Mercury Legacy: Use, Trade, and Anthropogenic Emission

Kenichi Nakajima
National Institute for Environmental Studies, Japan

Triple Planetary Crisis

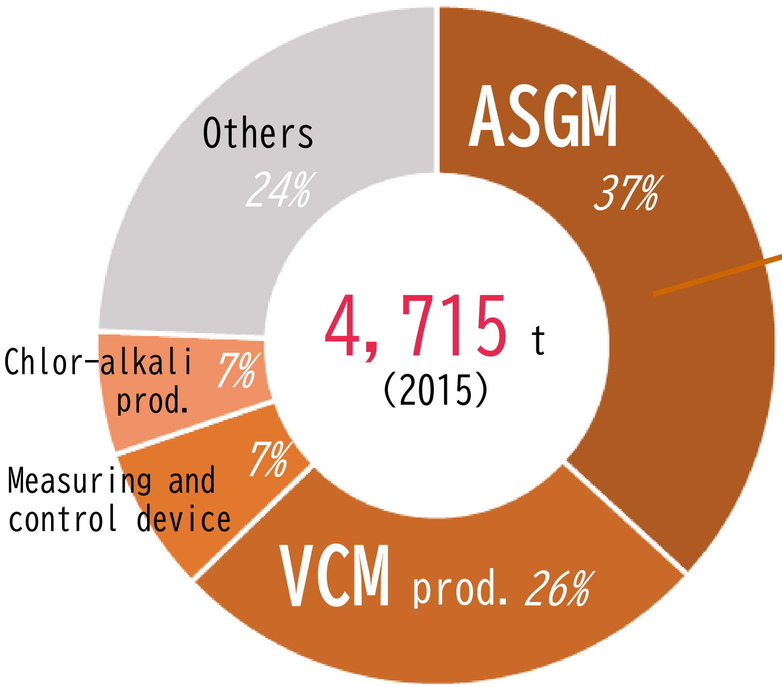
Climate change

Nature and Biodiversity loss

Pollution

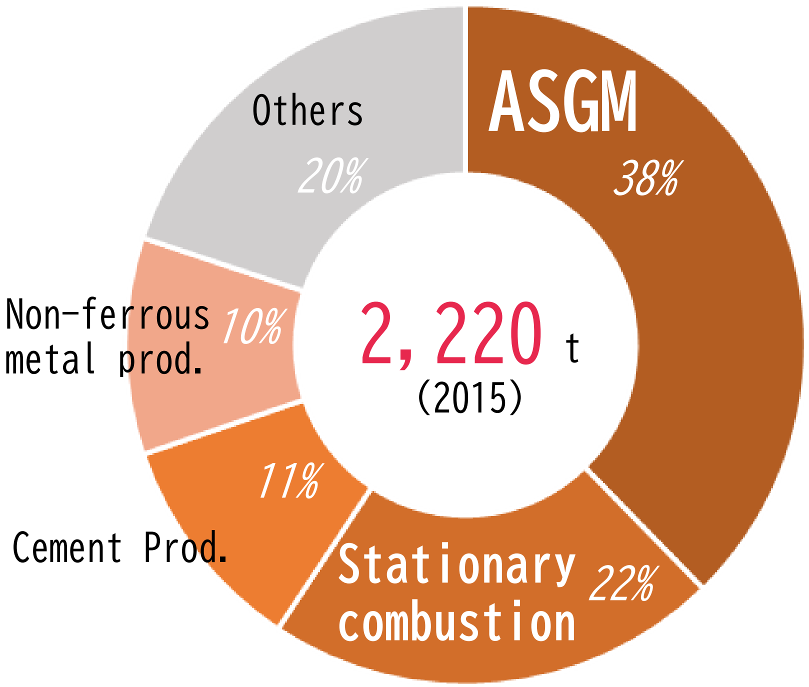
Mercury： Consumption and Emission

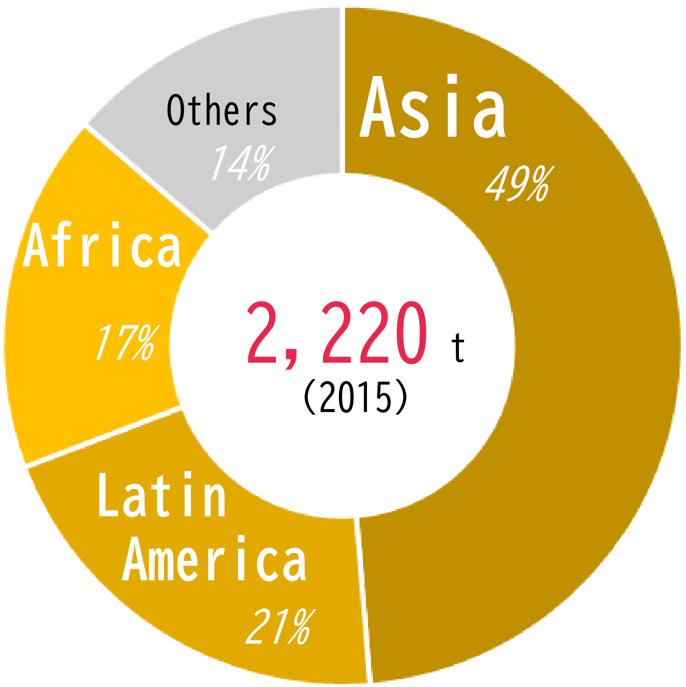
Consumption



UNEP(2017) Global mercury supply, trade and demand

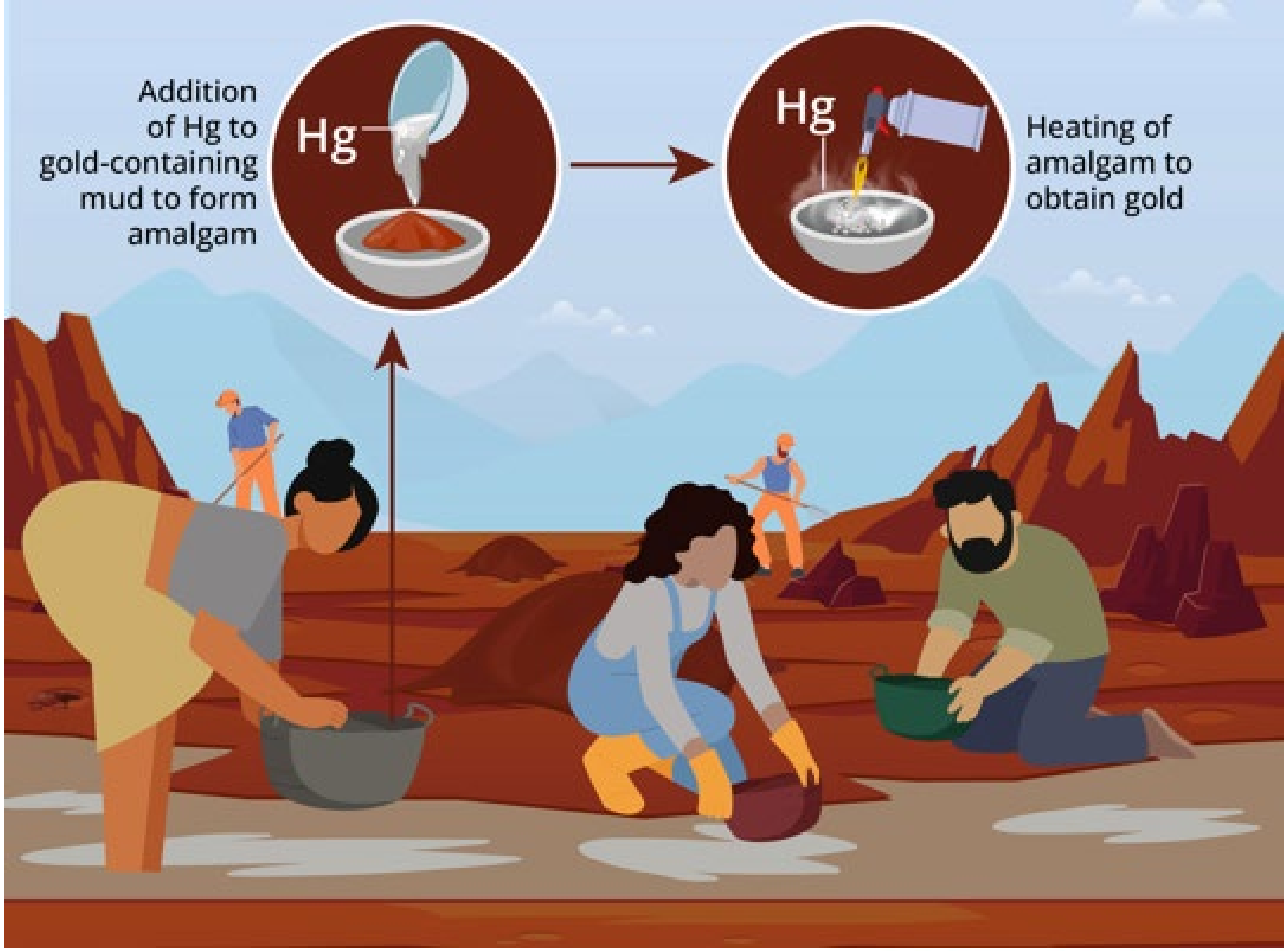
Emission





UNEP(2019) Global mercury assessment 2018

ASGM activities and mercury pollution



Mercury Emission Scenario

Mercury emission scenarios

Global actions for a healthy planet:

Climate change convention

Minamata conventions on mercury, etc.

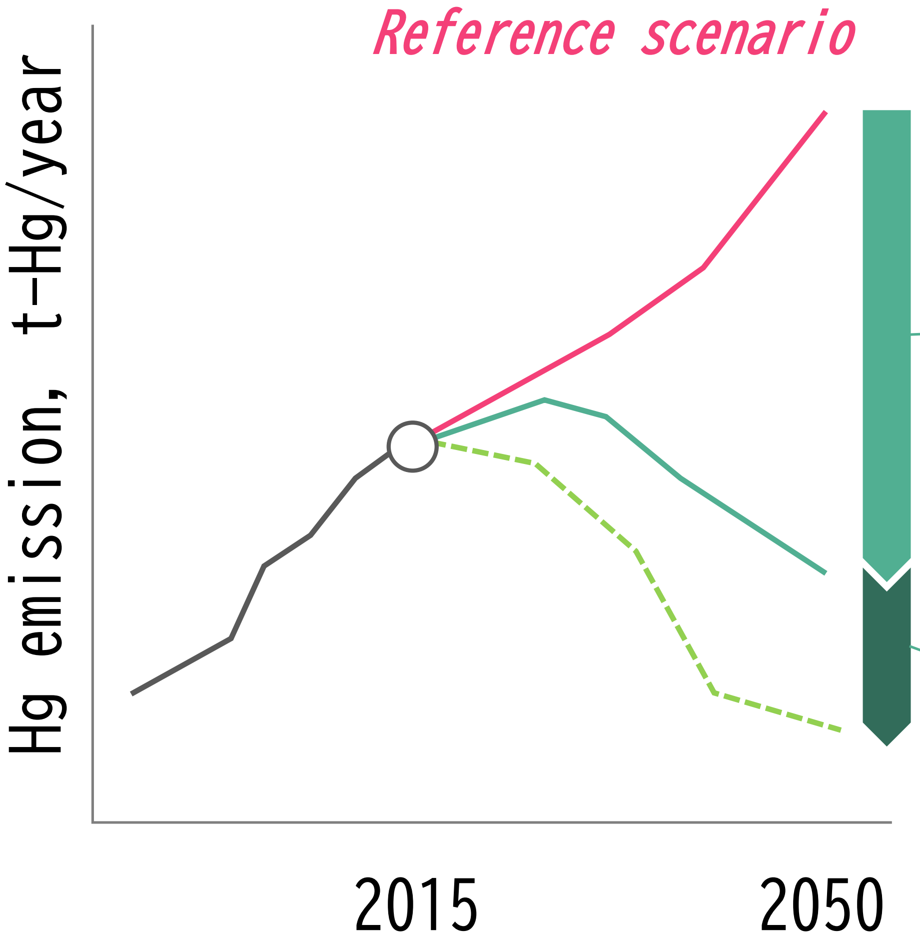
Growth in mercury emission sources

ASGM, Combustion, Cement, Mining & smelting, etc.

