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Grant Agreement No: 860497

GMOS-Train

Global Mercury Observation Training Network in Support of the Minamata Convention

Deliverable D7.2

Training materials from Winter School 1 "Introduction to Minamata Convention"

Start date of project: 01.01.2020 Duration: 48 months

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Acronyms and Abbreviations

PROJECT BENEFICIARIES:

AMU	Université d'Aix-Marseille – Mediterranean Institute of Oceanography, France
CNR IIA	Institute of Atmospheric Pollution Research of the Italian National Research Council, Italy
CNRS	Centre National de Recherche Scientifique, France
HZG	Helmholtz-Zentrum Geesthacht Zentrum für Material- und Küstenforschung GmbH, Germany
IFREMER	French Research Institute for Exploitation of the Sea, France
IOS	Institute for Environmental Protection and Sensors, Slovenia
JSI	Jožef Stefan Institute, Slovenia
PSA	PS Analytical, United Kingdom – project exit date 1.7.2020
UGA	Université Grenoble Alpes, France
UPPA	Université de Pau et des Pays de l'Adour, France
SU	Stockholm University, Sweden

PROJECT PARNTER ORGANISATIONS:

AMAP	Arctic Monitoring and Assessment Programme, Norway
AUTH	Aristotle University of Thessaloniki, Greece
EEB	European Environmental Bureau, Belgium
Harvard	Harvard University, USA
IPSJS	International Postgraduate School Jožef Stefan, Slovenia
IRD	Institut de Recherche pour le Développement, France
Lumex	Lumex, Germany/Russia
MIT	Massachusetts Institute of Technology, USA
MSC-E	Meteorological Synthesizing Centre – East of EMEP, Russia
PSA	PS Analytical, United Kingdom – project exit date 1.7.2020
SPRS	Swedish Polar Research Secretariat, Sweden
Tekran	Tekran, Canada
UBL	Université Bretagne Loire , France
UNEP	United Nations Environmental Programme, Switzerland
UPS	Université Paul Sabatier, France
VSL	Dutch National Standard Laboratory, The Netherlands

ESR	Early Stage Researcher
GA	Grant Agreement

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Executive Summary

This document captures the report on training activities on Introduction to the Minamata Convention – webinar by Mr Eisaku Toda, Senior Programme Officer of the Minamata Convention on Mercury at United Nations Environmental Programme (UNEP), and negotiation simulation "Mercury Game", organised by Prof Noelle E. Selin from Massachusetts Institute of Technology (MIT). The purpose of both events was to learn about complex interactions between science and society and to develop communication skills.

This deliverable has been submitted with some delay with respect to the original plan, as the COVID-19 pandemic has affected the organisation of this training event.

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1. Introduction

According to the Annex 1 of the GMOS-Train Grant Agreement the Winter School 1 "Introduction to Minamata Convention" was primarily planned to be organised in conjunction with the GMOS-Train Kick-off Meeting in December 2020 (month 12). Due to the global Covid-19 pandemic situation, the Kick-off meeting was organised virtually and the Winter School 1 has been postponed and organised in a form of a two separate online events. The first event was a webinar "Introduction to the Minamata Convention" performed by Mr Eisaku Toda, Senior Programme Officer of the Minamata Convention on Mercury at UNEP, who presented the history, content, implementation status and future direction of the Minamata Convention. This webinar was followed by Mercury Game, negotiation simulation, organised by Prof Noelle E. Selin from Massachusetts Institute of Technology (MIT). Attendance was obligatory for all GMOS-Train ESRs. Both events have been recorded for all those students who could not attend the lectures due to other student obligations or illness. Furthermore, the slides and recordings are available to all project partners on the GMOS-Train internal webpage. This training provided an opportunity for all ESRs to attend the COP5 meeting scheduled for 2023. With the signing of the UNEP Minamata Convention in 2013 and its ratification in 2017, the world's governments have accepted that mercury (Hg) is toxic and of global relevance; scientific needs will therefore shift towards best implementation practices of the Convention. The process of training a pool of 15 ESRs represents an excellent capacity building needed for the implementation of the Minamata Convention. In cooperation with all beneficiaries and ESRs, special scientific meetings will be organized where all ESRs will have an opportunity to follow the political decision-making process in the field of research that is the subject of their doctoral dissertations.

Figure 1 Invitation to the GMOS-Train webinar

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2. Webinar "Introduction to Minamata Convention"

The webinar "Introduction to the Minamata Convention" was organised via ZOOM videoconference system, on March 15th 2021. Mr Eisaku Toda, Senior Programme Officer of the Minamata Convention on Mercury, has presented the history, content, implementation status and future direction of the Minamata Convention.

Minamata Convention on Mercury was adopted in a diplomatic conference held in Kumamoto, Japan in October 2013, and entered into force in August 2017. It was named after Minamata Bay in southern Japan where thousands of people suffered from methylmercury poisoning due to effluents from an acetaldehyde plant. It controls the whole life cycle of mercury from primary mining, other supply sources, trade, use in products and processes, artisanal and small scale gold mining, emissions, releases, storage, waste disposal and contaminated sites. It also has provisions of health aspects, information sharing, awareness, research and monitoring. The Conference of the Parties (COP), the decision-making body of the Convention, is to evaluate the effectiveness of the Convention periodically starting six years after the entry into force of the Convention, using available information including monitoring data. COP at its third meeting in November 2019 requested the Secretariat to work on several intersessional work items to prepare for its fourth meeting to be held in November 2021, including indicators and monitoring guidance for the Convention.

The online lecture was attended by 24 participants, it lasted approx. 90 minutes, and it was followed by discussion. The webinar was recorded for those fellows, who could not attend it due to other student obligations. The lecture presentation is enclosed in the Appendix.

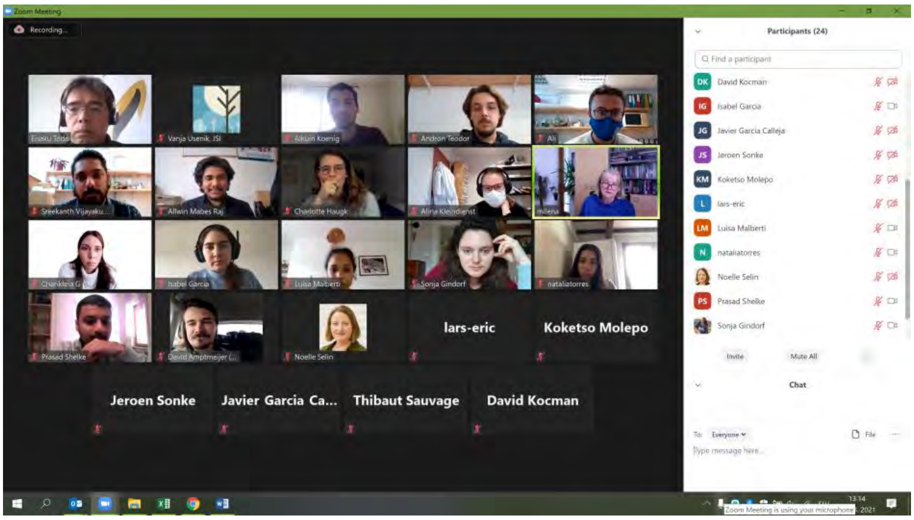

Figure 2 Webinar "Introduction to the Minamata Convention" Participants

Readings that were assigned to all ESRs before the webinar were:

- Toda E, ten Have C and Pacyna J (2020) "The Minamata Convention - A tool for global regulation of mercury pollution" https://www.degruyter.com/document/doi/10.1515/ci-2020-0403/html
- Convention's website on intersessional work:

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http://www.mercuryconvention.org/Meetings/Intersessionalwork/tabid/8279/language/en-US/Default.aspx

- Zero draft of the monitoring guidance: http://www.mercuryconvention.org/Portals/11/documents/meetings/COP4/submissions/MonitoringGuidanceZeroDraft2021FEB25.pdf
- Global Mercury Assessment 2018: https://www.unep.org/resources/publication/global-mercury-assessment-2018
- UNEP Global Mercury Partnership: https://web.unep.org/globalmercurypartnership/
- Selin, H., Keane, S.E., Wang, S. et al. Linking science and policy to support the implementation of the Minamata Convention on Mercury. Ambio 47, 198–215 (2018). https://doi.org/10.1007/s13280-017-1003-x

After the session Prof Noelle E. Selin from MIT provided the PhD students with short introduction to a Mercury Game and group assignments (http://mercurygame.scripts.mit.edu/game/). For environmental studies students, the mercury simulation demonstrates how scientific uncertainty can affect decision-making. Using the Mercury Game as an educational tool allows students to learn about complex interactions between science and society and develop communication skills. At this opportunity the students have received all the required instructions and literature to play the interactive game with Prof Selin on Monday, March 22nd 2021.

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3. The Mercury Negotiation Simulation

The Mercury Negotiation Simulation has been organised on March 22nd 2021 via ZOOM videoconference system. Prior to the event the ESRs received the general instructions and the scientific assessment for the Mercury Game, that are included in the Appendix. They have also received individual emails with info to each player on 1) which game they are in, which role they will play, the zoom link; and 2) additional confidential instructions. There were two separate ZOOMs for the negotiations and another one for the debrief. Students playing the chair hosted the negotiation zoom, so that they were able to set up breakout rooms if needed. The interactive game started at 12:00 PM (CET) and lasted for approx. 2 hours. It was followed by the debrief with Prof Noelle E. Selin (MIT) at 2:00 – 3:00 PM (CET). Short notes taken during the negotiation ZOOMs are enclosed in the Appendix.

Mercury Game	**GROUP 1**		**GROUP 2**	
March 22, 2021	**ZOOM link:**		**ZOOM link:**	
12:00 - 14:00 PM (CET)	https://us02web.zoom.us/j/83301445589		https://us02web.zoom.us/j/89757026931	
	Meeting ID: 833 0144 5589		**Meeting ID: 897 5702 6931**	
	Passcode: 344821			
ROLE	**PARTICIPANT**	**EMAIL**	**PARTICIPANT**	**EMAIL**
Chair	Sonja Gindorf	sonja.gindorf@aces.su.se	David Amptmeijer	david.amptmeijer@hzg.de
AMAP	Alina Kleindienst	a.kleindienst@univ-pau.fr	Charlotte Haugk - absent due to illness	charlotte.haugk@aces.su.se
Brazil	Isabel García Arévalo	igarciaa@ifremer.fr	Luisa María Malberti Quintero	lmalberti1996@gmail.com
Canada	Allwin Mabes Raj	allwinamc10@gmail.com	Igor Živković	igor.zivkovic@ijs.si
China	Prasad Shelke	Prasad.Shelke@iia.cnr.it	Saeed Waqar Ali	Saeed.Ali@ijs.si
EU	Teodor-Daniel Andron	Teodor.Andron@ijs.si	Charikleia Gournia	charikleia.gournia@iia.cnr.it
Mercury Free Future	Dominik Božić	dominik.bozic@ijs.si	Adna Alilović	adna.alilovic@gmail.com
Tanzania	Koketso Michelle Molepo	koketso.molepo@hzg.de	Natalia Torres Rodriguez	natatorresro@gmail.com
USA	Emira Begu	ermira.begu@ijs.si	Alkuin Maximilian Koenig	alkuin-maximilian.koenig@univ-grenoble-alpes.fr
World Coal Power Association	Jože Kotnik	joze.kotnik@ijs.si	Jan Gačnik	jan.gacnik@ijs.si
India	Sreekanth Vijayakumaran Nair	Sreekanth.Nair@ijs.si	David Kocman - changed role to AMAP	david.kocman@ijs.si

Figure 3 Mercury Game role distribution

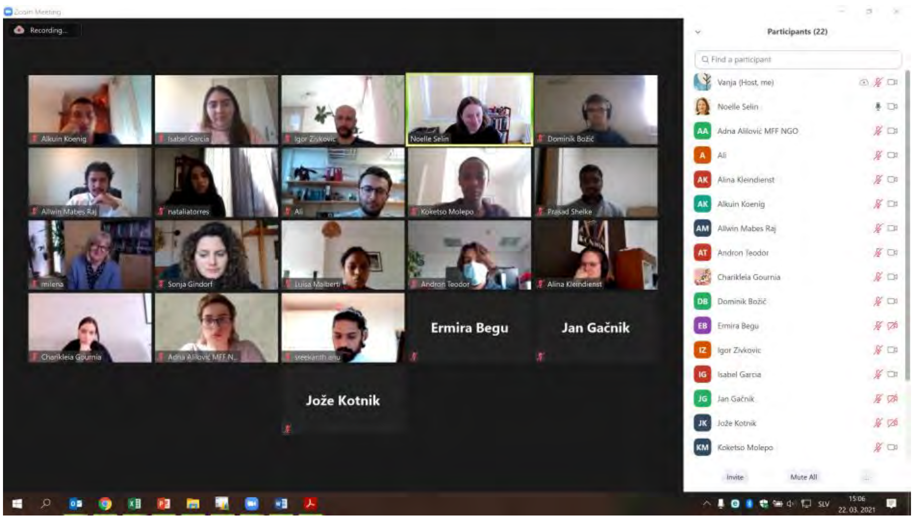

Figure 4 Mercury Game Participants

The Mercury Game is a multiparty role-play that helps designed to help participants actively learn about science-policy interactions in the context of global environmental treaty-making challenges. The main goal of

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the game is to help participants understand the important roles that scientific information, uncertainty and individual scientists play in addressing global environmental issues. The game explores the complex interactions between science, policy and politics, and is appropriate for audiences with both scientific and policy backgrounds at multiple educational levels. For scientists and science students, it introduces global environmental policymaking and illustrates ways of making sure that science is taken seriously in political decision-making. The game uses the global negotiations on mercury as a case to explore the prospect of collective action to manage environmental risks. Although the game setting is fictionalized, it reflects the dynamics of the real decisions confronting the United Nations Environment Programme (UNEP), which initiated discussions about the need for a global treaty on mercury. The main question that participants are asked to address in the game is whether there is sufficient scientific evidence that mercury is a global pollutant requiring global attention. Specifically, representatives are asked to address four issues on the possible form and scope of global cooperation. These issues were chosen to illustrate important science-policy dynamics, lessons from which are applicable to a wide range of international environmental issues. Key learning themes include understanding the balance between science, policy and politics; the role that scientists play in political negotiations and how science is used, misused and interpreted. From a negotiations perspective, the game explores coalitional dynamics, issue linkage, option-creation and integrative bargaining. The game was evaluated in a journal publication: Stokes, Leah C., and Noelle E. Selin. "The mercury game: evaluating a negotiation simulation that teaches students about science-policy interactions." Journal of Environmental Studies and Sciences 6.3 (2016): 597-605.

During the debrief Prof Noelle E. Selin reviewed with ESRs what has happened during the game and discussed the outcome of the game, the process and the important players. She also presented the history of UNEP mercury discussions (2003-2013). Prof Selin led a discussion contrasting the specific outcomes from the game. Amongst other, her questions were:

a) How did you interpret the scientific assessment, given your specific role in the game? How did the role you played affect how you viewed risk from mercury science? After playing the game, how do you think scientific assessment can better inform international environmental treaty making?
b) What were the main barriers you saw to creating consensus in the game? How do you think this translates in the real world? What challenges are blocking environmental agreements?

The fellows admitted that international environmental negotiations often involve conflicts between developed and developing countries. The developed world has been responsible for the majority of historic mercury emissions, but emerging economies are currently the largest emitters, becoming also more important politically, economically, and environmentally. The ESRs indicated the important role of China and India in the negotiation process. As emerging economies, China and India have prioritized development through expanding energy capacity. Both countries are using substantial amounts of coal. Thus, their mercury emissions trajectories depend not only on mercury control technologies, but also on energy demand and capacity expansion. As is also the case with climate actions, placing significant constraints on mercury emissions could hinder electricity expansion. These shared interests facilitate a coalition between China and India. The ESRs also noticed that the developing countries often stressed the importance of a financial mechanism, and emphasized that technical and financial assistance from developed countries should be mandatory.

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There was also a difference between the capacities and available funding to attend the negotiations. Most developing countries have one or two delegates, while rich countries have a group of representatives. EU and USA are usually represented by a specialised team. There is also a difference in mercury expertise. The ESRs stressed that science was not always a topic of discussion; it was mostly about the interests; the uncertainty is interpreted in a way that is suitable for the opponents. Therefore, it is really important on how to communicate the science to policy makers and to have a clear message. The scientist should choose words carefully and use simple terms (i.e. 'human caused' rather than 'anthropogenic'), begin with what you know, use metaphors and narratives, include positive frames and explain the benefits of action.

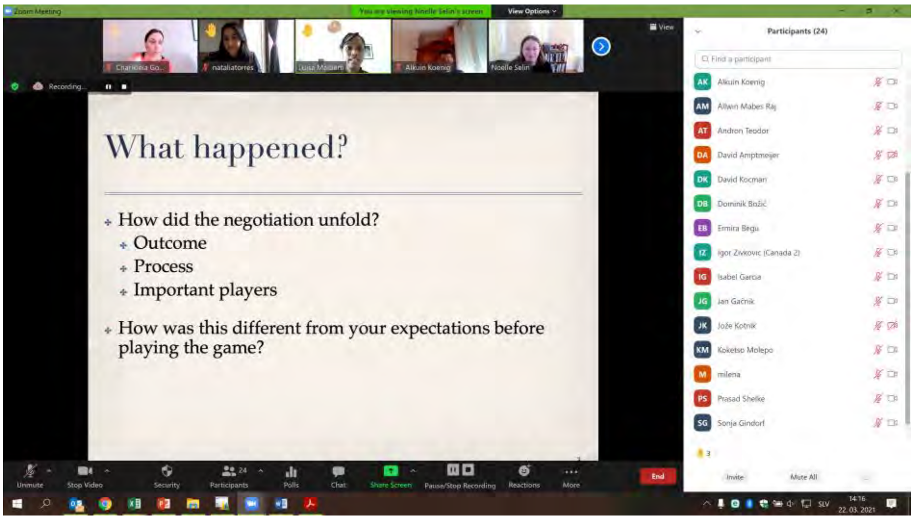

Figure 5 Debrief with Prof N.E. Selin (MIT)

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4. More about the lecturers

4.1 Mr Eisaku Toda, Senior Programme Officer, UNEP

Mr Eisaku Toda joined the Chemicals and Waste Branch in July 2015 as the Team leader of the Technology and Metals Team. The Team is responsible, inter alia, for UNEP's mercury programme and the lead and Cadmium programme, including the global mercury partnership and the global alliance to Eliminate lead in paint. Before joining UNEP, Eisaku was director of the International Strategy division in the ministry of the Environment of Japan from where he coordinated the government's international representation in UNEA 1 in June 2014 and contributed to the past three ICCMs as an Asia-Pacific regional focal point and a bureau member. Prior to this, Eisaku worked in OECD on chemicals test guidelines and risk assessments. He holds Bachelor's degree in systems science from the University of Tokyo.
Source: https://www.unep.org/people/eisaku-toda.

4.2 Dr Noelle Eckley Selin, Associate Professor, MIT

Noelle Eckley Selin is Associate Professor in the Institute for Data, Systems and Society and the Department of Earth, Atmospheric and Planetary Sciences and Director of Massachusetts Institute of Technology's Technology and Policy Program. Her research uses modelling and analysis to inform sustainability decision-making, focusing on issues involving air pollution, climate change and hazardous substances such as mercury. She received her PhD and M.A. (Earth and Planetary Sciences) and B.A. (Environmental Science and Public Policy) from Harvard University. Her work has focused on atmospheric chemistry, air pollution, as well as interactions between science and policy in international environmental negotiations. She is the recipient of a U.S. National Science Foundation CAREER award (2011), a Leopold Leadership fellow (2013-2014), Kavli fellow (2015), a member of the Global Young Academy (2014-2018), an American Association for the Advancement of Science Leshner Leadership Institute Fellow (2016-2017), and a Hans Fischer Senior Fellow at the Technical University of Munich Institute for Advanced Study (2018-2021).
Source: http://www.selingroup.org/noelle-eckley-selin.

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5. Conclusions

Both events, webinar "Introduction to the Minamata Convention" and negotiation simulation "Mercury Game" emphasised the importance of understanding the balance between science, policy and politics; the role that scientists play in political negotiations and how science is used, misused and interpreted. This training provided an opportunity for all ESRs to attend the COP5 meeting scheduled for 2023. In cooperation with all beneficiaries and ESRs, special scientific meetings will be organized where all ESRs will have an opportunity to follow the political decision-making process in the field of research that is the subject of your doctoral dissertations. As an example, the ESRs may visit the COP3 process on the website: https://www.google.com/search?client=firefox-b-d&q=Minmata+Convnetion+COP3. The Mercury Game presented the ESRs with potential roles they could play in future careers as policy-oriented scientists.

6. Appendix

6.1 Presentation - Introduction to Minamata Convention

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Introduction to Minamata Convention on Mercury

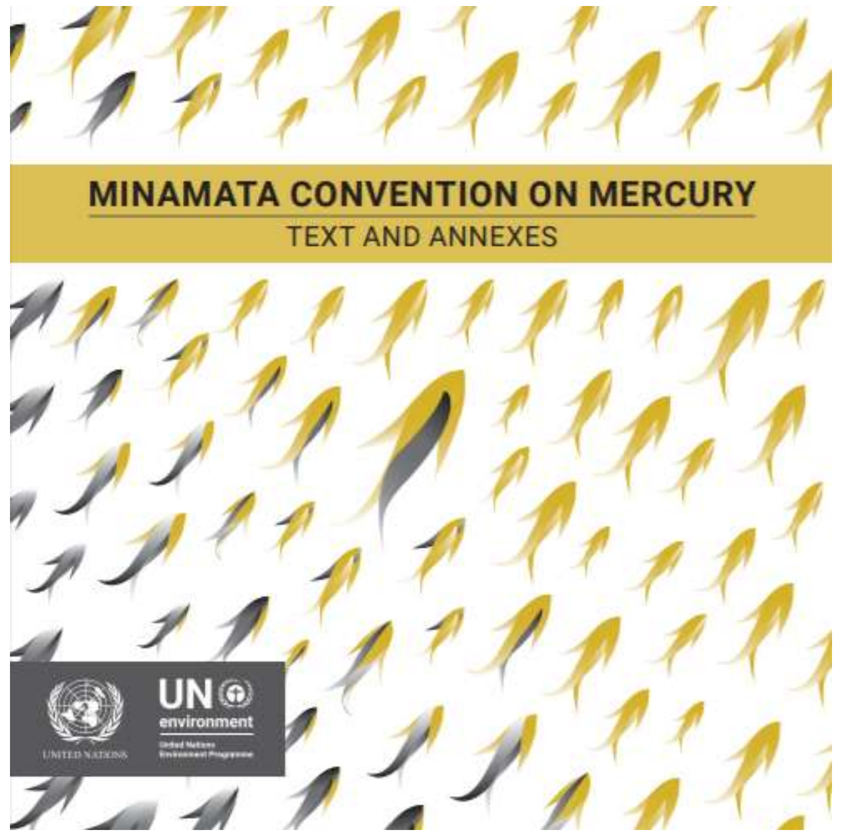
GMOS Train 2nd Webinar

15 March 2021

Eisaku Toda

Secretariat of the Minamata Convention

Minamata Convention on Mercury



The Parties to this Convention,
Recognizing that mercury is a chemical of global concern owing to its long-range atmospheric transport, its persistence in the environment once anthropogenically introduced, its ability to bioaccumulate in ecosystems and its significant negative effects on human health and the environment,
Recalling decision 25/5 of 20 February 2009 of the Governing Council of the United Nations Environment Programme to initiate international action to manage mercury in an efficient, effective and coherent manner,
Recalling paragraph 221 of the outcome document of the United Nations Conference on Sustainable Development "The future we want", which called for a successful outcome of the negotiations on a global legally binding instrument on mercury to address the risks to human health and the environment,
Recalling the United Nations Conference on Sustainable Development's reaffirmation of the principles of the Rio Declaration on Environment and Development, including, inter alia, common but differentiated responsibilities, and acknowledging States' respective circumstances and capabilities and the need for global action,
Aware of the health concerns, especially in developing countries, resulting from exposure to mercury of vulnerable populations, especially women, children, and, through them, future generations,
Noting the particular vulnerabilities of Arctic ecosystems and indigenous communities because of the biomagnification of mercury and contamination of traditional foods, and concerned about indigenous communities more generally with respect to the effects of mercury,
Recognizing the substantial lessons of Minamata Disease, in particular the serious health and environmental effects resulting from the mercury pollution, and the need to ensure proper management of mercury and the prevention of such events in the future,
Stressing the importance of financial, technical, technological, and capacity-building support, particularly for developing countries, and countries with economies in transition, in order to strengthen national capabilities for the management of mercury and to promote the effective implementation of the Convention,
Recognizing also the activities of the World Health Organization in the protection of human health related to mercury and the roles of relevant multilateral environmental agreements, especially the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal and the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade,
Recognizing that this Convention and other international agreements in the field of the environment and trade are mutually supportive,
Emphasizing that nothing in this Convention is intended to affect the rights and obligations of any Party deriving from any existing international agreement,
Understanding that the above recital is not intended to create a hierarchy between this Convention and other international instruments,
Noting that nothing in this Convention prevents a Party from taking additional domestic measures consistent with the provisions of this Convention in an effort to protect human health and the environment from exposure to mercury in accordance with that Party's other obligations under applicable international law,
Have agreed as follows:

Article 1 Objective
The objective of this Convention is to protect the human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds.

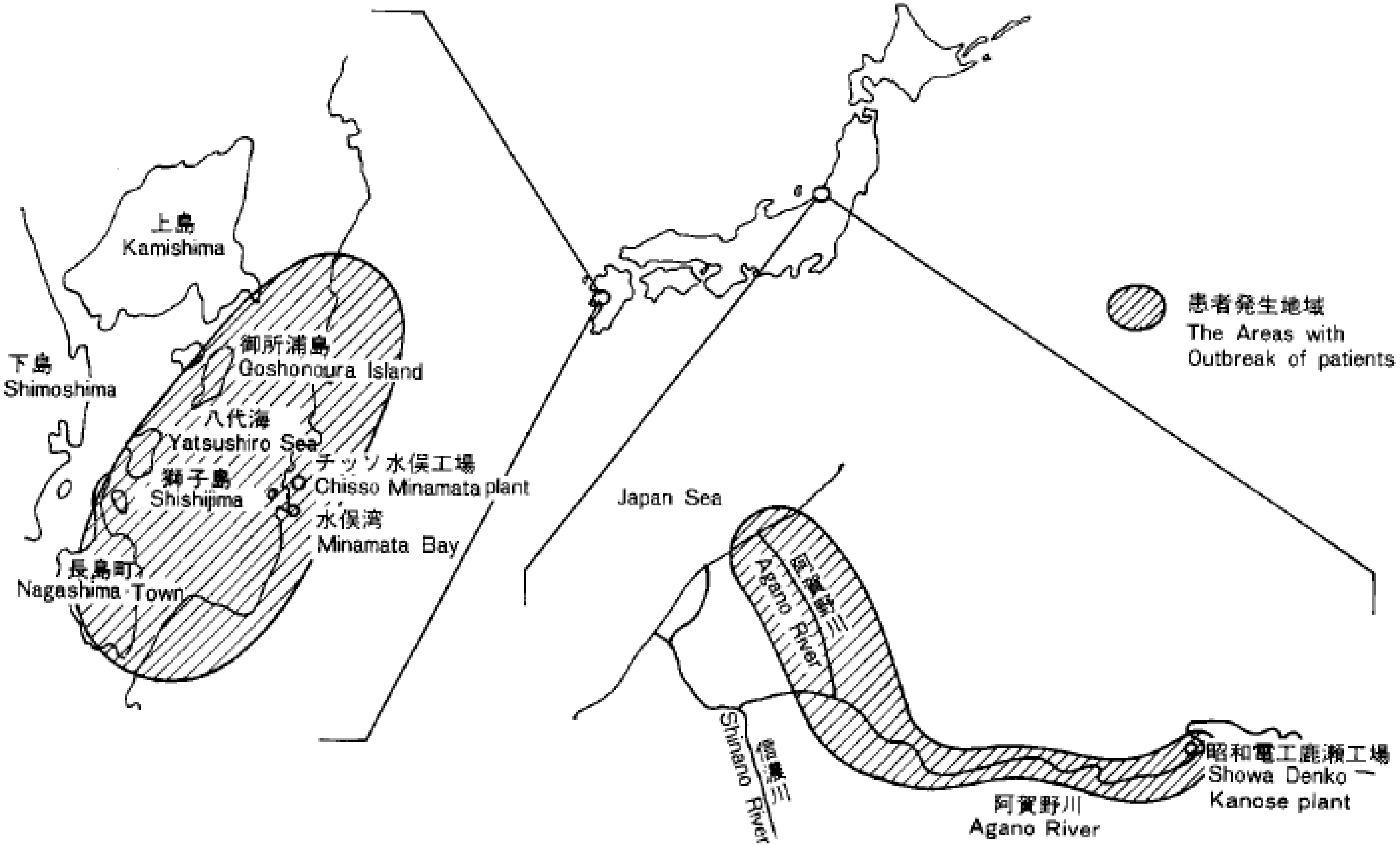
What is Minamata Disease?

Minamata Disease: 1950s – 60s, Japan

Poisoning from methyl-mercury through the consumption of fish contaminated by effluent from acetaldehyde plants situated in Minamata and Kanose, Japan.

Patients suffered from various damages to nervous system, in severe cases leading to death.

Some patients were exposed to mercury through placenta.



Minamata Disease – victims

Almost 3,000 people were officially certified as Minamata Disease patients, whose health damage were medically established as caused by mercury poisoning.

More than 30,000 people are recognized as Minamata Disease victims based on their exposure history and sensory disturbances.

Source: Ministry of the Environment of Japan (2002) “Minamata Disease – history and measures” http://www.env.go.jp/en/chemi/hs/minamata2002/

Minamata, Berlin Film Festival World Premiere

Friday, February 21, 2020

Minamata, a film featuring the Minamata Disease, a debilitating illness caused by mercury poisoning, premieres at the Berlin International Film Festival. Johnny Depp stars as W. Eugene Smith, a US war photographer, who with his wife Aileen Smith, documented the devastating effects of the disease on the local Japanese community in the 1970s.

At the time, many people in Minamata in southwest Japan, were suffering from this serious neurological disease having eating seafood contaminated with mercury from waste waters that a local company had discharged into the Minamata Bay for decades. The severe and widespread health damage from this pollution, at times leading to death, was also tragically passed from mothers to their unborn children.

The Minamata Convention on Mercury signed in 2013 in Kumamoto, Japan, in its preamble recognises the substantial lessons learned from this environmental disaster and calls on global action for such a tragedy never to be repeated. #MakeMercuryHistory

http://www.mercuryconvention.org/News/fromtheConvention/Minamata,BerlinFilmFestivalWorldPremiere/tabid/8336/language/en-US/Default.aspx
Minamata Disease - History and Measures: http://www.env.go.jp/en/chemi/hs/minamata2002/
Minamata film on Berlinale website: https://www.berlinale.de/en/programme/programme/detail.html?film_id=202007041

Tomoko in Her Bath, Minamata, Japan

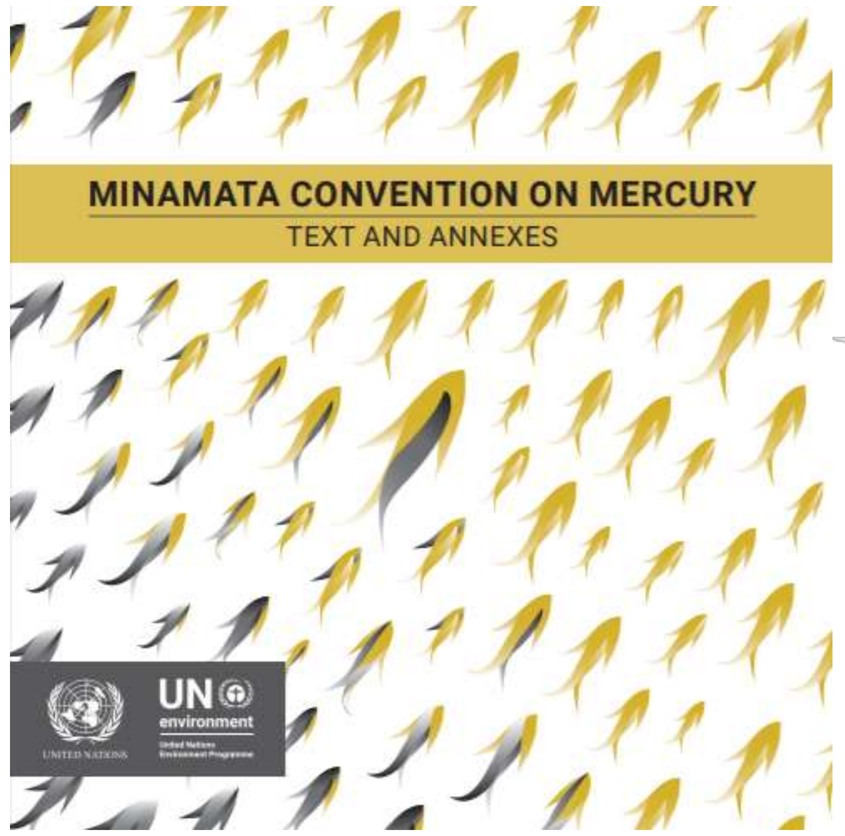
W. Eugene Smith, *Tomoko in Her Bath, Minamata, Japan,* 1972, gelatin silver print, Smithsonian American Art Museum, Transfer from the National Endowment for the Arts, 1983.63.1276 https://americanart.si.edu/artwork/tomoko-her-bath-minamata-japan-22604

W. Eugene Smith, *Shinobu Sakamoto*
https://www.icp.org/browse/archive/objects/shinobu-sakamoto-minamata-disease-victim

UN Conference on Human Environment, 1972

Minamata Convention COP-1, 2017 - See video.

