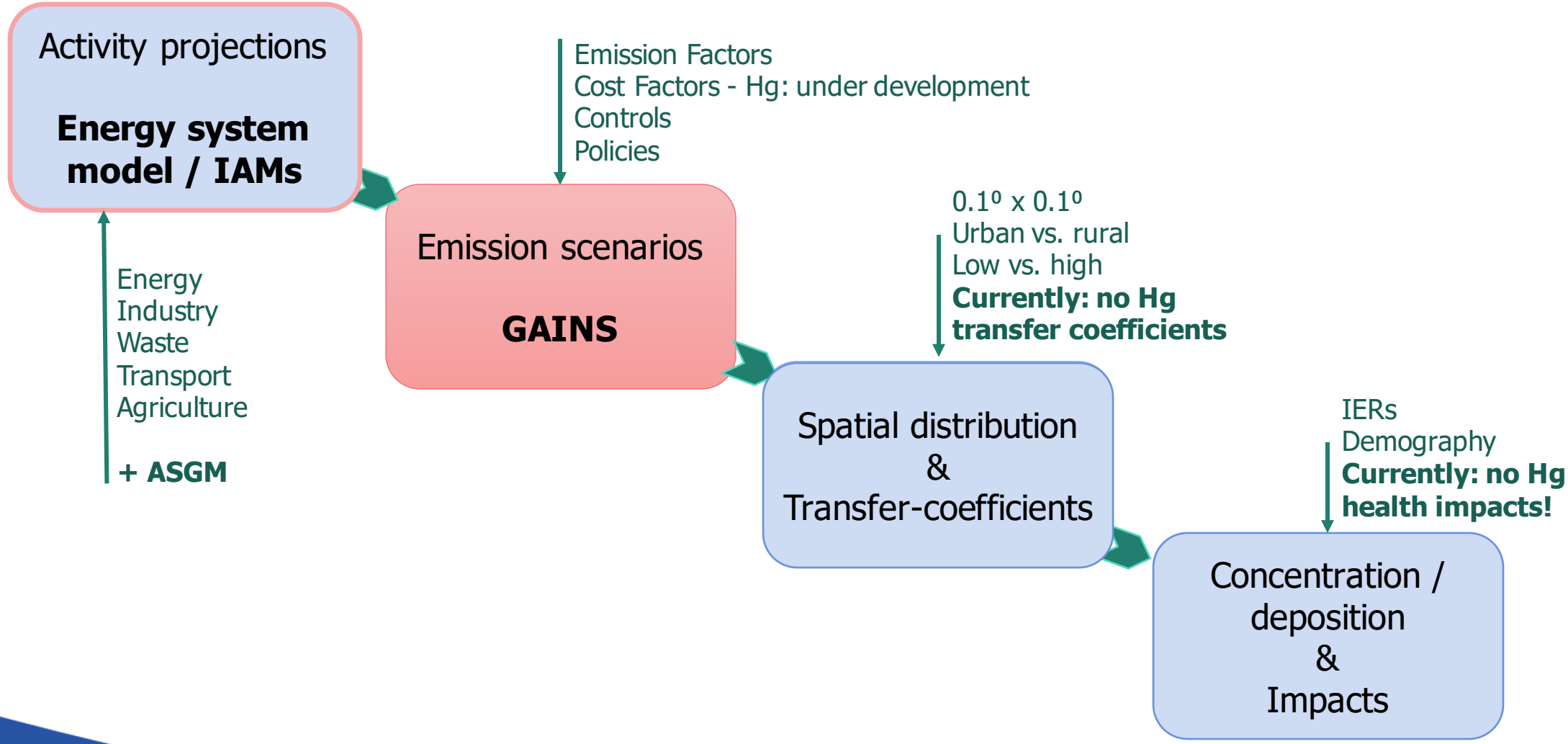
TF HTAP Workshop on Global Mercury Emissions and Modeling

18 May 2022

UNIVERSITY OF LEEDS

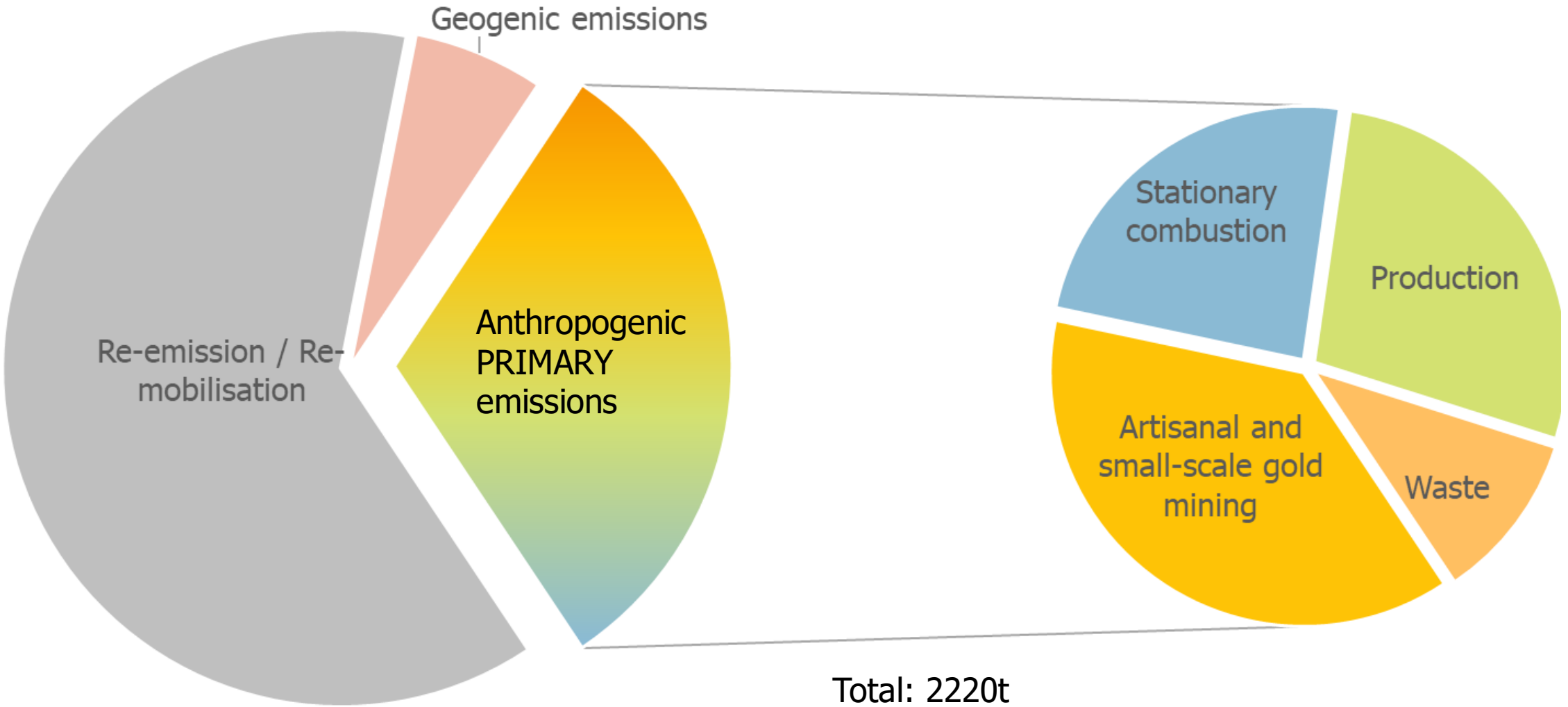
From exogenous inputs to GAINS model runs

