

Modelling future mercury emission control in GAINS

An update

Flora Brocza (brocza@iiasa.ac.at)

Peter Rafaj (rafaj@iiasa.ac.at)

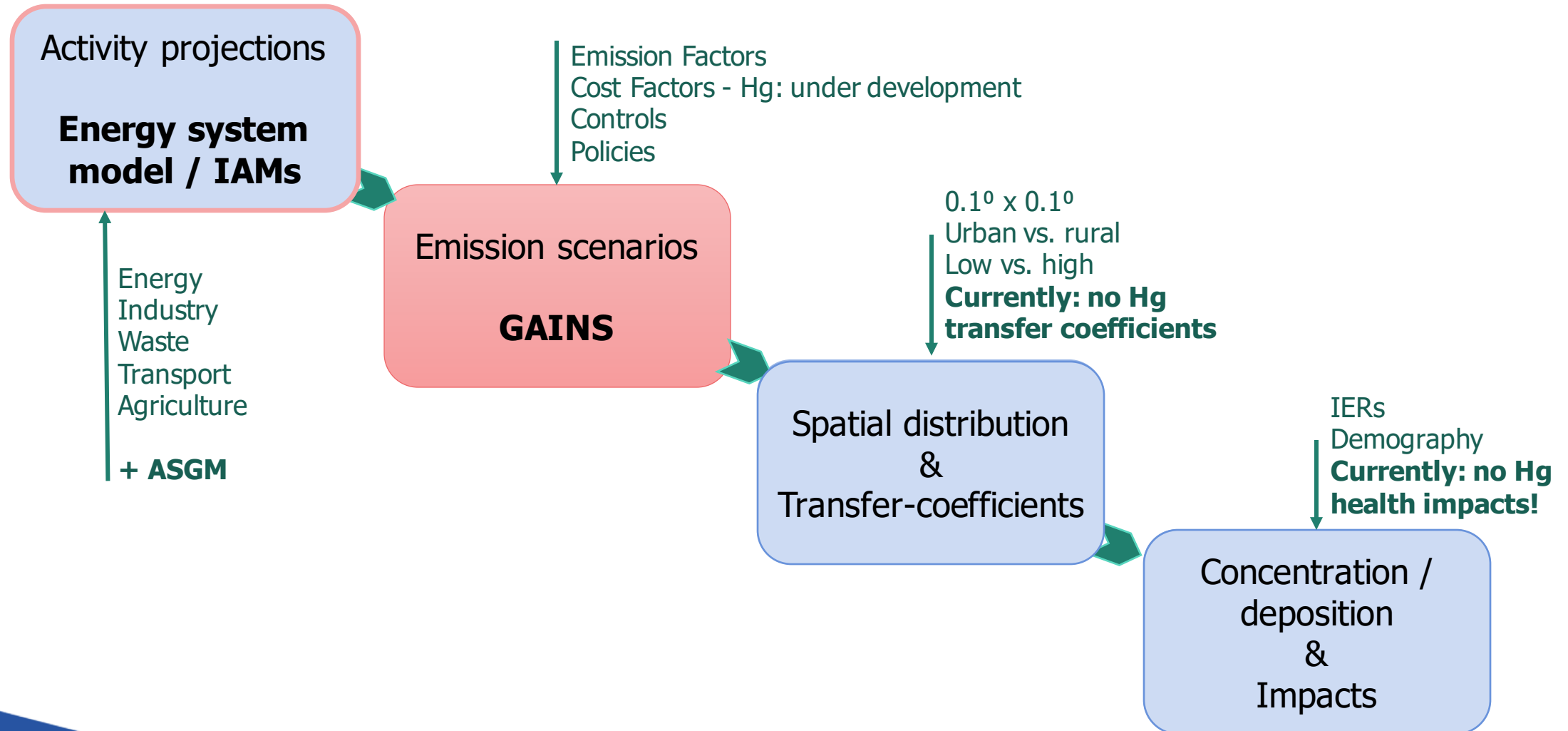
International Institute for Applied Systems Analysis (IIASA)
<http://gains.iiasa.ac.at/>