Minamata Convention on Mercury



The Parties to this Convention,
Recognizing that mercury is a chemical of global concern owing to its long-range atmospheric transport, its persistence in the environment once anthropogenically introduced, its ability to bioaccumulate in ecosystems and its significant negative effects on human health and the environment,
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Aware of the health concerns, especially in developing countries, resulting from exposure to mercury of vulnerable populations, especially women, children, and, through them, future generations,
Noting the particular vulnerabilities of Arctic ecosystems and indigenous communities because of the biomagnification of mercury and contamination of traditional foods, and concerned about indigenous communities more generally with respect to the effects of mercury,
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Stressing the importance of financial, technical, technological, and capacity-building support, particularly for developing countries, and countries with economies in transition, in order to strengthen national capabilities for the management of mercury and to promote the effective implementation of the Convention,
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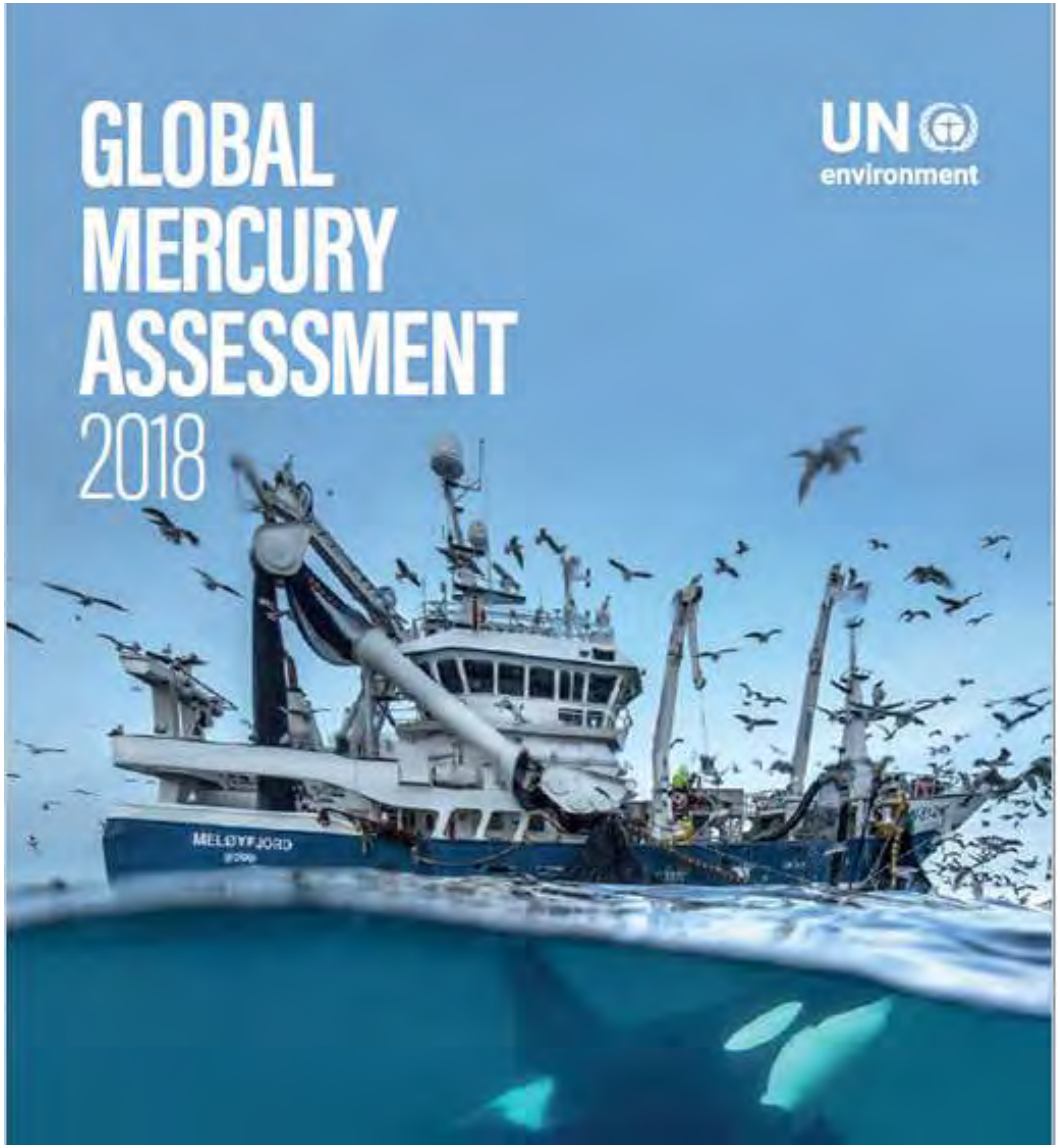
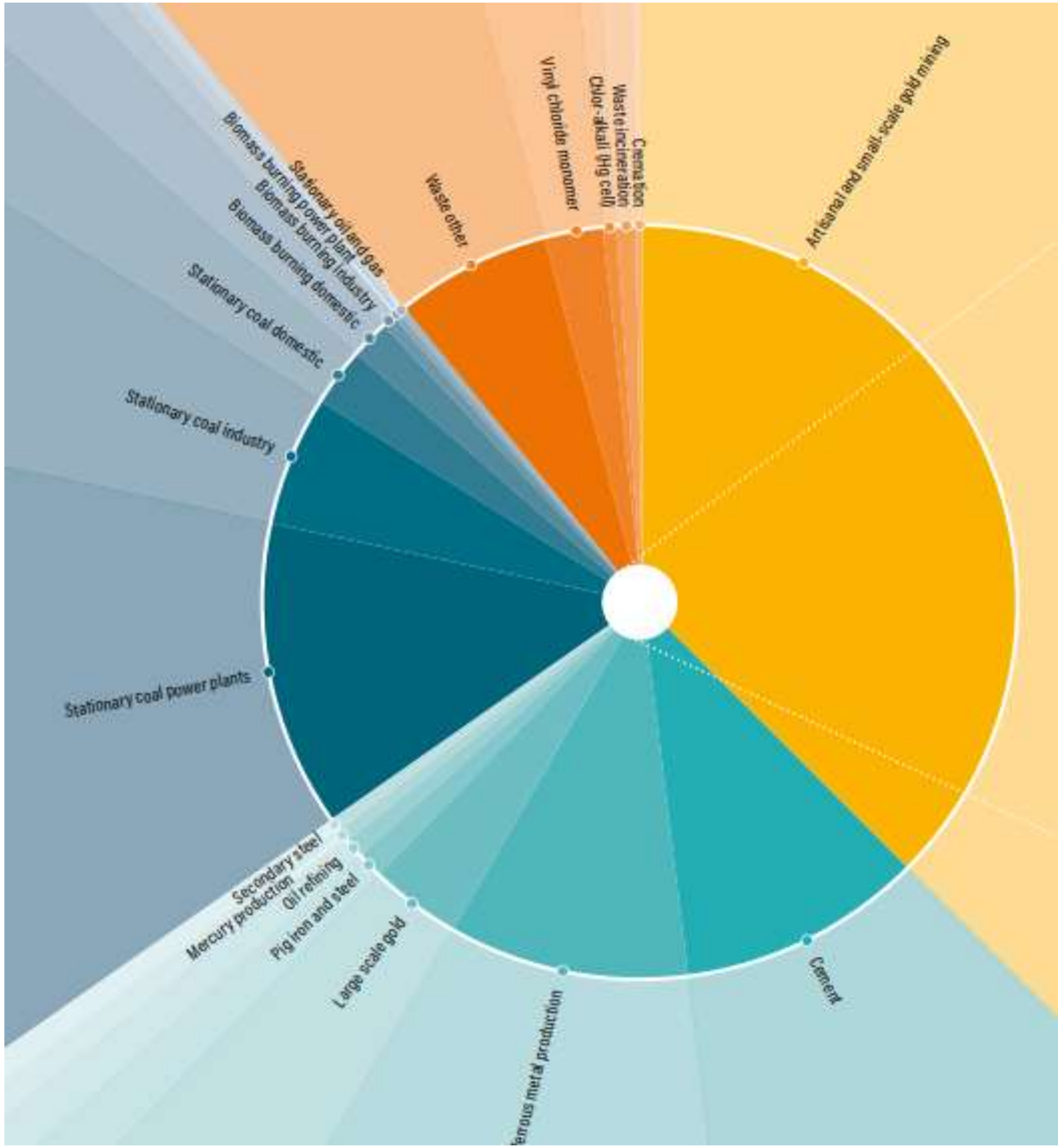
Emphasizing that nothing in this Convention is intended to affect the rights and obligations of any Party deriving from any existing international agreement,
Understanding that the above recital is not intended to create a hierarchy between this Convention and other international instruments,
Noting that nothing in this Convention prevents a Party from taking additional domestic measures consistent with the provisions of this Convention in an effort to protect human health and the environment from exposure to mercury in accordance with that Party's other obligations under applicable international law,
Have agreed as follows:

Article 1 Objective
The objective of this Convention is to protect the human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds.

Why a global convention on mercury?

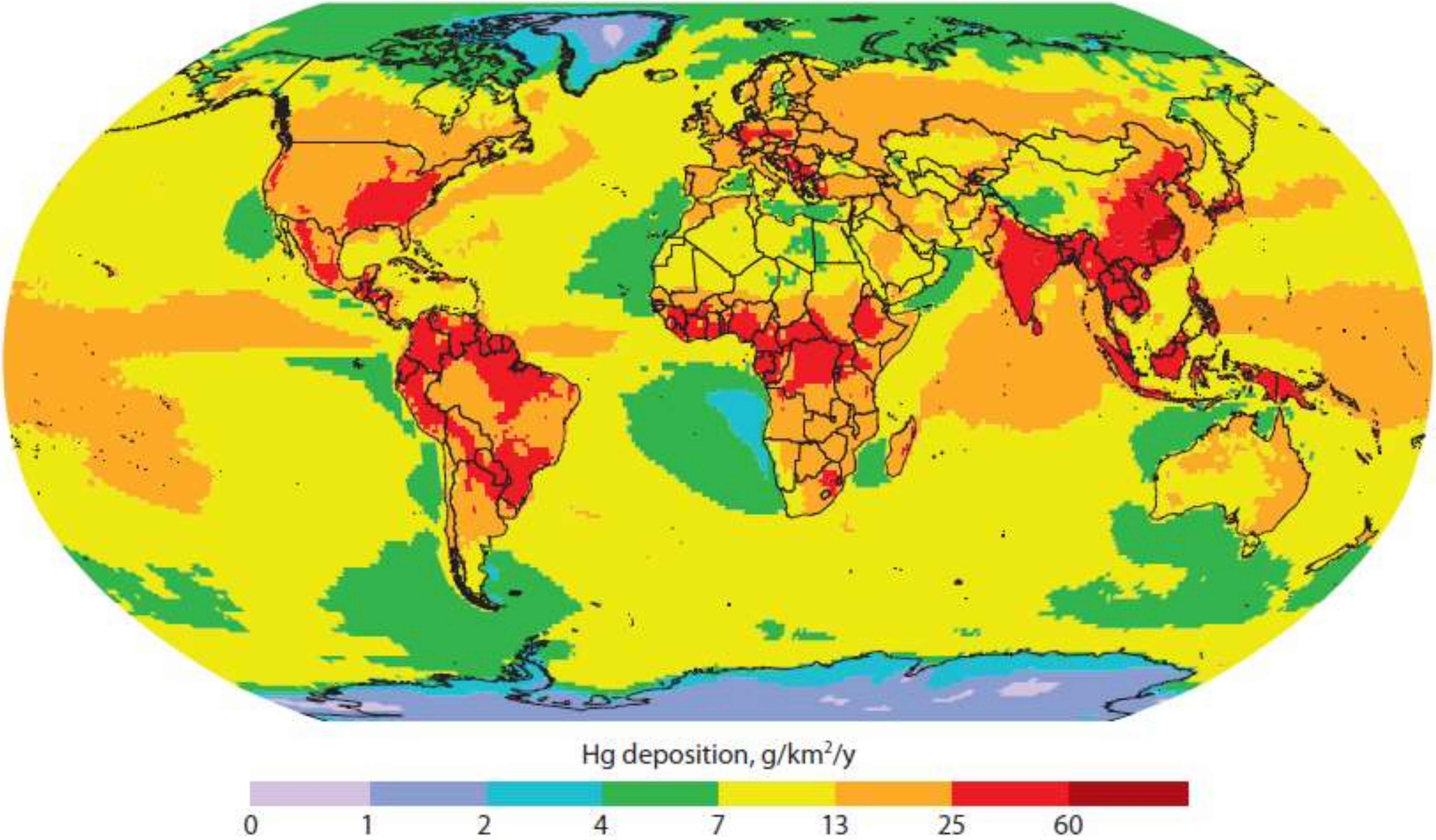
Atmosphere:
4400 (450%)
500
600
1000
2500
(2000-3000)
Biomass burning
Geogenic
Soil and vegetation
Anthropogenic
Deposition to land/ freshwater
Deposition to oceans
3600
3800
310%
Net Hg^0 evasion
3400
(2900-4000)
(250%)
600
Rivers
300 (130%)
Organic soils: 150 000 (15%)
Mineral soils: 800 000
Surface ocean: 2600 (230%)
Intermediate waters:
120 000 (25%)
Deep waters:
190 000 (12%)
100
Net vertical transport
Particle removal
Anthropogenic Hg masses (t) and fluxes (t/y)
Natural Hg masses (t) and fluxes (t/y)
Re-emission/Re-mobilization (natural and legacy Hg, t/y)


GLOBAL
MERCURY
ASSESSMENT
2018
UN
environment
MELØYFJORD

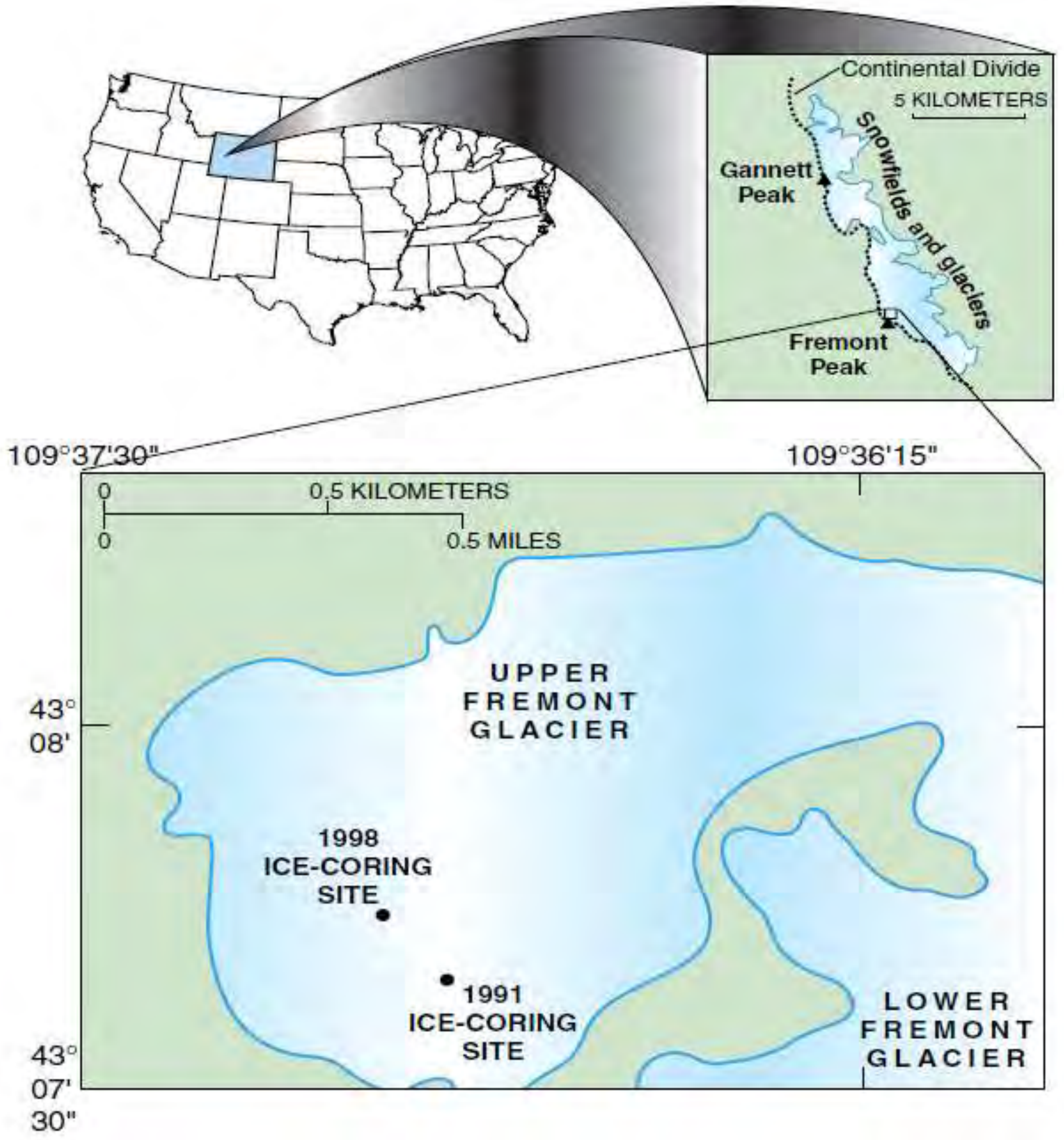

Artisanal and small-scale gold mining
Cremation
Waste incineration
Chlor-alkali (Hg cell)
Vinyl chloride monomer
Waste other
Stationary oil and gas
Biomass burning power plant
Biomass burning industry
Biomass burning domestic
Stationary coal domestic
Stationary coal industry
Stationary coal power plants
Secondary steel
Mercury production
Oil refining
Pig iron and steel
Large scale gold
Cement

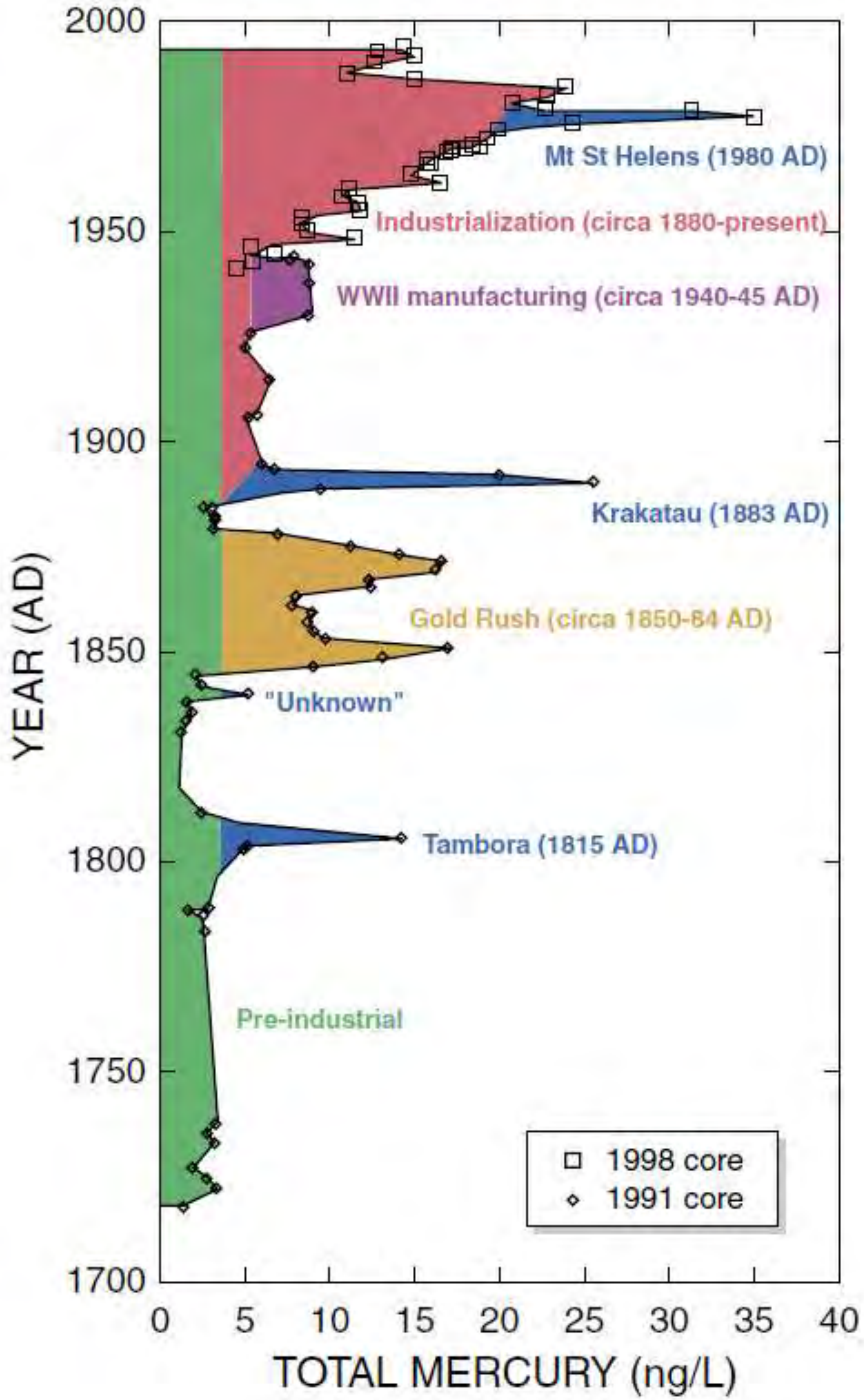
Global Mercury Assessment https://www.unep.org/explore-topics/chemicals-waste/what-we-do/mercury/global-mercury-assessment

Global distribution – estimation by modelling



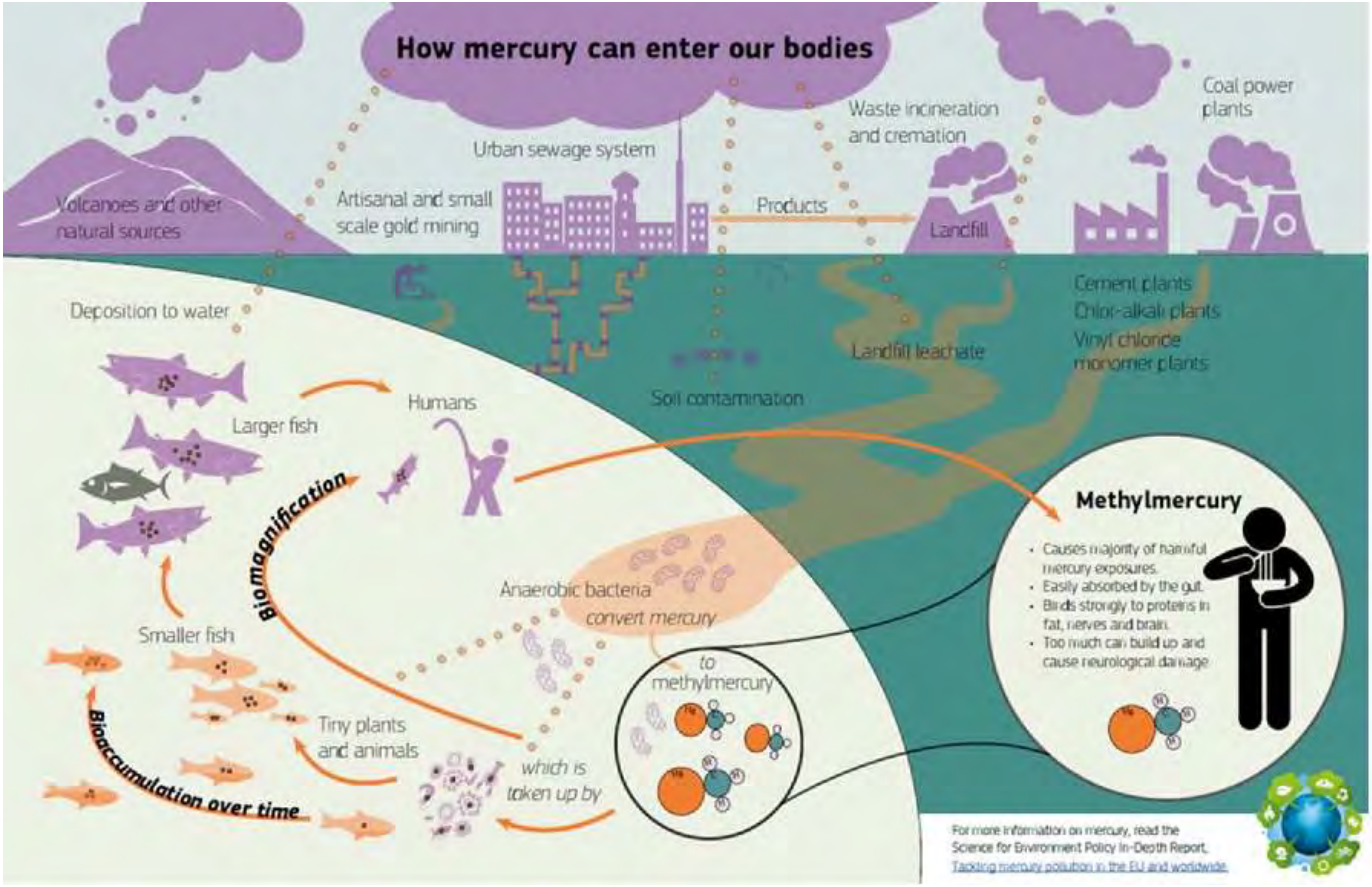
Glacial Ice Cores Reveal A Record of Natural and Anthropogenic Atmospheric Mercury Deposition for the Last 270 Years



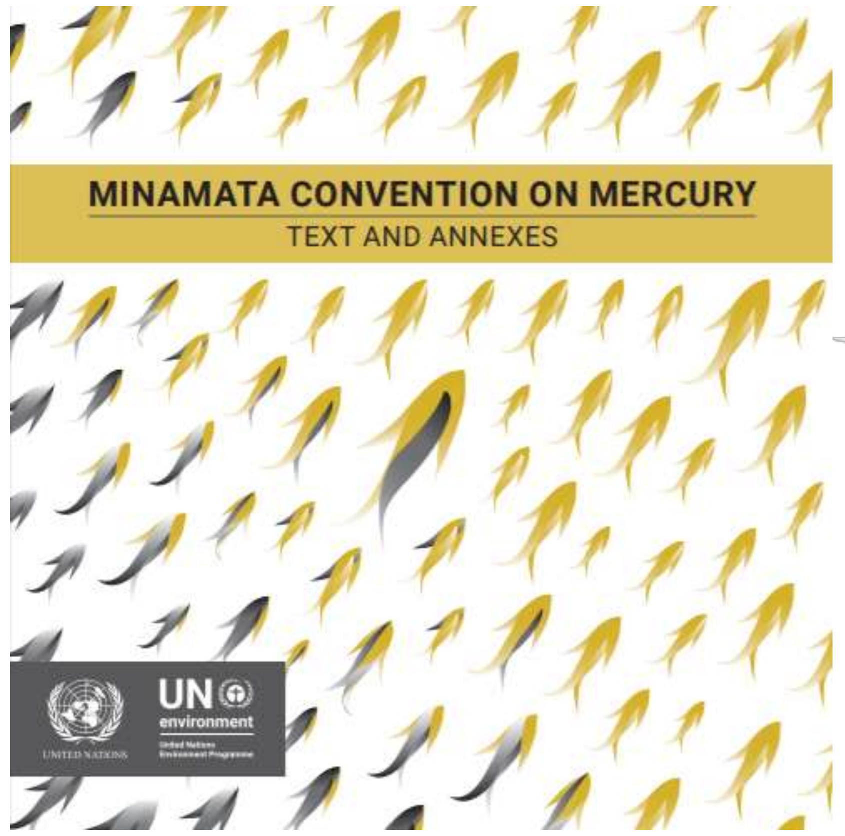


Atmospheric mercury deposition corresponds to volcanic and anthropogenic events over the past 270 years. Preindustrial deposition rates can be conservatively extrapolated to present time (4 ng/L; in green) to illustrate the increase during the past 100 years (in red) and significant decreases in the past 15-20 years.

USGS 2002, https://toxics.usgs.gov/pubs/FS-051-02/pdf/fs-051-02.pdf


How mercury can enter our bodies
Volcanoes and other natural sources
Artisanal and small scale gold mining
Urban sewage system
Products
Waste incineration and cremation
Landfill
Coal power plants
Cement plants
Chlor-alkali plants
Vinyl chloride monomer plants
Deposition to water
Soil contamination
Landfill leachate
Humans
Larger fish
Biomagnification
Smaller fish
Tiny plants and animals
Bioaccumulation over time
Anaerobic bacteria convert mercury to methylmercury
which is taken up by
Methylmercury
Causes majority of harmful mercury exposures.
Easily absorbed by the gut.
Binds strongly to proteins in fat, nerves and brain.
Too much can build up and cause neurological damage
For more information on mercury, read the Science for Environment Policy In-Depth Report, Tackling mercury pollution in the EU and worldwide.

Minamata Convention on Mercury



How was Minamata Convention born?

The Parties to this Convention,

Recognizing that mercury is a chemical of global concern owing to its long-range atmospheric transport, its persistence in the environment once anthropogenically introduced, its ability to bioaccumulate in ecosystems and its significant negative effects on human health and the environment,

Recalling decision 25/5 of 20 February 2009 of the Governing Council of the United Nations Environment Programme to initiate international action to manage mercury in an efficient, effective and coherent manner,

Recalling paragraph 221 of the outcome document of the United Nations Conference on Sustainable Development "The future we want", which called for a successful outcome of the negotiations on a global legally binding instrument on mercury to address the risks to human health and the environment,

Recalling the United Nations Conference on Sustainable Development's reaffirmation of the principles of the Rio Declaration on Environment and Development, including, inter alia, common but differentiated responsibilities, and acknowledging States' respective circumstances and capabilities and the need for global action,

Aware of the health concerns, especially in developing countries, resulting from exposure to mercury of vulnerable populations, especially women, children, and, through them, future generations,

Noting the particular vulnerabilities of Arctic ecosystems and indigenous communities because of the biomagnification of mercury and contamination of traditional foods, and concerned about indigenous communities more generally with respect to the effects of mercury,

Recognizing the substantial lessons of Minamata Disease, in particular the serious health and environmental effects resulting from the mercury pollution, and the need to ensure proper management of mercury and the prevention of such events in the future,

Stressing the importance of financial, technical, technological, and capacity-building support, particularly for developing countries, and countries with economies in transition, in order to strengthen national capabilities for the management of mercury and to promote the effective implementation of the Convention,

Recognizing also the activities of the World Health Organization in the protection of human health related to mercury and the roles of relevant multilateral environmental agreements, especially the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal and the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade,

Recognizing that this Convention and other international agreements in the field of the environment and trade are mutually supportive,

Emphasizing that nothing in this Convention is intended to affect the rights and obligations of any Party deriving from any existing international agreement,

Understanding that the above recital is not intended to create a hierarchy between this Convention and other international instruments,

Noting that nothing in this Convention prevents a Party from taking additional domestic measures consistent with the provisions of this Convention in an effort to protect human health and the environment from exposure to mercury in accordance with that Party's other obligations under applicable international law,

Have agreed as follows:

Article 1 Objective

The objective of this Convention is to protect the human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds.