Greenhouse Gas - Air Pollution Interaction and Synergies Model



Global annual Hg emissions to the atmosphere

Emission sources covered in GAINS

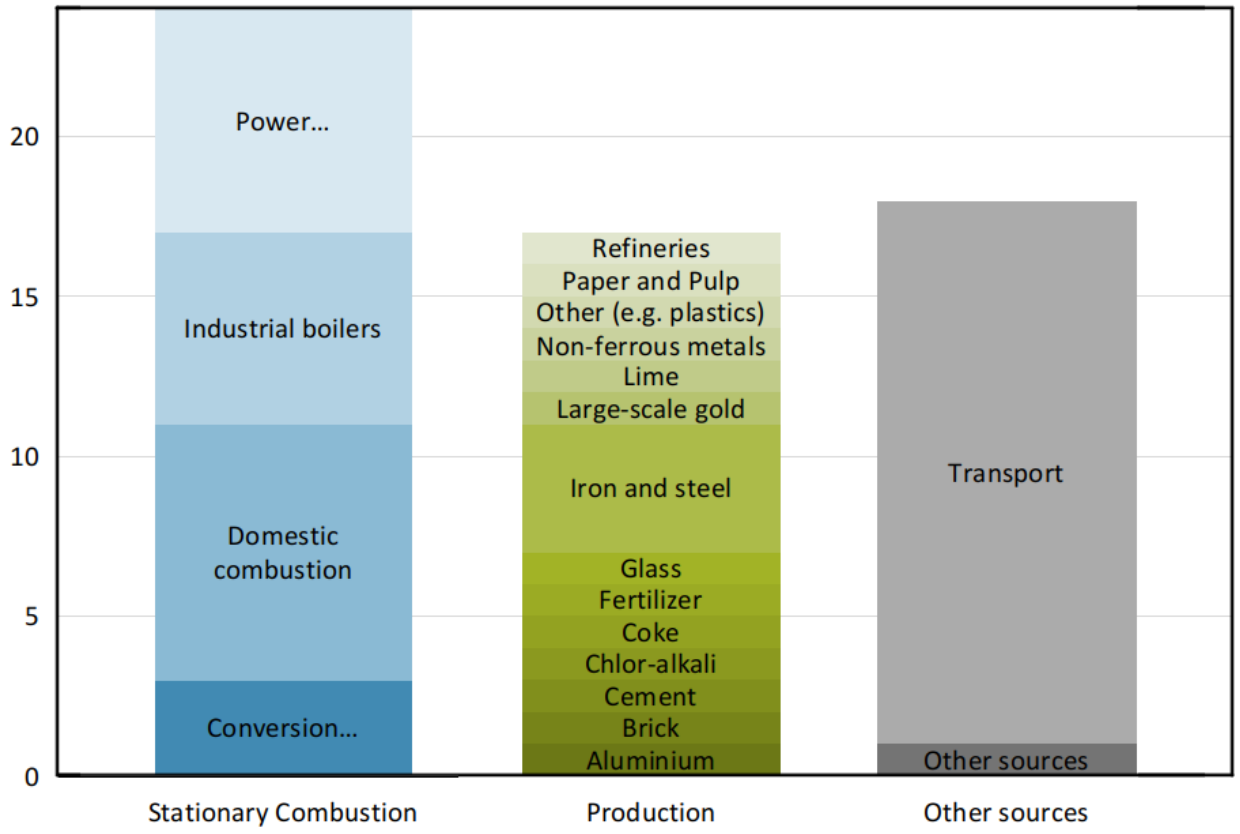