TF HTAP Workshop on Global Mercury Emissions and Modeling

18 May 2022

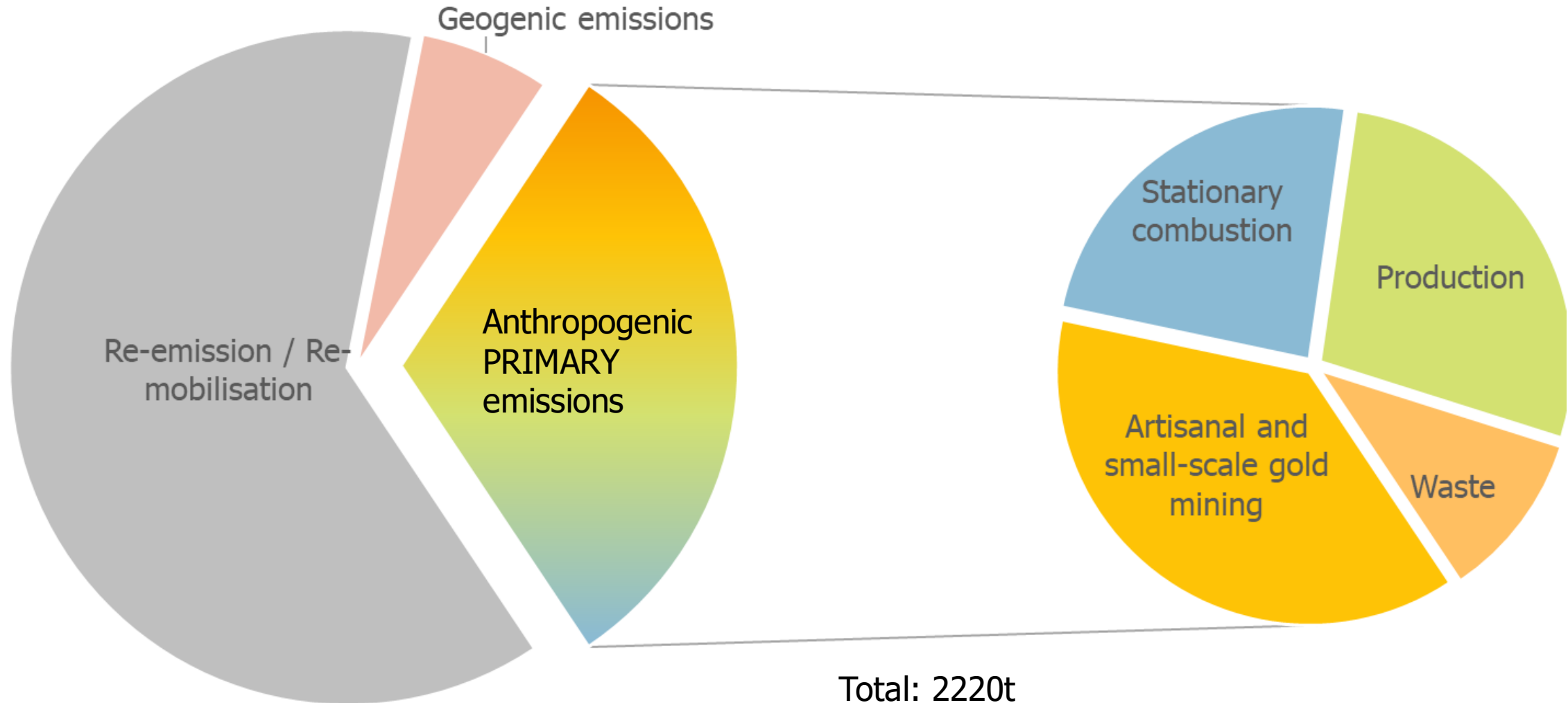


From exogenous inputs to GAINS model runs



Global annual Hg emissions to the atmosphere

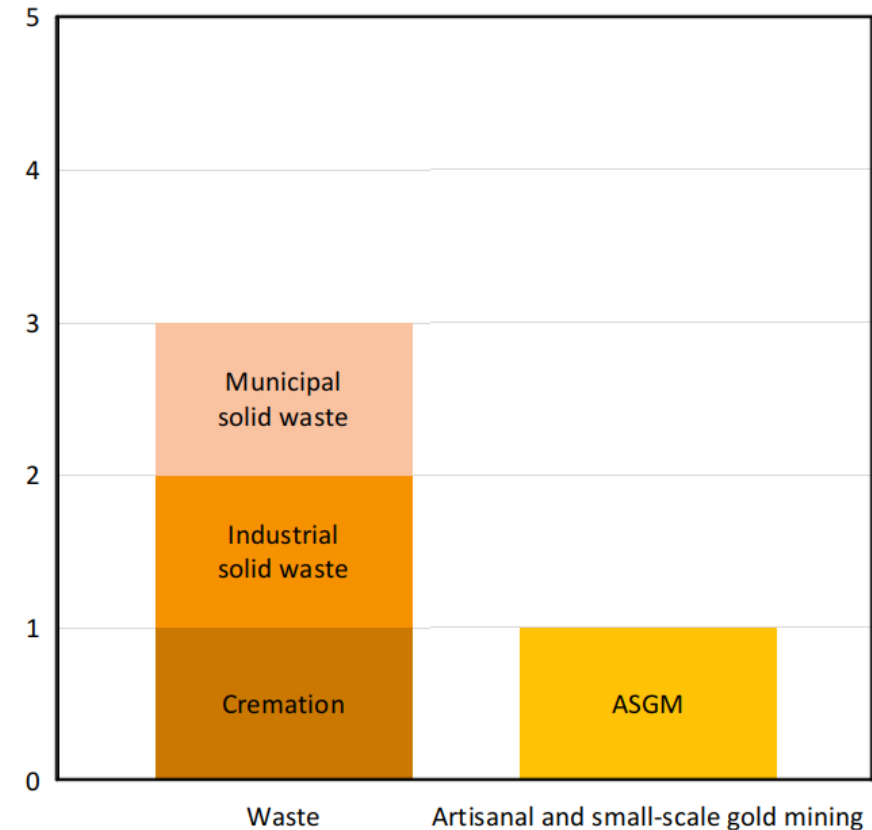
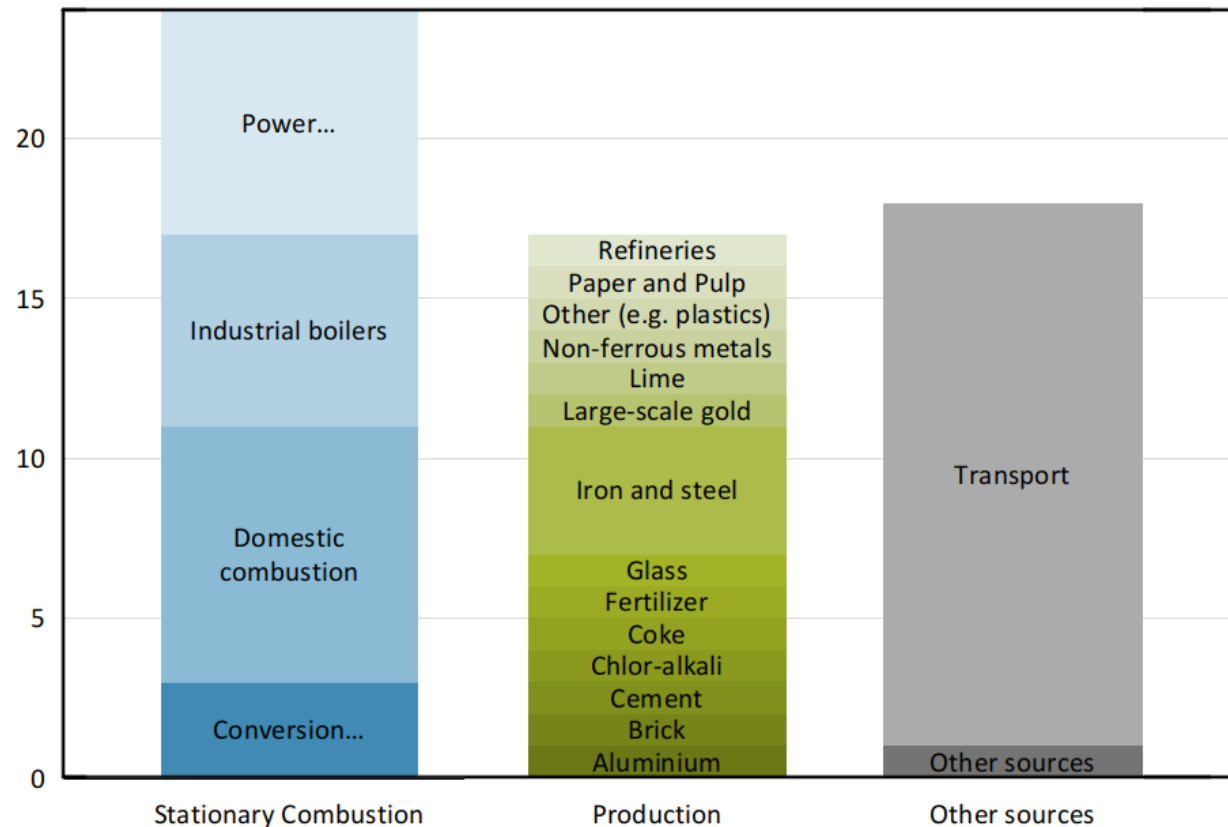
Emission sources covered in GAINS