2002
2003
2004
2005
2006
2007
2008
2009
2010
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2012
2013
2014
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2016
2017
Adoption of the Minamata Convention
UNEP GC 25
Diplomatic Conference
INC 6
INC 7
INC1 - INC 5
Intergovernmental Negotiating Committee
COP / 1
UNEP GC 24
UNEP Global Mercury Partnership
Global Mercury Assessment
Mercury Inventory Toolkit
Supply, Demand and Trade Report
Global Mercury Assessment
Global Mercury Assessment
Global Mercury Assessment
UNITED NATIONS ENVIRONMENT PROGRAMME
CHEMICALS
GLOBAL MERCURY ASSESSMENT
Hg
Toolkit for Identification and Quantification of Mercury Releases
Guideline for Inventory Level 1
Version 1.2
SUMMARY OF SUPPLY, TRADE AND DEMAND INFORMATION ON MERCURY
The Global Atmospheric Mercury Assessment: Sources, Emissions and Transport
Global Mercury Assessment 2013
Sources, Emissions, Releases and Environmental Transport
GLOBAL MERCURY ASSESSMENT 2018
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017

Global Mercury Assessments 2002–2018: Global cycle

- GMA 2002 (Figure above) estimated that the level of global mercury cycle was about three times that of the pre-industrial era level.
- GMA 2018 estimates a global mercury level 5.5 times higher than what it should be without human activities, i.e., at its natural level.

Minamata Convention Timeline

Adoption of text and opening for signature (Kumamoto, Japan) : 10-11 October 2013

Entry into Force: 16 August 2017

First Conference of the Parties (Geneva) 24 to 29 September 2017
President: Switzerland

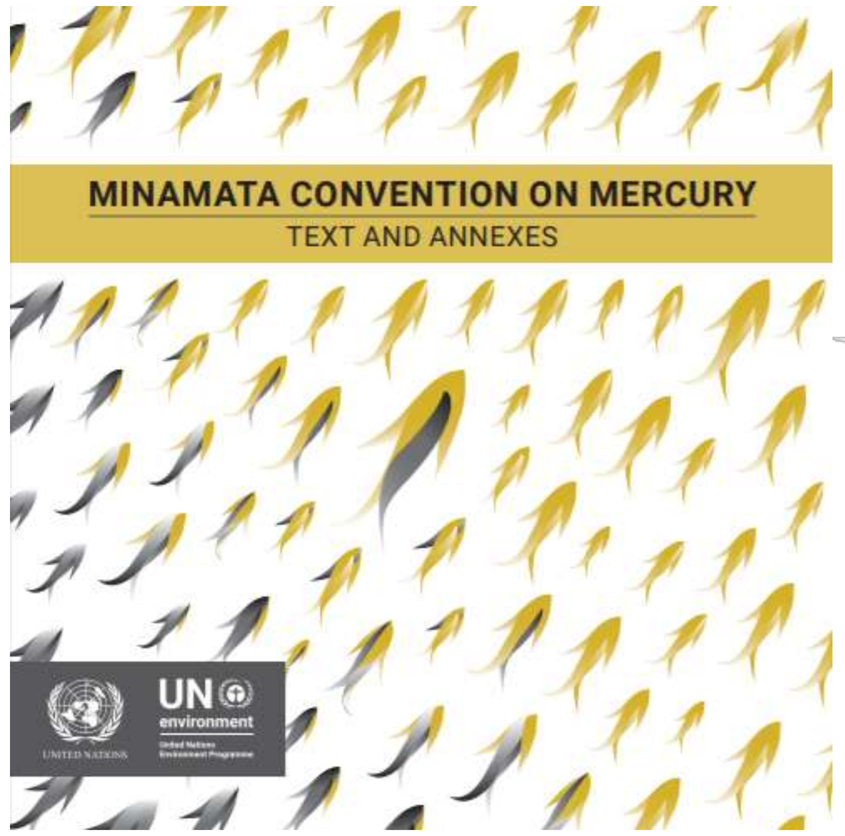
Second Conference of the Parties (Geneva) 19 to 23 November 2018
President: Switzerland

Third Conference of the Parties (Geneva) 25 to 29 November 2019
President: Zambia

Fourth Conference of the Parties (Bali) 1 to 5 November 2021
President: Indonesia

127 parties, 128 signatories, as at 14 March 2021

Minamata Convention on Mercury



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What does Minamata Convention do?

Minamata Convention Controls the whole life cycle of mercury

Article 3: Supply Guidance on identifying mercury stocks (COP-1)

Trade Guidance and format for import consent (COP-1)

Article 4: Products

Article 5: Processes

Article 7: ASGM NAP guidance (COP-1)

Article 8: Emissions BAT/BEP and inventory guidance (COP-1)

Article 9: Releases Inventory guidance (expected COP-4)

Article 10: Storage

Interim storage guidelines (COP-2)

Article 11: Waste

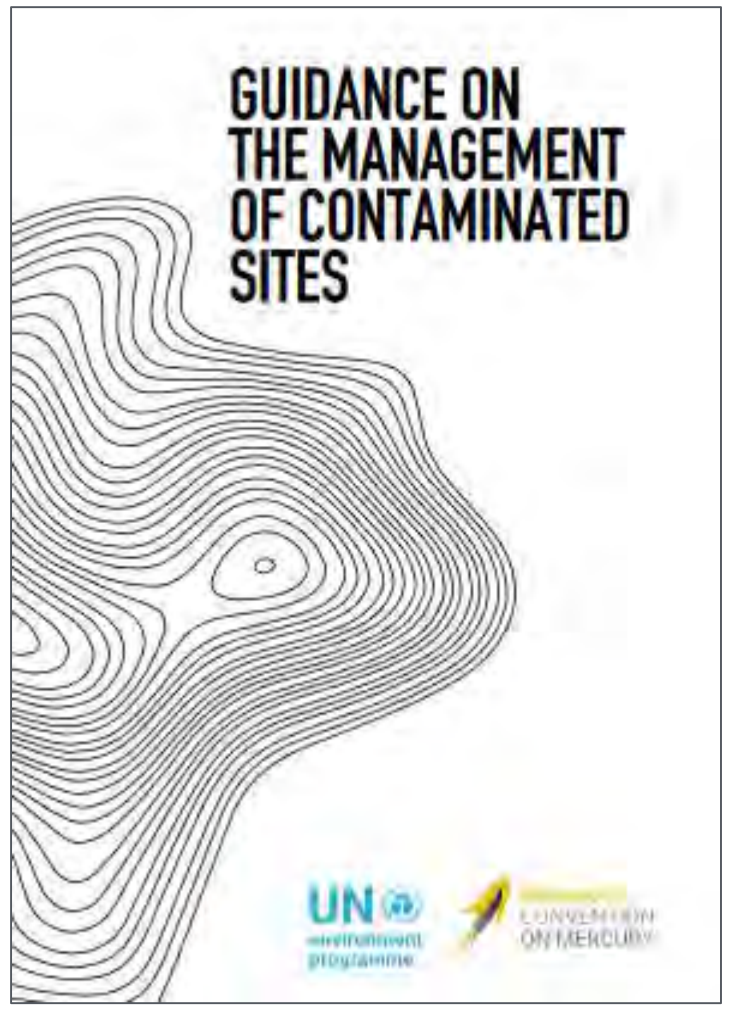
Basel Convention guidelines

Article 12: Contaminated sites

Guidance on management (COP-3)

Life cycle of mercury

Technical guidance available from Convention website.



Forms and guidance documents

At its first meeting, the Conference of the Parties to the Minamata Convention on Mercury adopted forms and guidance to assist Parties with its effective implementation.

These forms and guidance, as adopted, are presented below.

Arabic | Chinese | English | French | Russian | Spanish

Article	Adopted	Title	File	Further information
Article 3	COP1 MC-1/2	Forms related to Article 3 on Mercury trade		
Article 3	COP1 MC-1/2	Guidance on completing the forms required under article 3 related to trade in mercury		
Article 3	COP1 MC-1/2	Guidance on the identification of individual stocks of mercury or mercury compounds exceeding 50 metric tons and sources of mercury supply generating stocks exceeding 10 metric tons per year		
Article 6	COP1 MC-1/12	Format for the registration of exemptions for the products and processes listed in Part I of Annexes A and B		
Article 7	COP1 MC-1/13	Guidance on developing a national action plan to reduce and, where feasible, eliminate mercury use in artisanal and small-scale gold mining		UNEP website on National Action Plans
Article 8	COP1 MC-1/14	Guidance on Best Available Techniques and Best Environmental Practices - Taking into account any difference between new and existing sources and the need to minimize cross-media effects (Including guidance on support for Parties in implementing the measures set out in paragraph 5, in particular in determining goals and in setting emission limit values)		
Article 8	COP1 MC-1/16	Guidance on criteria that Parties may develop pursuant to paragraph 2(b)		
Article 8	COP1 MC-2/6	Guidance on the methodology for preparing inventories of emissions		Mercury inventory toolkit
Article 10	COP2	Guidelines on the environmentally sound interim storage of mercury other than waste mercury		
Article 11	Basel Convention	Technical guidelines on the environmentally sound management of wastes consisting of, containing or contaminated with mercury or mercury compounds		Basel Convention website
Article 12	COP3 MC-3/8	Guidance on the management of contaminated sites		Technical information supplementing the guidance
Article 16	WHO	Strategic planning for implementation of the health-related articles of the Minamata Convention on Mercury		WHO Website
Article 21	COP1 MC-1/8	Reporting format		National Report pursuant to Article 21

Article 3: Mercury supply sources and trade

Primary mercury mining

- Each Party shall not allow primary mercury mining that was not being conducted at the date of entry into force of the Convention for it (EIF)
- Each Party shall only allow primary mercury mining that was being conducted (at EIF) for a period of up to 15 years
- Uses of mercury from existing primary mines limited to products and processes according to Articles 4 and 5 or disposal – no use in ASGM

Stocks

- Parties to endeavour to identify individual mercury stocks (>50 tonnes) and sources of stocks (>10 tonnes pa) and to take measures for the disposal of excess mercury from the decommissioning of chlor-alkali plants

Article 3: Mercury supply sources and trade

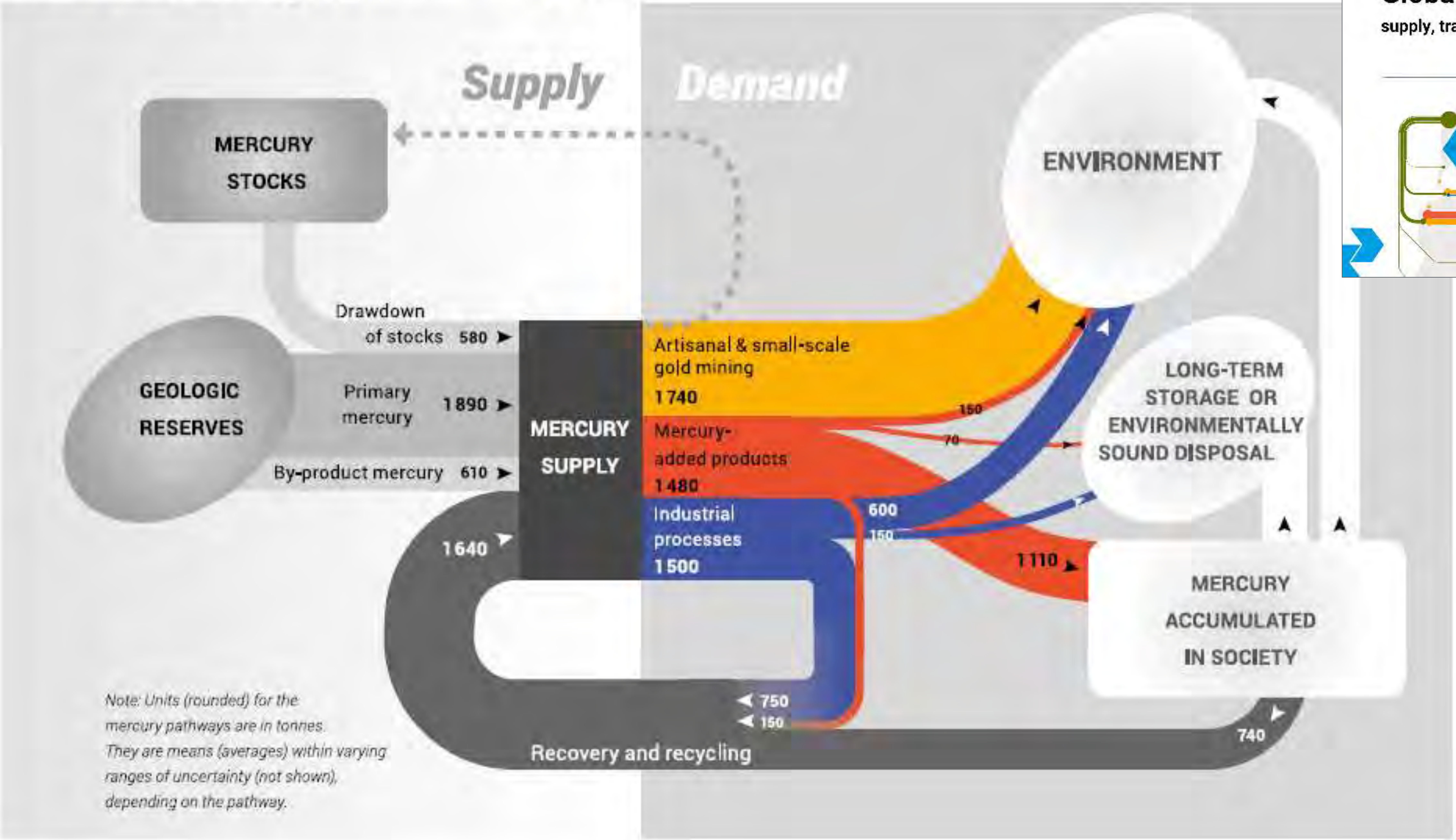
Trade - No export of mercury except:

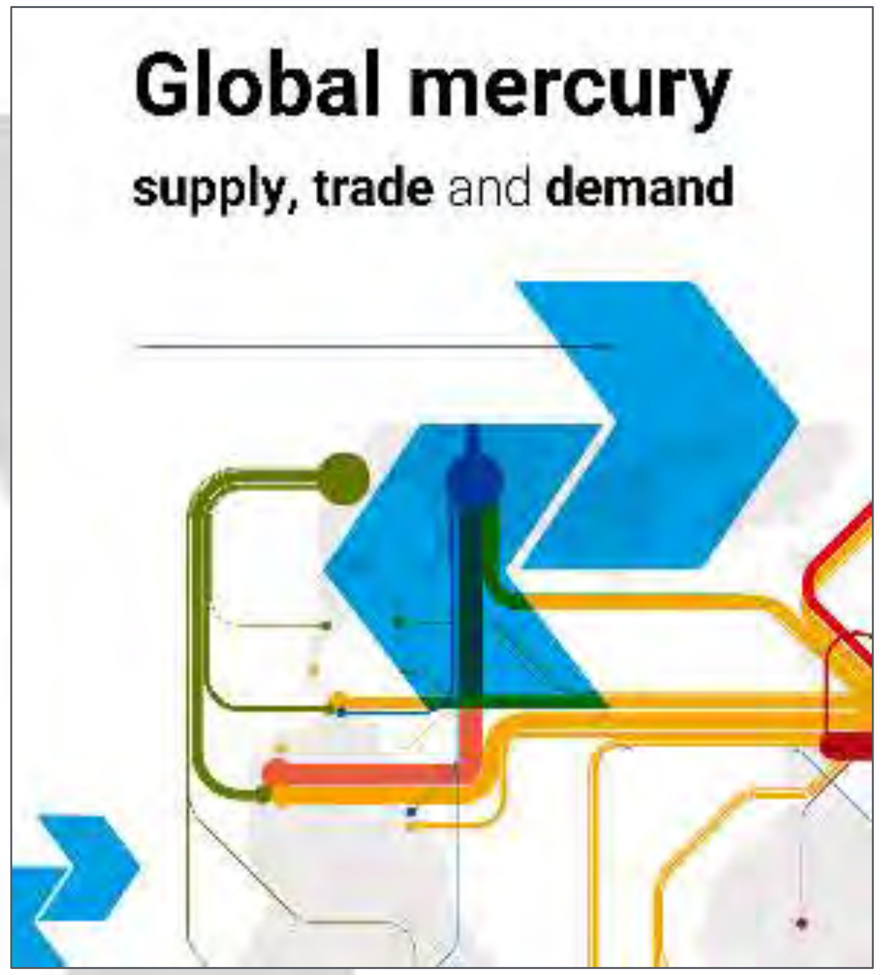
- ***To a Party*** that has provided the exporting Party with its written consent, and only for the purpose of a use allowed or environmentally sound interim storage (Article 10)

- ***To a non-Party*** that has provided the exporting Party with its written consent, including certification demonstrating that measures are in place to ensure the protection of human health and the environment and to ensure its compliance with Articles 10 and 11; and only for a use allowed or for environmentally sound interim storage.

No import of mercury from non-Parties unless – written consent and certification that the mercury is not from sources identified as not allowed (primary mercury mining or excess mercury from the decommissioning of chlor-alkali facilities)

Global mercury supply and demand, 2015





https://web.unep.org/globalmercurypartnership/global-mercury-supply-trade-and-demand

Primary mercury mining and byproduct mercury

Table 3. Global primary mercury mining, 2015

Country or region	Mercury marketed (tonnes)
China	800 – 1 000
Mexico	400 – 600
Indonesia	400 – 500
Kyrgyz Republic	30 – 50
Peru and other countries	minimal
TOTAL	**1 630 – 2 150**

Table 4. Global by-product mercury production, 2015

Country or region	By-product source	Mercury captured (tonnes)	Mercury marketed (tonnes)*
Russia	Gold ores	40-70	40-70
Peru, Chile, Argentina	Gold, zinc, copper ores	150-200	100-150
Tajikistan	Antimony ores	30-40	20-30
China	Zinc, antimony ores	120-240	100-200
United States	Gold, silver ores	150-250	20-30
European Union	Non-ferrous concentrates	no estimate	50-100
Mexico	Silver ores	25	25
Japan	Zinc ores	20-30	20-30
Other countries	Zinc ores	100-300	20-60
Other countries	Gold, copper, lead, antimony ores	100-200	30-50
All countries	Natural gas	30-100	15-30
TOTAL		**765-1 455**	**440-775**

* Including mercury sold on the domestic market as well as for export, where permitted.

Mercury consumption by region and by sector

Region	ASGM	VCM production	Chlor-alkali production	Batteries	Dental applications	Measuring and control devices	Lamps	Electrical and electronic devices	Hg compounds and other applications[2]	Regional totals
	mean[3]	mean[3]	mean[3]	mean[3]	mean[3]	mean[3]	mean[3]	mean[3]	mean[3]	mean[3]
East and Southeast Asia	645	1 215	8	95	52	208	69	52	62	2 407
South Asia	4	5	27	33	72	39	12	12	59	263
European Union (28 countries)	0	0	85	8	56	3	13	1	84	249
CIS and other European countries	24	6	45	13	19	12	7	7	37	171
Middle Eastern States	0	0	38	13	13	18	7	9	9	107
North Africa	0	0	11	8	4	6	4	2	5	41
Sub-Saharan Africa	366	0	1	24	7	11	5	19	15	447
North America	0	0	8	9	32	2	8	19	61	137
Central America and the Caribbean	16	0	19	9	6	9	4	6	8	78
South America	680	0	35	18	12	20	9	8	13	794
Australia, New Zealand and Oceania	0	0	0	1	3	1	3	13	1	22
Total per application	**1 735**	**1 226**	**277**	**231**	**274**	**330**	**142**	**147**	**354**	**4 715**

Figure 4. Global mercury trade as reported by the importing countries, 2015

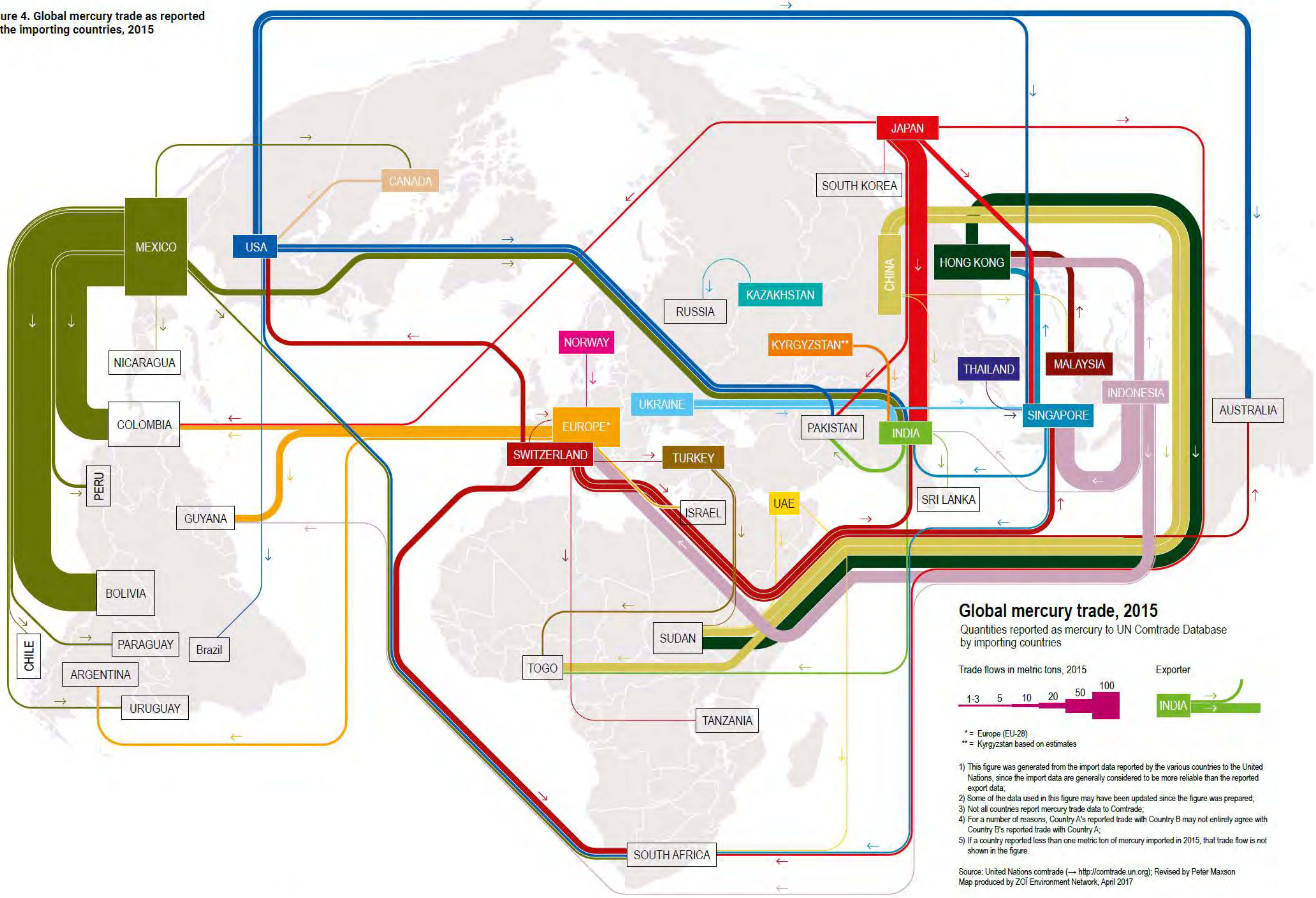
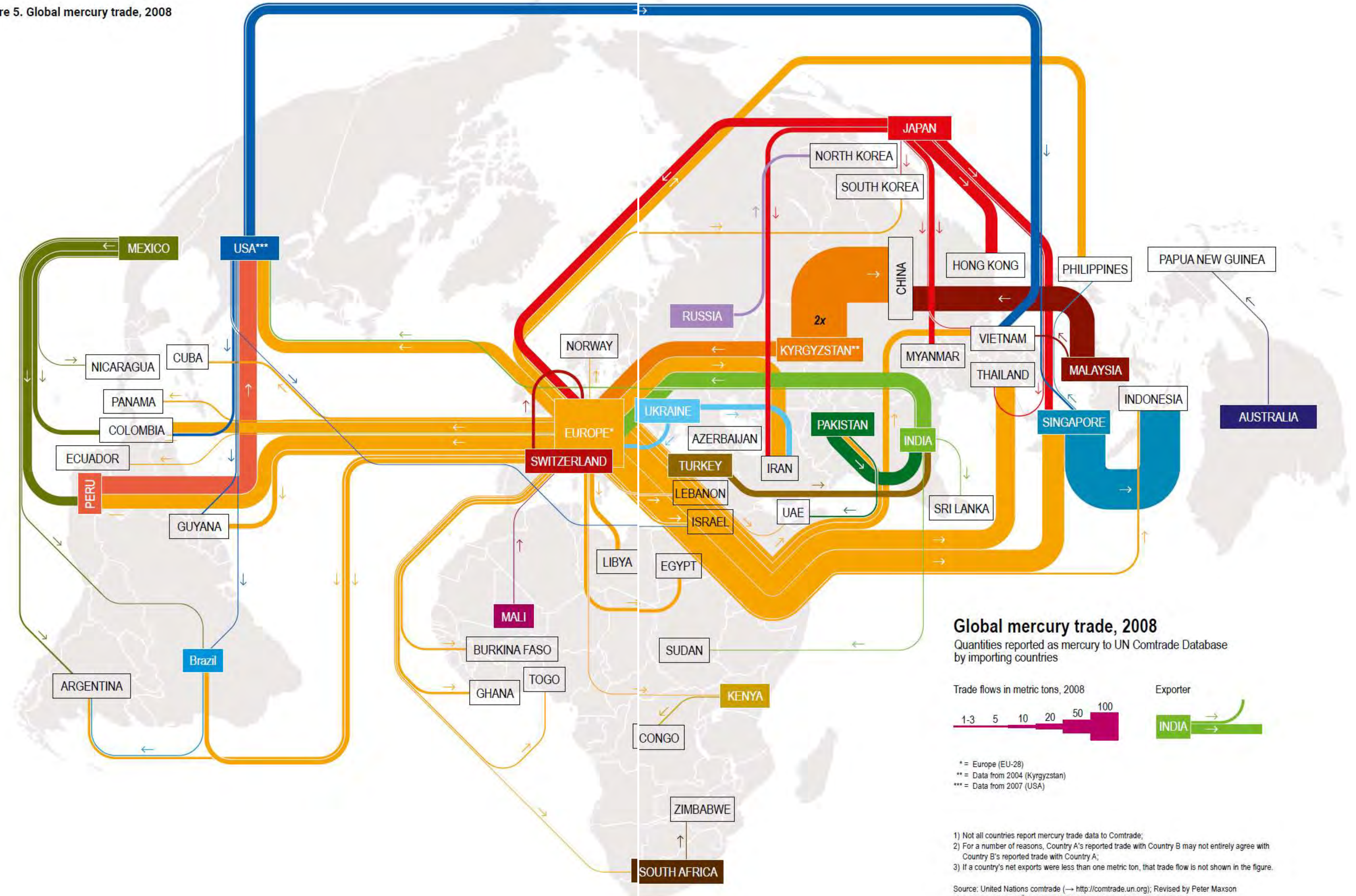


Figure 5. Global mercury trade, 2008



Global mercury trade in 2018 – from UN COMTRADE

Total mercury used by countries for ASGM, and estimated informal imports

GRID-Arendal 2019 "The Illegal Trade in Chemicals"

Article 4: Mercury-added products

Parties shall not allow manufacture, import or export of mercury-added products in part I of Annex A after the phase out date (2020, which may be extended to 2025)

- Batteries
- Switches and relays
- Lamps
- Cosmetics
- Pesticides, biocides and topical antiseptics
- Measuring devices (barometers, hygrometers, manometers, thermometers, sphygmomanometers)

Parties shall take measures for products in Part II of Annex A

- Dental amalgam

Article 5: Manufacturing processes

Controls the **manufacturing processes** using mercury.

- Phase out the use of mercury in **chlor-alkali production** by 2025
- Phase out the use of mercury in **acetaldehyde production** by 2018
- **Vinyl chloride monomer production**: reduce the use of mercury in terms of per unit production by 50 per cent by the year 2020 against 2010 use;
- **Sodium or potassium methylate or ethylate** and **production of polyurethane**: take measures to reduce the use of mercury aiming at the phase out of this use as fast as possible and within 10 years of the entry into force

Annexes A and B – Products and processes

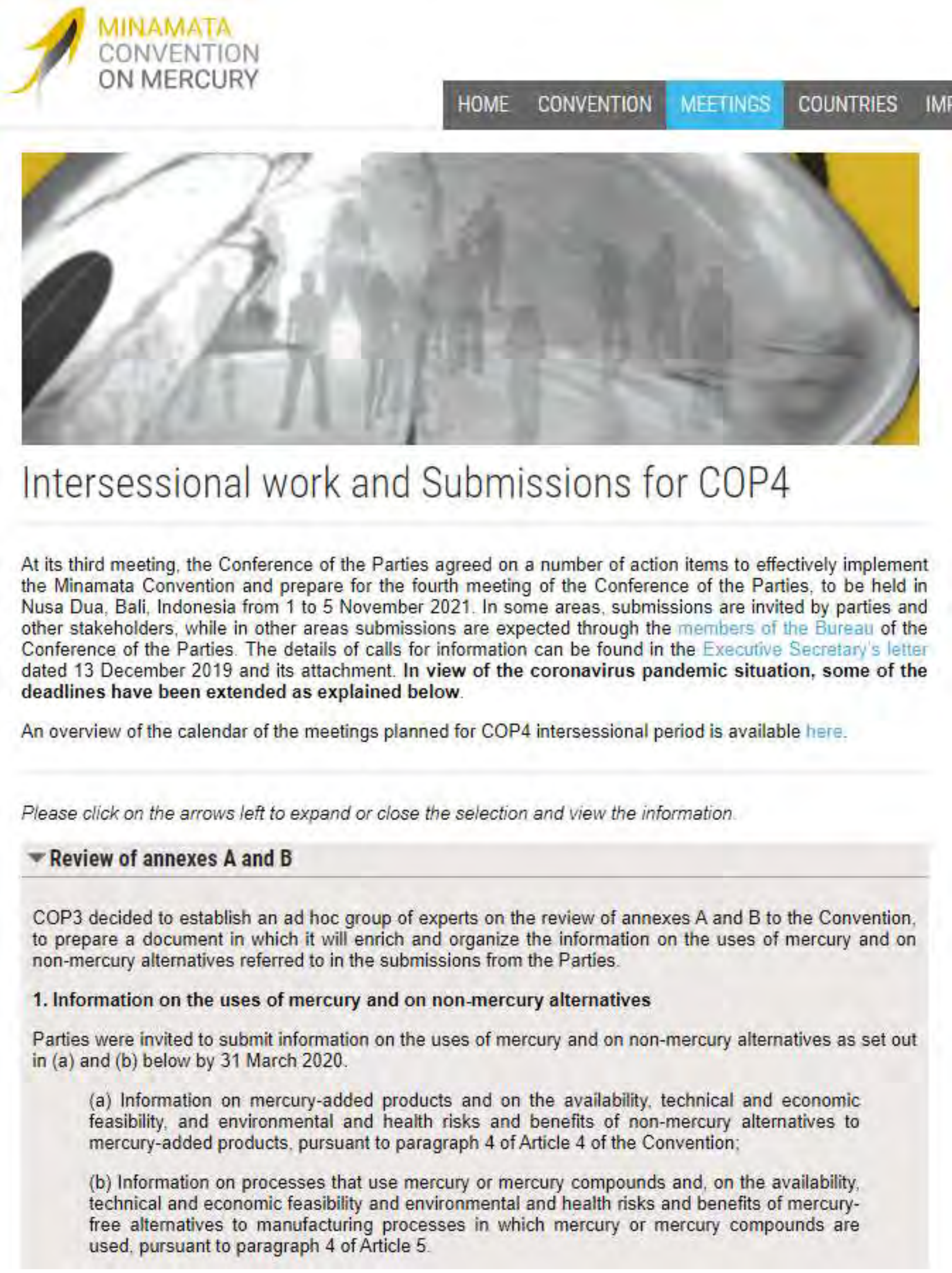
Annex A lists mercury-added products to be phased out by 2020 – batteries, switches, lamps, cosmetics, thermometers, etc.