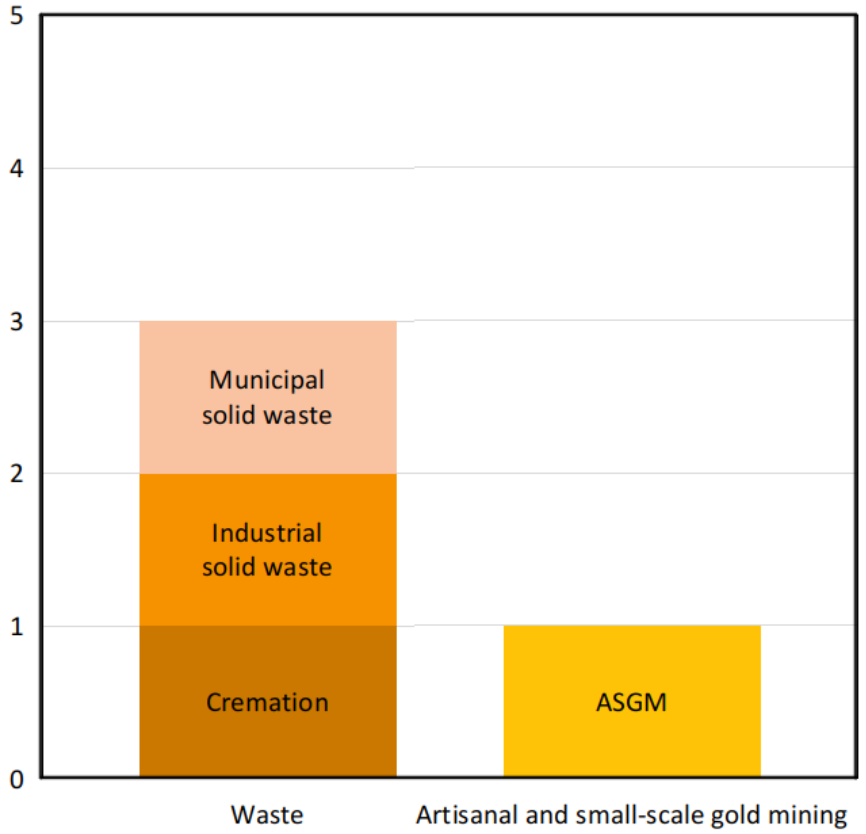
Total: 2220t

AMAP/UNEP (2018) estimates for 2015

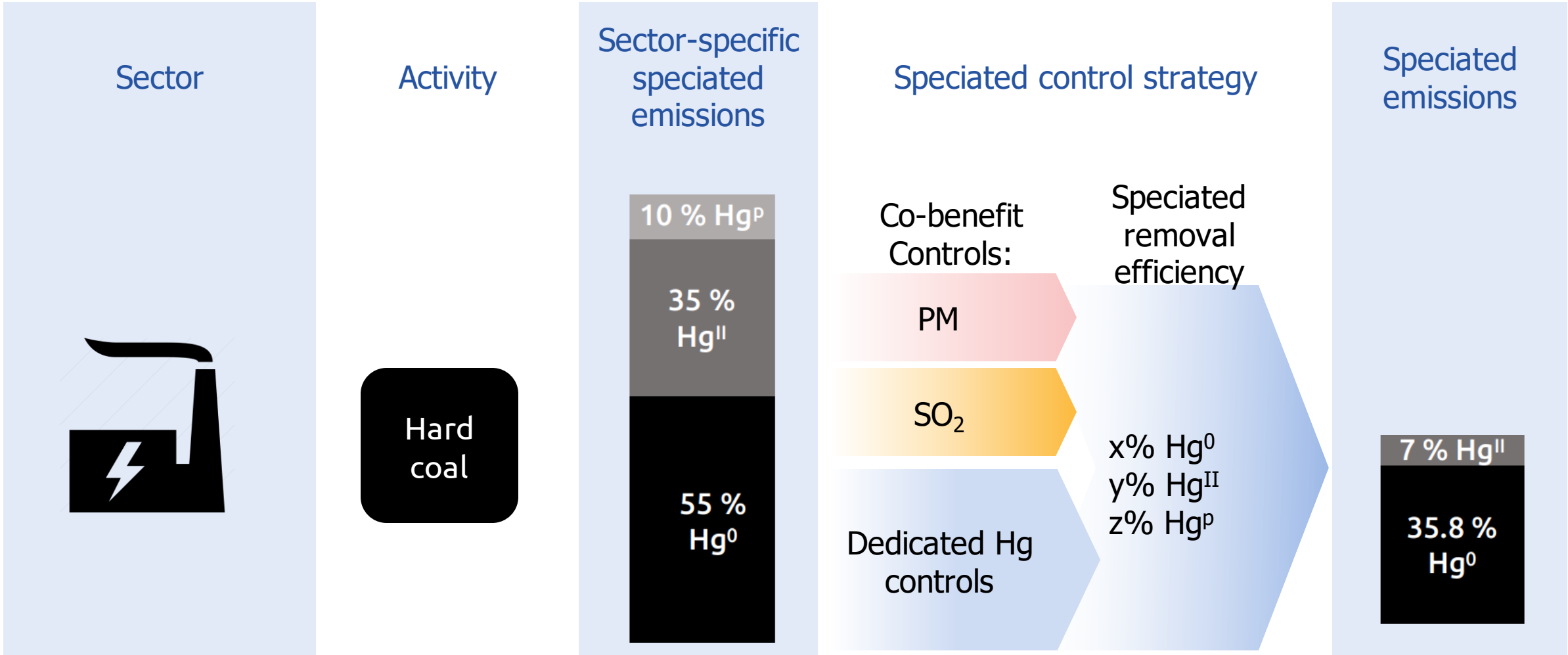
Sectoral resolution of mercury emissions in GAINS