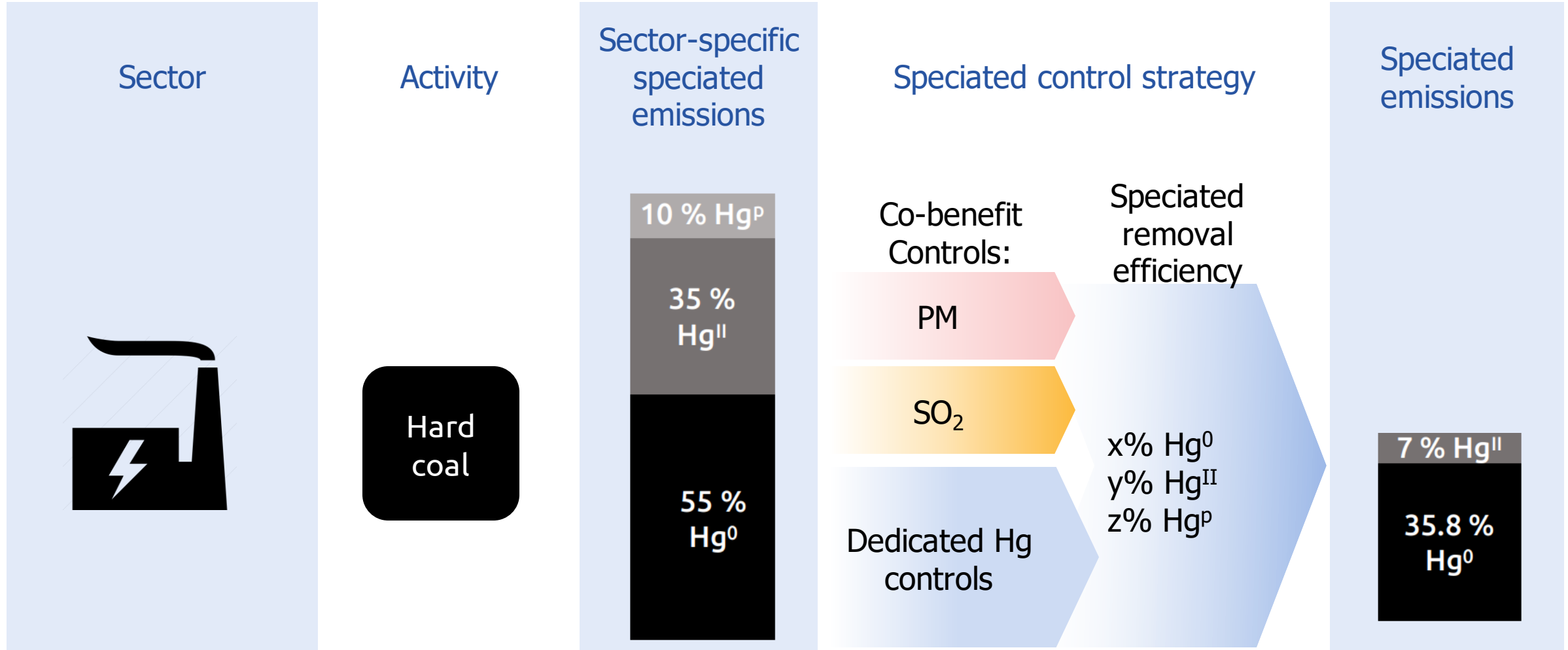
Total: 2220t
 AMAP/UNEP (2018) estimates for 2015

Sectoral resolution of mercury emissions in GAINS

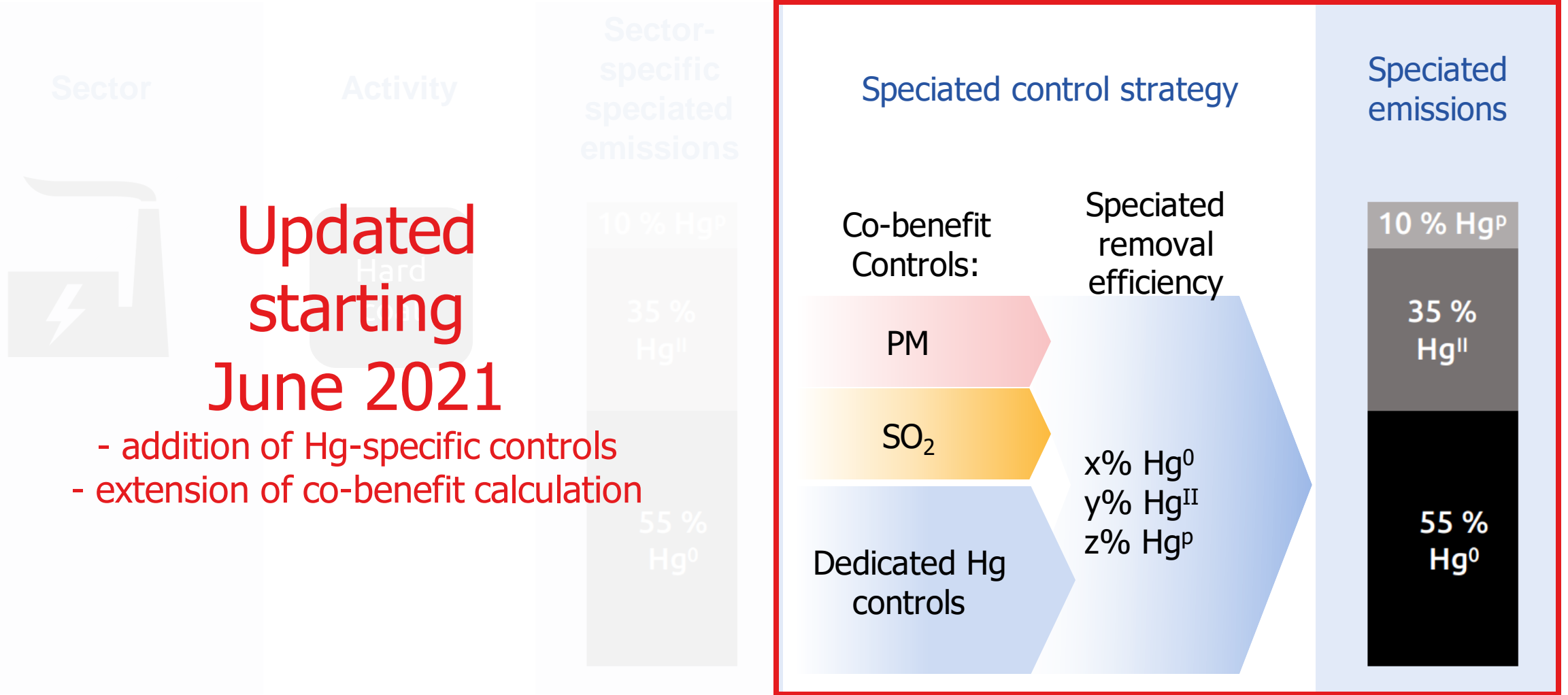
Y-axis: Number of GAINS sectors with associated Mercury emissions