Zhang 2021, Global health effects of future atmospheric mercury emissions, *Nat Commun* 12, 3035

	Streets 2017	Li 2017	Rafaj 2013	Streets 2009	Pacyna 2010
Sector	Major sectors	Mining	Major sectors	Stationary Combustion ・Mining	Major sectors
Region	Global/ 7 regions	Global/ 186 nations	Global/ 8 regions	Global/ 17 regions	Global/ 7 regions
Year	1850-2010	2010	2000-2050	1996, 2006, 2050	2005, 2020
Mitigation	-	-	Climate change (POLES)	Climate change (SRES)	Mercury (LRTAP)

Scenarios in SII-6 projects



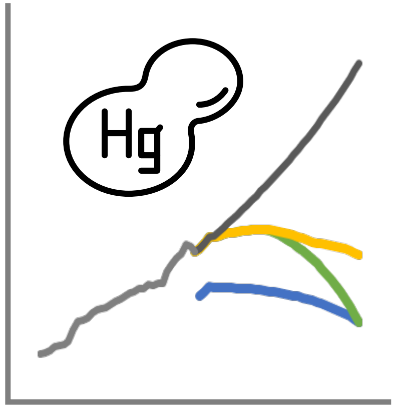
Mitigation scenario

Mercury mitigation (3 types)

a-1. Step-wise reduction(EPS)
/interview-based reduction

a-2. 2050 Max-reduction(EPM)

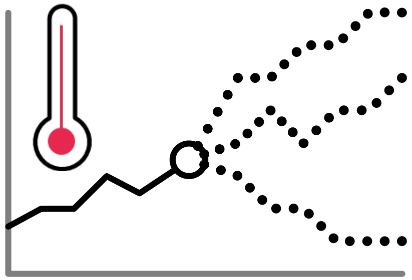
a-3. Ultimate reduction(EPU)
(2020 Max-reduction)



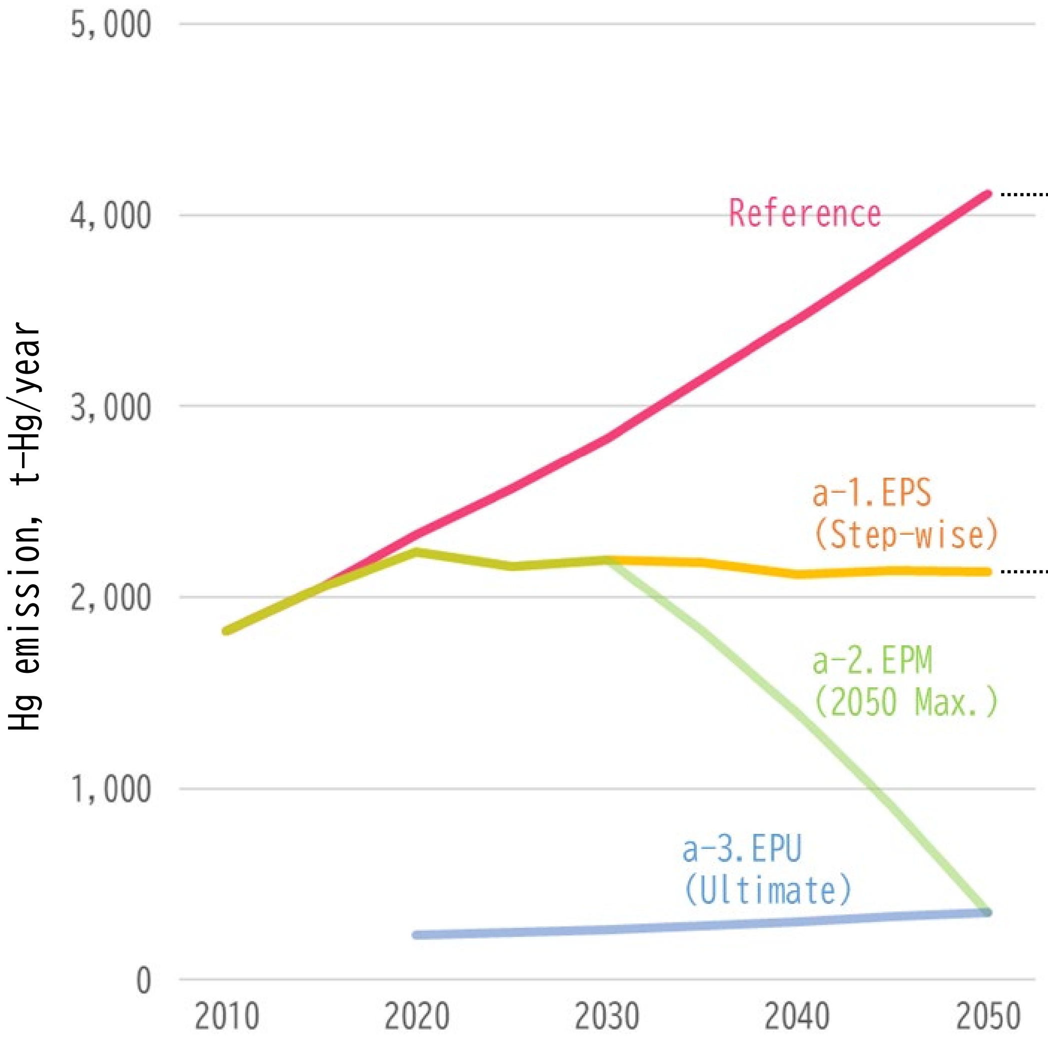
Decarbonization (2 types)