Y-axis: Number of GAINS sectors with associated Mercury emissions





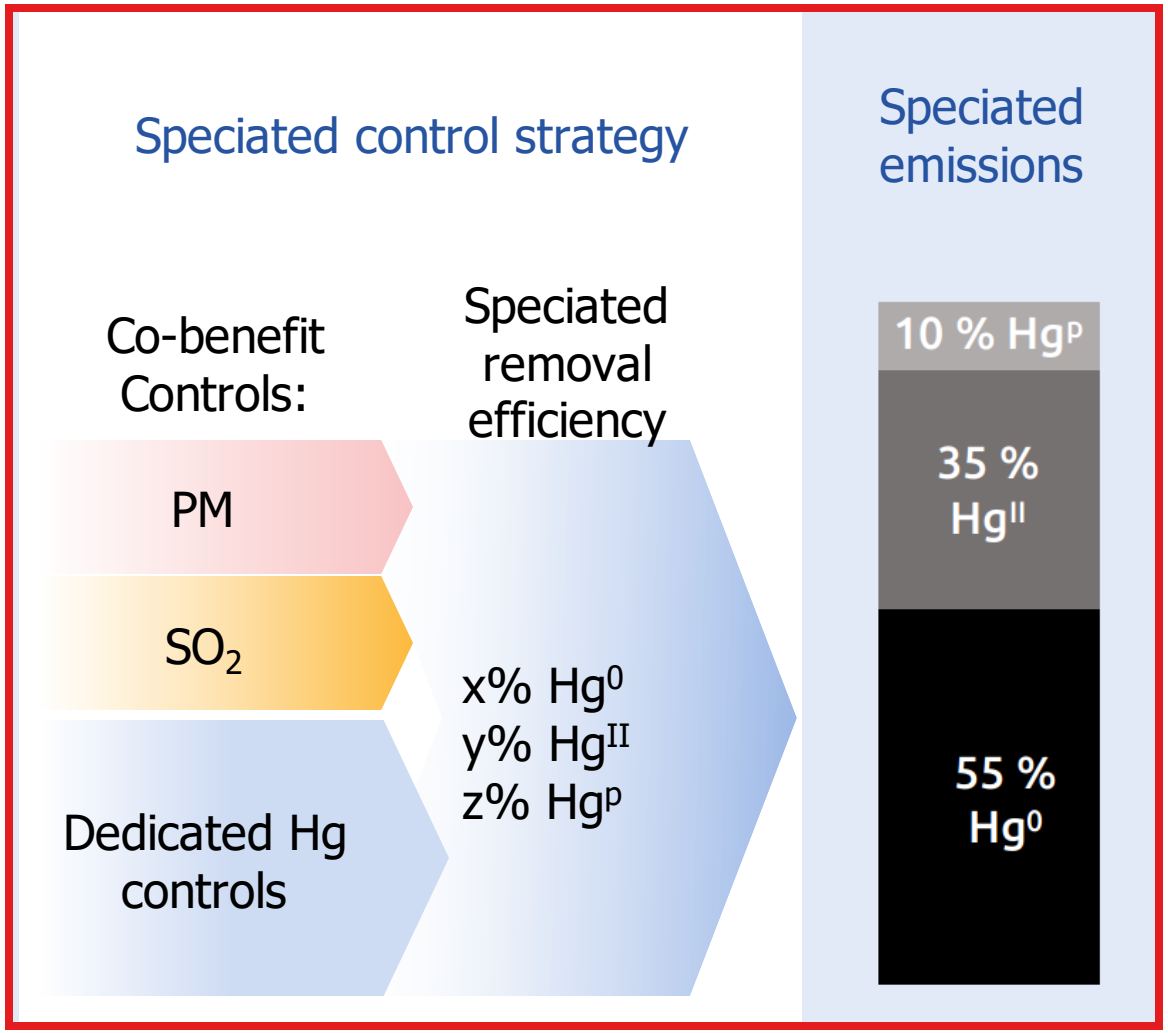
Speciated Hg emissions from all emission sources



Speciated Hg emissions from all emission sources

Updated starting June 2021

- addition of Hg-specific controls
- extension of co-benefit calculation



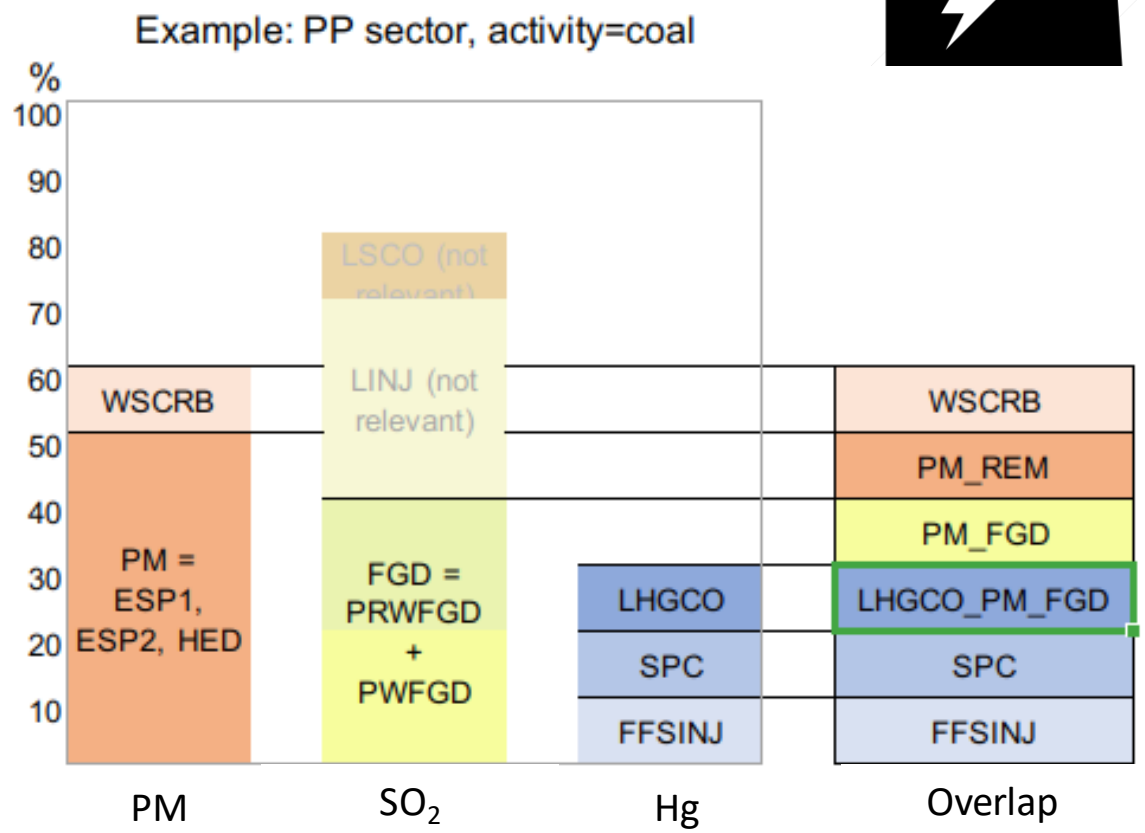
Control technologies: Power sector, industrial boilers

Co-benefit between PM, SO_2, Hg controls considered through calculation of "overlaps"