Speciated Hg emissions from all emission sources



Speciated Hg emissions from all emission sources

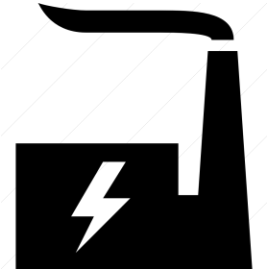


Updated starting June 2021

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

Control technologies: Power sector, industrial boilers

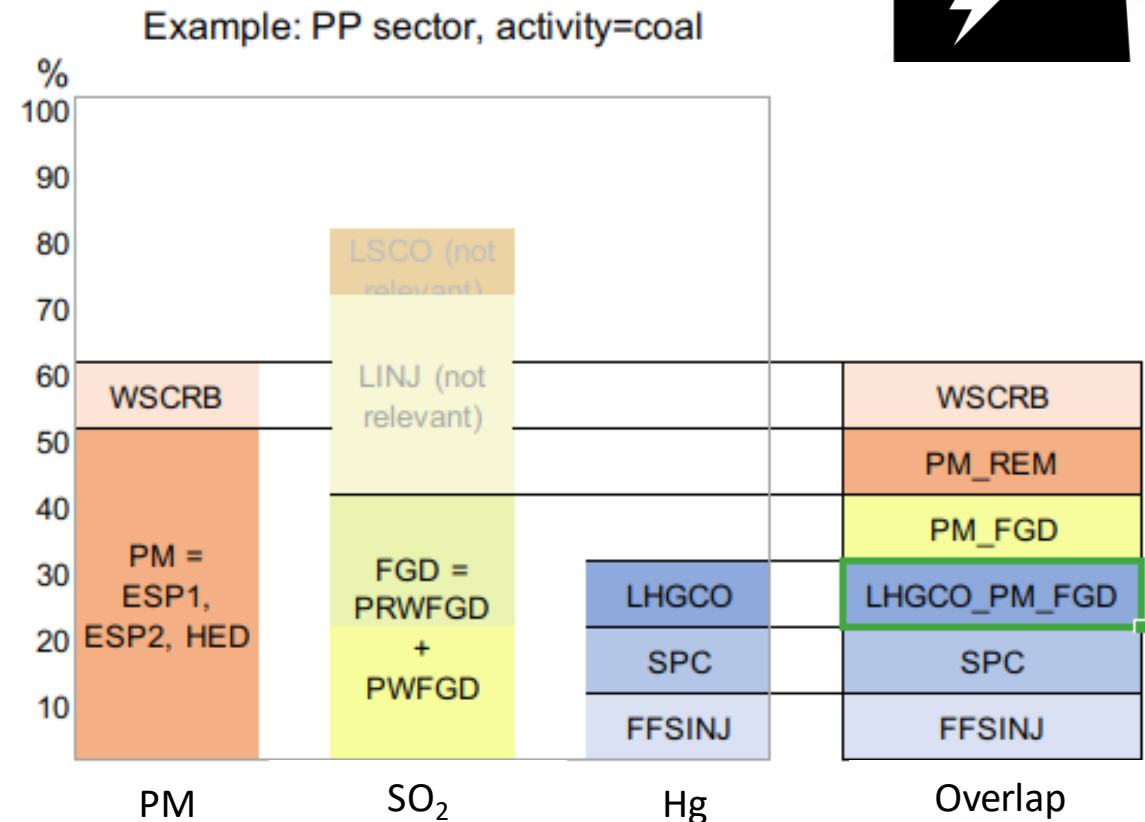
Co-benefit between PM, SO₂, Hg controls considered through calculation of “overlaps”



- PM and SO₂ controls clustered based on mercury removal efficiency
 - Dedicated mercury (...combined with PM + SO₂) controls
 - PM + SO₂ 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”

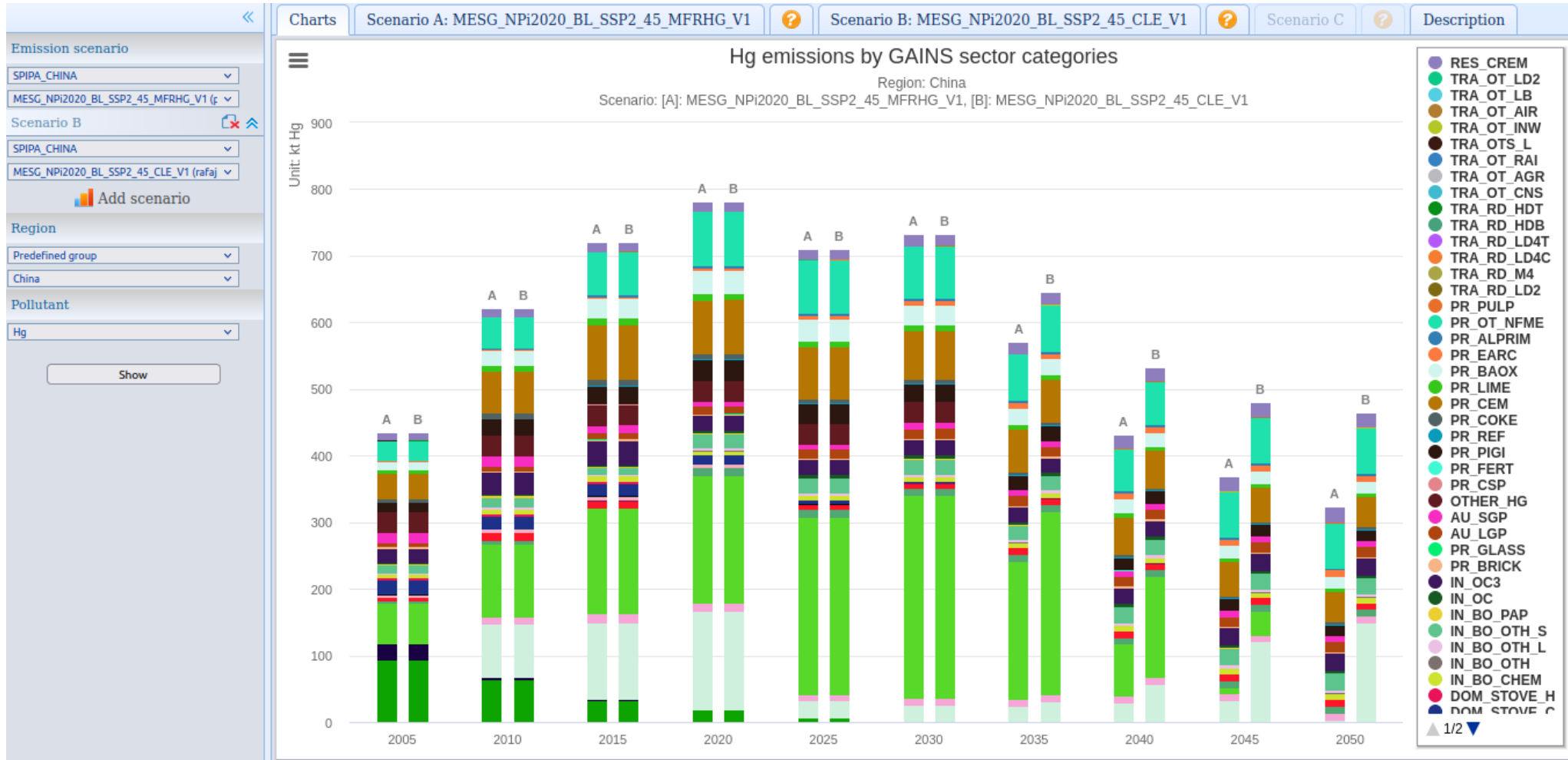
Solid waste (Industrial, municipal)