b-1. 2-degree goal(2D)

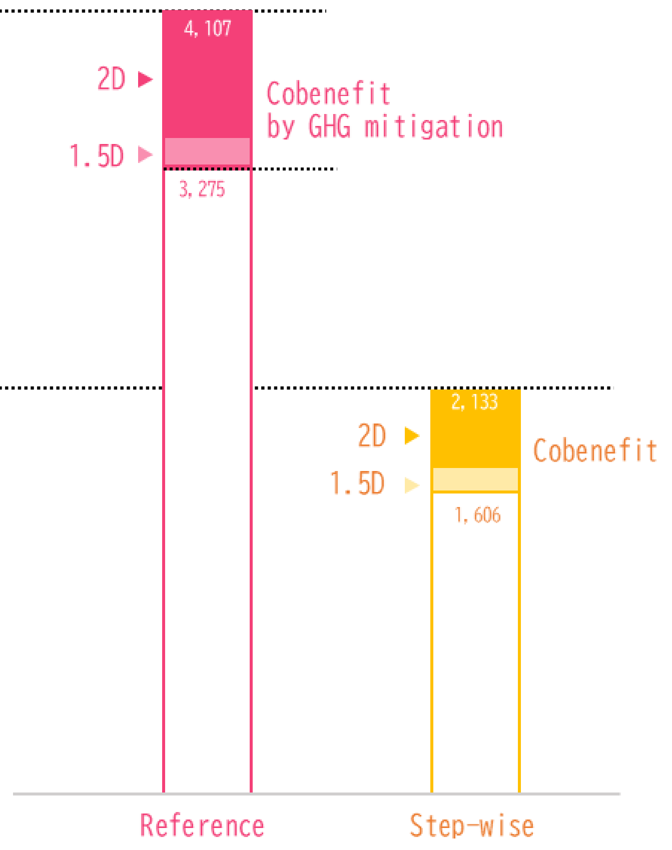
b-2. 1.5-degree goal(1.5D)