- PM and SO_2 controls clustered based on mercury removal efficiency
  - Dedicated mercury (...combined with PM + SO_2) controls
  - PM + SO_2 controls
  - Only PM controls

Mercury controls

- Washed / halogen-treated coal
- Stationary sorbent units
- Sorbent injection with and without additional fabric filter



Additional mercury control technologies

Cement & lime production

- Dust shuttling

Non-ferrous metal smelting, large-scale gold

- Acid plants

Small-scale gold production

- Ban
- "Good practice": e.g. use of retorts, lower mercury quantities per unit of ore

Chlor-alkali production

- Ban

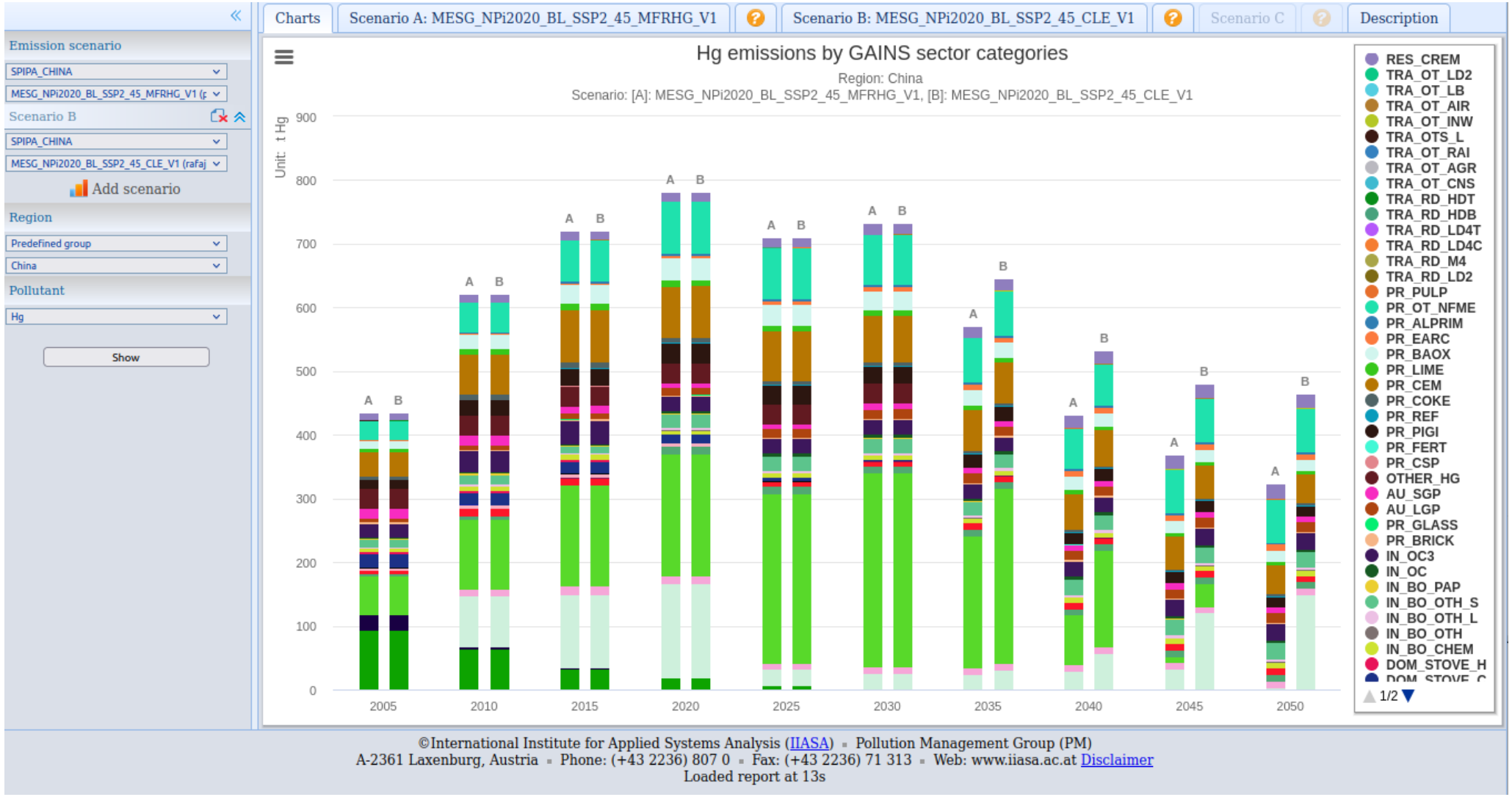
Cremation

- "Good practice"

Solid waste (Industrial, municipal)

- Landfill cover
- Landfill compaction
- Waste to energy

GAINS sectoral resolution



Current legislation - Minamata Convention

	Targets	BAT	Comment	GAINS implementation	
Supply, Sources & Trade	2032 (mining)		import/export bans	indirect via ACT/EF	WASTE, PR, AU
Hg-added products	reduce by 2020			indirect via ACT/EF	PR
Manufacturing processes with Hg (compound) use	-50%/VCM unit by 2020; Bans: acetaldehyde 2018, chlor-alkali 2025	x	Hg-catalysts	indirect via ACT/EF **Control strategy**	**PR**
Artisanal and small-scale gold mining			Sector formalization	**Control strategy**	**AU**
Emissions		x		**Control strategy**	**PP, IN, PR, RES, DOM, WASTE**
Releases to water and land		x	Reduce & control	not quantified	outside of GAINS
Environmentally sound interim storage		x		not explicity quantified	OTHER_HG
Waste		x	Basel Convention	Control strategy	WASTE
Contaminated Sites		x		not explicity quantified	OTHER_HG

EF ... Emission factor
PR ... Production
AU ... Gold production
IN ... Industrial combustion
PP ... Power sector
WASTE ... Waste sector
RES ... Residential sector
DOM ... Domestic sector
STH ... Storage & handling
ACT ... Activity