- Landfill cover
- Landfill compaction
- Waste to energy



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GAINS sectoral resolution

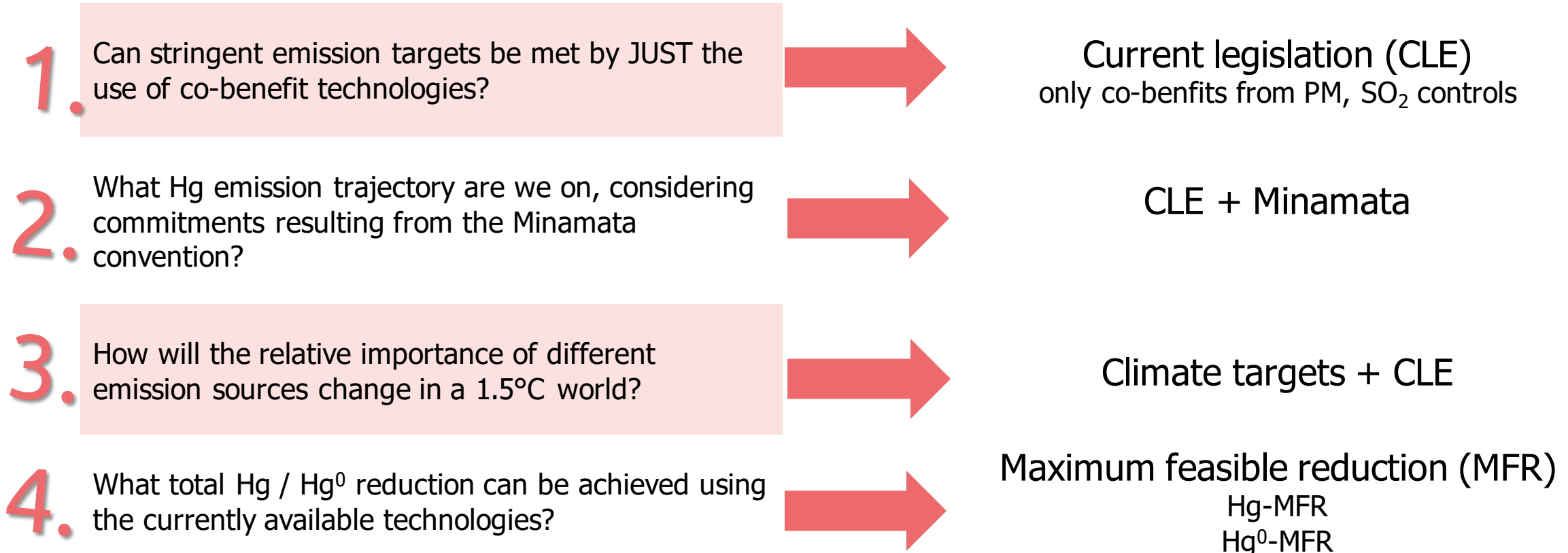


Current legislation - Minamata Convention

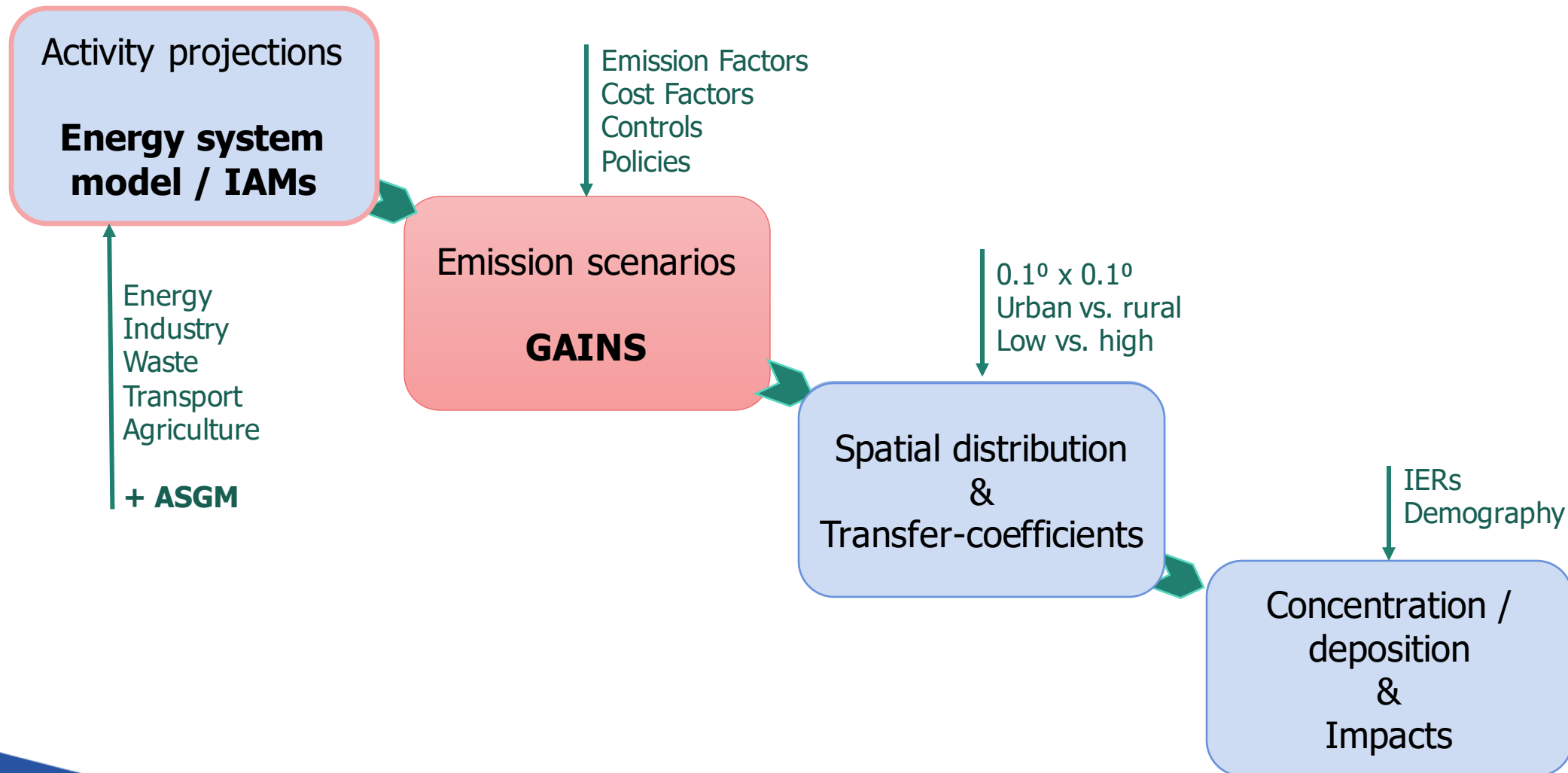
	Targets	BAT	Comment	GAINS implementation	
Supply, Sources & Trade	2032 (mining)		import/export bans	indirect via ACT/EF	WASTE, PR, AU
Hg-added products	reduce by 2020			indirect via ACT/EF	PR
Manufacturing processes with Hg (compound) use	-50% by 2020; Bans: acetaldehyde 2018, chlor-alkali 2025	x	Hg-catalysts	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 explicitly quantified	OTHER_HG
Waste		x	Basel Convention	Control strategy	WASTE
Contaminated Sites		x		not explicitly quantified	OTHER_HG