[Summary] Mitigation effects: Hg mitigation & GHG mitigation

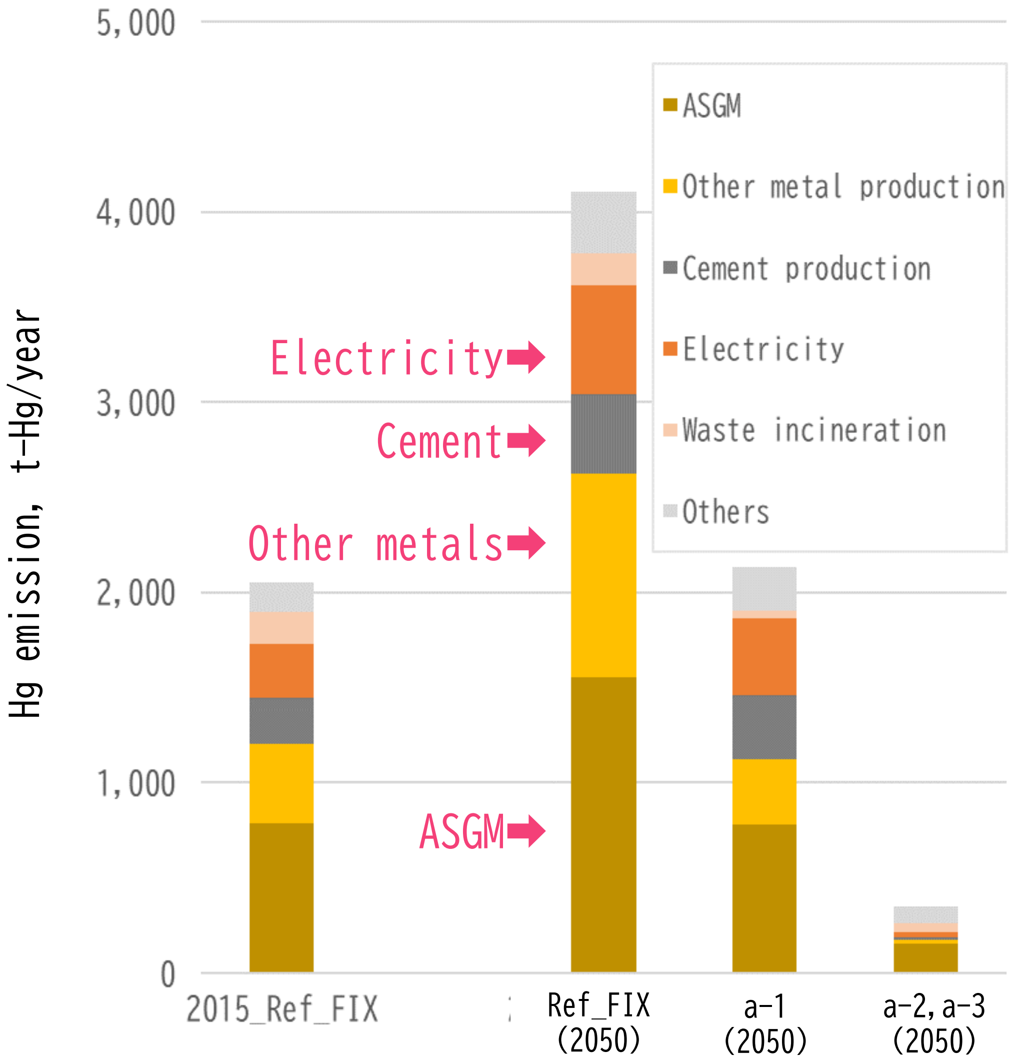


i. Mercury mitigation effects

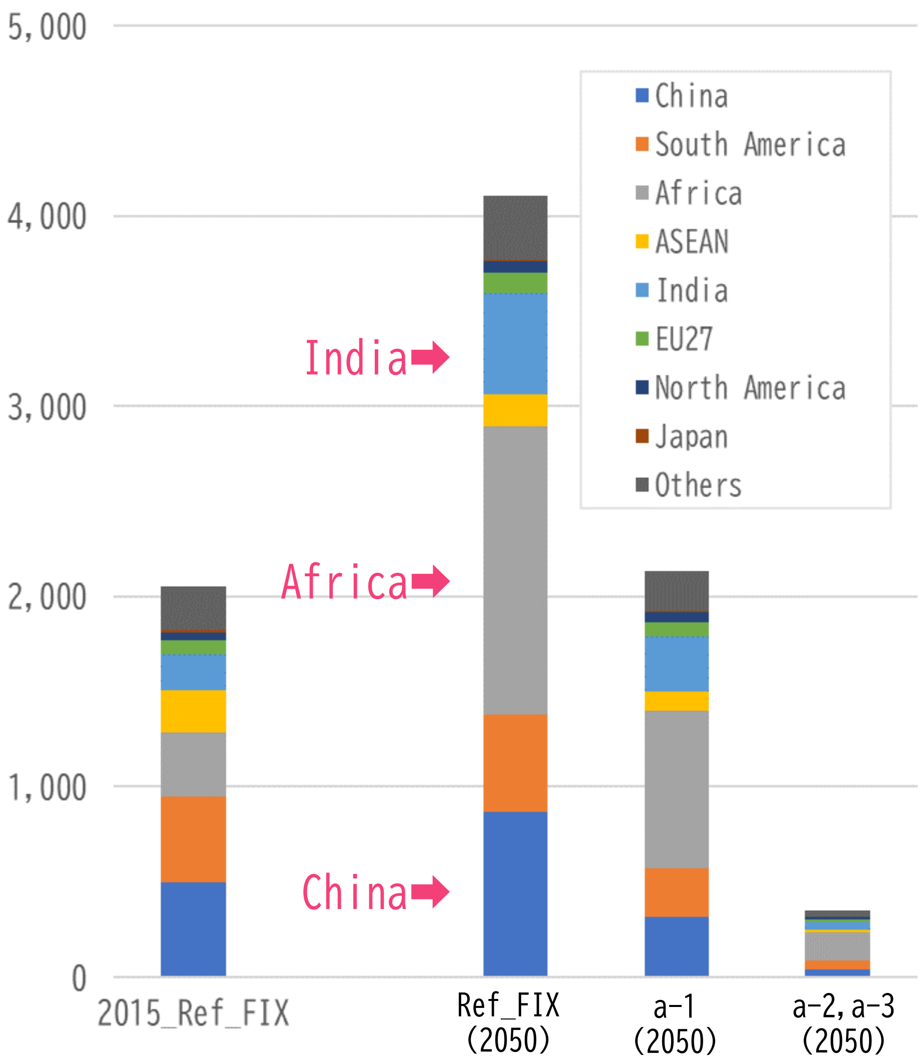


ii. Cobenefit by decarbonization(2050)

Mercury emission in 2015 and 2050

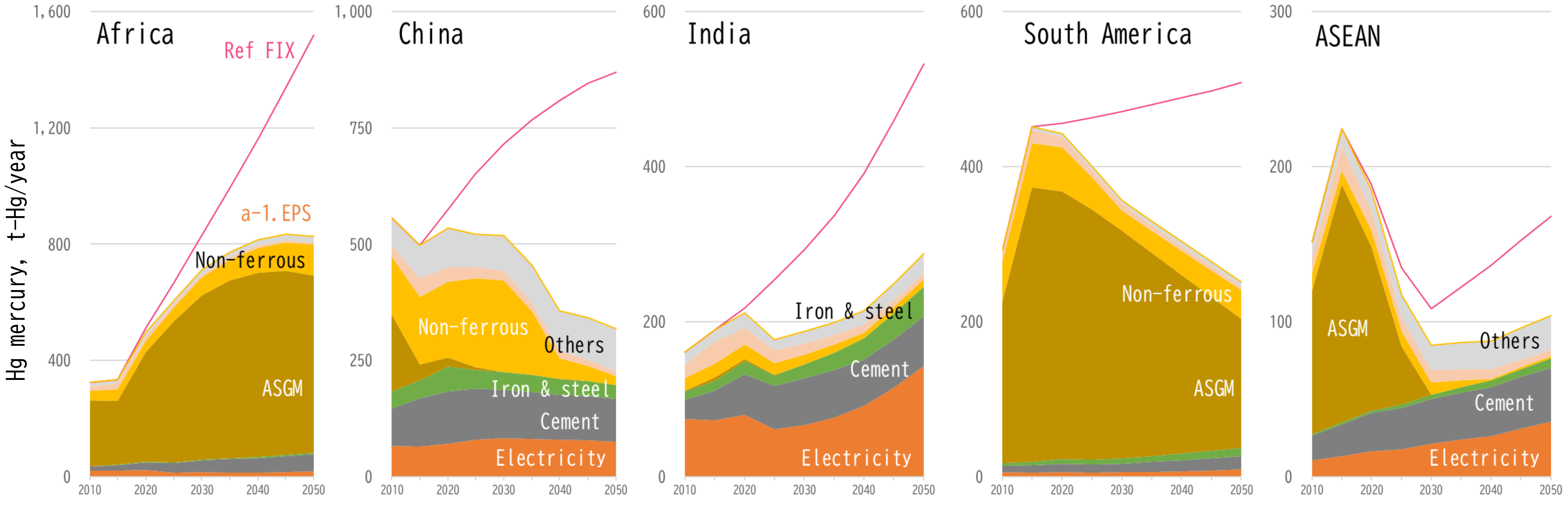


By sector



By nation

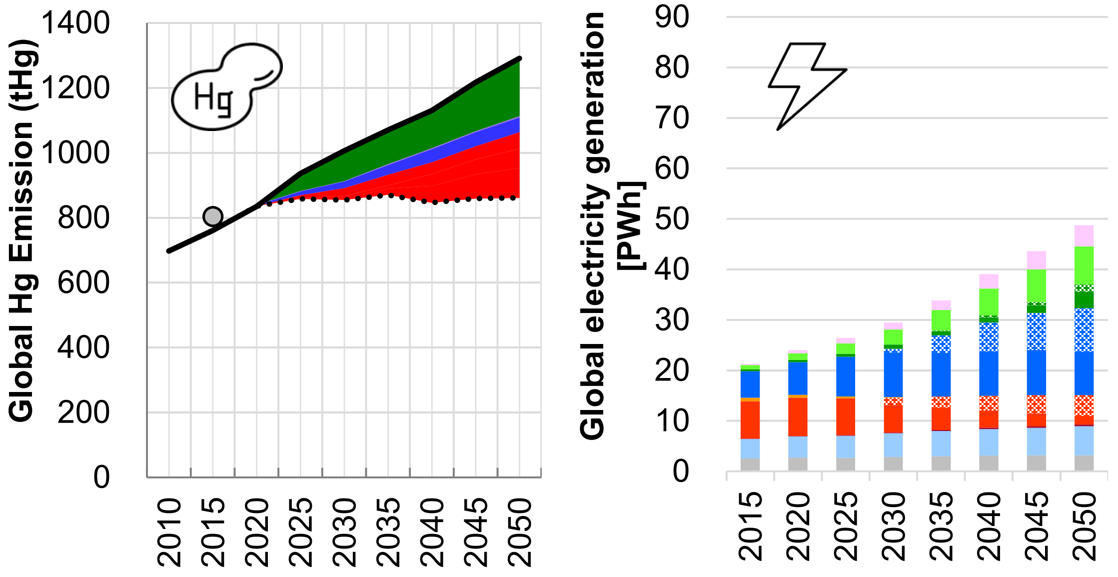
Mercury mitigation effects



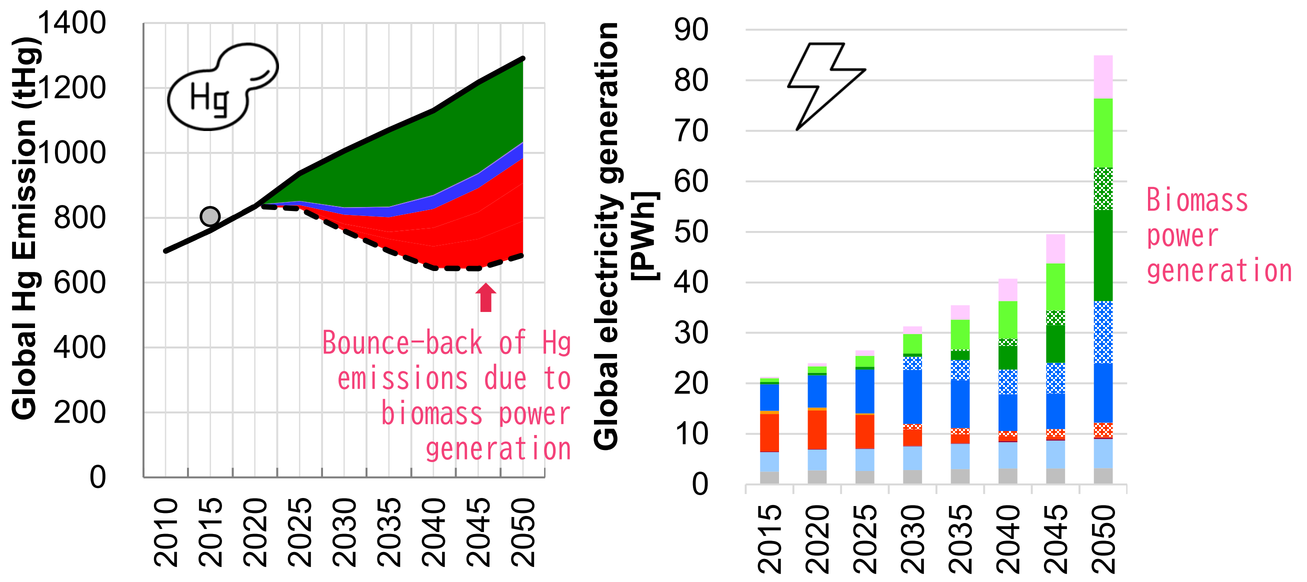
Cobenefit / Tradeoff on Mercury Emissions due to Decarbonization