Annex B lists industrial processes using mercury to be addressed – chlor-alkali production, vinyl chloride monomer production, etc.

COP is to review these annexes no later than 2022.

COP-3 established an Ad hoc Group of Experts for the review.

The group is reviewing the information submitted by Parties and other stakeholders, and will submit a report by 30 April 2021. Information on the work of the ad hoc group is available from the website.



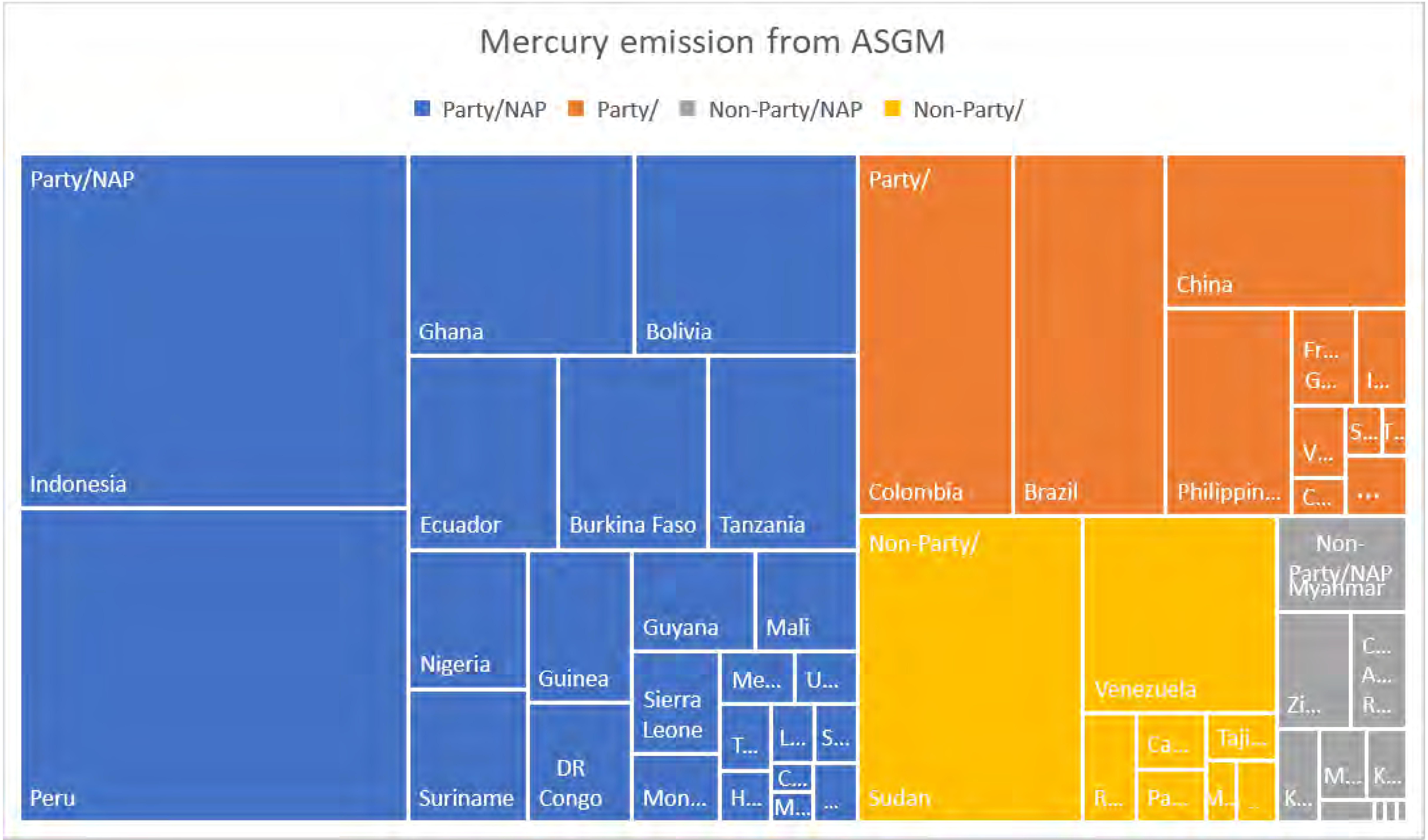
Article 7: Artisanal and small-scale gold mining

Requests parties to develop national action plan (NAP) on **artisanal and small-scale gold mining (ASGM)**, including:

- National objectives and reduction targets;
- Actions to eliminate the worst practice (whole ore amalgamation etc)
- Steps to facilitate the formalization or regulation of the ASGM sector;
- Baseline estimates of mercury use in ASGM
- Strategies for the reduction of emissions and releases of and exposure to mercury
- A public health strategy

COP-1 adopted guidance on developing NAP.

COP-3 requested the Secretariat to develop guidance on the management of ASGM tailings.


Mercury emission from ASGM
Party/NAP
Party/
Non-Party/NAP
Non-Party/
Party/NAP
Indonesia
Peru
Ghana
Bolivia
Ecuador
Burkina Faso
Tanzania
Nigeria
Suriname
Guinea
DR Congo
Guyana
Mali
Sierra Leone
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M...
Party/
Colombia
Brazil
China
Philippin...
Fr... G...
I...
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Non-Party/
Sudan
Venezuela
R...
Ca...
Pa...
Taji...
M...
Non-Party/NAP
Myanmar
Zi...
C...
A...
R...
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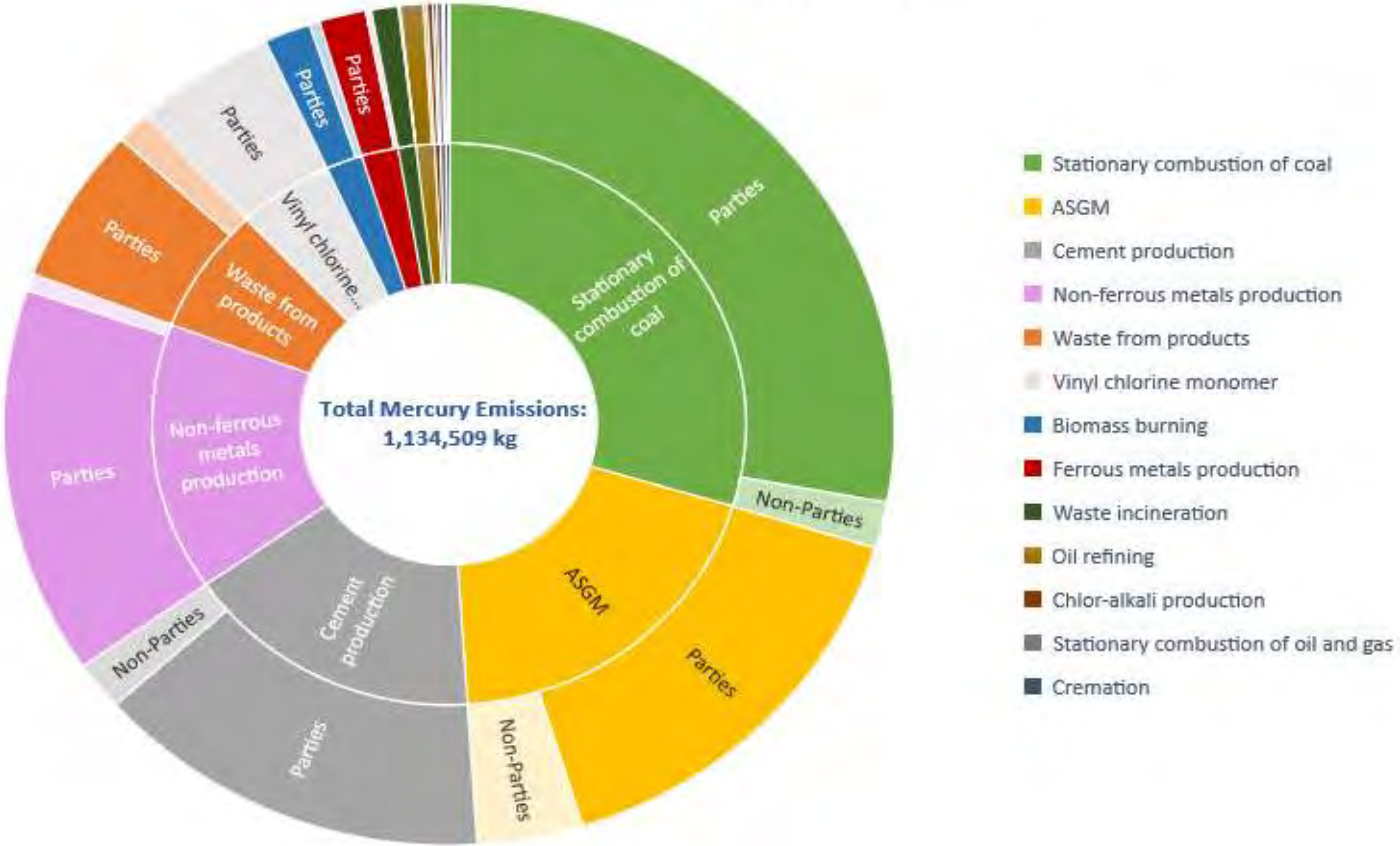
Article 8: Emissions

Controls the **emissions** of total mercury from

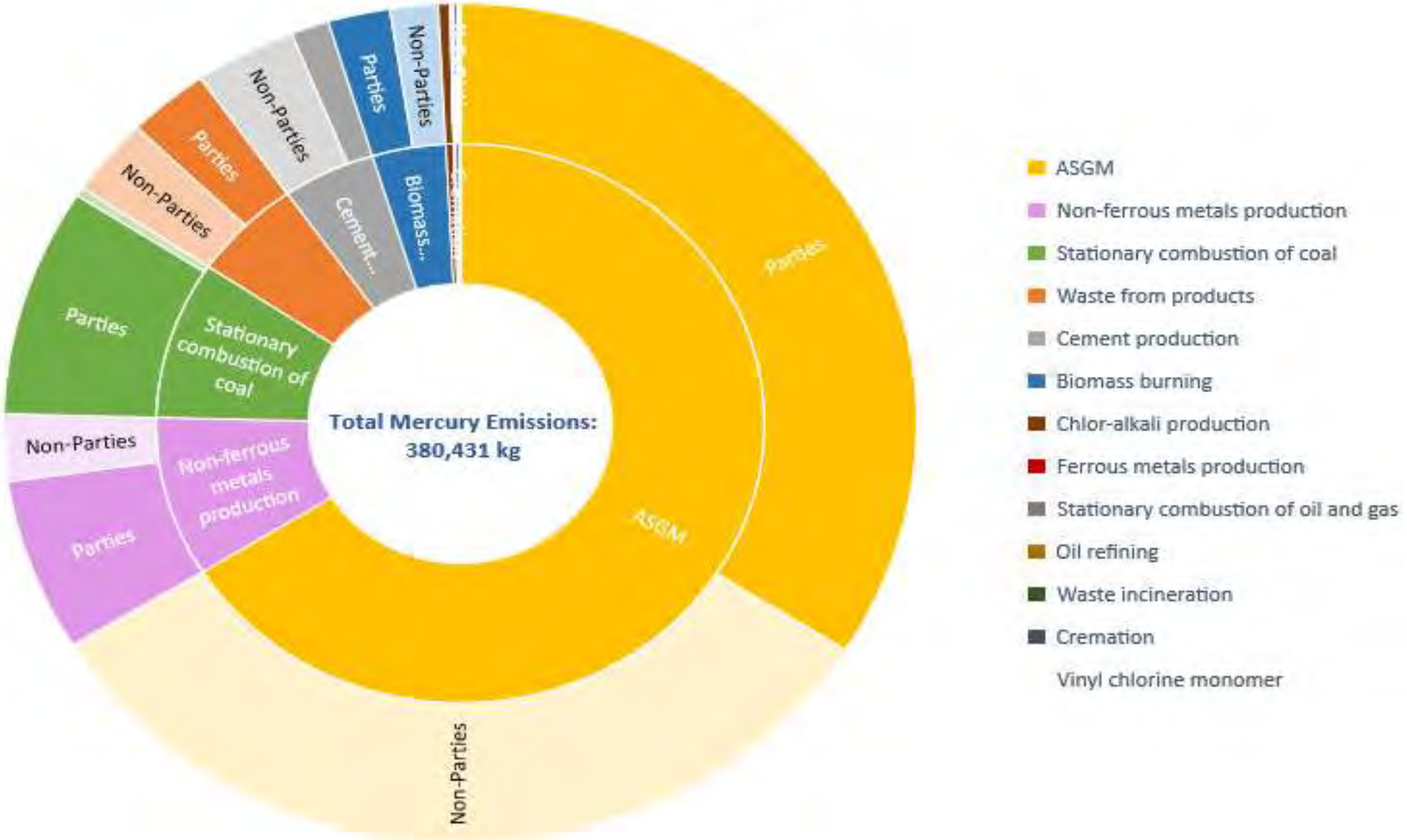
- Coal-fired power plants;
- Coal-fired industrial boilers;
- Smelting and roasting processes used in the production of non-ferrous metals (lead, zinc, copper and industrial gold);
- Waste incineration facilities;
- Cement clinker production facilities.

COP-1 adopted **guidance on emission inventory** and best available techniques/ best environmental practices (**BAT/BEP**)

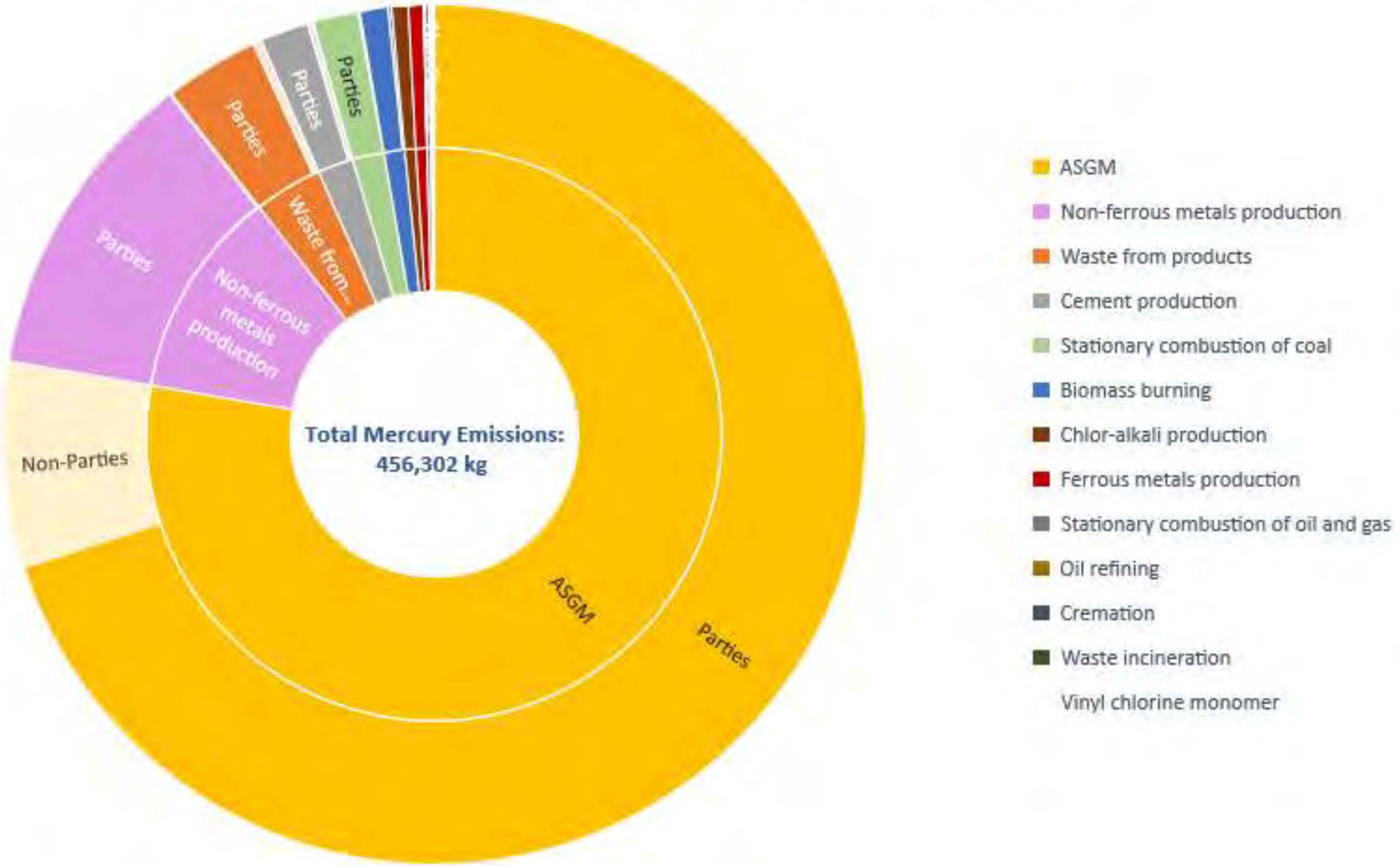
Asia and Pacific Emissions



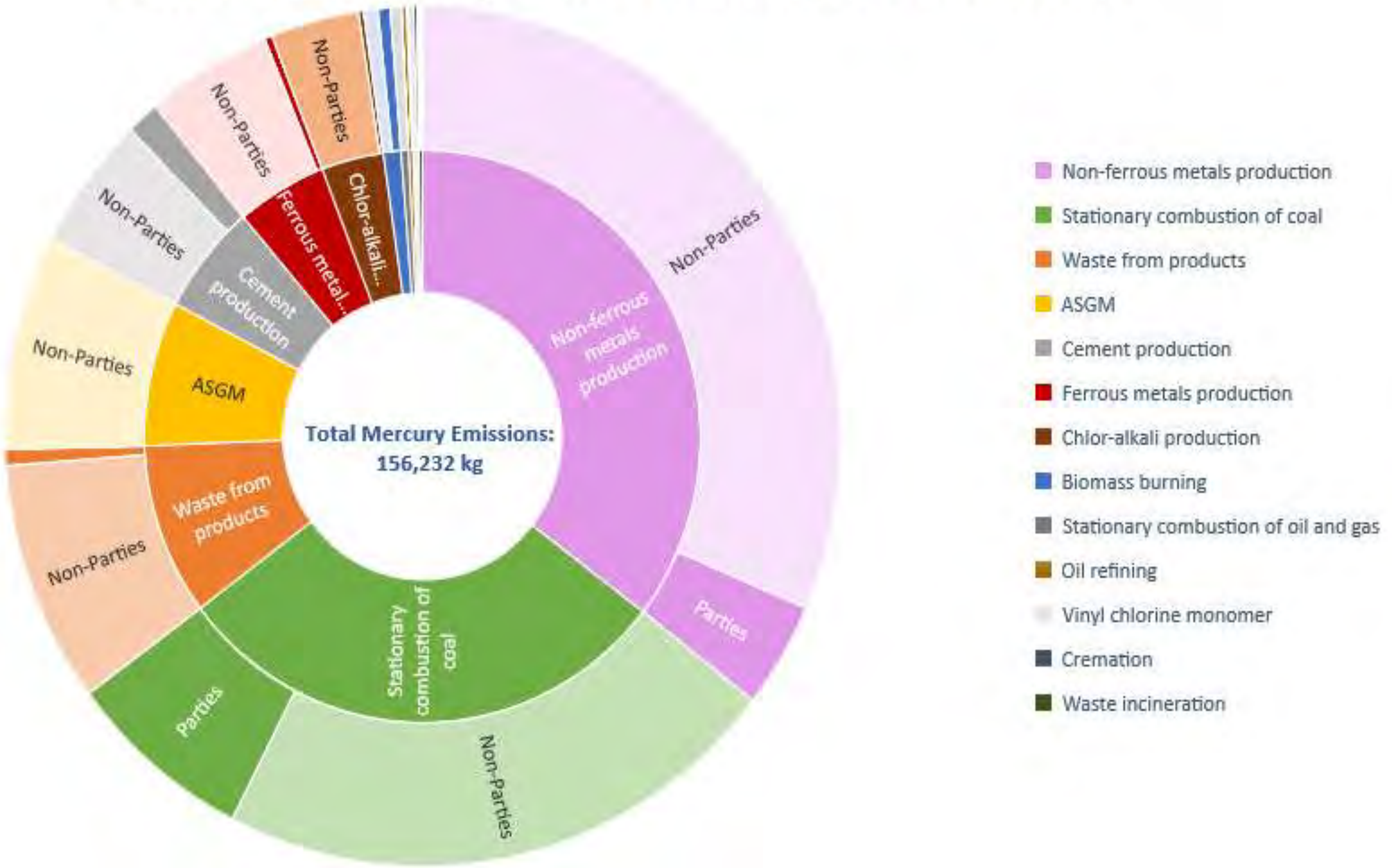
Africa Emissions



Latin America and the Caribbean Emissions



Central East Europe and Central Asia Emissions



Article 9: Releases

Article 9 concerns controlling and reducing **releases of mercury and mercury compounds to land and water** from the relevant point sources not addressed in other provisions of the Convention.

COP-2 established a group of technical experts that will prepare a report including **a list of any significant anthropogenic point source of release categories**, along with a suggested roadmap and structure for the development of draft guidance on methodologies for preparing its inventories, for possible adoption by COP-3.

COP-3 agreed on the roadmap, the group will further develop draft guidance on standardized and known methodologies for preparing inventories for possible adoption by COP-4.

Article 9 provides that COP shall adopt guidance on best available techniques and on best environmental practices.

Article 10: Interim storage

Each Party shall take measures to ensure that **the interim storage of mercury and mercury compounds other than mercury waste** that are intended for a use allowed to a Party is undertaken in an environmentally sound manner, taking into account any guidelines, and in accordance with any requirements adopted by COP.

COP-2 adopted guidelines for interim storage.

Article 11: Mercury waste

Each Party shall take appropriate measures so that **mercury waste** is managed in an environmentally sound manner, taking into account the Basel Convention guidelines.

Mercury wastes means substances or objects:
(a) Consisting of mercury or mercury compounds;
(b) Containing mercury or mercury compounds; or
(c) Contaminated with mercury or mercury compounds,
in a quantity above the **relevant thresholds defined by COP** that are, are intended to be, or are required to be disposed of.

This definition excludes overburden, waste rock and tailings from mining, except from primary mercury mining, unless they contain mercury or mercury compounds above **thresholds defined by COP**.

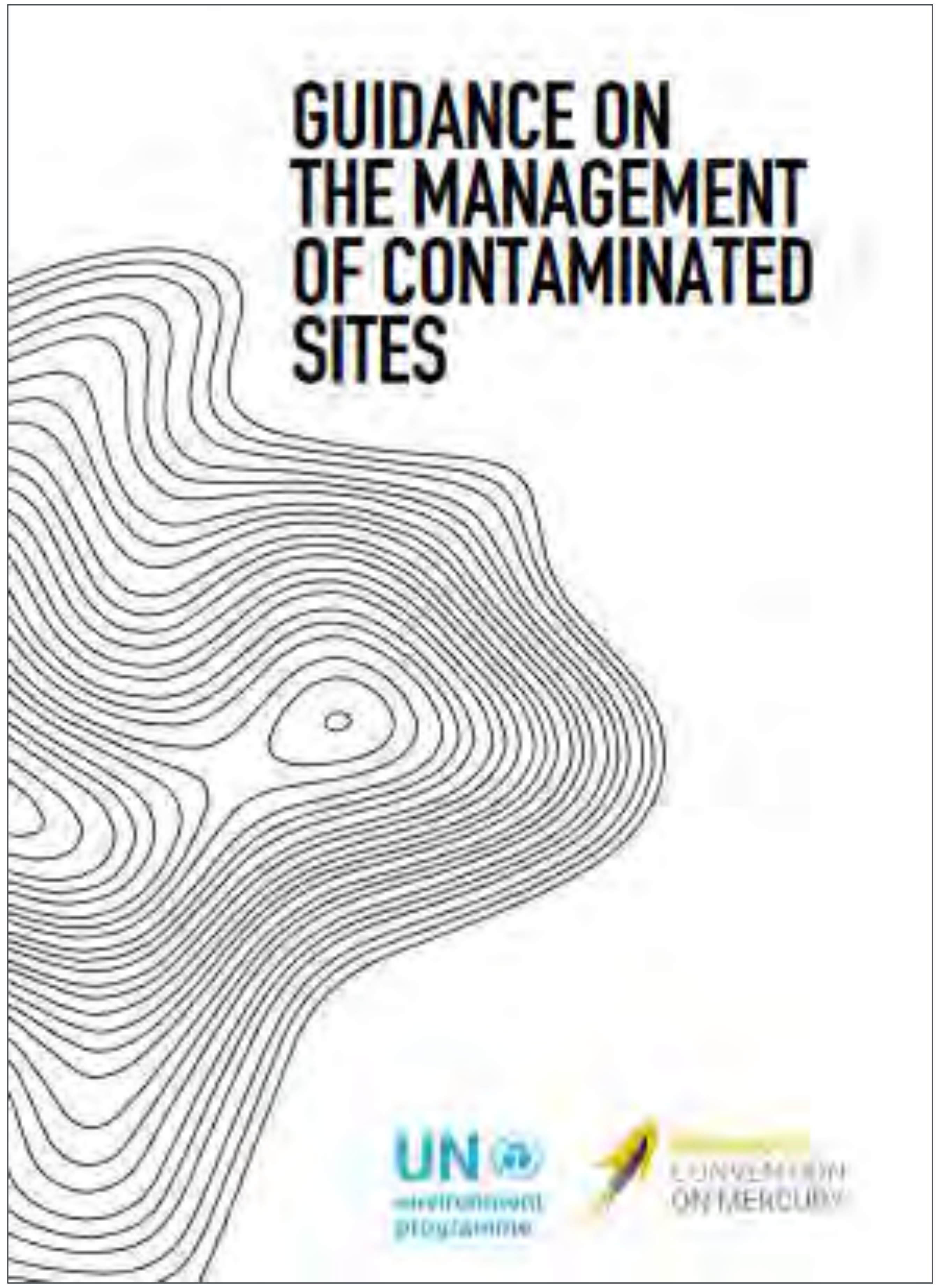
COP-3 agreed on the definition of category A and B mercury waste, and a group of technical experts are considering thresholds for category C waste.

Article 12: Contaminated sites

Each Party shall endeavour to develop appropriate strategies for identifying and assessing contaminated sites

Actions to reduce risks shall be performed in an environmentally sound manner, incorporating, where appropriate, an assessment of the risks to human health and the environment

COP-3 adopted guidance on managing contaminated sites



Article 16: Health aspects

Parties are encouraged to:

- Promote the development and implementation of strategies and programmes to identify and protect populations at risk
- Promote the development and implementation of science-based educational and preventive programmes on occupational exposure
- Promote appropriate health-care services for prevention, treatment and care for populations affected by exposure to mercury
- Establish and strengthen, as appropriate, the institutional and health professional capacities for the prevention, diagnosis, treatment and monitoring of health risks

Article 19 – Research, development and monitoring

1. Parties shall endeavour to cooperate to develop and improve, taking into account their respective circumstances and capabilities:

(a) Inventories of use, consumption, and anthropogenic emissions to air and releases to water and land of mercury and mercury compounds;

(b) Modelling and geographically representative monitoring of levels of mercury and mercury compounds in vulnerable populations and in environmental media, including biotic media such as fish, marine mammals, sea turtles and birds, as well as collaboration in the collection and exchange of relevant and appropriate samples;

(c) Assessments of the impact of mercury and mercury compounds on human health and the environment, in addition to social, economic and cultural impacts, particularly in respect of vulnerable populations;

(d) Harmonized methodologies for the activities undertaken under subparagraphs (a), (b) and (c);

(e) Information on the environmental cycle, transport (including long-range transport and deposition), transformation and fate of mercury and mercury compounds in a range of ecosystems, taking appropriate account of the distinction between anthropogenic and natural emissions and releases of mercury and of remobilization of mercury from historic deposition;

(f) (g)…

2. Parties should, where appropriate, build on existing monitoring networks and research programmes in undertaking the activities identified in paragraph 1.