Policy-relevant questions

1. Can stringent emission targets be met by JUST the use of co-benefit technologies?

→ Current legislation (CLE)
only co-benefits from PM, SO_2 controls

2. What Hg emission trajectory are we on, considering commitments resulting from the Minamata convention?

→ CLE + Minamata

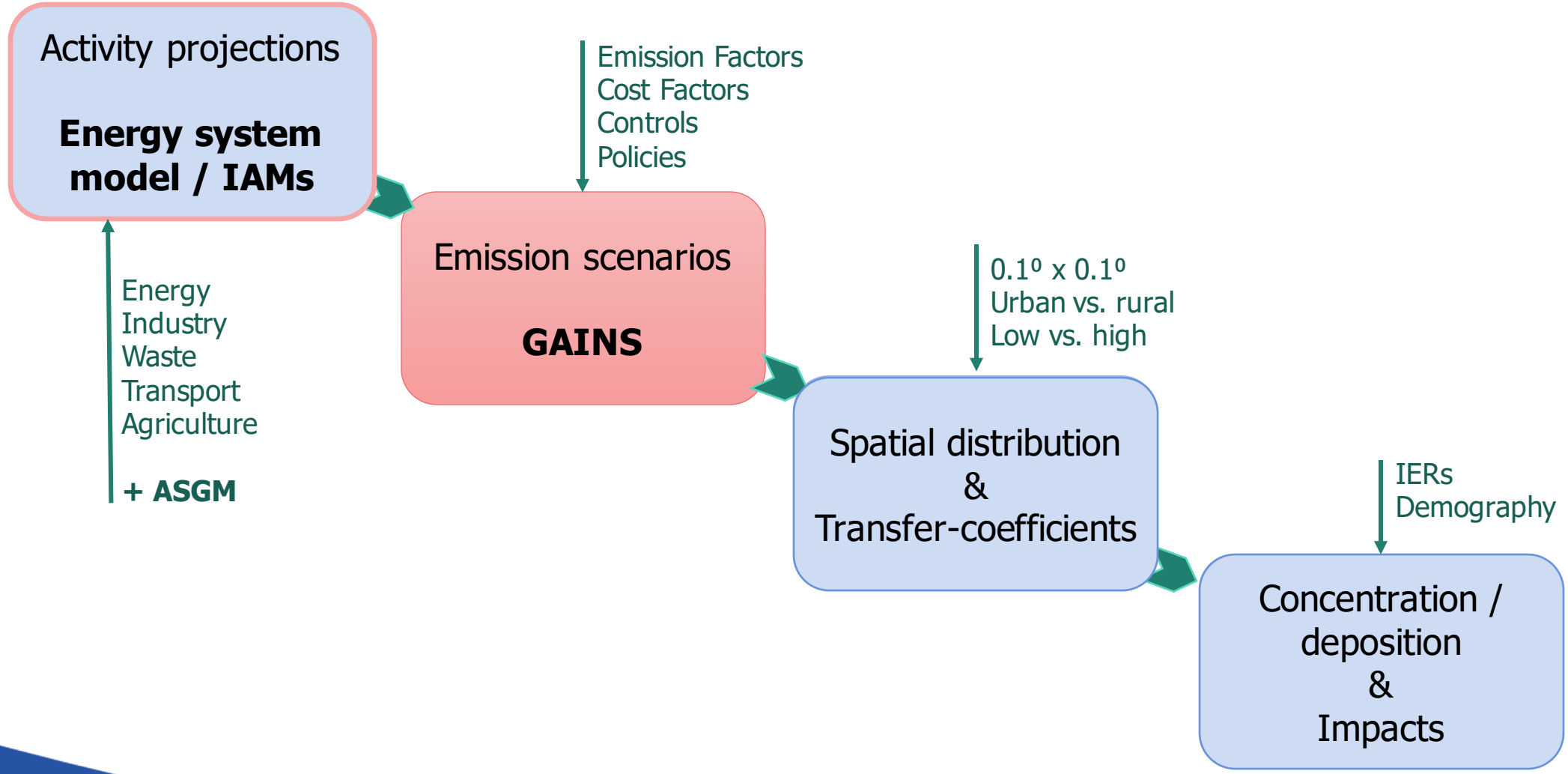
3. How will the relative importance of different emission sources change in a 1.5°C world?