National Institute for Environmental Studies, Japan

b-1. Low-carbon scenario toward the 2℃ target



b-2. Deep-decarbonization scenario toward the 1.5℃ target

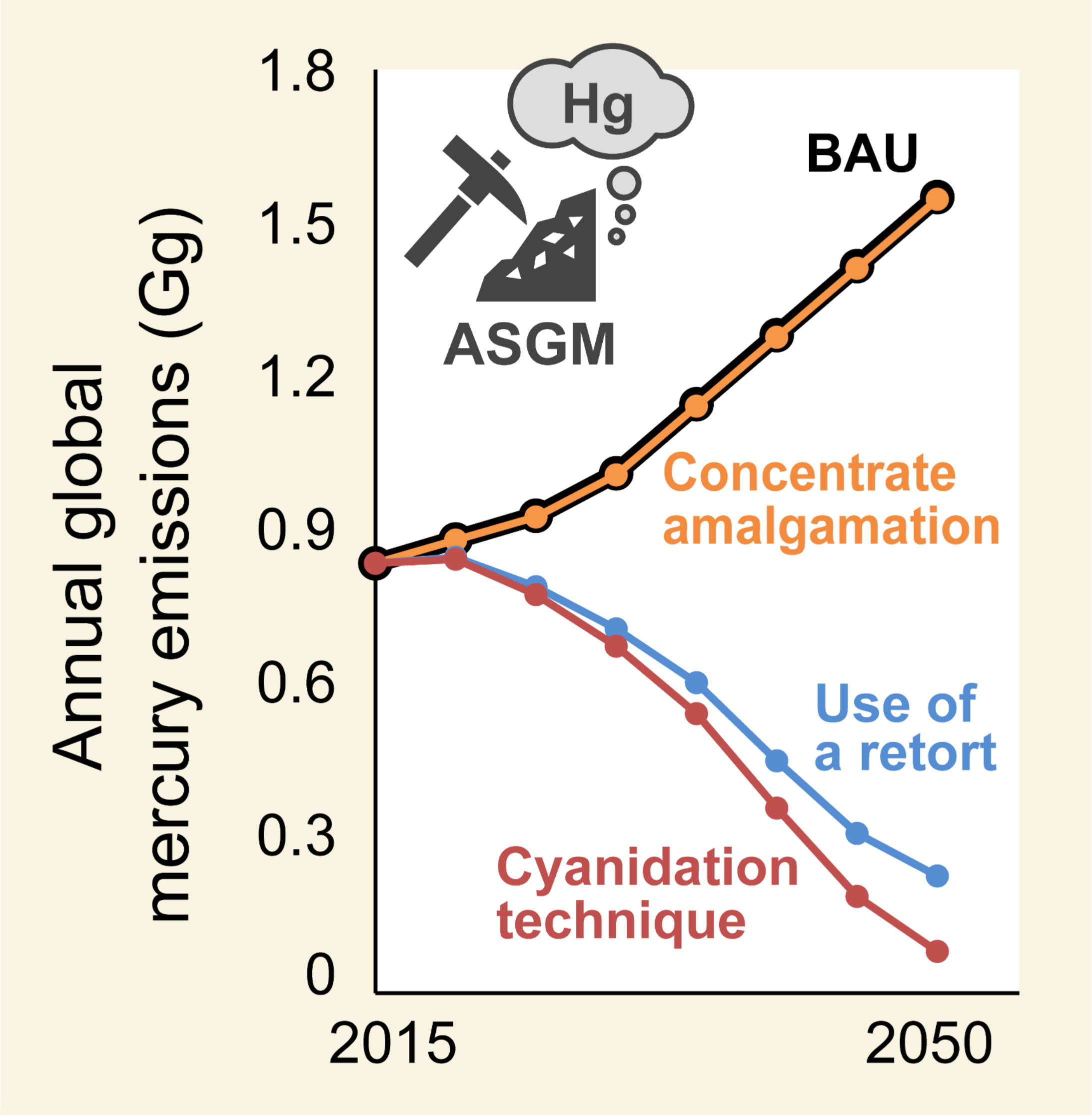


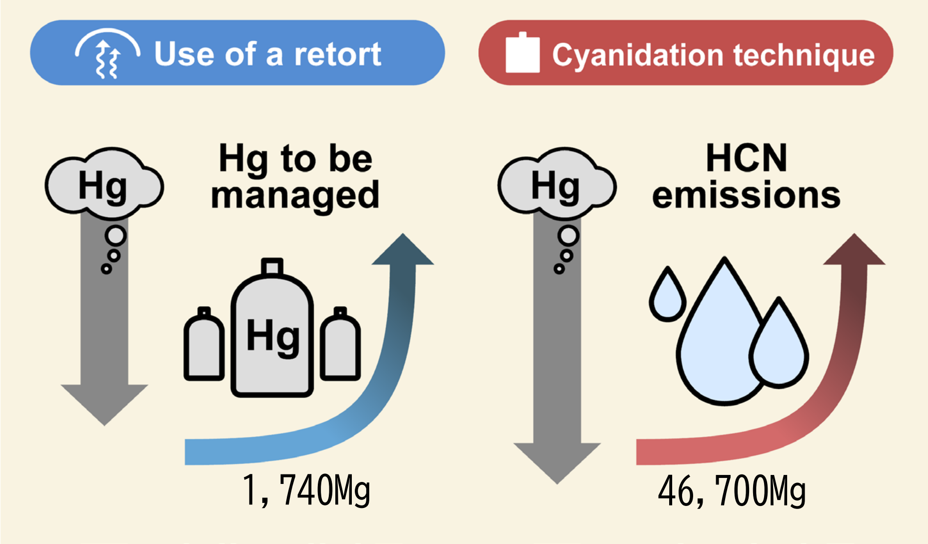
Emission pathway: Historical (GMA2018), Reference, Low-carbon, Deep-decarbonization

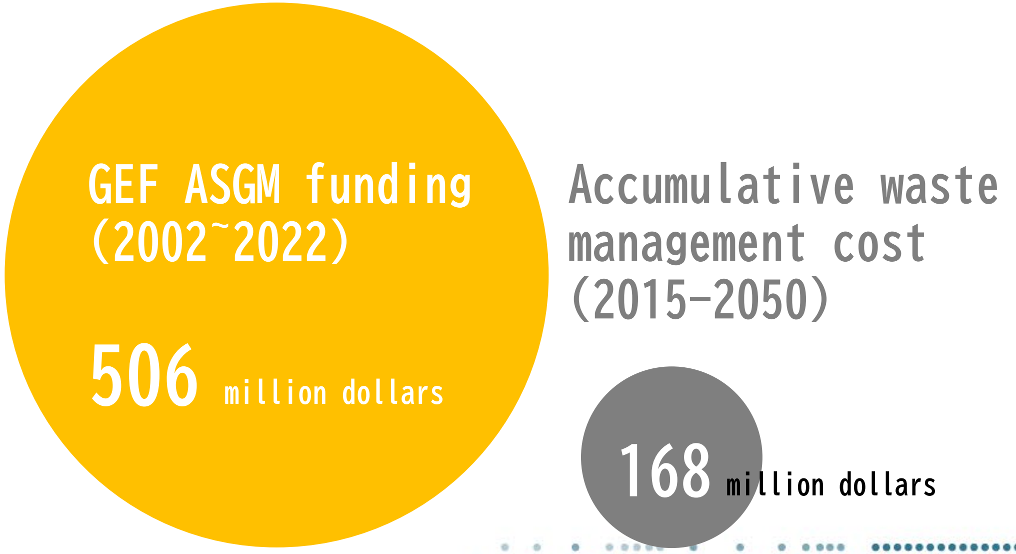
Cobenefit mitigation: Power, Transport, Building, Industry