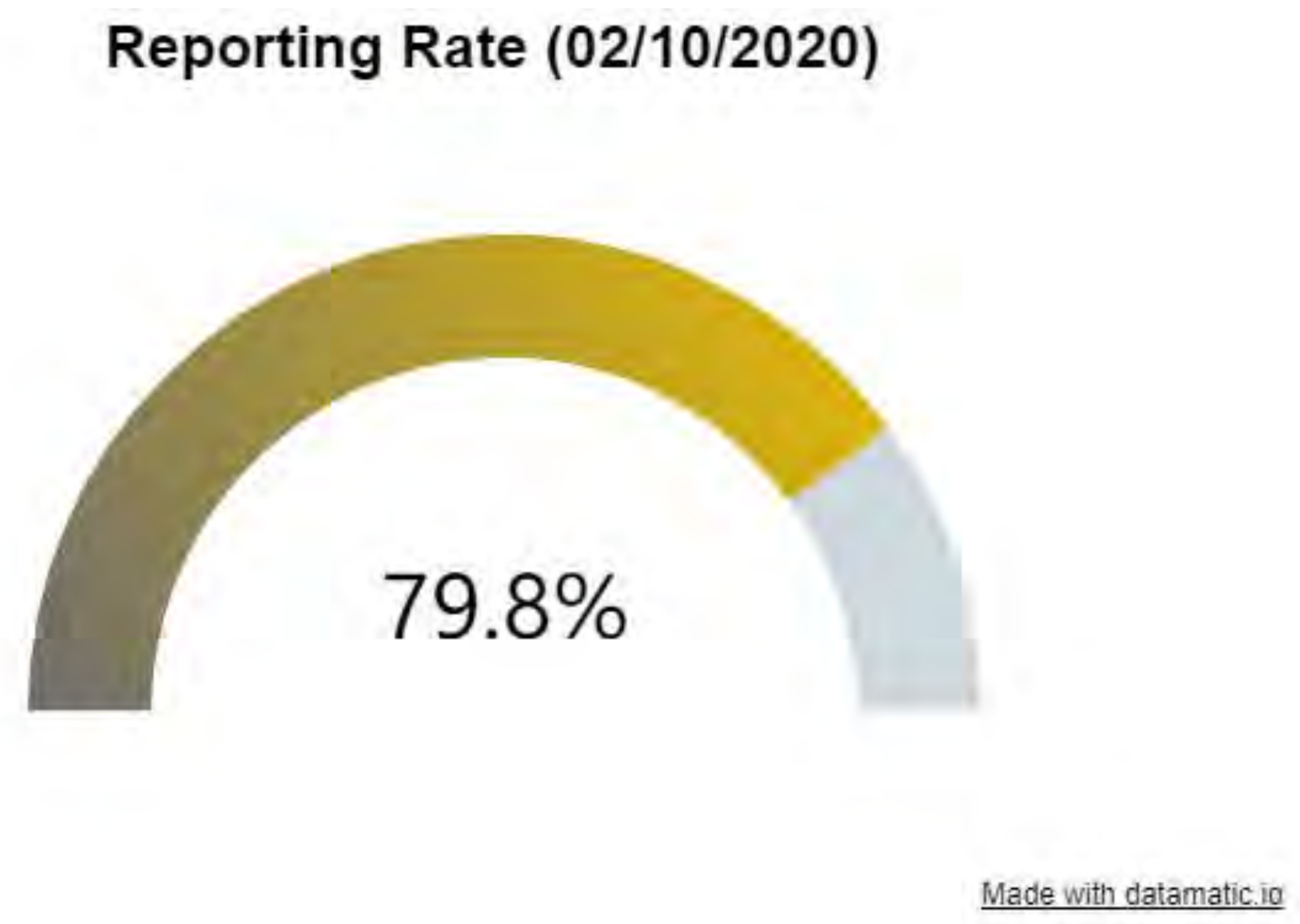
Article 21: Reporting

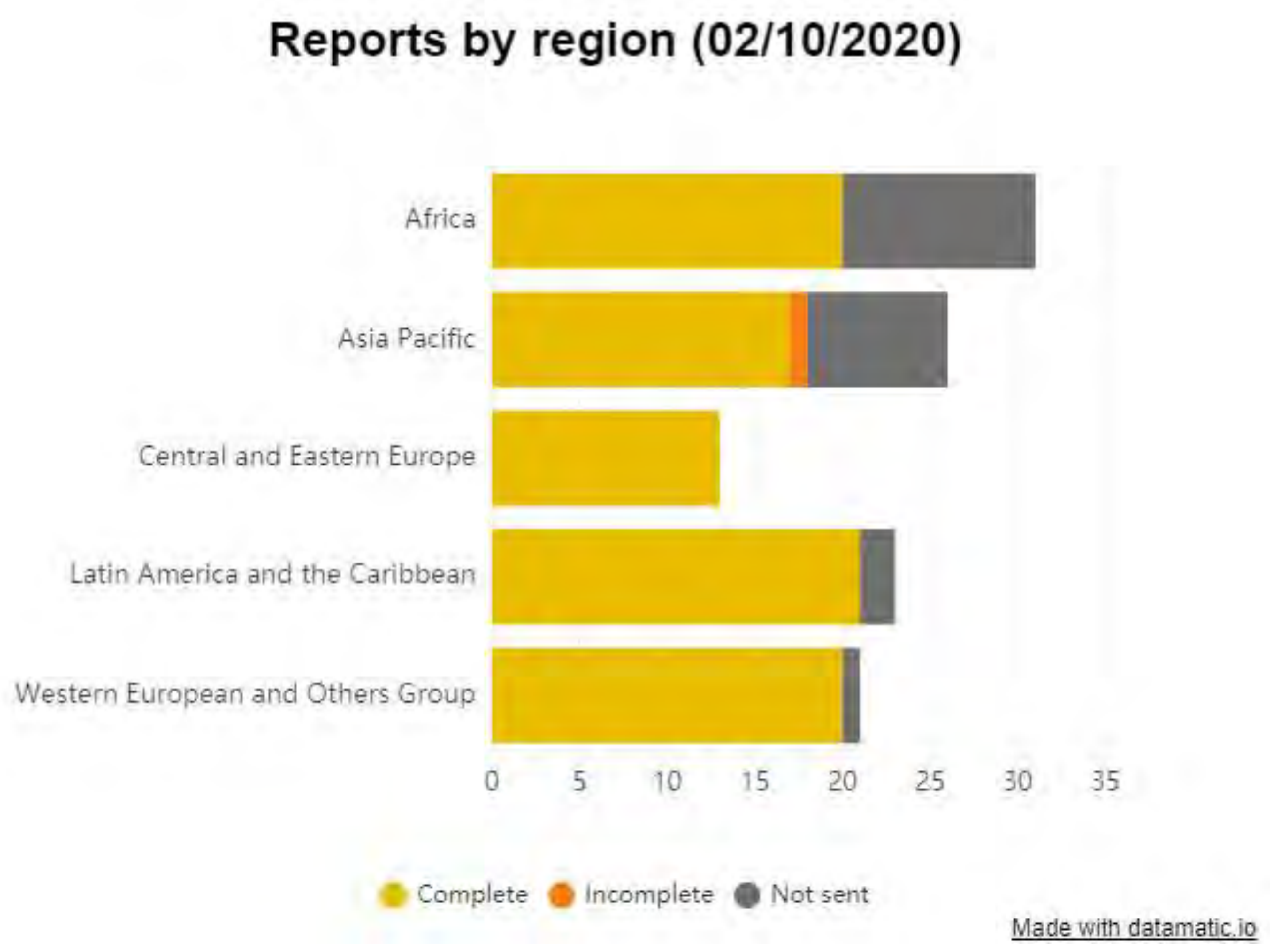
- Each party shall report to COP, through the Secretariat, on the measures it has taken to implement the Convention, the effectiveness of such measures and the possible challenges.

- COP-1 decided that short report should be submitted every two years starting with 31 December 2019, and full report every four years starting with 31 December 2021.

- The first short reports are available from the website.

- COP-3 requested the Secretariat to develop guidance on full reporting.





Effectiveness evaluation – Article 22

1. The Conference of the Parties shall **evaluate the effectiveness of this Convention**, beginning no later than six years after the date of entry into force of the Convention and periodically thereafter at intervals to be decided by it.

2. To facilitate the evaluation, the Conference of the Parties shall, at its first meeting, initiate the establishment of arrangements for providing itself with **comparable monitoring data** 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.

3. The evaluation shall 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 pursuant to paragraph 2;

(b) Reports submitted pursuant to Article 21;

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

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

Effectiveness evaluation – Decision MC-3/10

The Conference of the Parties,

1. Invites parties to submit views on the indicators set out in annex I to the present decision and requests the secretariat to compile those views in advance of the fourth meeting of the Conference of the Parties;

2. Requests the secretariat to advance the work by securing services for drafting:

   (a) Guidance on monitoring to maintain harmonized, comparable information on mercury levels in the environment, taking into consideration the draft structure set out in the note on background information on mercury monitoring;

   (b) Reports set out in the framework in annex II to the present decision with the exception of the emissions and releases report, the monitoring report, and the modelling report.

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Effectiveness evaluation – Intersessional work

- The Secretariat has developed an overview of the provisions of the Convention and the guidance by the COP on effectiveness evaluation.

- **Evaluation indicators:** In consultation with the COP-4 Bureau, the Secretariat has prepared a plan of work with the modalities and timeline for providing and receiving comments so as to assist Parties at COP-4.

- **Monitoring guidance:** The Secretariat has prepared a roadmap for developing monitoring guidance. The timeline in the roadmap has been developed taking into account comments by the COP-4 Bureau.

- **Trade, supply and demand report, which includes mercury waste flows and stocks, and an Article 21 synthesis report:** While some initial work on a trade report could be possible in the second half of 2020, most of the work is foreseen for 2021 (funding from the General Trust Fund is for 2021). The planning for an Article 21 synthesis report will be launched at a later stage.

Roadmap for developing monitoring guidance

Starting in May 2020	As a first step, the Secretariat collects information on the following: - Information and lessons learnt about the existing monitoring guidance and their use for effectiveness evaluation under other MEAs. - Information on existing global, regional and national monitoring networks, including sampling, sample analysis, data handling, statistical analysis and reporting. The collected information will be stored in an online web-based workspace.
Late May 2020	The Secretariat will advertise a call for consultants to develop elements of the draft guidance.
By 30 May 2020	The Secretariat develops a draft annotated outline of the guidance, taking into consideration the draft structure set out in UNEP/MC/COP-3/INF/15 and using the collected information. The draft annotated outline will be posted on the website for comments. Submission of technical information on sampling, chemical analysis, data handling, statistical analysis etc will also be invited.
Early June 2020	The Secretariat issues a call for interest in contributing to the drafting of the guidance on the Convention website. Parties and stakeholders are invited to identify experts and scientists to contribute to the drafting.
Early June 2020	The Secretariat makes itself available to present the draft annotated outline to interested parties and stakeholders.
By 31 July 2020	Parties and stakeholders submit their input on the annotated outline. The input received will be posted on the web-based workspace.
Early August 2020	The Secretariat will further develop the draft annotated outline taking into account the comments, and convening informal consultation as needed.
By 15 August 2020	The Secretariat will post the annotated outline on the website.

Development of annotated outline	Drawing on scientific expertise to create the content	Consultation with parties and stakeholders

Roadmap for developing monitoring guidance

By 15 August 2020	Parties and stakeholders identify experts and scientists interested in contributing to the drafting of the guidance.
August 2020	The Secretariat will collect further technical information on sampling, chemical analysis, data handling, statistical analysis etc., in addition to the information already collected by the Secretariat and stored in the web-based workspace.
Early September 2020	The first webinar of the identified experts and scientists is convened.
September – December 2020	The Secretariat and the consultants develop elements of guidance through thematic online meetings of identified experts and scientists. Thematic face-to-face meetings of relevant identified experts and scientists may be convened as needed.
24 February 2021	The Secretariat posts a zero draft of the guidance on the website .
March 2021	The Secretariat convenes additional round of thematic online meetings of identified experts and scientists to further develop the draft guidance. Parties may identify additional experts to contribute to the finalization of the guidance.
By 15 April 2021	The Secretariat posts draft guidance on the website for comments.
By 31 May 2021	Parties and stakeholders submit comments on the draft guidance.
June 2021	The Secretariat further develop the draft guidance taking into account the comments received, in cooperation with the consultants as appropriate.
July 2021	Draft guidance document finalized for processing as COP-4 document. The COP document may include issues that require COP-4 attention.

Development of annotated outline	Drawing on scientific expertise to create the content	Consultation with parties and stakeholders

Guidance on monitoring to maintain comparable information on mercury levels in the environment and humans
Annotated outline

1. Acknowledgements
2. List of abbreviations and glossary of terms
3. Introduction and objectives
4. Use of comparable monitoring data for the effectiveness evaluation
5. Air monitoring
   (1) Mercury monitoring in air – rationale
   (2) Consideration of monitoring sites
   (3) Sampling and measurement: methods
   (4) Quality control and assurance
   (5) Data collection
   (6) Data management, analysis and evaluation
6. Biota monitoring
   (1) Identification of target ecosystems
   (2) Mercury monitoring in biotic media – rationale
   (3) Consideration of monitoring sites
   (4) Sampling and measurement
   (5) Quality control and assurance
   (6) Data collection
   (7) Data management, analysis and evaluation
7. Human biomonitoring
   (1) Ethical considerations
   (2) Identification of target population
   (3) Human biomonitoring for mercury exposure – rationale.
   (4) Development of a survey protocol
   (5) Data management, analysis and evaluation with particular emphasis on health/risk guidelines
8. Cross-media data management, modeling and analysis
9. References

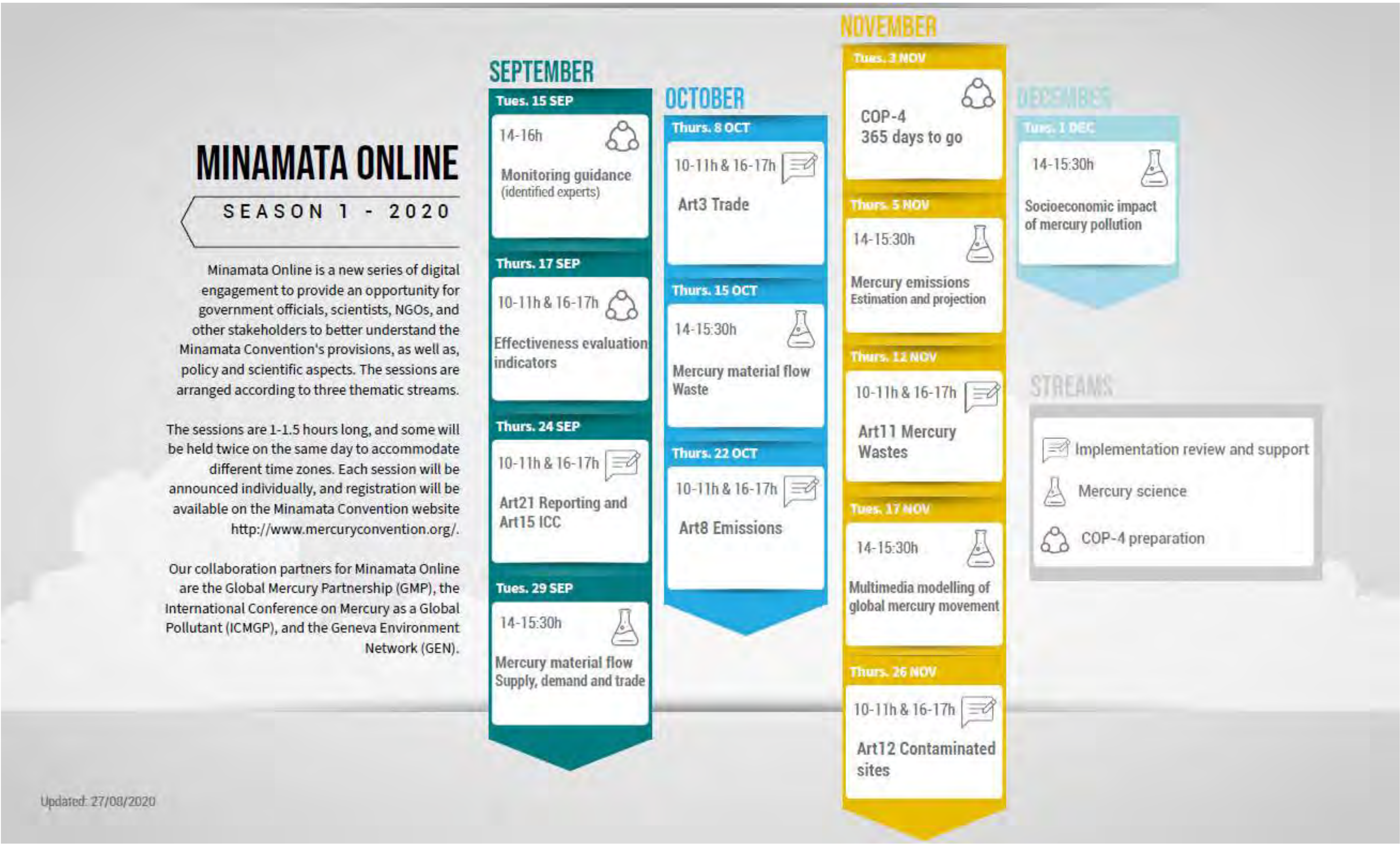
Annex 1: Review of existing monitoring, modeling and data management activities

Annex 2: Gap analysis

For further information

Visit our website

http://www.mercuryconvention.org/



Progress report 2020

MAKE MERCURY HISTORY

6.2 Presentation - Introduction to a Mercury Game

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement no. 860497.

Introduction to the Mercury Negotiation Simulation

Created by: Leah Stokes, Dr. Noelle Selin, Dr. Lawrence E. Susskind Massachusetts Institute of Technology

Agenda

- Game objectives
- Playing your role
- The players
- The options

Game objectives

- To explore the roles scientific information, scientific uncertainty and scientists play in the international mercury negotiations

- To explore the interaction between science and political concerns in environmental negotiations.

- To think about how to negotiate with multiple parties, including issues such as: coalitions, issue linkage and option-creation.

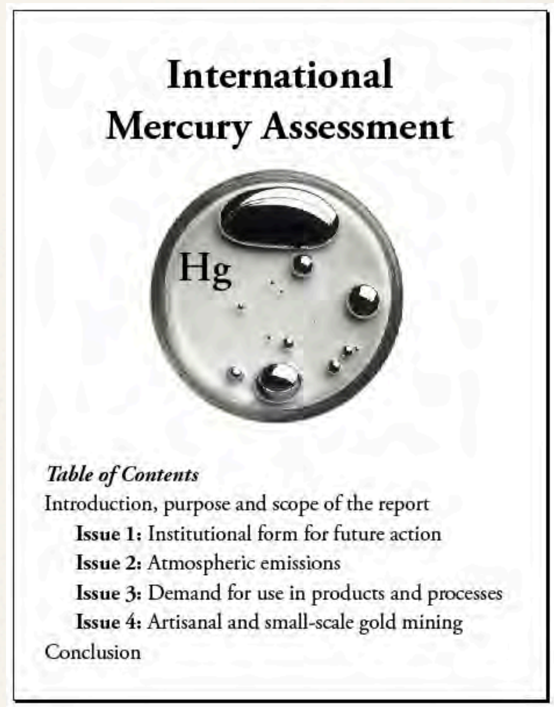
Playing your role

- Each player has:

  1) General instructions

  2) Role specific confidential instructions

  3) A copy of the *International Mercury Assessment* (IMA)


International Mercury Assessment

Hg

Table of Contents

Introduction, purpose and scope of the report

Issue 1: Institutional form for future action

Issue 2: Atmospheric emissions

Issue 3: Demand for use in products and processes

Issue 4: Artisanal and small-scale gold mining

Conclusion

You will have 30 minutes to review these materials and prepare your opening statement and position.

Playing your role

- The game situation is fictionalized, yet realistic.
  - The scientific facts in the *International Mercury Assessment* **are all true**.
  - The generals and confidentials provide context and roles for the game based on the actual negotiations.
  - These documents ***summarize*** key issues, and are ***illustrative*** rather than comprehensive.
  - The game focuses on the science, asking ***is there sufficient information to proceed with formal negotiations?***

Playing your role

- The game has flexibility:
  - It will be up to you how you play the role.
  - You can be creative.
  - You still need to reflect the direction in your confidentials
- Timing:
  - ~1 hour of negotiations
  - ~20 minute break out for informal negotiations
  - ~40 minutes of negotiation
  - ~30 minutes debrief

The players

- Japan is the Chair
- Brazil, also representing GRULAC
- Canada
- European Union
- People's Republic of China
- United Republic of Tanzania, also representing the African Group
- United States of America

The country roles were chosen to *illustrate* international environmental negotiation dynamics.

The players

- NGOs/IGOs also participate in this meeting, sharing information:
  - The Arctic Monitoring and Assessment Programme
  - Mercury Free Future
  - World Coal Power Association
- Countries are given speaking priority over NGOs/IGOs.

The options

- There are four issues and a series of related options.
- Your role ranks these options at the end of your confidentials.
- You can be creative.
  - If you want to add another option, you can – that is up to the group to discuss
- The options set the ***context*** for the negotiations
- Consider the ***linkages*** between issues; you may wish to discuss all four issues before commitments are made.

The options

- Issue 1: Form of future action

  - Voluntary agreement:
    - This action would likely be faster
    - It may not lead to as much action or financial commitments.
    - It may allow for the science to evolve over time.

  - Formal negotiations for a legally binding Convention:
    - This action would likely take longer.
    - It may bind parties more effectively than a voluntary agreement.
    - It would likely set common rules and guidelines (i.e. Best Available Technology)

Questions?

mit.edu/mercurygame

mercurygame@mit.edu

6.3 Mercury Game general instructions and the scientific assessment

General information for all participants

United Nations Environment Programme (UNEP) Governing Council and
Global Ministerial Environment Forum – 25th meeting

Working Group to Review and Assess Measures to Address the Global Issue of Mercury

Introduction

Over the past several decades, scientific studies have shown that mercury is a persistent pollutant in the environment and that it cycles globally. Mercury is a neurotoxin. It is able to pass through the blood-brain barrier as well as the placental barrier. Health effects are especially acute in utero, where exposure can cause long-term cognitive and developmental defects. Although humans are exposed through other mechanisms, eating predatory fish containing methylmercury is by far the most significant exposure pathway. Mercury also poses environmental risks because it accumulates in food webs, notably in lakes, oceans and the Arctic. Mercury may persist in ecosystems for decades to centuries once mobilized.

In response to growing concerns about health and environmental risks, the United Nations Environment Programme (UNEP) Governing Council, which includes 58 representatives from regionally diverse countries, called for a global assessment on mercury. This study, the ***International Mercury Assessment***, now complete and attached, details the risks mercury poses to humans and the environment. This is the first organized meeting of global representatives since the *Assessment* was released. Although the *Assessment* establishes many scientific facts, some issues, including mercury fluxes through atmospheric emissions and mercury demand, remain uncertain.

UNEP has established a Working Group on Mercury to discuss, in light of the *Assessment,* whether global actions to address mercury might now be appropriate. At today's meeting, the Working Group will address the **form** that future action might take (e.g. legally binding treaty, voluntary actions) as well as the **scope** of any international efforts (e.g. what issues to include), given the available scientific information.

UNEP has invited six country representatives to participate in today's meeting, including Brazil, Canada, the People's Republic of China, the European Union (EU), Tanzania and the United States of America. Three of these countries are also representing the standard regional groups of nations often used in UNEP discussions: Brazil is representing the Group of Latin American and Caribbean countries (GRULAC), the European Union is representing EU member states, and Tanzania is representing the African Group of countries. A list of countries in each group is included below.

In addition, three non-governmental organizations (NGOs) with a particular focus on the science and technical aspects of mercury have asked to participate in today's meeting: a scientist from Mercury Free Future (MFF), a scientist from the Arctic Council's Arctic Monitoring and Assessment Programme (AMAP) and the Chief scientist from the World Coal Power Association (WCPA). The six countries have agreed that these NGO scientists may speak and present information at the meeting. However, only countries will be allowed to vote, if any voting takes place.

A Chairperson from Japan has agreed to moderate today's discussion as necessary. This meeting's **mandate** is to decide whether to recommend to UNEP some kind of formal international mercury negotiations, and if so, what the agenda for such negotiations should include. Alternatively, the group might decide that only individual voluntary measures are appropriate, or that further information gathering is all that is required. If the group decides it wants to make a formal recommendation to UNEP or to any other organization, it will take a unanimous vote of the six country representatives. The Chair will record the outcome of the meeting on each issue and any specific information requests.

The following questions form the **agenda** for the Working Group meeting:

- Does the Working Group, given the current status of scientific information on mercury's impacts, feel that global action of some kind is warranted?
- What **form** should future collaborative action take (e.g. legally binding treaty, voluntary actions)?
- What might be the **scope** or focus of any future negotiations (e.g. what issues to include)?
- What **additional scientific information**, if any, will be necessary to inform future negotiations and collaborative action?

More specifically, the Working Group has identified four main questions on the form and scope of future action on mercury. The UNEP Secretariat developed a number of options for each of these issues:

1) **Is global action necessary to address mercury, and what form should it take?**
2) **Should atmospheric emissions of mercury be included within the scope of a potential agreement?**
3) **Should global demand for mercury use in products and processes be included within the scope of a potential agreement?**
4) **Should mercury use in artisanal and small-scale gold mining (ASGM) be included within the scope of a potential agreement?**

Issue 1. Is global action necessary to address mercury, and what form should action take?

In today's discussions, the Working Group should address whether there is sufficient evidence to justify concerted global action on mercury and, if so, what **form** that action ought to take. At today's meeting, a decision should almost certainly be made about whether or not to move forward with a formal treaty-making effort.

At previous scientific meetings, some countries have suggested that UNEP should initiate formal international negotiations that would lead to a freestanding, legally binding mercury Convention. Other countries, however, have suggested there is a need for more evidence that mercury poses a serious global threat. They suggest that voluntary measures and additional research might be sufficient at this point.

More broadly, countries have discussed several principles that might guide decision making, including:

- *The Precautionary Principle*: Future action may not require complete information; instead, scientific uncertainty should not be used as a justification for delayed action.

- *Common but differentiated responsibilities*: Future action may acknowledge that countries vary in their ability to act given the stage of development; although all countries may have responsibility to address this problem, this principle suggests their actions may vary in degree.

Option 1.1: There is sufficient evidence that mercury us a global problem with significant risks. Initiate formal international negotiations for a new legally binding mercury convention.

Option 1.2: There is a need for more evidence that mercury is a global problem with significant risks. Enhance voluntary measures.

Issue 2. Should atmospheric emissions of mercury be within the scope of a potential agreement?

The Working Group will need to determine whether there is sufficient information to say beyond a reasonable doubt that anthropogenic emissions are a significant source of mercury in the environment and, given the risks, should be within the scope of global action.

Atmospheric emissions will be a significant topic at today's meeting. Suggested mechanisms to address atmospheric emissions could include requiring national emission inventories (following pre-set procedures) as well as timetables and targets for reducing emissions. Countries might also decide that further information on emissions inventories is a necessary precursor to global action of any kind.

Option 2.1: There is sufficient information that atmospheric emissions are a large source of mercury. This issue should be *included* in the scope. Future negotiations could include requiring national emissions inventories and proposed timetables and targets for all major emitters.

Option 2.2: There is insufficient information that atmospheric emissions are a large source of mercury. This issue should be *excluded* from the scope. Future negotiations could gather information on emissions inventories to all media before taking action.

Issue 3. Should global demand for products and processes be included within the scope of a potential agreement?

The Working Group should consider whether there is sufficient evidence that demand for mercury in products and processes significantly contributes to the global mercury problem, and whether to recommend any actions to reduce both the supply and the demand for mercury compounds.

Future actions recommended by the Working Group could include a ban on some or all products and processes. The Working Group might also decide to draft a list on which products and processes should be the focus of future action. Finally, given the available scientific information and alternatives, some products and processes might be excluded from the list at the moment.

Option 3.1: There is sufficient evidence that demand for mercury used in products and processes significantly contributes to the global mercury problem. All products and processes should be *included* in the scope of future negotiations.

Option 3.2: Demand for mercury used in *some* products and processes contributes significantly to emissions and mercury releases, while other mercury uses do not. The parties should draft a list for inclusion in the scope of future negotiations.

Option 3.3: There is insufficient evidence that demand for mercury used in products and processes significantly contributes to the global mercury problem. All products and processes should be *excluded* from the scope of future negotiations.

Issue 4: Should mercury emissions from artisanal and small-scale gold mining (ASGM) be included within the scope of a potential agreement?

At today's meeting, representatives will have to assess if there is sufficient information that mercury use in ASGM is a significant part of the mercury problem and whether it should be considered within the scope of future negotiations.

Mercury is used in small-scale gold mining to aid in extraction. Artisanal mining could be an important issue within the global mercury negotiations, since it represents an acute, and preventable, exposure pathway. However, ASGM may prove difficult to mitigate because it intersects strongly with issues of poverty and development in the global South. This may link, in part, to discussions about financial and technical support to the developing world and whether further assessments of ASGM are needed before further actions could be prescribed.

Option 4.1: There is sufficient evidence that mercury use in ASGM is a significant part of the global mercury problem. ASGM should be *included* within the scope of future negotiations, with potential actions including requiring countries to submit national action plans on ASGM with timetables to phase out the usage.

Option 4.2: There is insufficient evidence that mercury use in ASGM is a significant part of the global mercury problem or that ASGM is a tractable problem. ASGM should be *excluded* from the scope of future negotiations while financial and technical support are provided to conduct further assessments on ASGM.

Cross-cutting concerns: Financial and technical support

Apart from the four main issues described above, several countries have raised the issue of financial and technical support as a key, cross-cutting concern that needs to be discussed at today's meeting. Developing countries in particular are seeking support from industrialized countries to enable a transition away from mercury use.

Meeting structure:

- The meeting will begin with a chance to review the *International Mercury Assessment* and for representatives to prepare their opening statements and positions.
- The Chair will moderate the discussion. If a country or NGO representative would like to speak, it should raise its placard. The speaker will be added to the list and acknowledged by the Chair in turn.
- Countries will be asked to make opening statements.
- NGOs will be asked to provide introductory information to the group.
- Negotiations will proceed on all issues for around one hour. NGOs will only be able to speak when country representatives are not on the Chair's speakers list.
- An informal negotiation period will occur to allow all representatives to speak informally. The Chair may assign countries as leads on particular issues, in order to try to make progress during this period.
- The meeting will conclude with a final formal negotiation period. Ideally, the Working Group will come to a decision on all four items.

Mercury Working Group participants

Japan is acting as the **Chair** at today's meeting.

Brazil is also representing the Group of Latin American and Caribbean Countries – **GRULAC** (Antigua and Barbuda, Argentina, Bahamas, Barbados, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Suriname, Trinidad and Tobago, Uruguay, Venezuela)

Canada

China

European Union (Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom)

United Republic of Tanzania is also representing the **African Group** (Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Republic of the Congo, Côte d'Ivoire, Democratic Republic of the Congo, Djibouti, Egypt, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, São Tomé and Príncipe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, Sudan, Swaziland, Togo, Tunisia, Uganda, Tanzania, Zambia, Zimbabwe)

United States of America

<u>NGO participants</u>

The Arctic Monitoring and Assessment Programme (AMAP), a Working Group of the Arctic Council (Canada, Denmark/Greenland, Finland, Iceland, Norway, Russia, Sweden and the United States of America), has sent a Senior Scientist to discuss recent reports.

Mercury Free Future (MFF), a coalition of environmental groups that operate globally, has sent a scientist to discuss mercury risks.

The **World Coal Power Association (WCPA)**, an association of coal power companies that operate globally, has sent a senior scientist to discuss mercury risks.

Glossary – Key Science & Policy Terms

artisanal and small-scale gold mining: small-scale gold extraction, usually without significant resources or equipment and often involving the intentional use of mercury

ataxia: loss of control of body movements

atmospheric mercury depletion events (AMDE)s: rapid drops in the concentration of elemental mercury in the lower atmosphere caused by sunlight-induced chemical reactions, that increase surface mercury deposition rates

atmospheric transport: movement of mercury between countries and continents via the atmosphere

benchmark dose: the level of mercury exposure necessary to produce a set level of harm relative to background exposure

bioaccumulation: the accumulation of toxic substances within the tissue of living organisms over time

biomagnifications: an increase in the accumulation of toxic substances at higher levels in the food web (trophic levels)

chlor-alkali production: an industrial process used for the production of chlorine and caustic soda; this process often employs mercury

common but differentiated responsibilities: a negotiating principle that recognizes all parties as jointly responsible for addressing global environmental challenges, but that distributes the implementation given uneven economic and social development

cost-benefit analysis: an approach to decision-making that quantifies the economic costs and benefits of a proposed policy, and weighs the two against one another

divalent mercury (Hg(II)): a common form of mercury present in many organic and inorganic compounds; divalent mercury has a short lifespan in the atmosphere (days to weeks) and therefore does not transport far distances

elemental mercury (Hg(0)): pure mercury

intentional mercury emissions: mercury released from sources that deliberately employ mercury, for example mercury used in artisanal and small scale gold mining

legally-binding treaty: an international legal agreement between countries that commits each party to a set of policy actions, including common rules and guidelines for all parties; while more difficult and slow to negotiate, treaties can be more effective than voluntary actions

methylation: the addition of a methyl group (CH_3)

methylmercury (MeHg): a common form of mercury in the environment, comprising one mercury atom and one methyl group; methylmercury has high bioavailability and can bioaccumulate in species

Minamata disease: a disease caused by exposure to high levels of methlymercury, leading to atrophy in the brain, tremors, loss of perception, major impairments in functioning and, in severe cases, death

national action plans: a framework and timeline to measure and manage mercury releases at the national level

neurotoxin: a toxic substance that acts on the human nervous system

precautionary principle: the principle that complete information is unnecessary to make policy decisions in the face of future risk or harm; it implies that scientific uncertainty should not be used as a justification for delayed action

re-emissions: mercury release into the atmosphere from actively cycling mercury; this mercury, previously deposited in marine and terrestrial ecosystems, is often re-emitted to the atmosphere from oceans

RfD, reference dose: the maximum oral dose of a toxic substance that is scientifically claimed will not cause adverse health effects

trophic level: an organism's position within a food web; predators are at a higher trophic level in a food web, and thereby, may have higher mercury levels

unintentional mercury emissions: mercury released from sources that do not deliberately use mercury, for example mercury emissions from coal-fired power plants

vinyl chloride monomer (VCM) production: an industrial chemical used to produce polyvinyl chloride (PVC), a common plastic

voluntary actions: an agreement to perform a set of policy actions on a voluntary basis, with no enforcement mechanisms or consequences for non-action; voluntary agreements are likely faster to negotiate than legally-binding treaties but may not result in as much action or financial commitments

Teaching Note: The Mercury Negotiation Simulation

Overview

The Mercury Negotiation Simulation (or, simply, The Mercury Game) is a multiparty role-play that helps designed to help participants actively learn about science-policy interactions in the context of global environmental treaty-making challenges. The game was evaluated in a journal publication: Stokes, Leah C., and Noelle E. Selin. "The mercury game: evaluating a negotiation simulation that teaches students about science-policy interactions." Journal of Environmental Studies and Sciences 6.3 (2016): 597-605.

Audience: The game explores the complex interactions between science, policy and politics, and is appropriate for audiences with both scientific and policy backgrounds at multiple educational levels. For scientists and science/engineering students, it introduces global environmental policy-making and illustrates ways of making sure that science is taken seriously in political decision-making. For those with policy backgrounds, including students of international relations and environmental policy, the simulation examines the key role scientific and technical information plays in environmental policy-making. The simulation is appropriate for undergraduate and graduate courses at both introductory and advanced levels.