→ Climate targets + CLE

4. What total Hg / Hg^0 reduction can be achieved using the currently available technologies?

→ Maximum feasible reduction (MFR)
Hg-MFR
Hg^0-MFR

Building scenarios

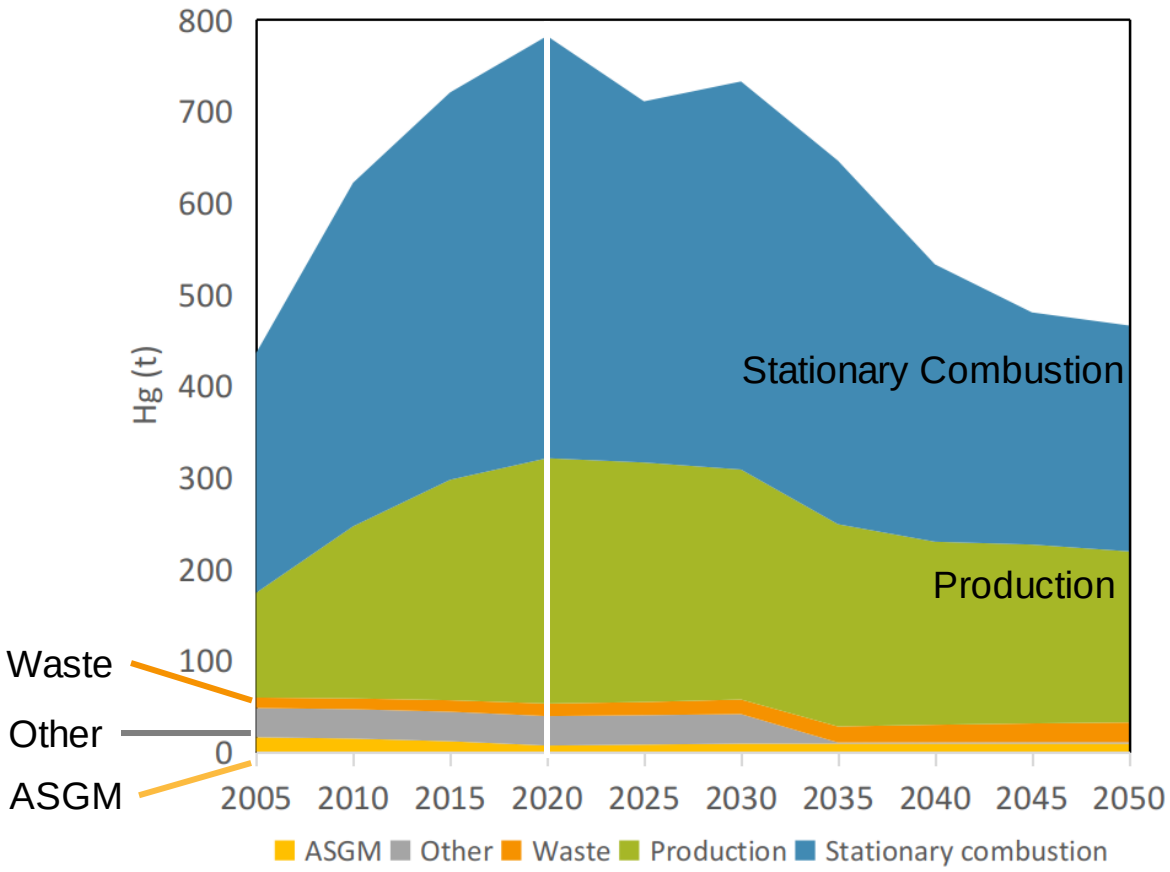


Scenarios

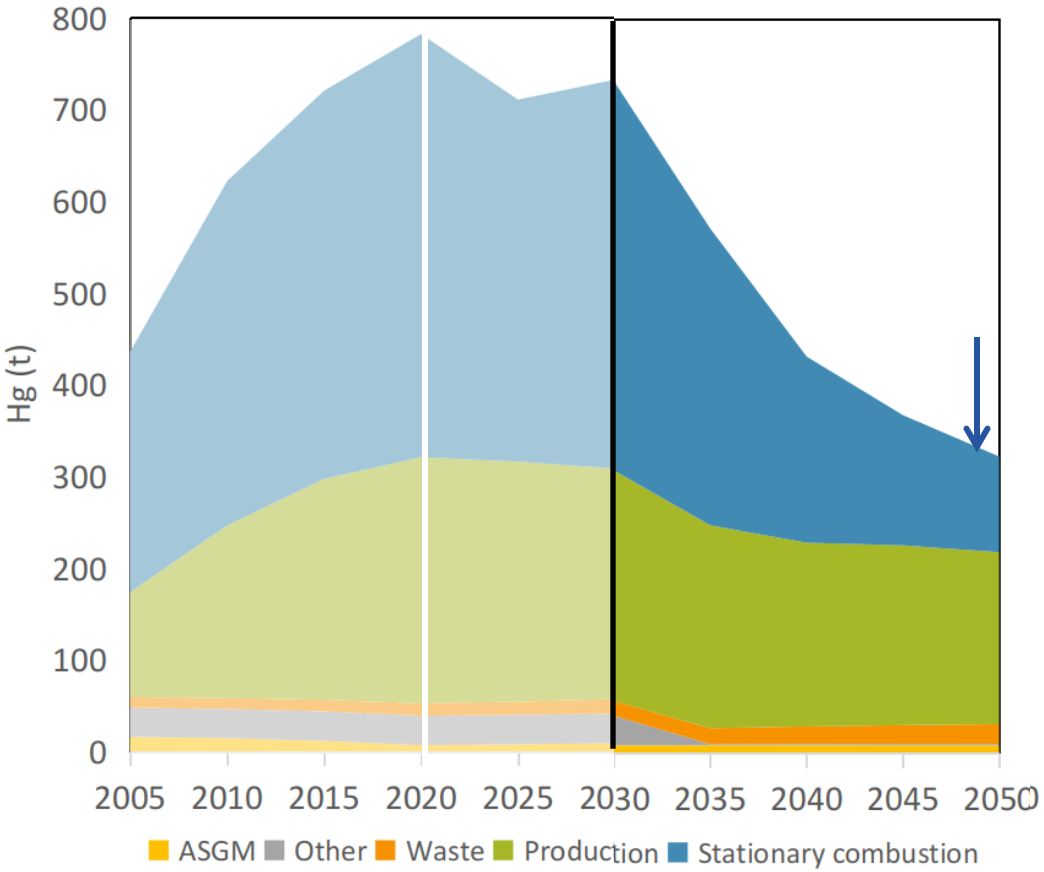
	NDC_CLE Baseline	**1.5_CLE** Climate targets + CLE	**Hg-MFR** Baseline + Hg MFR
Power plants	NOC PM+SO2	NOC PM+SO2	NOC Hg
Other combustion	PM PM+SO2	PM PM+SO2	PM PM+SO2 Hg
Production	PM BAN N/A	PM BAN Hg	Hg BAN Hg
Mining & metal production	NOC Hg PM+SO2	NOC Hg NOC	NOC Hg
Waste	NOC Hg	NOC Hg	Hg
ASGM	BAN	NOC	BAN
Others	PM NOC	PM NOC	PM NOC