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

Policy-relevant questions



Building scenarios

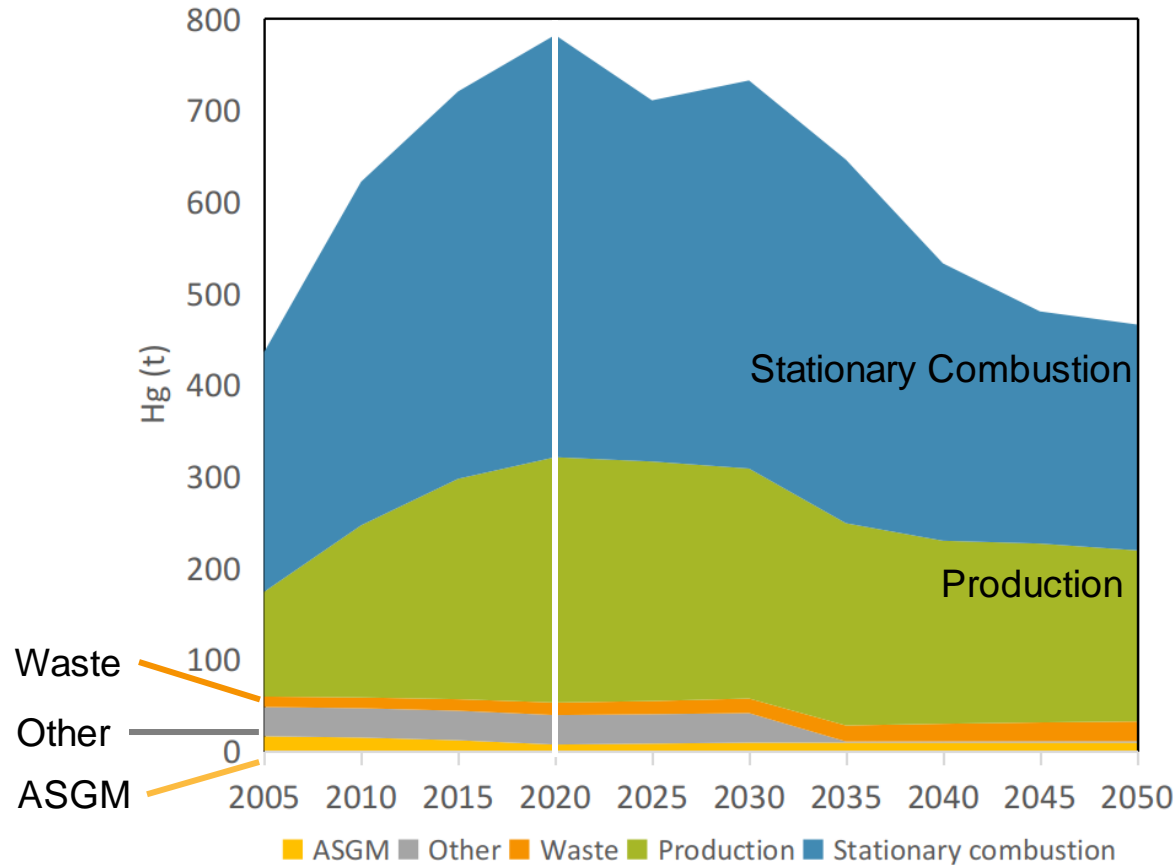


Scenarios

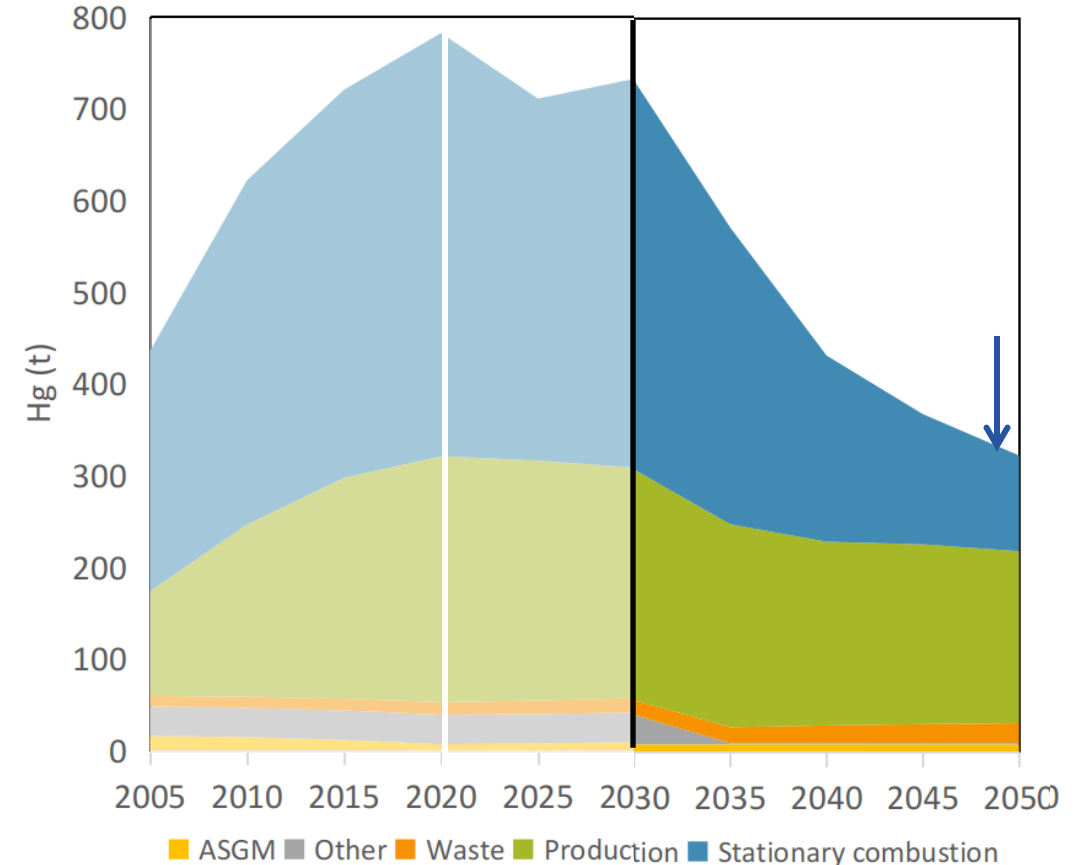
	NDC_CLE Baseline	1.5_CLE Climate targets + CLE	Hg-MFR Baseline + Hg MFR
Power plants	NOC	NOC	NOC
	PM+SO2	PM+SO2	Hg
Other combustion	PM	PM	PM
	PM+SO2	PM+SO2	PM+SO2
			Hg
Production	PM	PM	Hg
	BAN	BAN	BAN
	N/A	Hg	Hg
Mining & metal production	NOC	NOC	NOC
	Hg	Hg	Hg
	PM+SO2	NOC	
Waste	NOC	NOC	Hg
	Hg	Hg	
ASGM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