Emission pathway: Solar, Wind, Biomass, Biomass with CCS, Natural gas, Natural gas with CCS, Oil, Coal, Coal with CCS, Geothermal, Hydro, Nuclear

Mercury mitigation effect and tradeoff in ASGM







Mitigation effects and trade-off in ASGM

Resources, Conservation & Recycling 188 (2023) 106708

Contents lists available at ScienceDirect

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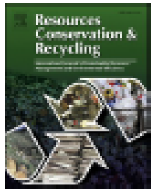
journal homepage: www.elsevier.com/locate/resconrec



Full length article

Mercury mitigation and unintended consequences in artisanal and small-scale gold mining

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[b] Global Resource Sustainability Research Section, National Institute for Environmental Studies, 16-2 Onogawa, Tsukuba, Ibaraki, 305-8506, Japan
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ARTICLE INFO

Keywords:
Artisanal and small-scale gold mining
Mercury amalgamation
Intervention strategy
Minamata convention on mercury
Cyanidation

ABSTRACT

The increased research attention on estimating the global mercury use and gold mining (ASGM) has improved awareness of the problems associated has been paid to the specific effects of particular intervention strategies emissions in accordance with the Minamata Convention on Mercury. In thi type of intervention (concentrate amalgamation, use of a retort, and the cya that, despite the massive reduction in mercury emissions associated with cyanidation technique, these interventions created new critical issues. terventions, there has been a significant increase in the quantity of global and permanently managed as a waste (< 1740 Mg in 2050) and also in g 46,700 Mg in 2050). The findings of this study indicate that, when tak mitigate mercury use and emissions in accordance with the Minamata Conv risks which, in effect, jeopardize sustainability in ASGM. Comprehensive also consider these unintended consequences should be included in the act the national level.

Abbreviations

Mercury has been used in ASGM about the devastating health effects ASGM came remarkably late (Drisco

Journal of Material Cycles and Waste Management
https://doi.org/10.1007/s10163-023-01731-7

SPECIAL FEATURE: ORIGINAL ARTICLE

Mercury cycles and their management

Check for updates

Cost of proper waste management of retorted mercury in artisanal and small-scale gold mining: global estimates and financial implications

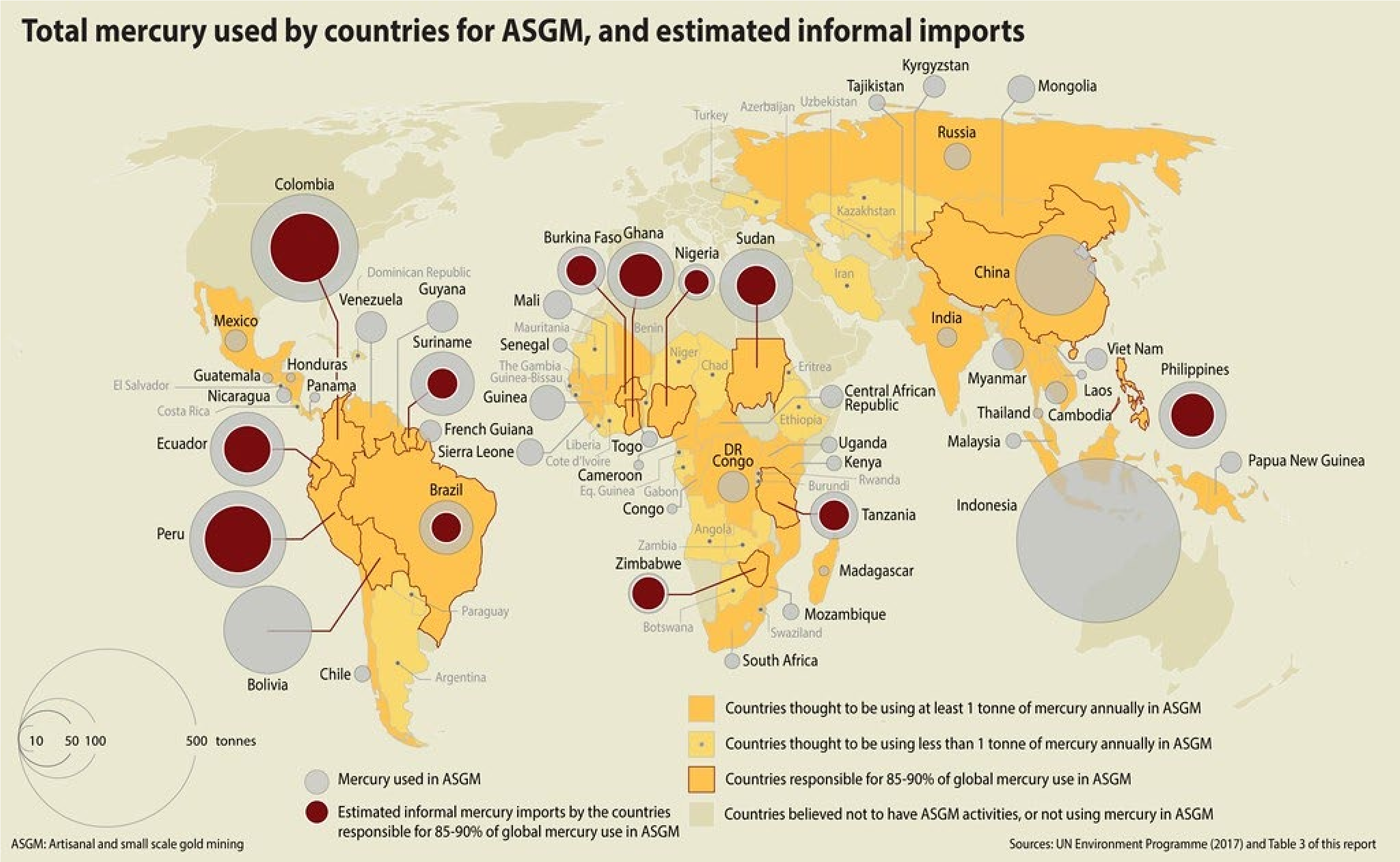
Shoki Kosai[1] · Shion Yamao[2] · Shunsuke Kashiwakura[2] · Eiji Yamasue[2] · Tomonori Ishigaki[3] · Kenichi Nakajima[3,4]

Received: 19 December 2022 / Accepted: 14 June 2023

Abstract

Implementing retorts in artisanal and small-scale gold mining (ASGM) to mitigate mercury emissions is a positive development. However, it creates a new challenge: the need for proper management of retorted mercury waste. This study aimed to estimate the global waste management cost for retorted mercury using stringent guidelines for mercury waste management. The results showed that the estimated cost could reach a maximum of 16.6 million USD by 2050, which is 44.7 times higher than the global retort purchase cost. Thus, securing waste management costs for retorted mercury is essential when implementing retorts for mercury mitigation. However, this may be challenging in many artisanal and small-scale

Discrepancies in Mercury Trade



Indicators for effectiveness evaluation of the MC on Mercury

UNITED NATIONS

UNEP

UNEP/MC/COP.5/16/Add.1

MINAMATA CONVENTION ON MERCURY

Distr.: General
8 August 2023

Original: English

Conference of the Parties to the Minamata Convention on Mercury
Fifth meeting
Geneva, 30 October–3 November 2023
Item 4 (k) of the provisional agenda*

Matters for consideration or action by the Conference of the Parties: effectiveness evaluation

First effectiveness evaluation of the Minamata Convention on Mercury

Addendum

Indicators

Note by the secretariat

1. Article 22 of the Minamata Convention on Mercury states that the Conference of the Parties to the Minamata Convention will evaluate the effectiveness of the Convention, beginning no later than six years after the Convention's entry into force and periodically thereafter at intervals to be decided by the Conference of the Parties. The effectiveness evaluation is to be conducted on the basis of available scientific, environmental, technical, financial and economic information, including:

(a) Reports and other monitoring information provided to the Conference of the Parties on the presence and movement of mercury and mercury compounds in the environment as well as trends in levels of mercury and mercury compounds observed in biotic media and vulnerable populations;

(b) Reports submitted pursuant to article 21;

(c) Information and recommendations provided pursuant to article 15;

(d) Reports and other relevant information on the operation of the financial assistance, technology transfer and capacity-building arrangements put in place under the Convention.