Participants: The Mercury Game is designed for a group of ten players. Each participant is assigned a different role: six will play countries, three represent non-governmental and intergovernmental organizations (NGOs/IGOs), and one is asked to act as the Chair of the group. The game can also be played with 9 players (Canada is excluded) or with 11 players (India is included). Teams of 2 can share any of the roles.

Game context: The game uses the global negotiations on mercury as a case to explore the prospect of collective action to manage environmental risks. Although the game setting is fictionalized, it reflects the dynamics of the real decisions confronting the United Nations Environment Programme (UNEP), which initiated discussions about the need for a global treaty on mercury. The main question that participants are asked to address in the game is whether there is sufficient scientific evidence that mercury is a global pollutant requiring global attention. Specifically, representatives are asked to address four issues on the possible form and scope of global cooperation. These issues were chosen to illustrate important science-policy dynamics, lessons from which are applicable to a wide range of international environmental issues.

Learning goals: The main goal of the game is to help participants understand the important roles that scientific information, uncertainty and individual scientists play in addressing global environmental issues. Key learning themes include understanding the balance between science, policy and politics; the role that scientists play in political negotiations and how science is used, misused and interpreted. From a negotiations perspective, the game explores coalitional dynamics, issue linkage, option-creation and integrative bargaining.

 This material is based upon work supported by the National Science Foundation under Grant No.1053648. This authors would appreciate appropriate acknowledgment.
Suggested citation: Stokes, L. C., Selin, N. E., Susskind, L. E. “The Mercury Negotiation Simulation.” *MIT Joint Program on the Science and Policy of Global Change*, Report, August 2011.

Teaching Points and Learning Objectives

- Players should be able to identify important technical, political, and economic issues that are usually considered during global environmental treaty negotiations.

- Players should be able to identify the advantages and disadvantages of a legally-binding international treaty as compared to a voluntary approach to addressing global environmental problems.

- Players should be able to describe the different ways scientists can participate in global policy-making -- as advisors to or members of national delegations, non-governmental representatives, or independent science advisors.

- Players should understand and acknowledge that scientific information is not value-neutral, and that scientists bring personal interests, biases and viewpoints to the table.

- Players should be able to identify differences between the global North and South with respect to scientific and technical capacity and the emphasis that each tends to place on scientific and political concerns.

- Players should gain additional skill in evaluating scientific evidence and argumentation used to advance policy interests.

- Players should develop their ability to summarize, analyze, and communicate technical information.

- Players should be able to explain the global mercury cycle, identify human and environmental risks posed by mercury, identify major sources of mercury releases, and identify options for mitigating mercury risk.

Logistics

The game should be played over a **3 to 4.5 hour period**, depending on whether participants are able to read the documents in advance as well as the length of the introduction and the debrief provided by the Instructor.

- To shorten the game play, instructions can be distributed to players in advance (preferred), particularly the ***General Instructions***, and the ***International Mercury Assessment***.
- Participants must also have time prior to the simulation to go through their Confidential Instructions on the day of the game. You can individually email the ***Confidential Instructions*** to each player; but be sure to have them thoroughly review this document the day of, and only share the file with players assigned to each role.

Recommended range in timing

Activity	*Longer Version*	*Shorter Version*
Reading materials	1 hour	30 mins* (see above)
Introduction	15 mins	10 mins
Chair's welcome and negotiators' introductions	30 mins	20 mins
Negotiations (Issues 1-4)	40 mins	35 mins
Informal negotiations	30 mins	25 mins
Final Negotiations (Issues 1-4)	45 mins	40 mins
Debriefing	1 hour	45 mins
Total time	4 hours 30 mins	3 hours 15 mins

Group Size: 10 players including one Chair and nine parties
- The game can be played with 9 players (excluding Canada).
- The game can be played with 11 players (including India).
- For larger groups, players can form teams, with more than one person representing a player.

Materials:

1) General instructions for all players including the Chair
(9 to 11 copies needed – one for each player)

2) Ten confidential, player-specific instructions for all players
including the Chair (1 copy of each set)

3) The "International Mercury Assessment" (IMA)
(9 to 11 copies needed – one for each player)

4) Placards (10 placards)

Set up: The game requires a large table that the players can be comfortably seated around. A large spacious room is recommended. There should also be ample, easily accessible space that can be used during the informal negotiation session. A projector will be necessary if you plan to use the introduction and debriefing presentations. You may wish to schedule the introduction to the game for one class, email the assigned readings (Generals, IMA), and then play the game the following week, depending on the length of your class or meeting time.

Notes on the timing and flow of the simulation

Time mechanics and the flow of the simulation is critical to this game because it attempts to cover a number of objectives in a very short time, particularly given the complex scientific information presented.

During the game itself, the facilitative role played by the Chair is important. One of the many responsibilities of the Chair is to be an efficient time manager. The instructor or game manager should meet the Chair before the simulation begins to go through the various responsibilities of the Chair, including the importance of ensuring that the suggested timing of the simulation is followed closely. The instructor or TA may also choose to play the Chair role.

The importance of the debriefing at the end of the game cannot be over emphasized; it is important to help the players process the experience and discuss what they learned. A minimum of 45 minutes should be allotted for this activity.

The various activities listed in the above table are described in more detail below. Further details about the logistics and objective of this exercise are also provided in the Chair's confidential instructions and in the introduction presentation. It is recommended that the instructor or game manager discuss this exercise in particular, and the rest of the activities in general, with the person playing the Chair's role before the game begins. The Chair will need to introduce the timing of the negotiation to the other players and this information is not in their confidential instructions.

Introduce the game

Either the Chair or the Meeting Facilitator can introduce the game. There is an example power point included in the game package, which can be used and modified give the group's specific background. The introduction will likely take 10-15 minutes and the group should be able to ask any clarifying questions.

Read documents

It is important that students be given enough time to read all their documents: the general instructions, their confidential instructions and the scientific assessment. It is suggested that, whenever possible, they be given time to do so just before the simulation begins. If they are asked to have read the general instructions and the scientific assessment in advance (as in the short version), it is preferable to give them some time (30 minutes) to review these materials again just before the game begins and to allow time to review their confidentials. If the reading is assigned in advance, be sure to communicate to the students that the game will not be possible to follow if they do not review these documents thoroughly in advance. If the confidentials are shared in advance be sure to communicate that the players should keep this information privately.

Chair’s welcome and introductions – *The game begins*

At this point, everyone is playing their role. The Chair should use this time to briefly explain the purpose of the meeting, the fact that NGOs are present to provide information and to introduce how the process will unfold, particularly the informal breakout. This time should also be used for a round of quick introductions and opening statements from the 10 negotiators. The Chair should signal that each participant has 2-3 minutes (strictly enforced) for a brief opening statement. Countries should speak before the NGOs.

Negotiations

The negotiations should begin by proceeding through each issue in turn, with the understanding that all issues will likely need to be covered before consensus begins to emerge on any specific issue. Countries are encouraged to discuss what options they prefer for each issue, consider the scientific information, and identify important information gaps that, from their perspective, need to be filled.

Break out negotiation

After 30 minutes of formal negotiations, the Chair should allow the participants a 20-30 minute break for informal discussions. The Chair should indicate that this is a point in the negotiations where the group should seek to create deals that meet everyone’s interest and make progress on the four issues. The Chair may consider assigning a country as the lead on Issues 2, 3 and 4, to gather information during the break, attempt to create agreement, and report back after the informal period is over. Sample leads could include: Issue 2: Canada; Issue 3: Tanzania; Issue 4: Brazil.

Final negotiations – *The game ends*

The group should seek to find consensus on all the issues and bring the meeting to a decision before the game is finished. The decision can be written on a board formally or just discussed out loud depending on time. In some cases, no agreement may occur.

Debriefing

The Meeting Facilitator should lead the group in a discussion of the game. The debrief presentation included in the game package can be used for this purpose and includes a number of questions for the group to begin discussion. The debriefing presentation can be modified to meet the specific group’s needs.

Class Set Up and Assignment

Time is of the essence in this simulation. The instructor or game manager should make every effort to ensure that the time allotments described above are followed. This point should be stressed to the participants collectively and to the Chair in particular, since it is the Chair who will bear the main burden of managing time and adhering to time limits.

Even beyond the time issue, the Chair's facilitative role is of the utmost importance to the success of this simulation. The instructor should, therefore, meet with the Chair individually before the simulation begins and a) reiterate the importance of time-keeping, b) review facilitation skills and strategies, and c) review the rationale and mechanics of the negotiation sequence.

Readings that might be especially assigned to the Chair include:

Lawrence Susskind & Jeffrey Cruikshank. 1987. Breaking the Impasse. "Chapter 5: Mediation and Other Forms of Assisted Negotiation" (Pages 136-185). New York: Basic Books.

Schwartz, Robert M. 1994. The Skilled Facilitator: Practical Wisdom for Developing Effective Groups. "Group Facilitation and the Role of the Facilitator" and "What Makes Group Effective" (Pages 3-41). San Francisco: Jossey Bass.

The Chair should be given full prominence and importance by the instructor from the beginning so that the other participants understand the importance of the Chair's role during the negotiation.

The instructor should also seek to fill particularly important roles with strong players who will be able to read and understand the materials and who will feel comfortable speaking in front of a group. In some cases, more than one person can fill a role, in which case the instructor may wish to partner individuals with more and less comfort speaking in front of a group.

Readings to be assigned to all players may be selected from the following:

Scientific Assessments

Farrell, A, S Vandeveer, and J Jager. 2001. "Environmental assessments: four under-appreciated elements of design." *Global Environmental Change* 11(4): 311-333.

Environmental Negotiations

Susskind, Lawrence E., and Saleem H. Ali. *Environmental diplomacy: negotiating more effective global agreements*. Oxford University Press, 2014.
[*Note: You may wish to select a specific chapter from this book.*]

Mercury science and policy

Stokes, Leah C., Amanda Giang, and Noelle E. Selin. "Splitting the South: China and India's Divergence in International Environmental Negotiations." *Global Environmental Politics* (2016).

N.E. Selin. 2011. "Science and strategies to reduce mercury risks: A critical review." *Journal of Environmental Monitoring*

Scientific Communication

Somerville, R., & Hassol, S. (2011). "Communicating the science of climate change." *Physics Today*, 64(10).

Debriefing the game

The debriefing should engage and excite the participants. A skillful debriefing will employ examples from the play of the game to: 1) illustrate the major obstacles to effective global environmental treatymaking; and 2) explore how scientific information can be effectively communicated in an international environmental negotiation.

Different instructors have different debriefing styles. Invariably, the ones that work the best are those that are well suited to the individual style of the instructors leading them. Moreover, the experience of the participants in each particular negotiation will itself flavor particular debriefings. Given the broad scope of this simulation, the debriefing session can be used to focus upon a number of different issues. This selection will depend, in part, on the setting in which the game is played, the teaching objectives of the instructor, and the type of players who are participating.

Having said this, in this section we will briefly highlight one potential approach to the debriefing, an approach which, in our view, brings out some of the more important substantive themes of this simulation. Our discussion is not meant to be exhaustive. Furthermore, these comments relate to discussion themes regarding international environmental treatymaking. A similar list of important general lessons about the art of facilitation and negotiation could also be generated, but is not the subject of this discussion.

The debriefing should begin with a review of what actually happened in the negotiation and possible alternative outcomes.

- In some cases, the group may have reached an agreement to move forward with an international negotiation on mercury. Parties may have agreed that, despite information gaps and scientific uncertainty, collective international action was necessary to address the risks from mercury.

- In other cases, the group may have found that there is insufficient information to compel action at this point. In this case, certain players may have successfully convinced the group that scientific information that mercury posed a significant enough risk was lacking. Instead, the group may have opted for voluntary measures and increased information gathering

The instructor should lead a discussion contrasting the specific outcome from the game play with what the participants had expected to happen going into the simulation or other alternative outcomes. This should provide a launching point for a larger discussion of:

a) how the participants evaluate the outcome of the negotiation;
b) what they consider to be the key features of the scientific information that account for this outcome
c) what the results suggest about the key obstacles to effective international environmental negotiation
d) what possible approaches and innovations may be used to overcome these obstacles, for example, how could assessments be more relevant and credible within negotiations

If the game is played in a formal classroom environment, the instructor may wish to assign follow-up, written reflection assignments. Possible questions include:

a) How did you interpret the scientific assessment, given your specific role in the game? How did the role you played affect how you viewed risk from mercury science? After playing the game, how do you think scientific assessment can better inform international environmental treatymaking?

b) What were the main barriers you saw to creating consensus in the game? How do you think this translates in the real world? What challenges are blocking environmental agreements?

UNITED NATIONS ENVIRONMENT PROGRAMME[1]

International Mercury Assessment

Table of Contents

[1] This report is part of The Mercury Game, 2011, a negotiation simulation available at mit.edu/mercurygame. Portions of this assessment are directly adapted from *The Global Mercury Assessment*, UNEP Chemical Branch 2002, *Summary of supply, trade and demand information on mercury*, UNEP Chemicals Branch 2006, *The Global Atmospheric Mercury Assessment*, UNEP Chemicals Branch 2008, *Technical Background Report to the Global Atmospheric Mercury Assessment*, UNEP Chemicals Branch 2008 and *Arctic Pollution 2011*, Arctic Monitoring Assessment Protocol 2011. These reports are closely adapted in order to preserve their language and form. The representation of mercury science is realistic and as up to date as possible for the purpose of the simulation. All errors are the authors own. This report does not represent the views of UNEP and is fictionalized.

• Introduction, Purpose & Scope

Introduction

This report is the Secretariat's response to the United Nations Environment Program's (UNEP) Governing Council, who requested UNEP undertake a global assessment of mercury and mercury compounds. The report provides a global overview of scientific information on the most important mercury issues, drawing on information primarily from the scientific literature. National governments, intergovernmental and nongovernmental organizations, and private sector groups have also submitted their own assessments and reports to be incorporated into the assessment. Given that many published scientific assessments focus on devloping countries, an explicit effort was made here to include information on mercury impacts relevant to developing countries.

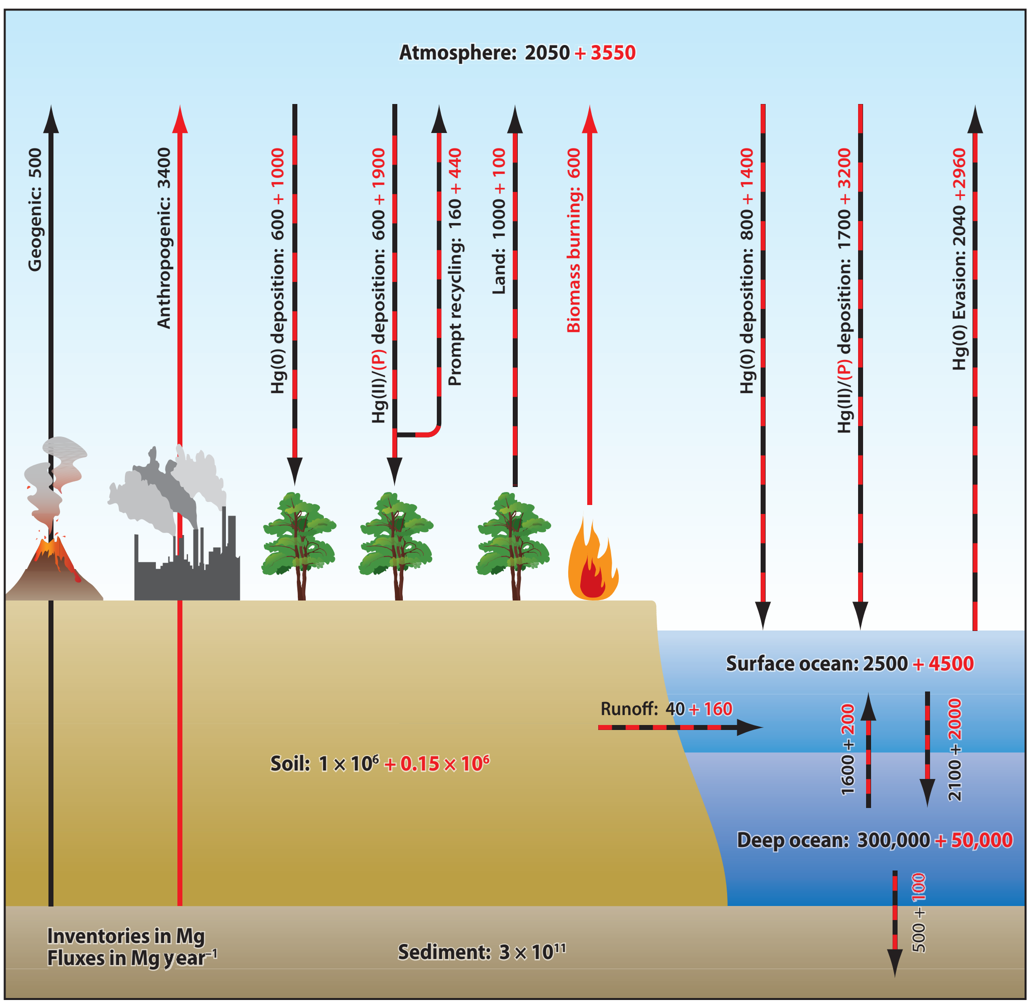
Sources of mercury:

Mercury is released from a variety sources, both natural and anthropogenic (see Figure 1). Natural emissions sources include volcanoes, geothermal vents and land emissions from areas naturally rich in mercury. Anthropogenic releases include fossil fuel combustion, biomass combustion, mining and industrial processes. Mercury is also found in various commercial and consumer products, and is released to the environment when those waste products are incinerated. Finally, artisanal and small-scale gold mining (ASGM) employs mercury, contributing to significant local and global releases. This report will address key mercury issues in each of the following sections.

Reasons for concern:

- Mercury and mercury-containing compounds are toxic for humans and ecosystems.
- Although mercury is a naturally occurring heavy metal element, and has always been present in the environment, human activity has increased mobilized mercury by a factor of three to five. Once mobilized, mercury persists, cycling for centuries to millennia until it is sequestered in deep ocean sediments (1).
- Mercury transports by air and water. In its gaseous elemental form, mercury has a long atmospheric lifetime of 6 to 18 months, allowing the element to be transported globally. Global transport is a key reason prompting international cooperation.
- Once mercury is deposited from the atmosphere, mercury can be transformed, primarily by microbial action, into methylmercury. Methylmercury is highly toxic and bioavailable, increasing in concentrations at higher levels in food webs.
- Human exposure to mercury occurs by eating fish or through occupational hazards. At high exposure levels, methylmercury is toxic. At lower exposure levels, methylmercury is associated with cognitive developmental delays in children and may be associated with heart attacks.

FIGURE 1. The Mercury Cycle (1)



1 Institutional Form for Future Action

Issue 1. Introduction

The question of whether mercury is a ***global*** problem, and therefore whether actions should be taken at the global level, largely concerns exposure mechanisms, toxicity, health impacts and environmental impacts. This section will address each issue in turn, in an attempt to provide the negotiating parties adequate information on the reasons for international action.

1.1 What are mercury's main human exposure pathways?

In order for mercury to be readily bioavailable, sulfate or iron-reducing bacteria can convert it to ***methylmercury (MeHg)*** under anaerobic conditions. Methylmercury is formed in aquatic ecosystems, primarily freshwater ecosystems including wetlands (Figure 2). In marine ecosystems, the exact methlyation mechanisms and the rates of methylation are unknown (2).

Once mercury is converted to methylmercury, it is highly toxic and can ***bioaccumulate*** up the food chain, particularly in fish. **MeHg can be present in predatory fish at 1,000,000 times the background level (3).** Since these fish travel long distances, bioaccumulation also contributes to global mercury transport.

Most human populations are exposed to methylmercury primarily through eating fish, with heightened exposure from eating fish at higher trophic levels. Populations that eat marine mammals, particularly whale and seals, also increase their exposure (for a summary, see AMAP 2011).

Additional exposure occurs through mercury-containing skin-lightening creams, use in medicines and rituals and in dental products.

Workers may be at an elevated risk of exposure to mercury in chlor-alkali plants, mercury mines, dental clinics and small-scale gold mines.

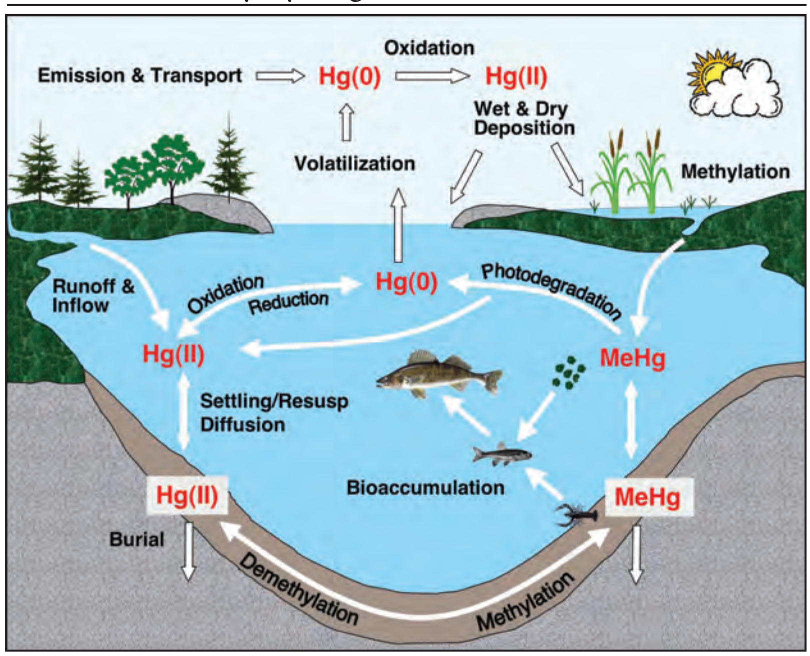
1.2 What are mercury's health impacts and toxicity?

All mercury-containing compounds are readily passable through the placental and the blood-brain barrier. Mercury's toxicity depends on its chemical form; the same exposure to elemental mercury and organic mercury compounds can produce different symptoms in the same patient. **It is well known that mercury is toxic at high levels and that methylmercury exposure poses the most severe risks.**

The developing nervous system is highly sensitive to methylmercury. For these reasons, exposure during pregnancy and infancy are of the highest concern. Exposure during fetal development and childhood may create ***long-term cognitive developmental impacts*** affecting language, attention and memory (5).

Mercury may also raise the risk for ***cardiovascular disease,*** although the epidemiological effects are uncertain. A recent review paper conducted by scientists for the US EPA found that methylmercury exposures may increase the likelihood of heart attacks. This relationship was demonstrated with moderate evidence for a number of risk factors, and expert scientists state the likelihood of a relationship between MeHg and heart attacks is between 45 to 80% (6).

Figure 2. Mercury Cycling in a Lake and Watershed (3)



At very high exposure levels, methylmercury can cause ***Minamata disease***, first observed in Japan in the 1950s. This ***neurophysiological disorder*** leads to atrophy in the brain, tremors, loss of perception, major impairments in functioning and, in severe cases, death (7, 8). For those exposed in the womb, with congenital Minamata disease, symptoms are extreme, resembling cerebral palsy with deafness and mental retardation (9) (Figure 3).

In Minamata, exposure occurred because mercury-containing effluent was discharged directly into the bay, where it bioaccumulated in fish; when the community ate this fish, they became sick. Similarly, in Canada in the 1970s, several Northern Ontario aboriginal communities were exposed to high levels of mercury because chlor-alkali plants were discharging mercury-containing effluent into a river system (10). A third case occurred in Iraq in the 1970s when MeHg was sprayed on seed as a fungicide, resulting in mass poisoning when people ate the seed (8). For a summary of the Iraq and Japanese cases, see Table 1.

Methylmercury can also have adverse effects at concentrations lower than those seen in the poisoning incidents listed in Table 1. **Three large epidemiological studies were undertaken in the Faroe Islands, Seychelles and New Zealand to examine the effects of long-term chronic exposure to mercury for children.** These studies provide evidence that methylmercury exposure in the womb creates cognitive deficits in children, even at concentrations from 10-20% of observed effect levels in adults (5, 13). The results are summarized in **Table 2** (next page).

Figure 3. Congenital Minamata Disease

- The **Faroe Island study**, which is the most widely accepted figure for non-lethal neurodevelopmental effects, sets the benchmark dose level at 10 µg/g total mercury in maternal hair (5, 14, 15).
- The **Seychelles study** in contrast found no developmental effects associated with exposure levels at an average of 7 µg/g total mercury in maternal hair (16, 17).
- The **New Zealand study** found an association between maternal hair concentrations in MeHg and childrens' test scores, provided one outlier was omitted from the data. This study put the lowest benchmark dose level between 7.4 to 10 µg/g (18)

As reference, the US EPA reference dose (RfD), the maximum acceptable oral dose of a toxin, is 0.1 µg/kg body weight per day, corresponding to 5.8 µg/L in blood or 11 µg/g in maternal hair (19). The mean hair mercury level in the United States in 2000 was 0.12 µg/g in children, 0.20 µg/g in women and 0.38 µg/g in women who frequently consumed fish (19); this study also found 8% of women of childbearing age had mercury concentrations exceeding the US RfD (19; **Table 3**). However, traditional diets within some Arctic and indigenous populations put these populations at greater risk of high mercury exposure (4, 20).

Table 1. Acute Methylmercury Cases

Case	Hair Sample Exposure Level
Minamata, All patients with health effects	2 - 705 µg/g (7)
Minamata, Congenital cases	5 - 110 µg/g (7)
Minamata, Mother's hair (5-8 years after birth)	1 - 191 µg/g (7)
Iraq, Congenital cases Iraq, Congenital cases (reanalysis)	>10 µg/g (11) >80 µg/g (12)
Iraq, Severe effects[1]	125-1250 µg/g (8)
Iraq, Death[1]	750-1250 µg/g (8)

[1] These values were calculated using a hair to blood mercury conversion of 250 (38).

Table 2. Epidemiological Studies			
	Faroe Islands	**Seychelles**	**New Zealand**
Average MeHg concentration in maternal hair	3 µg/g	7 µg/g	20 µg/g or less (excluding outlier)
Benchmark Dose Level (BMDL) - 10%	10 µg/g	No effect found	7.4 - 10 µg/g

Benchmark Dose Level (BMDL) is the concentration at which an increase (e.g. a 10% increase) in an observed adverse effect (e.g. an abnormal test scores) occurs above the background level or population average. The BMDL is the statistical lower bound, on a 95% confidence interval, on this concentration. For mercury, the BMDL can be intepreted as the concentration at which a 10% increase in likelihood of an abnormal test score or another adverse effect is observed.

Table 3. Mean and Selected Percentiles of Hair Mercury Concentrations for Children (1-6 years) and Women (16-49 years) in µg/g in the US, 1999 (19, 21)					
		Selected Percentiles			
Hair Hg	**Number**	**Mean**	**10^{th}**	**90^{th}**	**95^{th}**
Children	838	0.22 µg/g	0.03 µg/g	0.41 µg/g	0.65 µg/g
Women	1726	0.47 µg/g	0.04 µg/g	1.11 µg/g	1.73 µg/g

1.3 What are mercury's environmental impacts?

Mercury harms ecosystems through ***bioaccumulation*** in individual organisms and then ***biomagnifications*** along the food chain. Concentrations are lowest in smaller, non-predatory fish and increase dramatically at higher trophic levels in the food chain.

Animals at the top of the aquatic food web, including seabirds, seals, otters and whales, are most at risk for mercury-related health impacts. Additional factors affecting population exposures include the population's location and habitat use (4). Concentrations tend to increase with the organism's age, potentially affecting population dynamics.

As a ***central nervous system toxin***, methylmercury can harm wildlife, particularly gestating animals. Inorganic mercury harms animals' kidneys and reproductive systems.

- In bird species, mercury can create adverse effects on reproduction with egg concentrations of Hg as low as 0.05 to 2.0 mg/kg (wet weight) (13).
- **Mercury levels in many Arctic species (beluga, ringed seal, polar bears, birds of prey) continue to rise, despite reduced or stabilized levels in global mercury (4)**. This is concerning since Arctic species face multiple stressors, including climate change.

Finally ***climate change***, with effects including increased flooding in areas of existing rainfall and warmer average temperatures, may increase the methylation process (13). This in turn could increase bioaccumulation of MeHg in ecosystems, and eventually, exposure through human diets (4).

2 Atmospheric Emissions

2.1 What is the scale of atmospheric emissions?

Estimating human and natural mercury emissions, including their relative contributions, is a difficult task (for a review of the literature, see Table 1 in Selin 2009 and Pacyna et al. 2010).

- In 2005, global ***anthropogenic*** *emissions* to the atmosphere were estimated to be 1930 tonnes (range 1230–2890 tonnes).
- In 2005, ***natural emissions*** were estimated to be within the same order of magnitude as anthropogenic emissions, considering ocean emissions (400–1300 tonnes per year) and land emissions (500–1000 tonnes per year). Combined, nautral emissions were estimated between 900-2300 tonnes.
- ***Re-emissions*** of previously mobilized mercury add an additional 1800–4800 tonnes per year. Since these re-emissions are likely in the same proportion as the initial emissions, half of these re-emissions can be considered of anthropogenic origin and the other half natural.

Using data from lake sediment cores, it is estimted that current mercury deposition is three to five times above pre-industrial levels (1).

In summary, anthropogenic emissions, natural emissions and re-emissions each contribute approximately one-third of total annual emissions (22-25; Figure 4).

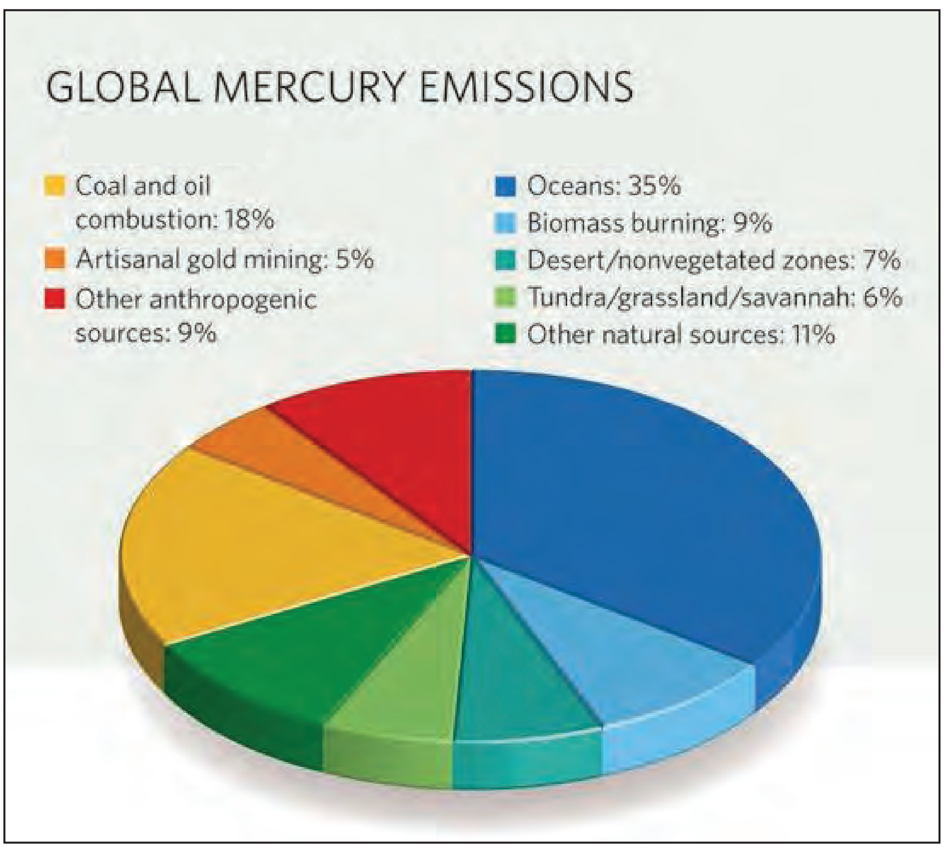
Notably, atmospheric mercury emissions are believed to have remained relatively constant between 1990 and 2005, although the location of emissions has shifted significantly (22, 25, 26; Figure 10).