Example: CHINA

Baseline, current legislation



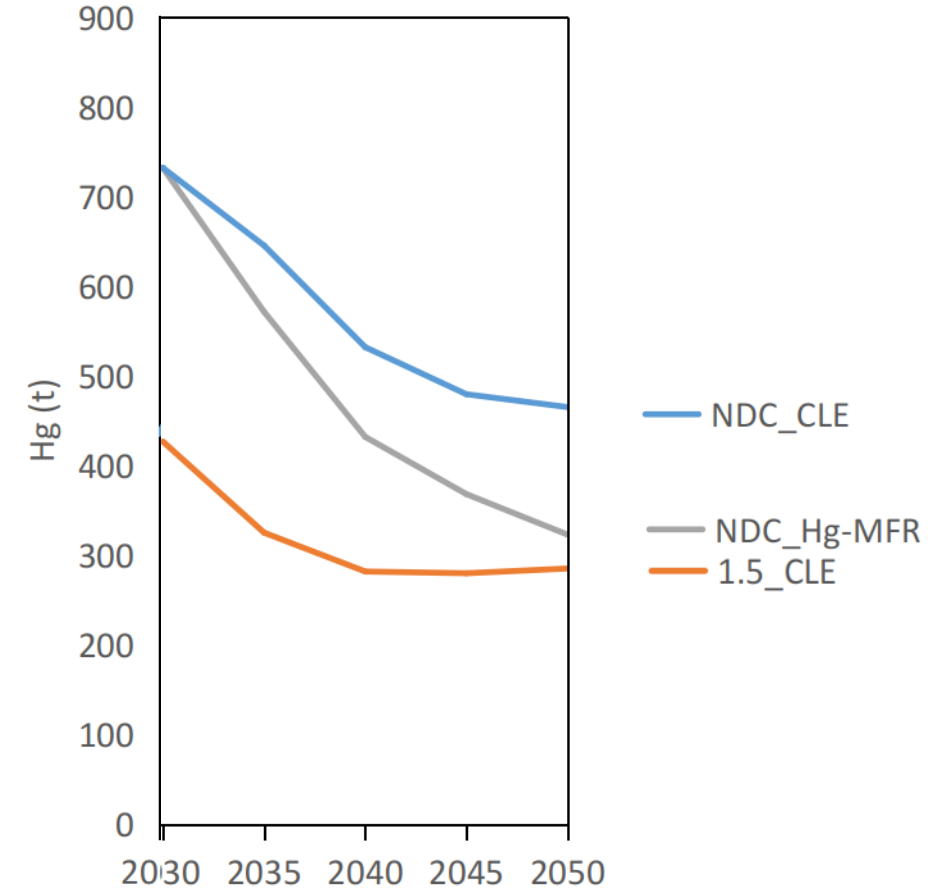
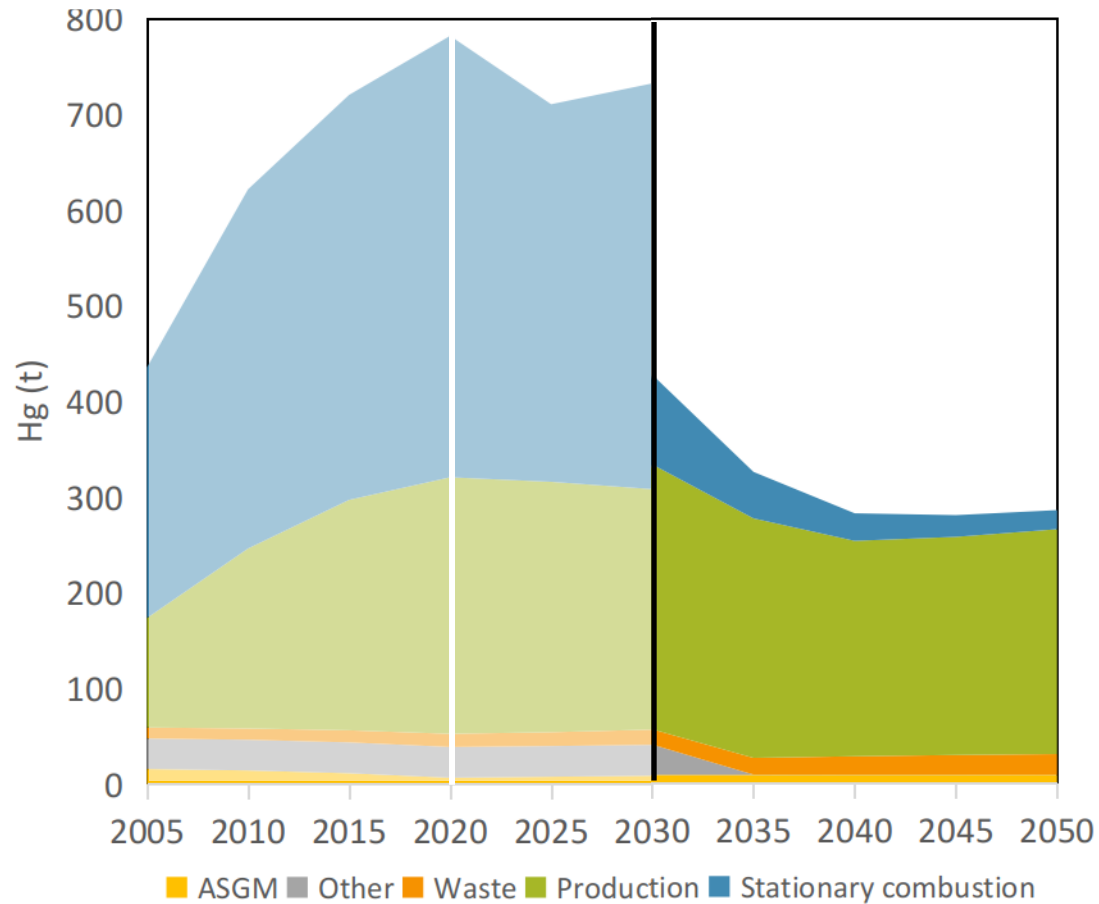
MFR for mercury



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

Example: CHINA

Climate policy scenario, 1.5°C target, CLE



Discussion

Quantification of co-benefits

- HG-GAINS can quantify co-benefits from PM, SO₂ 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!

<http://gains.iiasa.ac.at/>

Flora Brocza (brocza@iiasa.ac.at)

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Additional slides

Control technologies: Power sector, industrial boilers

		No effect on Hg removal efficiency			Relevant SO2 controls			
		NOC	LSCO	LINJ	PRWFGD	PWFGD	RFGD	IFGD
PM controls	NOC							
	CYC	CYC_REM						
	WSCRБ	WSCRБ_REM						
	ESP1	PM_REM			PM_FGD			
	ESP2							
	HED							

		Co-benefit controls (PM, SO2)				
		NOC PM, SO2	CYC	WSCRБ	PM_REM	PM_FGD
Hg controls	FFSINJ	FFSINJ				
	PMSINJ		PMSINJ			
	SPC	SPC				
	LHGCO	LHGCO_REM	LHGCO_PM			LHGCO_PM_FGD

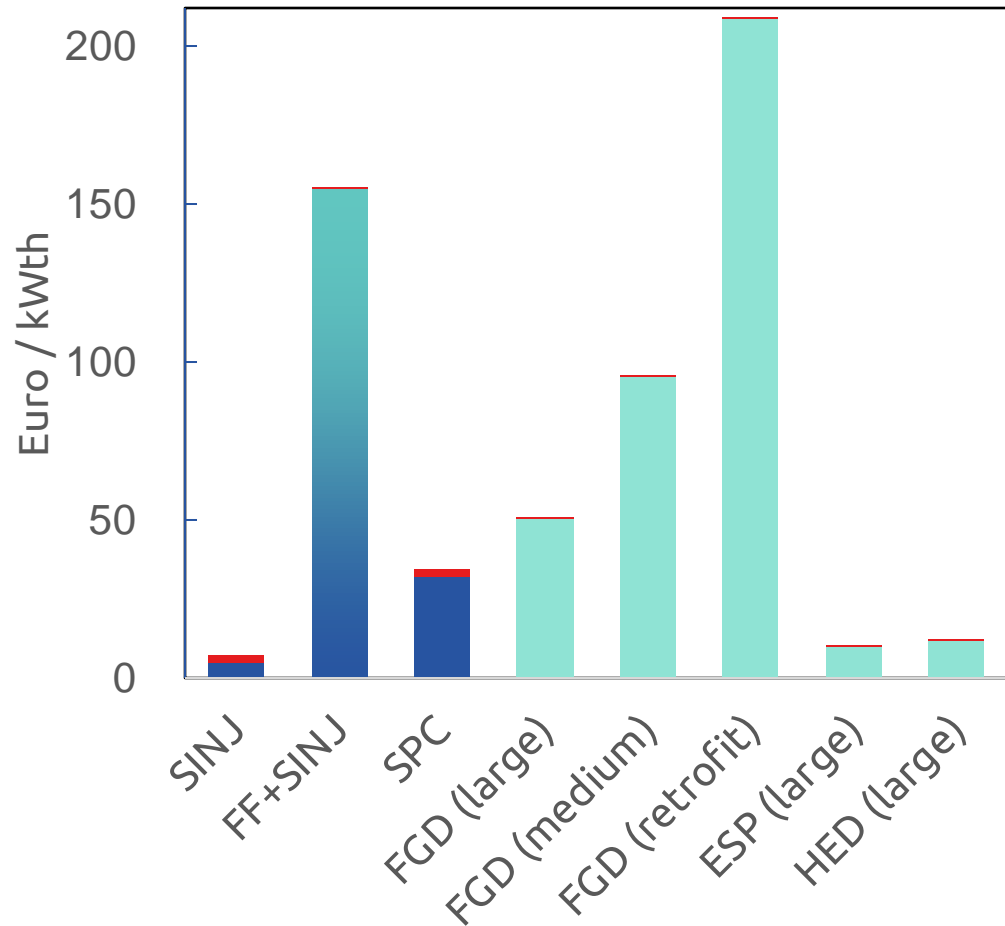
Control technologies: Non-ferrous metal production (including large-scale gold)