Example: CHINA

Baseline, current legislation



MFR for mercury

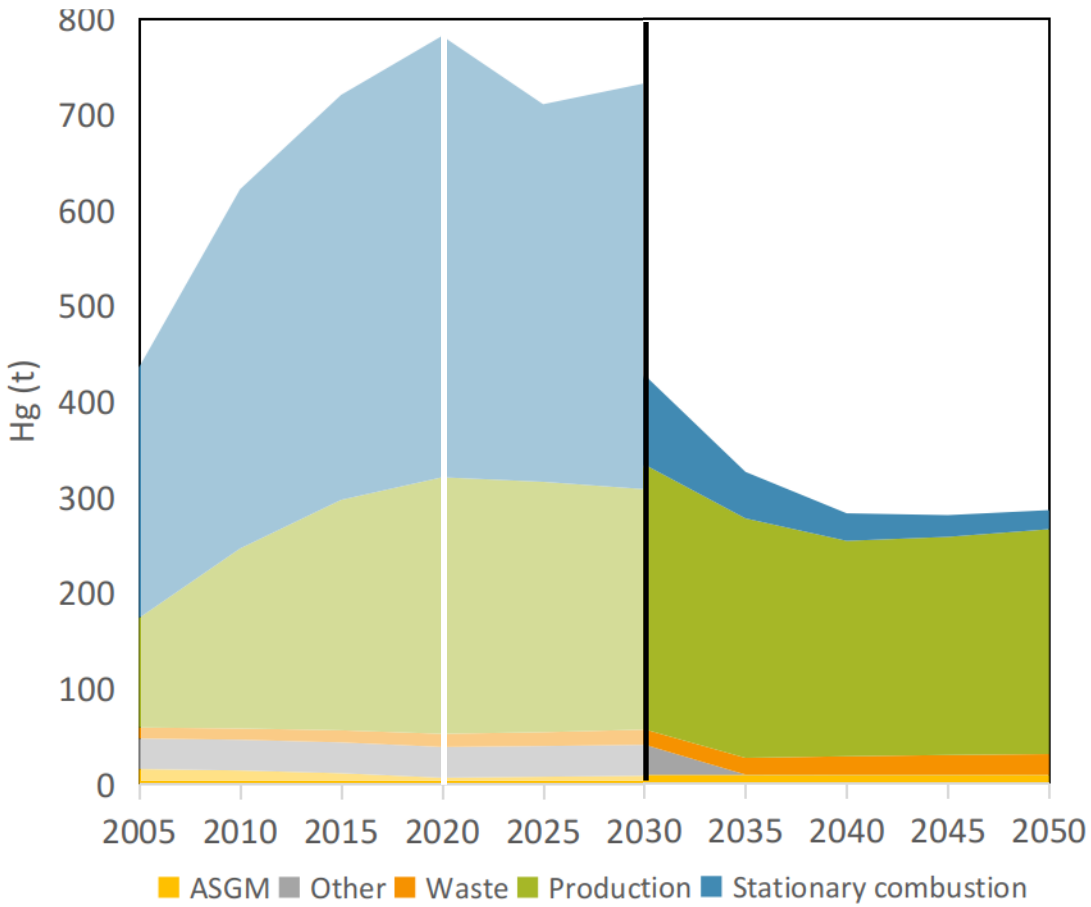


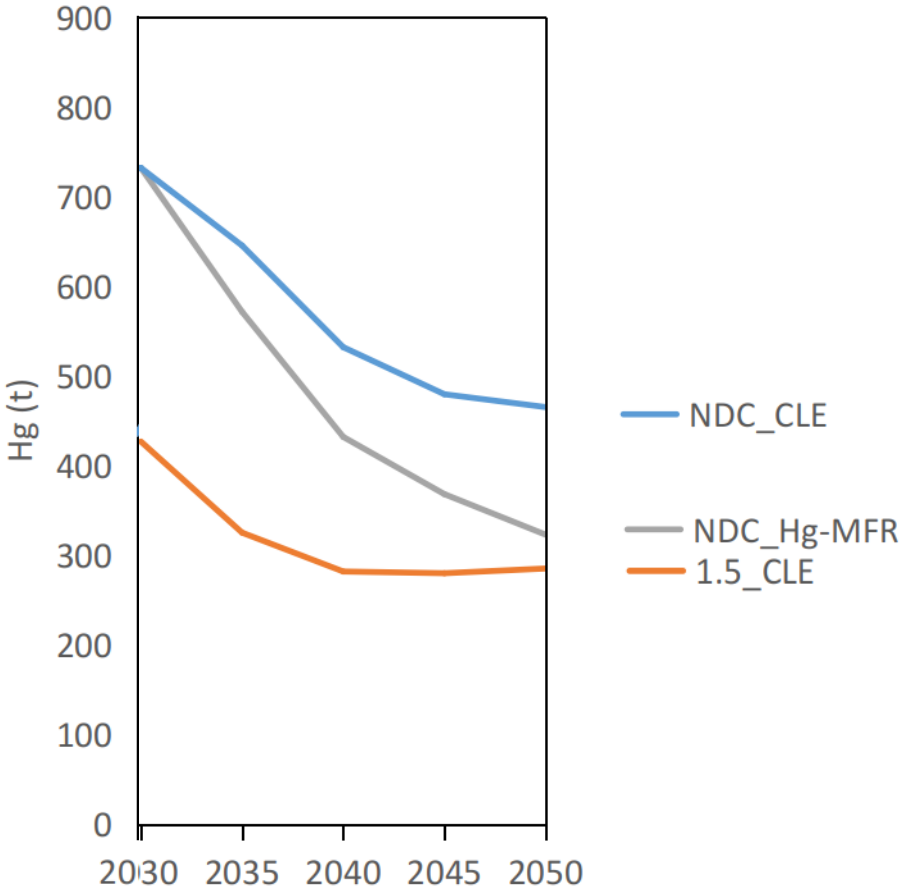
MFR ... Maximum Feasible Reduction
ASGM ... Artisanal and Small-scale Gold Mining

GAINS 3 implementation (only Hg co-benefits in stationary combustion)

Example: CHINA

Climate policy scenario, 1.5°C target, CLE





GAINS 3 implementation (only Hg co-benefits in stationary combustion)

Discussion

Quantification of co-benefits

- HG-GAINS can quantify co-benefits from PM, SO_2 and climate policy
- Large co-benefit mercury reduction can be achieved even in the baseline scenario.

Dedicated mercury control technologies

Link to Minamata

- Impacts of Best Available Technologies from different emission sources
  - through control strategy
  - through adjustment of activities, emission factors
- Maximum feasible reduction

Outlook

Open Hg-GAINS to external users (via online interface)

Implementation of cost factors

Cost-effectiveness analysis

Thank you!

https://gains.iiasa.ac.at/models/

Flora Brocza (brocza@iiasa.ac.at)
Peter Rafaj (rafaj@iiasa.ac.at)