2. At its third meeting, in paragraph 1 of decision MC-3/10, the Conference of the Parties invited parties to submit views on the indicators set out in annex I to the decision and requested the secretariat to compile those views in advance of the fourth meeting of the Conference of the Parties. The secretariat's compilation of the views submitted by parties is summarized in document UNEP/MC/COP.4/18/Add.1 and set out in full in document UNEP/MC/COP.4/INF/11.

3. At its fourth meeting, in paragraph 7 of decision MC-4/11, the Conference of the Parties requested the secretariat to support an intersessional process to refine the list of indicators to be used in the effectiveness evaluation process, with a view to providing a final list of indicators for consideration and possible adoption by the Conference of the Parties at its fifth meeting.

* UNEP/MC/COP.5/1.

K2315392[E] 040923

UNEP/MC/COP.5/16/Add.1

Annex

Draft indicators to support the evaluation of the effectiveness of the Minamata Convention

#	*Draft indicator*	*Relevant article of the Convention*	*Possible sources of information for measuring progress against the indicator*	*Notes*
1	Levels and trends of mercury and mercury compounds in the …	Article 1	• Reports and other …	As the analysis of …
	… of mercury disposed of through such measures			
5	Number of parties that have exported or imported mercury in accordance with the procedures established under article 3	Article 3	• Reports pursuant to article 21 • Forms pursuant to article 3 • Reports developed under the Convention	Consideration of this indicator during the evaluation will take into account the fact that trade is permitted from sources and for uses allowed under the Convention.
6	Estimated global amount, in metric tons per year, of: (a) Mercury traded in accordance with the Convention (b) Mercury supply (c) Mercury used in products and processes	Article 3	• Reports pursuant to article 21 • Forms pursuant to article 3 and article 30, para. 4 • Reports developed under the Convention	Consideration of this indicator during the evaluation will take into account the fact that trade is permitted from sources and for uses allowed under the Convention. Additional sources of information will likely be necessary to accurately …

https://minamataconvention.org/en/documents/first-effectiveness-evaluation-minamata-convention-mercury-indicators

Inconsistencies of mercury flow in global trade concerning artisanal and small-scale gold mining activity

Resources, Conservation & Recycling 185 (2022) 106461

Contents lists available at ScienceDirect

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journal homepage: www.elsevier.com/locate/resconrec

Full length article

Examining the inconsistency of mercury flow in post-Minamata Convention global trade concerning artisanal and small-scale gold mining activity

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ARTICLE INFO

Keywords:
Mercury
Minamata convention
Global trade
Artisanal and small-scale gold mining (ASGM)

ABSTRACT

In 2017, the Minamata Convention (MC) on mercury (Hg) control entered into force. However, whether the MC is effective and how it reshapes the global Hg flow remain unclear. In this study, we established a method to detect inconsistencies in data on global Hg trade, and calculated the gap between the demand and supply of Hg to the artisanal and small-scale gold mining (ASGM) sector (i.e., the largest source of Hg emissions globally) in 39 countries across four regions. According to our results, inconsistencies in statistical data concerning Hg for ASGM activities exist in both Africa and Central and South America. Asia showed a considerably lower amount of Hg applied to ASGM than apparent Hg consumption; nevertheless, the largest consumer of Hg was Asia, predominantly China and India. Many countries in which ASGM is conducted are already MC parties; however, only few submitted their national action plans (NAPs) or have established/enforced specific laws to curb Hg use in ASGM. Analysis of Hg-related trade information suggests that in 2017, the trade of metallic Hg disappeared in some African and Central and South American countries, but new trade flows of goods with higher Hg content emerged. The method established in this study can support the search for countries implementing ASGM with hidden Hg use and flows, thereby contributing to the planning of further Hg control regulations. To enforce sound Hg management, the submission of NAPs should also be promoted in addition to the expansion of MC parties.

1. Introduction

Mercury (Hg) is a toxic pollutant. Owing to its high vaporization, it travels a long distance and affects areas that are located long distances from the emission sources (Moreno-Brush et al., 2016). Elemental Hg in the gas phase can be inhaled, thereby inducing toxic effects at elevated concentrations (Swain et al., 2007). After deposition into soil or water, metallic Hg can be oxidized and transformed into an organic form, such as methylmercury (MeHg), and bioaccumulated in the food web (Bravo et al., 2017; Göthberg and Greger, 2006; Wang et al., 2018). Humans are often exposed to MeHg predominantly via seafood and rice consumption (Swain et al., 2007; Zhang et al., 2010). MeHg, which is also known as the cause of Minamata disease half a century ago in Japan, has health impacts associated with neurocognitive deficits in human fetuses and cardiovascular effects in adults (Axelrad et al., 2007; Roman et al., 2011).

While the total emissions of Hg to the atmosphere represent 6,500 to 8,200 tonnes/a, natural sources account for 56% to 82% of this amount (Driscoll et al., 2013). The main anthropogenic sources of Hg emissions include artisanal and small-scale mining (ASGM) (Telmer and Veiga, 2009), coal combustion (Streets et al., 2018), cement production (Kogut et al., 2021), and nonferrous metal production (Pacyna et al., 2006). Among these sources, ASGM is the largest source of anthropogenic Hg emissions, accounting for 38% of total Hg emissions or 838 tonnes of Hg going into the atmosphere in 2015 (UNEP, 2019a). Anthropogenic releases of Hg to water and land account for 1,800 tonnes/a in which ASGM represents 67% or 1,200 tonnes/a (UNEP, 2019a). Mercury emissions, as well as the direct release, are of primary concern because of the extensive use of Hg to amalgamate gold by artisanal miners (Basu et al., 2015; Cordy et al., 2013). Approximately 15 million individuals,