2.2 What is the current state of emissions inventories?

Emissions inventories are available from 2005 with some countries reporting data. **However, many countries lack data on current or past mercury emissions. Where information is lacking, models have been used to estimate total anthropogenic mercury emissions.**

- Currently, Asia accounts for ~67% of mercury emissions (Figure 5).
- Monitoring stations are not well distributed globally, leading to significant data gaps (Figure 8).
- Overall, mercury emissions have remained stable since 1990, with some decline in the EU and USA as a result of regulations, and some amplification in Asia (22) (Figure 10). Emissions estimates associated with products, disposal and artisanal and small-scale gold mining (ASGM) are now included in this atmospheric emissions inventory, although these figures are relatively uncertain.

FIGURE 4. Natural, Anthropogenic and Re-emissions



Source: Mercury Fate and Transport in the Global Atmosphere (Springer, 2009)

2.3 What are the sources of atmospheric emissions?

Emissions are often subdivided into ***unintentional*** and ***intentional*** releases (see Figures 5, 6 & 7).

- **Coal-fired power production, an unintentional release, is the single largest global source of atmospheric mercury emissions**, accounting for approximately 45% of the total quantified atmospheric emissions from anthropogenic sources (23, 25). Coal-plants emit mercury in its elemental and divalent forms, and also in association with particulate matter, with implications for global transport.
- Cement production, mining, combustion of other fossil fuels, iron and steel processing also contribute to unintentional mercury releases. Waste treatment contributes to emissions through incineration of municipal, medical and hazardous wastes and cremation (dental amalgams).
- **Mercury is released from intentional use and extraction including mercury mining, artisanal and small-scale gold and silver mining (ASGM), chlor-alkali production, production of mercury-containing products, and waste treatment.**
- There is a range of uncertainty for emissions from all sources (Figures 6 & 7).

FIGURE 5. Anthropogenic Mercury Emissions, 2005

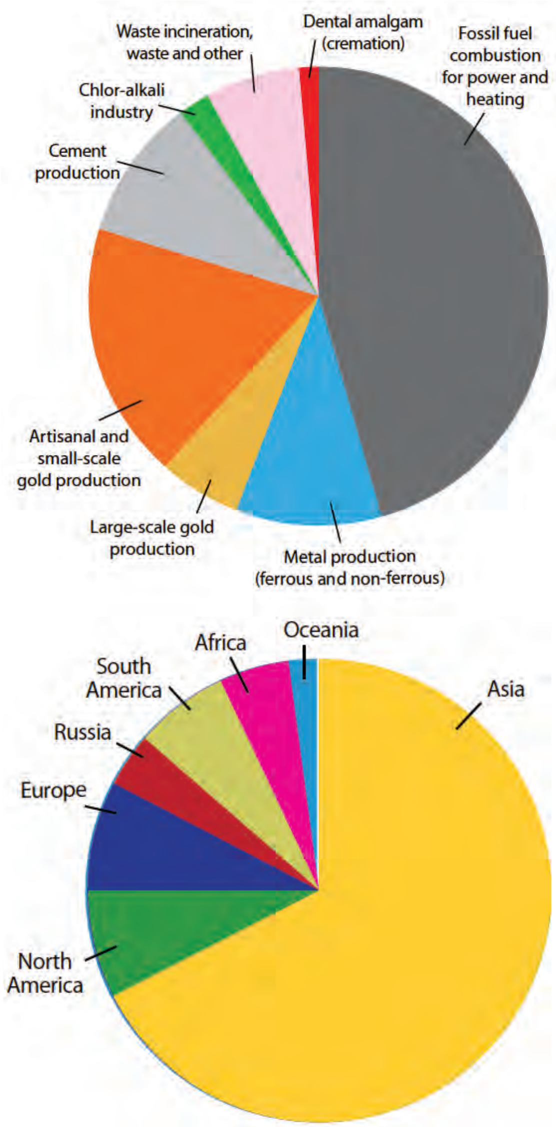


FIGURE 6. Uncertainty Factors for Hg Emissions (25)

Uncertainty of Hg emission estimates by sector.

Industrial source	Uncertainty (±%)
Stationary fossil fuel combustion	25
Non-ferrous metal production	30
Iron and steel production	30
Cement production	30
Waste disposal and incineration	As much as 5x
Mercury and gold production	?

Uncertainty of Hg emission estimates by continent.

Continent	Uncertainty (±%)
Africa	50
Asia	40
Australia	30
Europe	30
North America	27
South America	50

2.4 How is mercury transported in the atmosphere?

Mercury exists in a variety of forms in the atmosphere, which affects the distance it transports:

- In the atmosphere, mercury exists most abundantly in its **gaseous elemental form, Hg(0)**. Elemental mercury is emitted by natural sources and anthropogenic sources, including coal power plants.
- Elemental mercury **persists in the atmosphere between 0.5 and 1.5 years, allowing it to transport globally** (25). Through reactions, elemental mercury is often converted into divalent mercury, which is readily deposited out of the atmosphere and into ecosystems.
- Anthropogenic sources also emit mercury in its **divalent form (Hg(II))** and associated with **particulate matter (Hg(P))**.
- In contrast to Hg(0), **Hg(II) and Hg(P) have much shorter lifetimes in the atmosphere, on the order of days to weeks**. As a result they do not tend to be transported long distances, and instead contribute to local and regional pollution. Hg(II) and Hg(P) are removed, incidentally, through conventional scrubber technology on power plants.

Elemental mercury emissions transport over long distances via atmospheric and oceanic processes. **For this reason**, **remote areas may have mercury concentra-**

Figure 7. Range in Emissions Estimates by Sector, 2005 (25)

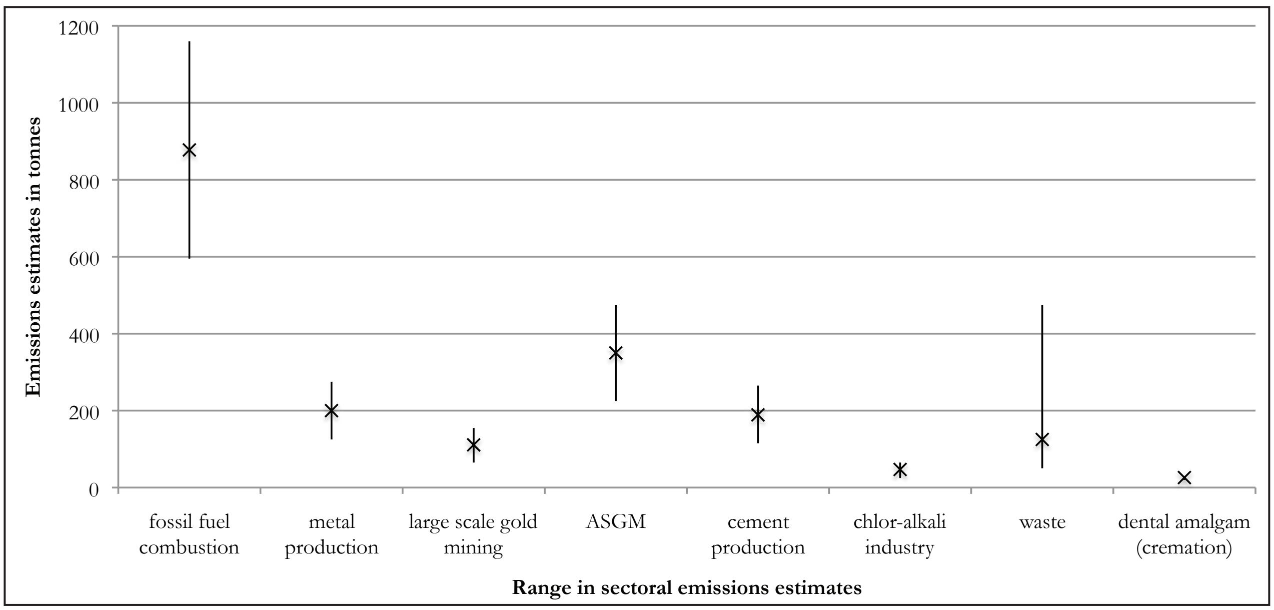
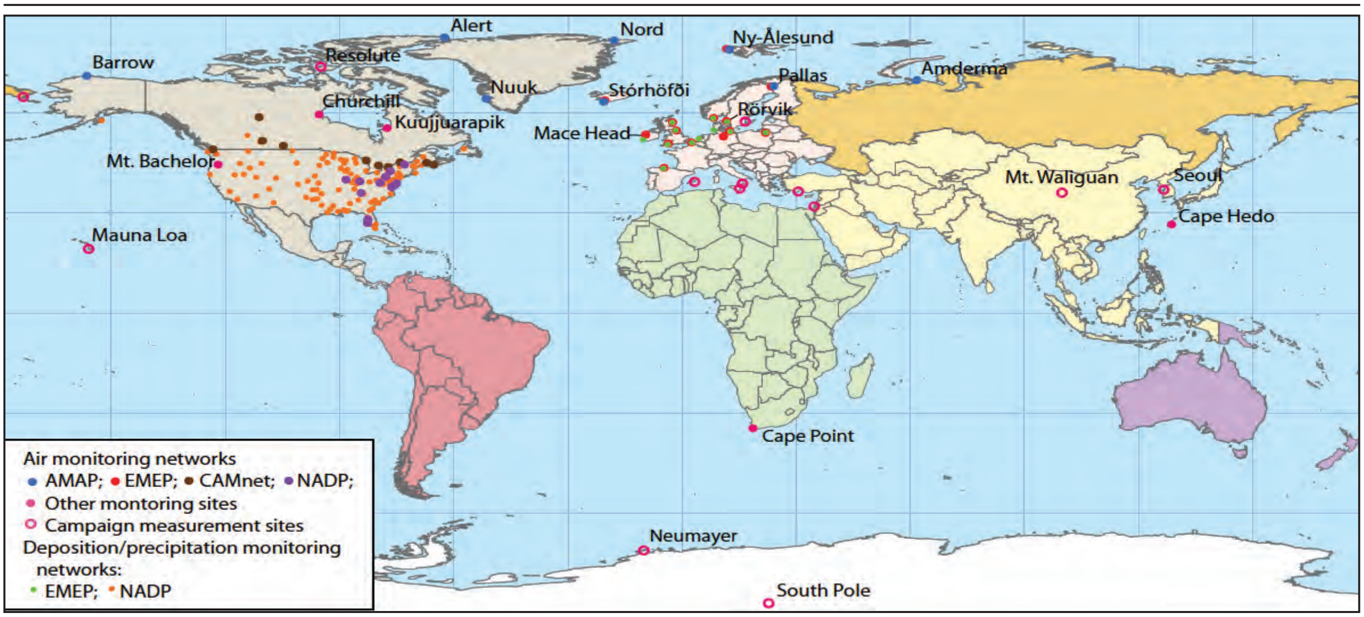


Figure 8. Atmospheric Mercury Monitoring Stations (25)



tions three to five times above preindustrial levels, despite limited local emissions. In areas with high levels of local emissions, mercury concentrations may be elevated 10 times or more above baseline, largely due to divalent and particulate mercury emissions (27).

However, while long range transport is important, there are locations where Hg(0) is easily transformed into Hg(II) and rapidly deposited. In these locations, regional inputs are more important than global inputs leading to local hotspots of mercury accumulation (28).

Mercury may have disproportionate effects on **the Arctic**, which is particularly noteworthy given the Arctic does not emit significant amounts of mercury. The Arctic Monitoring and Assessment Programme has released detailed information on mercury in the Arctic:

- Mercury arrives in the Arctic via long-range environmental transport. **Models estimate most natural deposition in the Arctic originates from the ocean while most anthropogenic deposition originates from East Asia (Figure 9)**.
- **Traditional diets within some Arctic populations put these populations at greater risk to high mercury exposure (4, 20).**
- Arctic ecosystems may play an important role acting as a global sink for mercury, through Atmospheric Mercury Depletion Events (AMDEs). However, much of this mercury is rapidly re-volatilized; for this reason, its importance of these events to Arctic foodwebs remains unclear.

Figure 9. Model Estimates for Emissions Contributions to Arctic Deposition by Region (4)

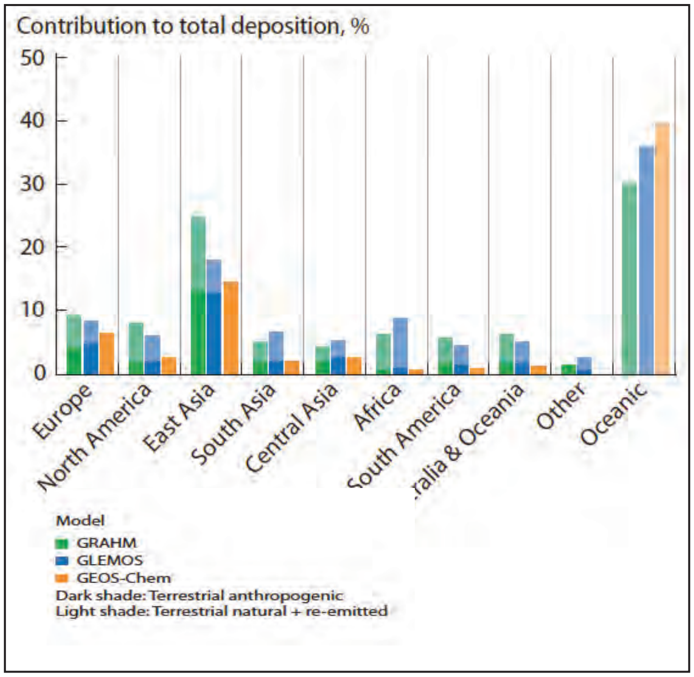
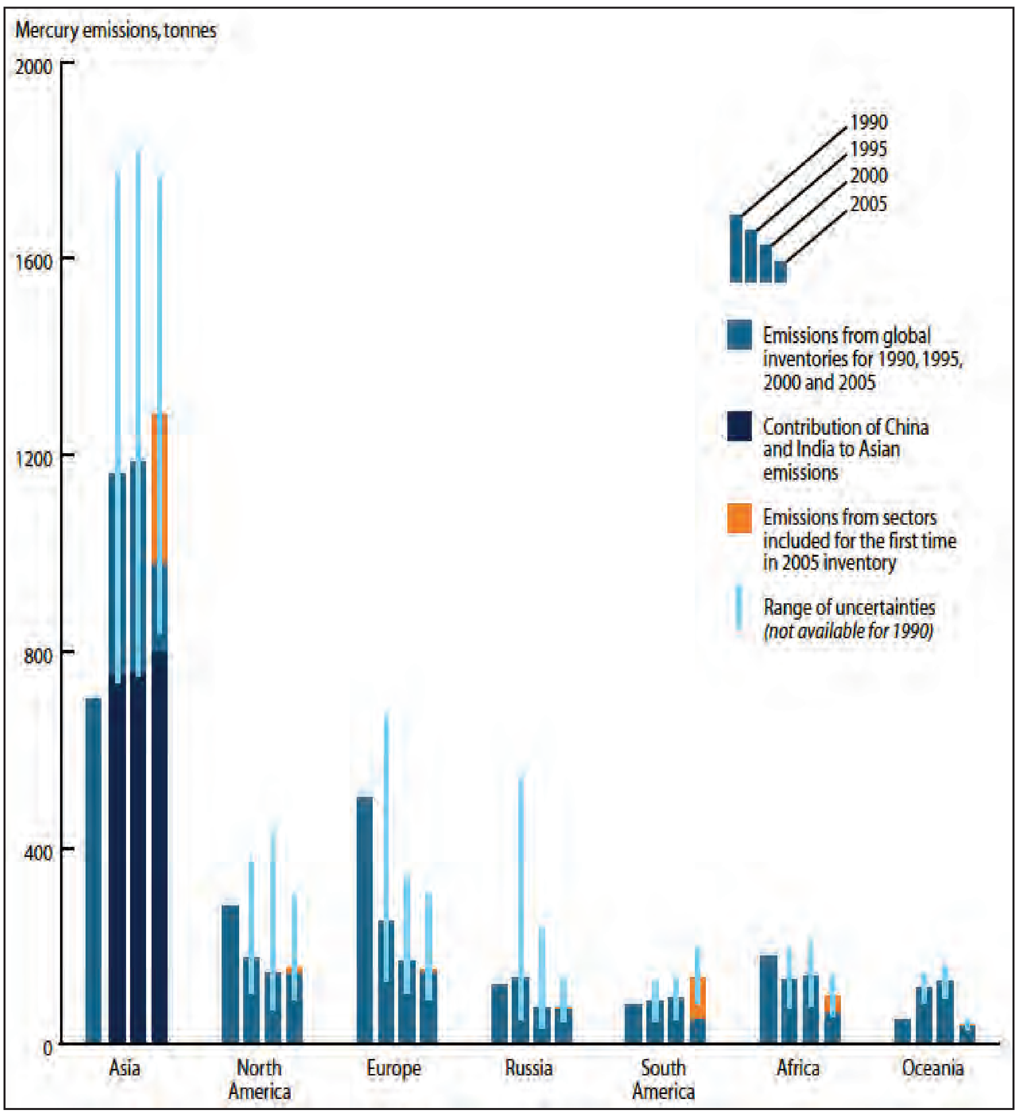


Figure 10. Regional Mercury Emissions Trends, 1990-2005 (25)



2.5 How will ecosystems respond to emissions reductions?

Ecosystem responses to mercury abatement vary depending on the type of ecosystem, location specific hydrology, water quality, soil cover, trophic structure, temperature and the timing and delivery of deposition into waterbodies (27). For these reasons, proximate ecosystems can vary significantly in their mercury concentrations. Together, several factors affect a given ecosystem's sensitivity to mercury loading:

- The topography of nearby terrestrial ecosystems, including the watershed size and watershed-to-surface water ratios, affect the residence time of mercury in the soil. This in turn alters the speed of mercury loading in waterbodies and later conversion to MeHg.
- Larger watersheds with less surface water likely retain larger amounts of mercury in the soil, although this effect is perhaps small (29).
- Wetlands, lake sediments and anoxic bottom waters are significant sites of MeHg conversion as these ecosystems have longer water residence times, allowing greater opportunity for greater conversion.
- Land use change, through conversion of forested areas, may also increase mercury loading in waterbodies; however, runoff in agriculturally converted areas may lead mercury to be associated with particulate matter, decreasing its bioavailability.

Although scientific research suggests mercury concentrations in ecosystems and fisheries should decline with reduced mercury emissions, the timing and extent of the ecosystem response is uncertain. The effect mercury abatement has on methylation rates in ecosystems is particularly important for the ongoing global negotiations on mercury.

One study, which added enriched mercury isotopes into a watershed, found methylmercury deposited directly into the lake was readily bioaccumulated in fish. However, mercury deposited into the watershed was stored, with little uptake in fish. Although this study found a rapid initial decline in fish mercury concentrations, on the order of years, full recovery was delayed as watersheds continued to export mercury to the lake. In addition, contaminated peat and upland soils could take centuries to decline entirely (30).

A second study suggests that ecosystem responses to input reductions may occur over two phases: first a relatively fast 20-60% reduction in mercury levels in predatory fish over a few decades, but then a long-tailed reduction over decades and even centuries to reach a more complete reduction (31). For this reason, ecosystem responses to mercury abatement may not be linear and remain uncertain.

3 Demand for Mercury Used in Products & Processes

Issue 3. Introduction

Mercury is an excellent material for many products and processes because of its unique combination of characteristics: it is a liquid at room temperature, acts as a good electrical conductor, has a high density and high surface tension, and is toxic to microorganisms. For these reasons, mercury is used in a number of products and processes globally, despite clear reasons for concern (Figure 11). Although mercury is also used for ASGM, this issue is treated separately in the following section (Issue 4: ASGM).

3.1 Which products contain mercury?

- Mercury is used in measuring devices (manometers, thermometers), electrical and electronic switches, fluorescent lightbulbs, dental amalgam fillings, batteries, biocides (in the paper industry), antiseptics (in pharmaceuticals), catalysts, pigments and dyes, detergents, and explosives.
- Mercury compounds are used in a wide variety of health and beauty products, including pesticides, biocides, pharmaceuticals, and cosmetics, despite their known human toxicity.
- In some cases, substitutes have been implemented, however, mercury continues to be intentionally used in some products.

Figure 11. Global Mercury Demand by Sector (31)

Global mercury demand (2005)	Metric tonnes
Small-scale/artisanal gold mining	650-1,000
Vinyl chloride monomer (VCM) production	600-800
Chlor-alkali production	450-550
Batteries	300-600
Dental use	240-300
Measuring and control devices	150-350
Lighting	100-150
Electrical and electronic devices	150-350
Other (paints, laboratory, pharmaceutical, cultural/traditional uses, etc.)	30-60
Total	**3,000-3,900**

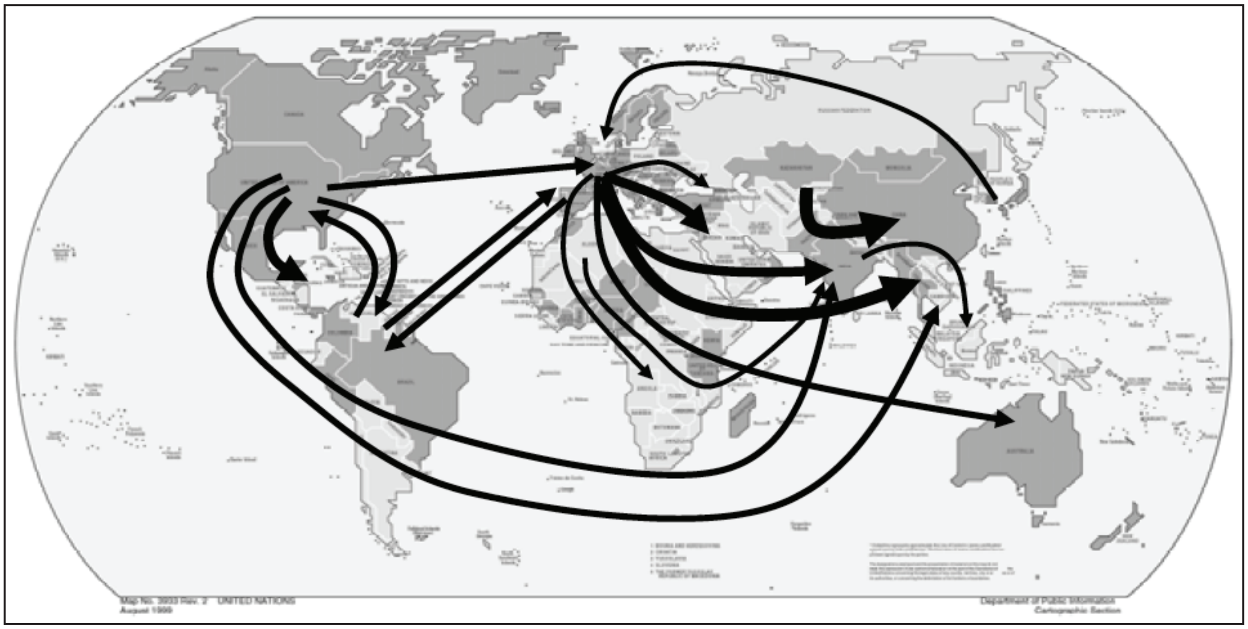
3.2 Which industrial processes use mercury?

Mercury is used in a number of industrial processes including chlor-alkali production and vinyl chloride monomer production (VCM).

Chlor-alkali production, used to make chlorine and caustic soda, creates significant demand for mercury. If the mercury cell process is used, mercury is released to the atmosphere and nearby waterways. When chlor-alkali plants close or are converted, large amounts of mercury can be released to the environment if not carefully managed. Emissions from existing mercury process plants in Western Europe and the U.S. have been reduced via regulation, as well as voluntary efforts. Many other countries, including Brazil, have taken action to reduce emissions; however, these plants appear to be relea sing more mercury than comparable European plants (32). Roughly three-quarters of the entire global chlorine production capacity exists in Western Europe and North America.

Vinyl chloride monomer (VCM) production is a process used to create polymers particularly polyvinyl chloride (PVC). The use of mercury in VCM is particularly concerning as it is not clear how much of the mercury is lost during the process (32). The process has been phased out in Europe and the United States. However, China demands >600 metric tonnes of mercury per year as an input to the VCM process, representing an estimated 80-90% of the world's VCM production. Demand for PVC in China is increasing, with mercury use in VCM nearly doubling between 2002 and 2004 from 350 tonnes to 610 tonnes of mercury (32).

Figure 12. Mercury Trade Shipments, 2004 (31)



3.3 How much mercury is traded?

There is significant trade in mercury and mercury-containing products, some of which is illegal, uncontrolled and/or unregulated. Global trade in mercury products is likely in the range of $100-150 million annually (32).

Global demand for mercury has declined from more than 9,000 metric tonnes annually in the 1960s, to just under 7,000 metric tonnes in the 1980s, and less than 4,000 metric tonnes since the late 1990s. In 2005, global demand for mercury was 3,000-3,900 metric tonnes per year (32).

While demand for mercury has been declining in developed countries, there is evidence that **mercury demand remains relatively robust in many lower income economies and supply is shipped from many developed countries (Figures 12 & 13)**:

- In South and East Asia, demand continues for mercury use in products, vinyl chloride monomer (VCM) production and ASGM.
- In Central and South America, demand for mercury continues for ASGM.
- Significant quantities of mercury are shipped from Western Europe (the EU plus Switzerland) to Asia, Africa, and Australia.
- The United States also exports mercury to Central America and Asia. Figure 12 shows different sizes of arrows representing larger and smaller volumes of mercury moving between regions during 2004.

Figure 13. Global Mercury Demand & Supply by Region, 2005 (31)

Elemental mercury, 2005	Regional demand (metric tonnes)	Regional supply (metric tonnes)
East and Southeast Asia	1,600-1,900	900-1,300
South Asia	300-500	100-200
European Union (25 countries)	400-480	400-800
CIS and other European countries	150-230	800-1,200
Middle Eastern States	50-100	0-50
North Africa	30-50	0-50
Sub-Saharan Africa	50-120	0-50
North America	200-240	300-500
Central America and the Caribbean	40-80	20-100
South America	140-200	100-200
Australia, New Zealand and Oceania	20-40	0-50
TOTAL	**3,000-3,900**	**3,000-3,800**

4 Artisanal & Small-Scale Gold Mining

Issue 4. Introduction

Mercury has been used in the process of gold and silver mining since Roman times. **Today, high gold prices, combined with difficult socio-economic situations in some communities, has led to increased use of mercury for small-scale mining, particularly in the southern hemisphere.** These practices largely occur within the informal sector and are unregulated, making information on scale, impacts and solutions difficult to ascertain (33).

4.1 What is the scale of ASGM globally?

It is estimated that ASGM for livelihood purposes involves more than 100 million people on all continents and in 55 countries. Of this, it is estimated 10-30 million people are miners, including 4.5 million women and 1 million children. **ASGM produces ~20-30% of the world's gold production**. Although ASGM can be conducted without mercury, speed and simplicity make mercury-use the most common method (33).

- Currently, mercury amalgamation is used as the major artisanal technique for gold extraction in South America, China, Southeast Asia and Africa. **Countries with significant operations include China (200-250 tonnes released) and Brazil, Columbia, Peru, Bolivia, Venezuela, Tanzania, and Zimbabwe (10-30 tonnes each) (33; Figure 16)**.
- As a consequence of poor practices, recent estimates suggest mercury amalgamation in ASGM results in the discharge of 650 to 1000 tonnes of mercury annually, representing approximately one-third of all global, anthropogenic mercury releases. Thus, ASGM may be the single largest intentional-use source of mercury pollution in the world (34). Almost all mercury used in ASGM is eventually released (34).
- It is estimated that as much as 300 tonnes of mercury per annum are volatilized directly to the atmosphere, while 700 tonnes are discharged in mine tailings into soil, rivers and lakes. In addition to domestic pollution impacts, both air emissions and tailings discharge contaminate international waters and air (34).
- Although the sale and use of mercury for ASGM is officially banned in Brazil, China and several other countries, this ban is clearly difficult to enforce in the rural areas where ASGM occurs – especially since these activities often occur in the informal sector.

4.2 What are the impacts of ASGM?

During one of the steps of the gold purification process, gold amalgam is heated, releasing mercury vapor (Figure 14). Occupational hazards from ASGM are significant. **Miners and community members may breathe air with Hg concentrations above 50 µg/m3, which is 50 times the WHO maximum public exposure guideline.** As a result, miners can exhibit mercury-poisoning symptoms including tremors (34).

Figure 14. ASGM Techinques Using Hg

In addition to occupational hazards, ASGM generates thousands of dispersed, polluted sites, often presenting serious, long-term environmental health hazards to populations living near and downstream of mining regions (35). As a result of ASGM practices, mercury is found in surrounding soils, plants, sediments, waterways, and especially mine tailings at extraction sites and at trading posts.

Recent scientific research suggests most mercury pollution from ASGM occurs locally (~60%) with a smaller proportion contributing to the global mercury pool (~30%), although this research was based on historic mining periods (34).

4.3 What are the potential actions to address mercury use in ASGM?

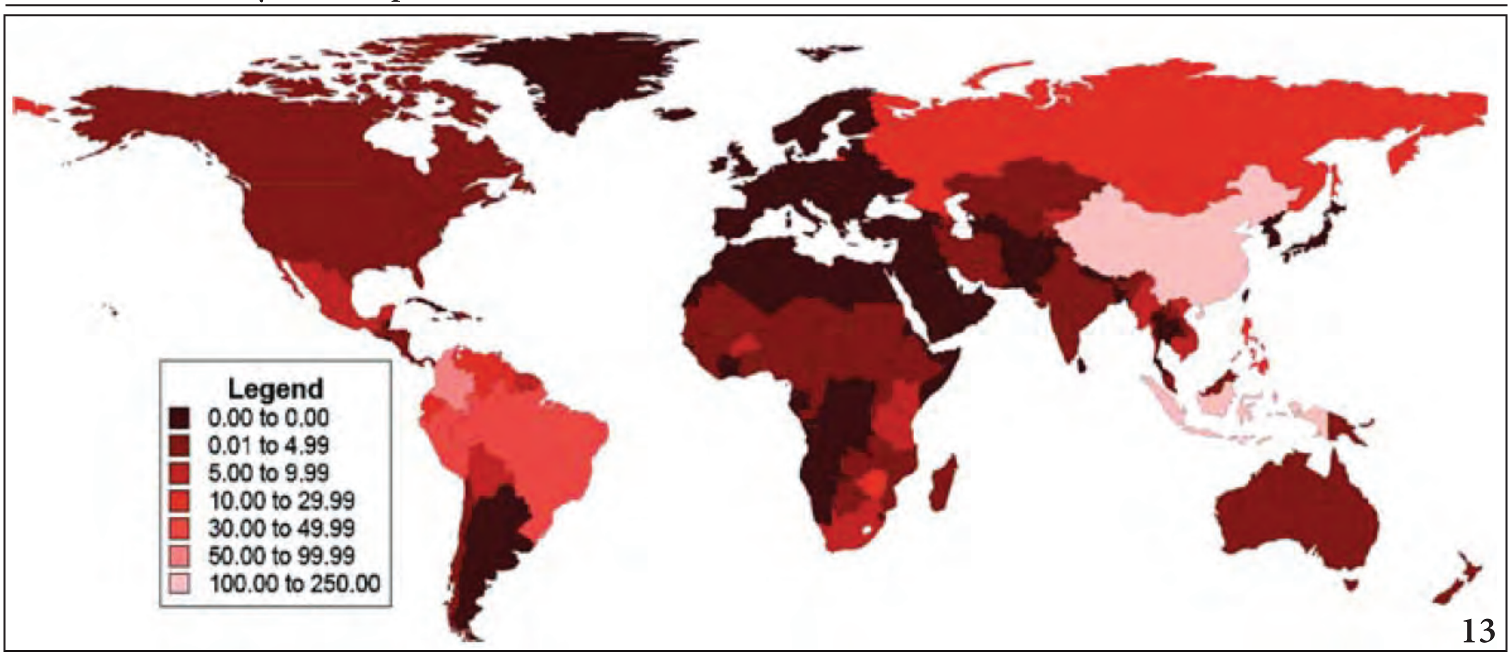
ASGM continues due to a combination of high-gold prices, access to mercury and persistent poverty (35). In addition, the practice takes place largely within the informal sector, making regulation difficult. The impacts of mercury pollution are complex, time-delayed and difficult for miners to see, impeding efforts to reduce hazardous practices (34). Finally, many miners are unacquainted with cost-effective hazard reduction techniques (36). Nevertheless, mercury releases and health hazards may be reduced by:

- educating miners and families about hazards and alternative techniques
- **promoting capture devices, such as retorts, which can reduce mercury emissions up to 95% (35; Figure 15)**
- developing facilities where miners can take concentrated ores for the final refining process
- banning the use of mercury by artisanal miners, which may encourage central processing facility use; however, enforcing bans can be difficult.