PR_OT_N FME, AU		SO2 controls			
		NOC	SO2PR1	SO2PR2	SO2PR3
PM controls	NOC				AP
	CYC	CYC_REM			
	ESP1	PM_REM		PM_FGD	
	ESP2				
	HED				

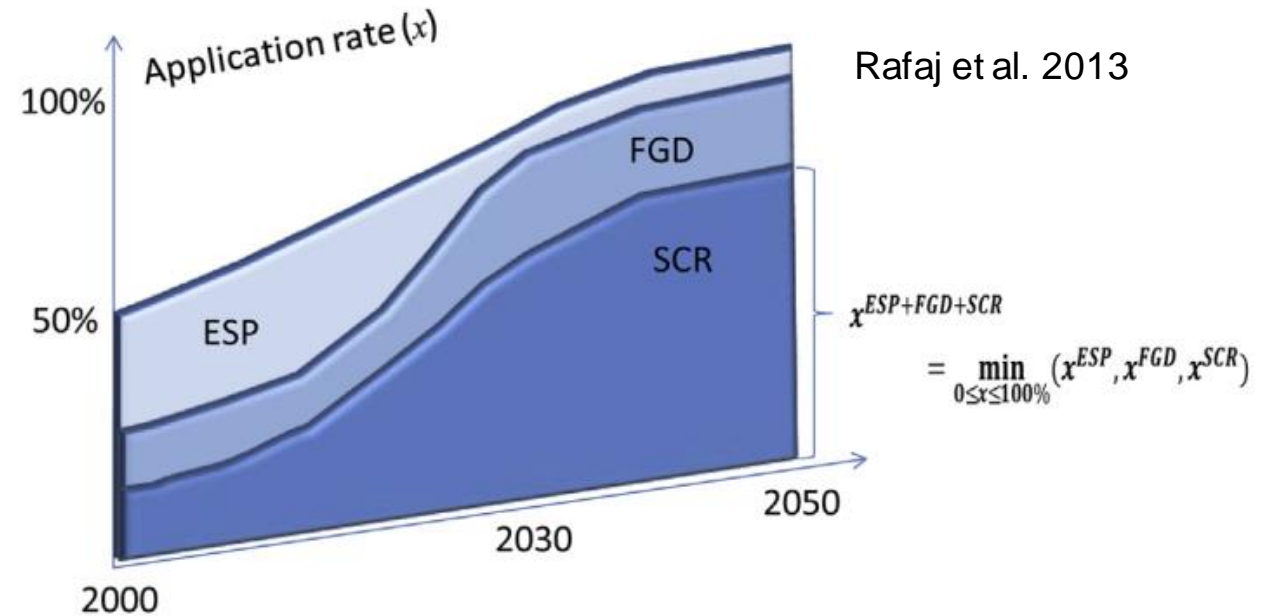
		Co-benefit controls (PM, SO2)				
		NOC PM, SO2	CYC	PM_REM	PM_FGD	AP
Hg controls	FFSINJ	FFSINJ				AP
	PMSINJ		PMSINJ			
	SPC	SPC				

Hg abatement Cost

- O&M costs (Eur/kW/yr)
- Investment costs (Eur/kW)



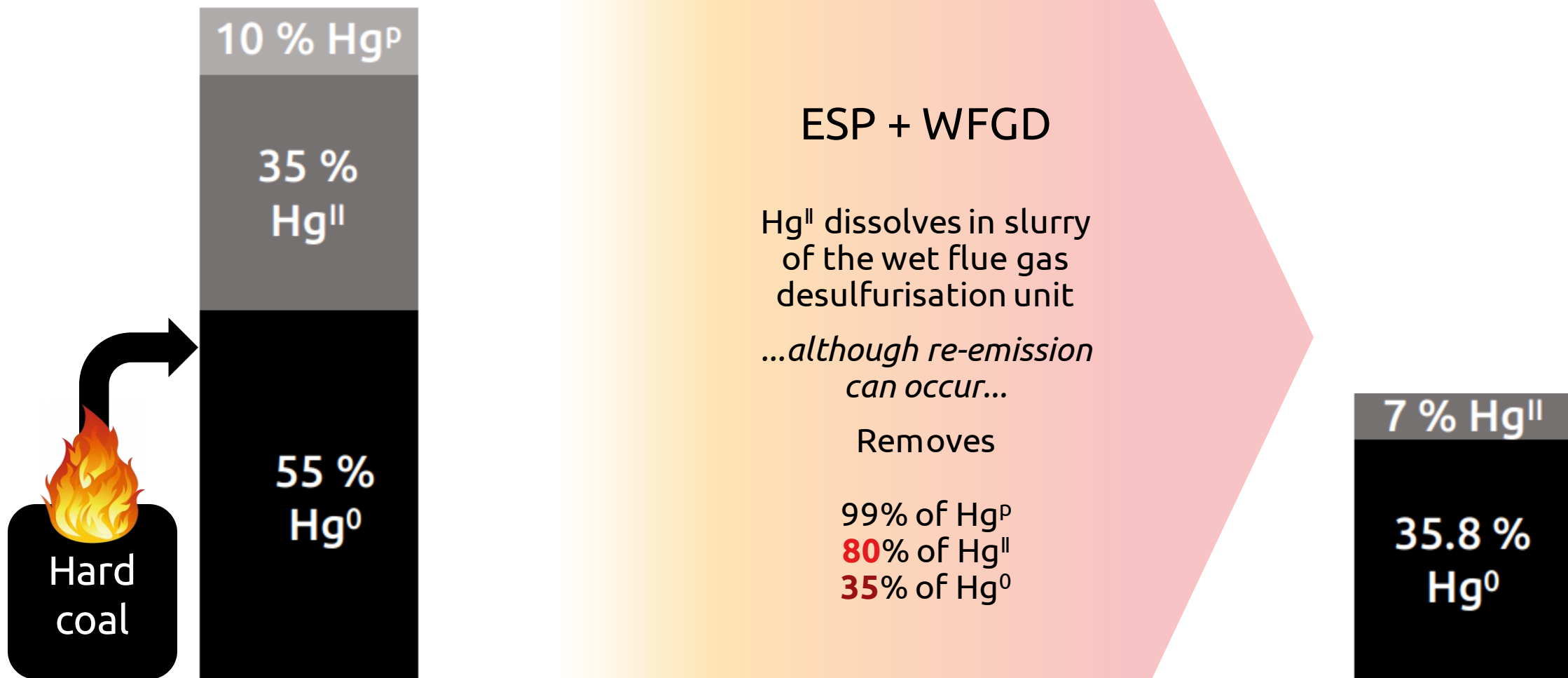
Co-benefit calculations from overlap of PM, SO₂ and Hg technologies in GAINS



SINJ... sorbent injection, FF ... fabric filter, FSPC ... stationary sorbent polymer units, FGD ... flue gas desulfurization, ESP... electrostatic precipitator, HED ... high efficiency deduster

Example 1: Co-benefit from PM and SO₂ control

Fuel = Hard coal 1, sector = existing power plant >50MW



Example 2: Sorbent Injection + Fabric Filter

Fuel = Hard coal 1, sector = existing power plant >50MW