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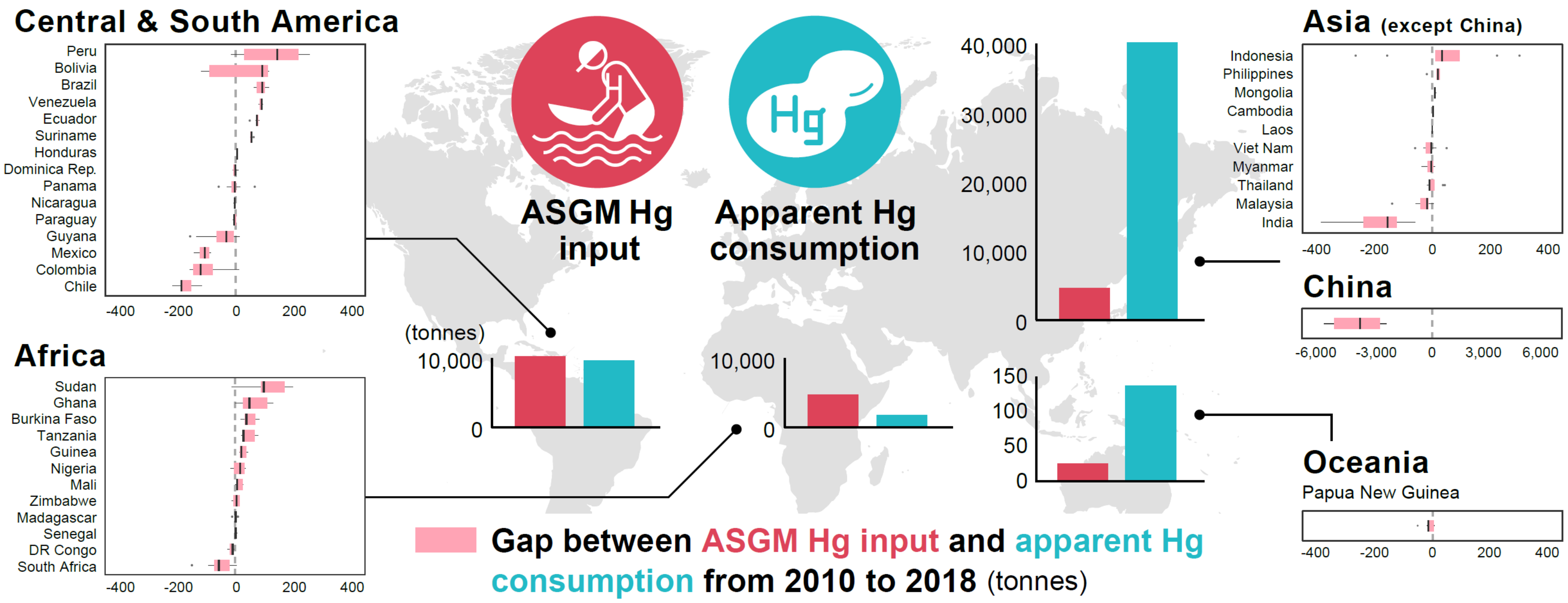
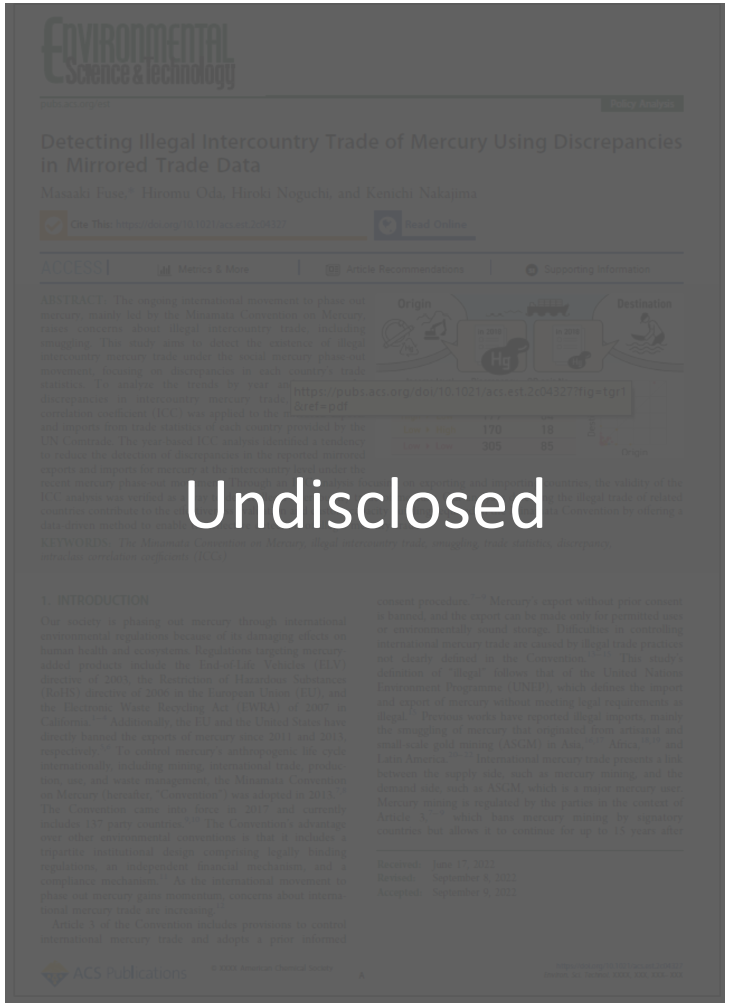
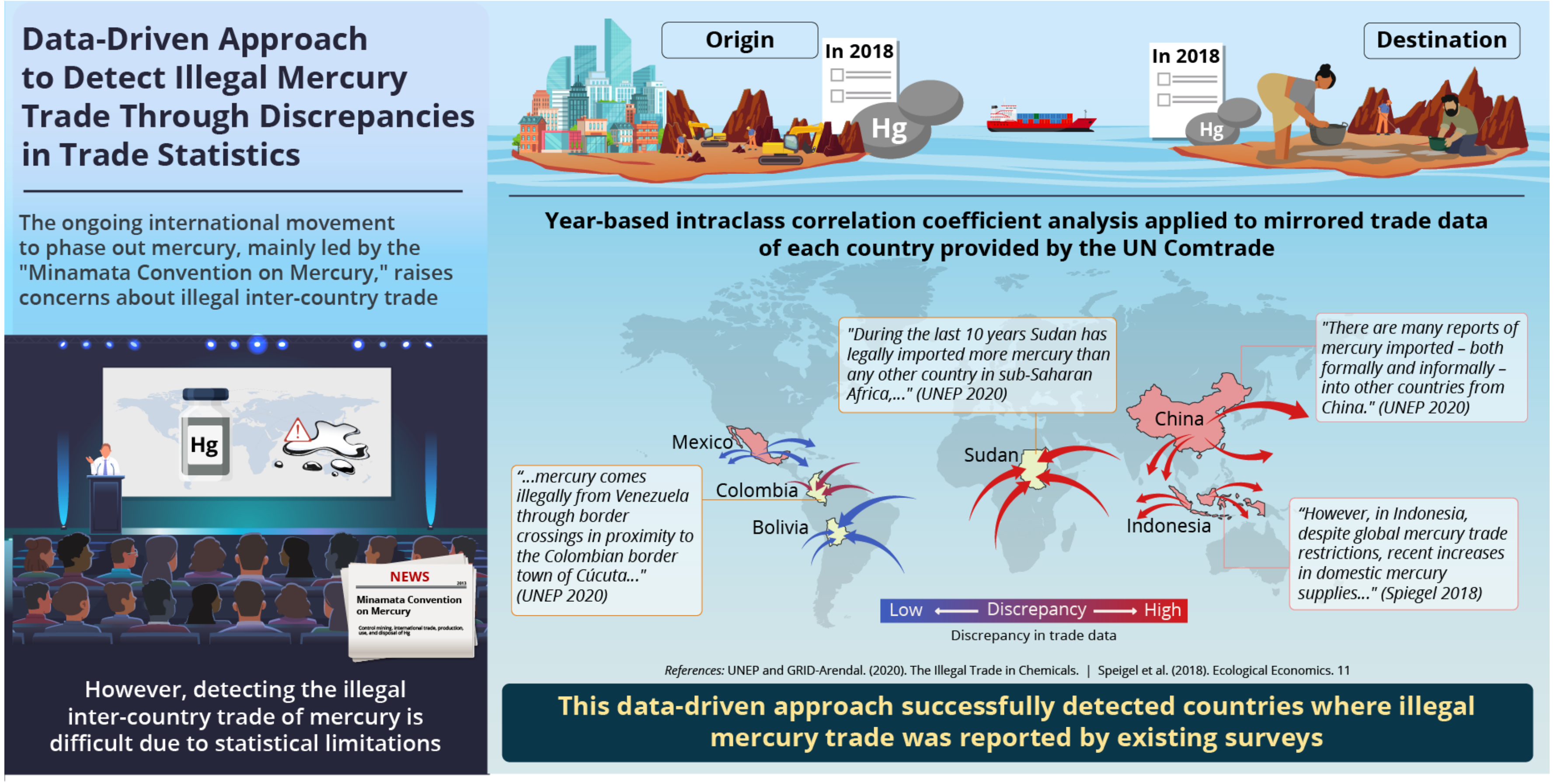
https://doi.org/10.1016/j.resconrec.2022.106461
Received 1 February 2022; Received in revised form 8 June 2022; Accepted 8 June 2022
Available online 25 June 2022



Exploring illegal trade of mercury from discrepancy with trade statistics





Detecting illegal inter-country trade of mercury using discrepancies in mirrored trade data

Fuse *et al.* (2022) | *Environmental Science & Technology* | DOI: 10.1021/acs.est.2c04327

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National Institute for Environmental Studies, Japan

Thank you for your kind attention!

This research was financially supported by
the Environment Research and Technology Development Fund of Japan [SII-6-2(JPMEERF20S20620)].