For all these actions, widespread adoption of mercury-free or reduced risk gold-mining practices **will require substantial investment in terms of technology and training (37)**. Trade regulation may also be necessary as much of the mercury that is used for ASGM enters the country legally for other purposes, including use in products and processes (33).

Figure 15. Using a Retort

Figure 16. Mercury Consumption for ASGM



Conclusion

Options for actions on mercury

There are several actions available to reduce global mercury releases:

- controlling mercury emissions through end-of-pipe technologies (e.g. scrubbers on coal power plants)
- reducing consumption of raw materials and products that generate mercury releases
- substituting products or processes for those that do not use mercury
- reducing mercury use in ASGM

Unintentional atmospheric emissions: mercury releases through coal combustion can be reduced with existing scrubber technology used for sulfur dioxide and nitrogen oxides; these scrubbers also remove Hg(II) and Hg(P). However, mercury specific scrubbers are required to remove Hg(0). The use of particular control techniques depends on the type of coal being combusted, as this alters the relative amount of Hg(0) and Hg(II).

Mercury use in processes: mercury releases and occupational exposures may be reduced through strict mercury accounting procedures, management measures to keep mercury from being dispersed, filtering exhaust air and proper disposal of mercury wastes. Several prevention or alternative technologies already exist with more in development.

Mercury in products: substituting non-mercury products and managing the waste stream may reduce mercury releases and exposures.

ASGM: mercury releases and exposures can be reduced through the use of capture devices, including retorts. Actions may focus on technology transfer, including building central processing facilities. Bans on mercury may also be pursued. All actions on ASGM will require technical and institutional support to ensure success.

Data Gaps

A number of countries have data gaps in their national mercury release inventories or lack inventories altogether. Missing data may include: information on uses and emissions, sources of releases, levels in the environment and prevention and control options for mercury and mercury compounds.

Many countries could also benefit from developing a national action plan for mercury.

Some data needs include:

- National inventories on use, consumption and releases of mercury.
- Monitoring of levels of mercury in various media and biota and assessment of the impacts of mercury on humans and the environment.
- Information on transport, transformation, cycling, and fate of mercury in various compartments.
- Evaluation tools for human and ecological risk assessments.
- Information on possible mercury exposure prevention and reduction measures.
- Public awareness-raising on the potential adverse impacts of mercury and proper handling and waste management practices, particularly for mercury use in ASGM.
- Capacity building and physical infrastructure for safe management of mercury as a hazardous substance, potentially on a regional basis.
- Information on trade in mercury and mercury-containing materials.

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6.4 Mercury Game Group 1 Minutes

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement no. 860497.

Mercury Game Minutes (Group 1) – 22nd March 2021

Attendence

Scope

- The chair welcomed the parties and introduced the negotiations
- Each party introduced themselves and their position
- 3 Breakout rooms were created (India, China, Canada / EU, MFF, WCPA, Africa / Brazil, USA, AMAP)
- After 30 minutes of negotiations in the small groups, the parties presented and discussed the outcome of their discussions in the main session
- Major disagreements were then discussed in the main session together
- Some could be solved, some had to be postponed (no agreement at this point in time)
- Summary & Outlook (chair)

Outcome

1. Form of future action

Most countries agreed on a globally binding legal treaty (except China (only voluntary measures at this time); The agreement was based on the condition that developing countries receive financial and technical support from the developed countries which in turn is bound to the condition that developing countries have to prove their willingness and progress

2. Atmospheric emissions

China disagrees to include atmospheric emissions; India, Tanzania and Brazil agree only under the condition of support from developed countries

3. Products and Processes

All countries agree that there should be a binding and explicit list of products and processes to ban (developed countries will support developing countries in the elimination process)

4. ASGM

Africa disagrees to sign a legally binding document at this time as ASGM is a large informal sector there. They, however, agree to set up monitoring measures and are willing to work towards a future legislation. All other countries agree that ASGM should only be possible when applying capture devices under the condition that developed countries will support developing countries in the implementation process of such capture devices. USA wants exact timetables for the implementation phase

6.5 Mercury Game Group 2 Minutes

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement no. 860497.

Mercury Game Minutes (Group 2) – 22nd March 2021

Introduction statements:

Countries:

Brazil: Wants to reduce Hg, but can only do it with the financial and technical aid of western countries

Canada: Canada would like to reduce global emissions. Canada is depending on a lot of fisheries and is worried about Hg in fish.

Tanzania: We believe Hg is a unique element and is worrying and poses threats to all humankind. This meeting is a once in a lifetime opportunity to create a legally binding resolution to reduce admissions. We are willing to reduce products using Hg and reduce Hg in ASGM if we get support and aid.

The European Union: The EU has already taken measures to reduce Hg emissions and wants to continue to guarantee human health. We need international regulations since Hg travels across borders.

The people's republic of China: China feels small scale gold mining is the main source of mercury and coal mining is a smaller factor. China feels like more research is needed to fully understand historic emissions before legally binding resolutions can be formed.

United States of America: The US sees Hg as a contaminant of global concern and it cannot be controlled by local regulations. The US has already taken measurements to protect people, but we want strong international treaties as it is a global threat and are willing to aid. Developing countries

Republic of India: India respects scientific evidence about mercury and we respect that we emit Hg. We do however believe enough scientific evidence is necessary and more research is needed for binding resolutions. There is also very little evidence about low-level emissions and their effect on public health. India feels like Hg emissions should be considered on a per capita bases and in this way India emits less than most developed countries. Per capita, India can be seen as a small consumer of Hg and no proper alternatives are yet present. Therefore, India is in favour of voluntary commitments but no binding regulations.

NGO's

Mercury Free Future: Our position is that there is sufficient evidence that Hg is a global problem with significant risk and atmospheric emissions and a large source of Hg and should be considered. And all processes should be considered in these negotiations.

Arctic council and monitoring programme: Not present

World coal power association: We believe that even though there is research on Hg there is not enough to determine the long term effects. Acute effects are not related to coal fire power plants. We have the positions that natural sources still contribute 2/3 of atmospheric Hg and ASGM is a much larger contributor than coal and should receive the most attention in regulations. Coal power plants are heavily regulated whereas ASGM are not.

Notes free discussion

USA: The reemission is also anthropogenic and therefore I the statement of the world coal power association is not fully true. And we can only tackle anthropogenic emissions so we need to address this. To India, there are alternatives available so we think bindings regulations could be implemented.

World coal power association: We disagree that coal power plants are the main contributor. We think it is better researched as it is carefully monitored. Whereas this is not the case for small scale mining. Coal power emits more Hg2+ and bound Hg which is more of local problems, so laws should be at a national level.

USA: We agree that ASGM emits and unknown amount and we see that coal power emissions are well known, but this also makes it easier to make well functioning regulations. What else can be done for ASGM as it is already illegal in most countries?

Tanzania: We think that it is important to regulate ASGM, and because of that we want to have a treatment. We are very interested in finding out how much African countries are truly contributing. We do however not have the technical expertise and finance to make this budget. So we do feel like we need developed countries.

Brazil: We agree with Tanzania. The GRULAG is in the same situation and we are eager to tackle the Hg problem but are low in resources. The different methods mentioned by the US are not possible for us as we do not have the technology available. But we also think it is necessary to study how much gold mining emits as international regulation is now necessary. We disagree with the world coal power, we think gold mining generates more local than global pollution.

EU: The EU is willing to give financial support to developing countries. But we do want to reach an agreement, as countries such as Finland are remote and don't emit a lot themselves but they are most at risk due to a high dependence on seafood.

Canada: We believe there is not a lot of real monitoring being performed in power plants. Secondly, there is no research on the Hg^{2+} which is deposited locally is not retransmitted. So it is now known how much this effect global transfer. We also think ASGM is a global emitter and should be regulated more. Canada receives 80% of global Hg even though we are a small emitter and we are very worried about Hg in the Arctic and in the marine food chain. Also because of the health of the Inuit relying on this food.

India: We like to reply to the USA, we agree that strategies exist to reduce Hg. This is however costly and to implement this we would need substantial financial support. Our comment on the lack of alternative was focused on Hg holding products. Not all products have the same impact and exceptions should be made.

Tanzania: The African countries believe we admit 5% of total Hg. When it is stated that ASMG is the main emitter this is a lie. We should look at international efforts as the fish we are eating is polluted and this Hg is coming from somewhere else. African countries also get a lot of waste from developed countries filled with Hg. So we want a legally binding agreement that states that developed countries cannot just jump their Hg in other countries but must manage their waste.

Brazil. We are in agreement with India to reduce the ASMG pollution but it must be a slow process.

US. We like to respond to India. Financial aid is possible if there is a legally binding agreement. When it comes to banning Hg containing products, we think we should only ban the main emitting products now. We should start with the highest emitters.

EU. We support almost a total ban on the use of Hg and we propose we make a time table. We want a full ban on products in 5 years. We support the idea of phasing out Hg in production plants. We can have a small window for exemptions and thresholds for Hg concentrations and then decide which ones to ban.

China. China believes there are a lot of other factors and we are against a full ban on Hg in products. We are only ready to act if there is not a full ban on the table. The ball should be in developed countries that emitted most Hg in the past.

Developing countries should be giving some leverage as we also fight poverty.

Canada. We want to reduce emissions. Emissions of carbon are also linked to global warming and they should all be considered together.

Tanzania. We could except a non-total ban of products. Tanzania could except this if there is an agreement on a ban on the export of Hg containing waste. We think China and Brazil are not struggling in developing countries in the same way as African countries and financial aid should be focused on those who need it most.

MFF. We just wanted to state that we are in favour of a complete ban of Hg in all products and processes. We agree with Tanzania that Hg waste dumping should be banned.

WCPA. We think voluntary action is much more cost productive without damaging countries depending on energy. We are not sure about the transfer of Hg emission to fish and therefore are against strict laws.

US: We are not in favour of closing all powerplants. We are in favour of controlling emissions of coal power plants. And therefore we want a legally binding agreement. We also agree with China that we don't want a full ban on Hg holding products. And we agree that a different time table for developing countries is oke.

China: In response to what the US said about reducing emissions we would like to add that some of the statistics are flawed and are not representing what the actual statistics is. We would like to see what these statistics explain per capita. And China is not a big global emitter and historically re-emissions are an important part.

China and USA went to break out room

India left meeting

AMAP joined meeting

EU: We would like to respond to WCPA, actions should be taken even while uncertain. It is better to wait for act now better than to wait as Hg pollution is irreversible.

MFF: We think there is enough scientific evidence to state that Hg is a severe health risk so we think we need an immediate reaction right now. And we know what sources these emissions come from and we think developed countries should be the first to reduce their emissions while helping developing countries.

Agreement demand (countries statement demands before any agreement can be made)

Canada: Strongly desires agreement, but willing to economical support developing countries, especially for ASMG.

Tanzania: We agree to a legally binding agreement if help is provided. And developed countries cannot dump Hg waste in developing countries. We think atmospheric admissions are most important. We rather have a reduction in ASGM voluntary.

EU: Clearly in favour of a legally binding treaty. And we would like to take early actions and we want to time table for commitment. But we are also willing to help developing countries.

Brazil: Agrees with Tanzania. We are in favour of a legally binding agreement if help is provided by developing countries. We do think atmospheric admissions inventories should not include ASMG until we have more data.

USA: Strongly in favour of an agreement and want to reduce atmospheric emissions. Not a full ban on products and processes but we can give financial aid to developing countries. We can help with gold mining but can understand if a ban is not possible.

China: There are two conditions. We believe that there is not sufficient information to reduce atmospheric mercury. But if this worked on in future meetings we would be willing to go for legally binding agreement. We don't want to have a ban on products and processes.

#NGO (advice)

WCPA: We would suggest voluntary measures for power plants

Notes finalization discussion and agreed on points.

Objectives

1. **Is global action necessary to address mercury and what form should it take?**

   All agreed
2. **Should atmospheric emissions of mercury be included within the scope of a potential agreement?**

   All agreed with the below amendments
   a. National emissions are measured and country-specific time-tables are proposed future meeting to reach a legally binding agreement.

Notes

China: more science is necessary

EU: Scientific evidence is sufficient and we should move as quickly as possible. EU is willing to contribute to help developing countries make a mercury inventory.

AMAP: Lots of emissions inventories have been made, there are differences, however, these inventories are in good agreement and therefore we believe there is sufficient evidence for emissions from china.

3. **Should global demand for mercury use in products and processes be included within the scope of a potential agreement?**

    All agreed with the below amendments

    a. A voluntary commitment
    b. Legally binding product-specific bans can be negotiated
    c. There is a full ban on the shipping of Hg containing waste

Notes:

EU: we would like a full ban.

Chin: We only agree if the restrictions are only voluntarily, or product-specific bans.

USA: We agree that compiling a list of products to be banned but no general ban.

Tanzania: We want a complete ban, but we will only accept the convention if there is a ban on the shipping of Hg containing waste.

MFF: We are just like the EU in favour of a complete ban within the time frame of 5 to 10 year. We also think the shipping of Hg waste to developing countries should be banned.

4. **Should mercury use in artisanal and small scale gold mining (ASGM) be included within the scope of a potential agreement?**

    All agreed with the below amendments

    a. Voluntary agreement
    b. Financial aid available for specific binding target
    c. A long term planning to phase out ASGM if financial aid is giving.

Notes:

Canada: It should be included. And we are willing to help provide financial aid and technical expertise to help. We would also like to propose a time table for phasing this out. Within a reasonable time.

Tanzania: We would like to include this but we cannot accept anything that is not voluntarily. We are willing to do our best if help is provided.

USA: We can live with both voluntarily and legally binding. But we can only give substantial help if legally binding agreements are reached.

China: We don't oppose this but it should be voluntarily, but there should be aid available. Countries should be given the chance to submit national action plans on ASGM with timetables to phase out the usage.

EU: EU is willing to provide financial and technical support. But we do believe immediate action is necessary.

Brazil: Gold mining is an important source of income so it is not so easy to stop it. We agree to a non-binding reduction of gold mining activities.

Tanzania: We will agree with brazil, We will not agree to a binding agreement.

MFF: We think that each country should develop a national action term. And we want a full ban on the worst techniques.

Summary: all parties agreed to the following:

1. **Is global action necessary to address mercury and what form should it take?**

   All agreed

2. **Should atmospheric emissions of mercury be included within the scope of a potential agreement?**

   All agreed with the below amendments

   a. National emissions are measured and country-specific time-tables are proposed for a future meeting to reach a legally binding agreement.

3. **Should global demand for mercury use in products and processes be included within the scope of a potential agreement?**

   All agreed with the below amendments

   a. A voluntary commitment
   b. Legally binding product-specific bans can be negotiated
   c. There is a full ban on the shipping of Hg containing waste

4. **Should mercury use in artisanal and small scale gold mining (ASGM) be included within the scope of a potential agreement?**

   All agreed with the below amendments

   a. Voluntary agreement
   b. Financial aid available for specific binding target
   c. A long term planning to phase out ASGM if financial aid is giving.

6.6 Presentation - Mercury Game Debrief Presentation

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement no. 860497.

Debrief to the Mercury Negotiation Simulation

Created by Leah Stokes, Dr. Noelle Selin, Dr. Lawrence E. Susskind Massachusetts Institute of Technology

Agenda

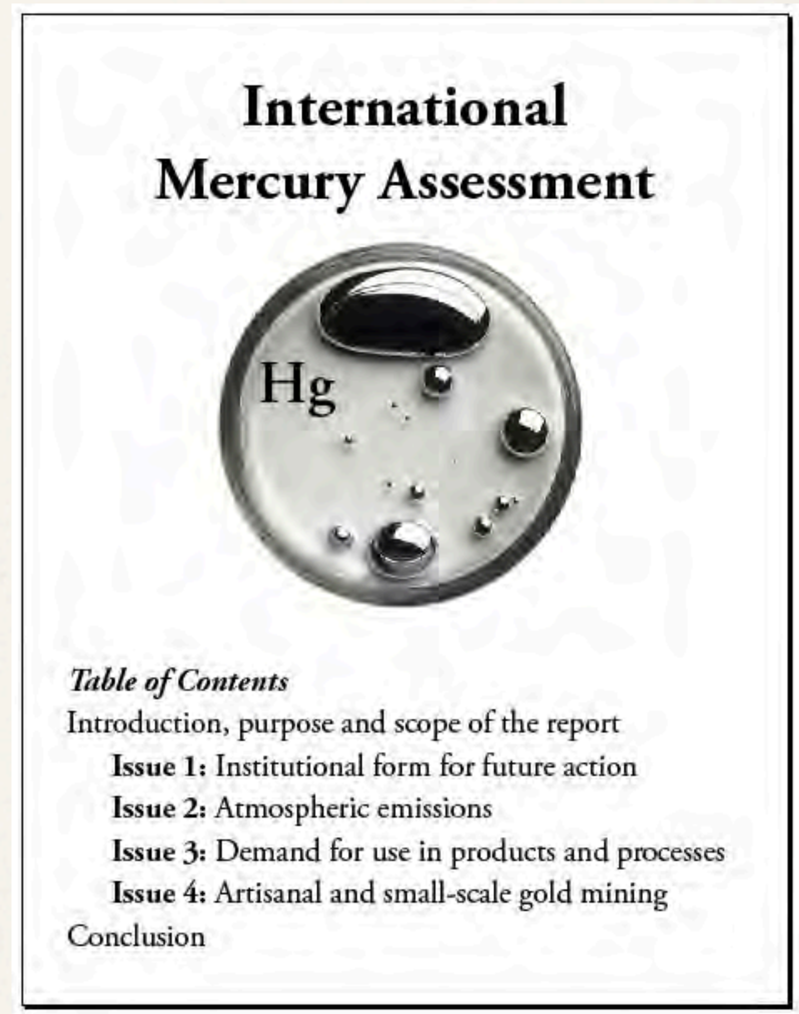
- Review what happened
- Discussion on game outcome
- History of UNEP mercury discussions (2003-2013)
- Ideas from negotiation theory
- Ideas on scientific communication

What happened?

- How did the negotiation unfold?
  - Outcome
  - Process
  - Important players
- How was this different from your expectations before playing the game?

Game outcome

- What key features of the ***science*** account for the game outcome?
- Can you think of approaches to communicating scientific information that could overcome these obstacles?



International Mercury Assessment

Hg

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Introduction, purpose and scope of the report

Issue 1: Institutional form for future action

Issue 2: Atmospheric emissions

Issue 3: Demand for use in products and processes

Issue 4: Artisanal and small-scale gold mining

Conclusion

Scientific uncertainty is normal for scientists.
How do policymakers understand uncertainty?

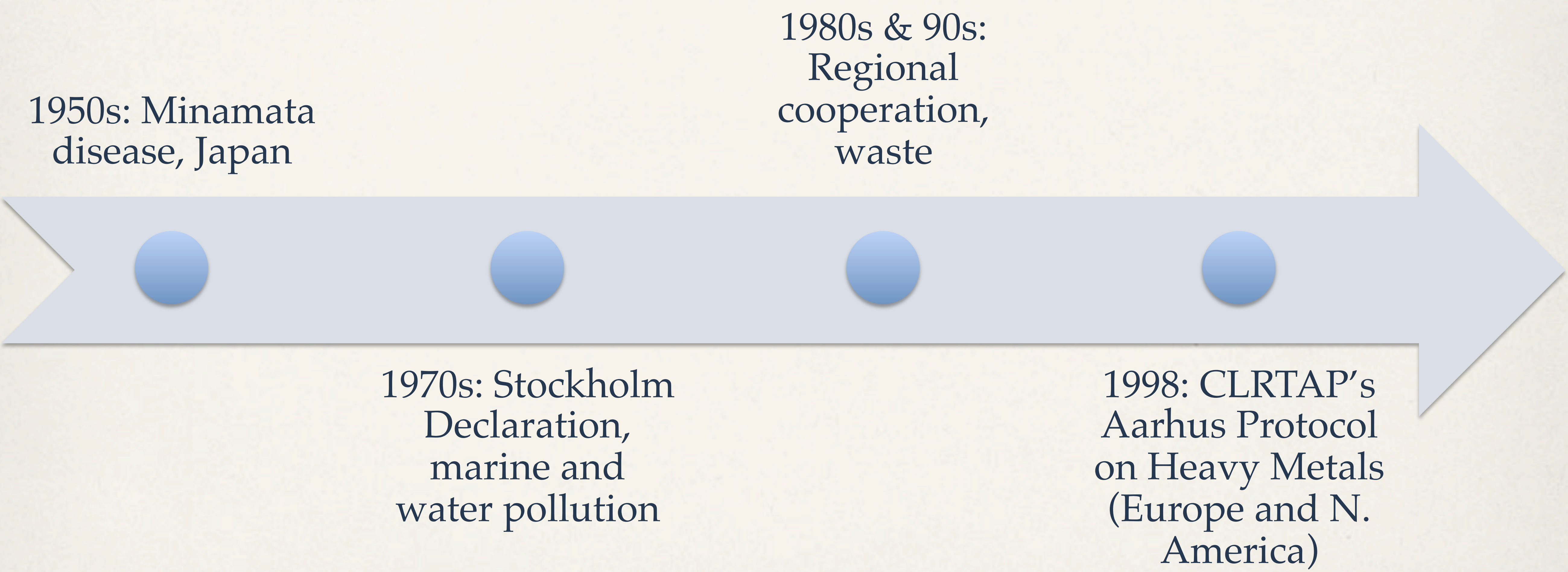
Game outcome

- After playing the game, what do you think are the ***key obstacles*** to the mercury treaty negotiations?
- What did your experience playing the game suggest about the balance between ***science, politics and economics*** when international negotiators consider options?

Game outcome

- <u>Country roles:</u>
  - How were you interpreting the scientific information from your position, playing a country?
  - Did the experience help you think through what kind of information is useful for actual negotiators?
- <u>Scientific NGO roles:</u>
  - What can an NGO do to create information that influences a negotiation?

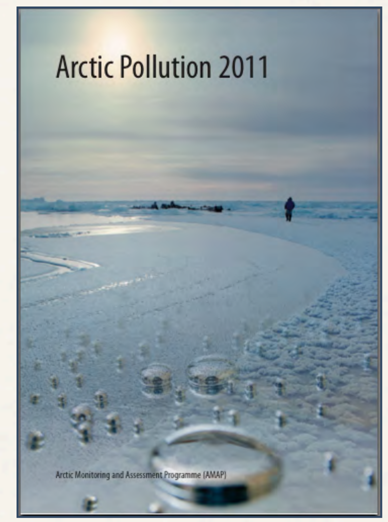
History of global mercury regime



- Movement from local to regional to global regime

Mercury science assessments

CLRTAP reports (EU & North America)



1989
1995

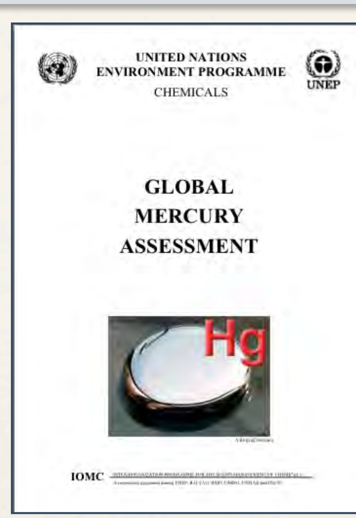
2002

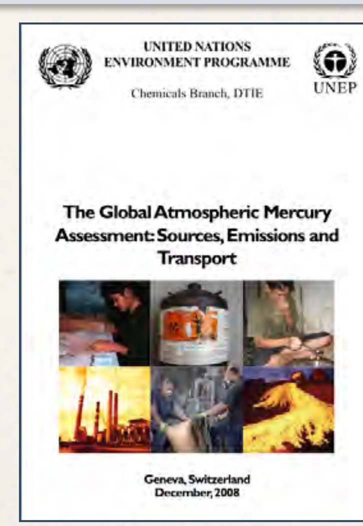
2006

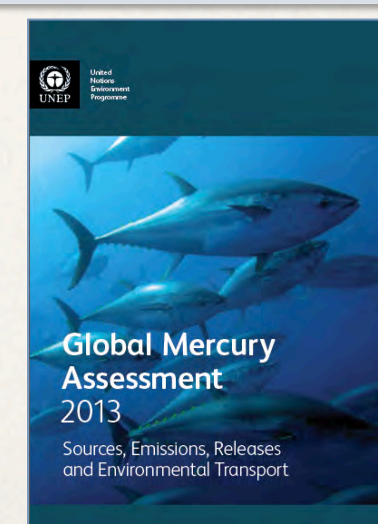
2008

2011

2013



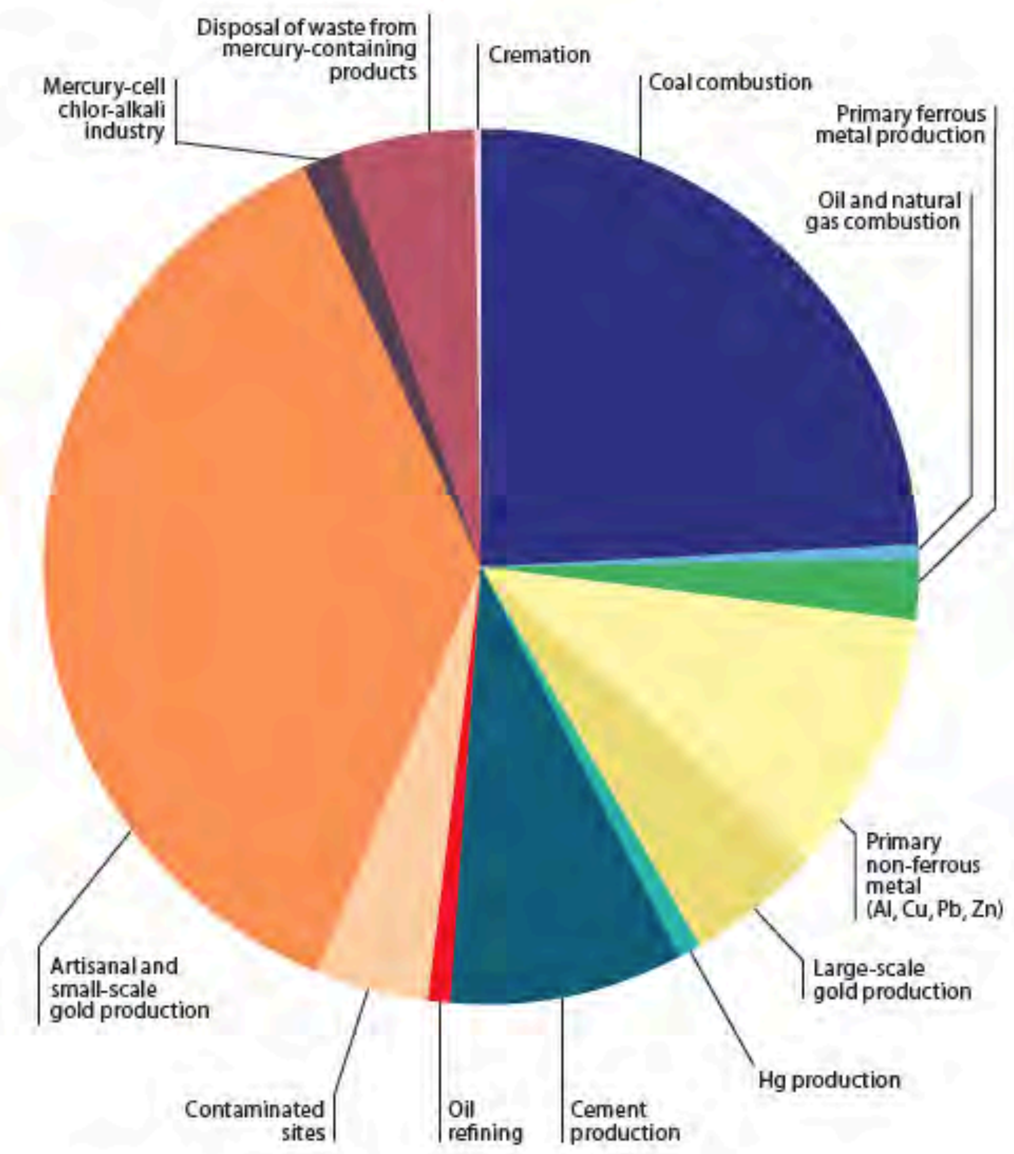




➡ Scientific assessments informing international action

Scientific assessments' uncertainty

- Scientific assessment can often change over time, giving negotiators new insights into the problem.
- The 2013 Global Mercury Assessment gave a new picture of mercury emissions sources:
  - Larger estimates for ASGM.
  - Smaller estimates for coal.
  - Smaller estimates for East and Southeast Asian emissions (40%).
- ***How do you think these revised estimates affected the negotiations?***



Relative contributions to estimated emissions to air from anthropogenic sources in 2010.

History of UNEP mercury discussions (2003-2013)

- 2001: US led proposal for a global mercury assessment, rather than a heavy metals assessment (lead & cadmium)

- 2002: *Global Mercury Assessment* established global scientific baseline
  - Debate: voluntary or binding action?

- 2005: UNEP's *voluntary* Global Mercury Partnership established

- 2007: Two track process for voluntary and legally binding approaches
  - → Attempt to build consensus for action through accumulating scientific evidence

History of UNEP mercury discussions (2003-2017)

- 2007-8: Open-Ended Working Group
  - Concerns on cost of negotiating a stand alone treaty andfit with existing chemicals treaties
  - 90 countries supported a legally binding instrument
  - US, China and India delayed
- 2009: Intergovernmental Negotiating Committee (INC) established
- 2010-13: INC1, INC2, INC3, INC4 & INC5 held
- January 2013: INC5 Final negotiation session in Geneva
- October 2013: Minamata Convention signed
- May 18, 2017: 50th party ratifies the Minamata Convention
- August 16, 2017: Minamata Convention enters into force

Final treaty – Minamata Convention

- Final negotiations concluded with Minamata convention:
  - Emissions: Countries can prepare national plans for existing sources within four years; countries must use best available control technology for new sources within five years.
  - Products and Processes: The treaty contains an annex with mercury use in products and processes to be phased out with specific timetables, including chlor-alkali production, batteries, lightbulbs, cosmetics, pesticides and measuring devices. VCM and dental amalgam will be reduced but not phased out.
  - ASGM: National Action Plans for countries with ASGM to take steps to reduce and where feasible eliminate the use of mercury.
  - Signed in Japan in Fall 2013

Final treaty decisions

- After playing the game, are you surprised by these decisions?
  - What factors do you think account for the final compromises?
- Given your knowledge on mercury emissions sources, what do you think of the final treaty in the real world. Do you think it is stringent or weak? Why or why not?

Scientific communication

- How do global environmental assessments influence policy?
- What makes assessments effective? (Mitchell et al., 2006)
    1. credibility: is it accurate?
    2. saliency: is it relevant?
    3. legitimacy: is it democratic/fair?

Scientific communication

- How does the language we use affect how people understand environmental issues?
- Tips:
  - Repeat clear, simple and memorable messages.
  - Avoid excess detail.
  - Choose words carefully and use simple terms ('human caused' rather than 'anthropogenic')
  - Begin with what you know.
  - Use metaphors and narratives.
  - Include positive frames and explain the benefits of action.

Terms that have different meanings for scientists and the public

Scientific term	Public meaning	Better choice
enhance	improve	intensify, increase
aerosol	spray can	tiny atmospheric particle
positive trend	good trend	upward trend
positive feedback	good response, praise	vicious cycle, self-reinforcing cycle
theory	hunch, speculation	scientific understanding
uncertainty	ignorance	range
error	mistake, wrong, incorrect	difference from exact true number
bias	distortion, political motive	offset from an observation
sign	indication, astrological sign	plus or minus sign
values	ethics, monetary value	numbers, quantity
manipulation	illicit tampering	scientific data processing
scheme	devious plot	systematic plan
anomaly	abnormal occurrence	change from long-term average

Somerville, R., & Hassol, S. (2011). Communicating the science of climate change. Physics Today, 64(10), 48.

Thanks for playing.

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