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Dear Gunnar Futsaeter and Simon Wilson,

Thank you for the opportunity to comment on the document entitled *UNEP/AMAP 2012 Technical Report, Review Draft (6 July 2012), Part A: Global Emissions of Mercury to the Atmosphere*. This document shows good progress fine tuning global emission inventories for mercury. The following are the consolidated comments of members of the Zero Mercury Working Group (ZMWG), on that draft document. We have several general comments listed here, followed by specific suggested edits.

We are pleased to see a rigorous approach applied to the improvement and refinement of the global mercury inventory. While the greater use of abatement equipment is a positive development that has reduced global emissions, careful attention must be paid to the use of abated emission factors, making sure not to overstate the use of controls across broad sectors or regions. While many of the sectors have seen improvements in methods and data used to estimate mercury emissions, and particularly artisanal and small scale gold mining (ASGM), we are gravely concerned over the failure to include natural gas and fossil fuel extraction in the inventory. Mercury has been recorded in natural gas fields at levels as high as 4,500 µg/m³; in Indonesia, one single gas field is reported to generate 1 tonne of elemental mercury per year.¹ This suggests a large potential for emissions from this activity where mercury capture is not perfectly efficient or not applied at all.

¹ Bingham 1990; Mussig & Rothman, 1997; and US EIA, 2008.

“Management of Mercury from Oil & Gas Operation in Indonesia” Presentation by Rasio Ridho Sani on behalf of Republic of Indonesia Ministry of the Environment.

We would like to draw special attention to the comment on page 8 and recommend a more prominent placement of it: “It is imperative, therefore, that international efforts to reduce current emissions begin as soon as possible, because delays in action now will inevitably lead to future delays in noticeable reductions of mercury in the world’s ecosystems.” We also appreciate the acknowledgment of climate change as a contributing factor to increased mercury emissions (page 8). The following are specific suggested edits to the draft document.

A1.1 Natural, anthropogenic and re-emission sources of mercury to the atmosphere

On page 6, we find some of the terminology for primary and secondary anthropogenic sources confusing. For example, intentional uses of mercury, such as in ASGM, which currently seems to be the largest single source of mercury emissions, are classified as “secondary sources,” while “primary sources” come from unintentional emissions. While these terms may be established, we find them misleading and recommend to change them and/or clarify that the origin of the source types is reflected, and to ensure that they don’t imply an order in source importance to the overall emissions, because the importance can change (as we see with the example of ASGM).

We also recommend the following edits to line 134, page 6: Make “source” plural to read “three types of sources.”

On page 8, we recommend splitting the long sentence starting on line 207, starting a second sentence with “For example, intentional biomass burning (as opposed to natural wildfires) enhances...” at line 2010. We appreciate the acknowledgement of climate change as a likely contributor to increased mercury re-emissions. Please add these examples of increased mercury releases due to human-induced climate change: increased wildfires, permafrost melting, and increased microbial activity that impacts mercury cycling.

A1.2 Global mercury budgets and estimates of emission from different sources

On page 10, please add an explanation (perhaps as a footnote) of the differences between the two models discussed (GRAHM and GLEMOS, lines 267 – 268, e.g. are they comparable and do they estimate the same things?). Also, how do the estimates reported by the GRAHM and GLEMOS models relate to the estimates listed in Table A?

A2.2 Sectors and activities considered, and those not considered in the 2010 inventory

On page 14, line 368, there is a footnote missing related to the superscript “2” at the end.

On page 15, many important sectors and activities are listed as not yet being addressed in the inventory. Some of these items may be addressed within the “other” category. Please clarify which are included and which are not and provide an explanation for those that are not included anywhere in the inventory. While we understand that data are not necessarily available for these other important sectors, the document should highlight more emphatically the need for data to better characterize these sources.

On page 17, Figure C is difficult to read, especially in the lower right boxes. Increasing the contrast between the text and background would improve it.

On page 18, please split the sentence into two beginning on line 496, to improve the clarity.

Estimating mercury from Artisanal and Small-scale Mining (ASGM) - methodology

Page 19 Lines 542-544 of this section states:

“Based on information on practices used in different countries, it is estimated that on average 45% of mercury used in ASGM is emitted to the atmosphere; in regions where concentrate amalgamation is practiced, up to 80% of the mercury used may be emitted to the atmosphere.”

To the uninformed reader, this may imply that concentrate amalgamation is a worst practice that has higher than average percentage of air emissions. This is misleading. For example, whole ore amalgamation may have a lower percentage of emissions to air, but the overall amount of mercury used in this practice is substantially higher than concentrate amalgamation. In addition, the mercury that is not emitted to air is released to land and water. This paragraph needs to be clarified. A suggested revision might read (*Additional text in italics*):

“Based on information on practices used in different countries, it is estimated that on average 45% of mercury used in ASGM is emitted to the atmosphere, *with the remainder released to land and water*; in regions where concentrate amalgamation is practiced up to 80% of the mercury used may be emitted to the atmosphere; *however the absolute amount of mercury used in concentrate amalgamation is typically lower than in other practices such as whole ore amalgamation.*”

On line 545 of page 19, please replace “estimates” with “estimated.”

Also on page 19, the paragraph that begins at line 554 “The most reliable results...” is an informative description of a solid and practical method for deriving mercury use estimates for ASGM. However, by including this method as written, some readers may have the impression that the mercury use/emissions estimates presented in this report were derived using such an intensive, field-based method. A look at the global database on www.mercurywatch.org indicates this is not the case; rather there are a wide variety of sources that presumably used a number of different estimation methods, some better than others. (The paragraph that begins on line 528 indicates the use of a variety of sources, but for the purposes of determining presence/absence of ASGM, rather than the quantity of mercury used). It would be helpful to have a statement to that effect at the beginning of this paragraph, and then clearly indicate that the method described is a desirable method and has been used for some but not all of the country estimates that are used as the basis of the overall global estimate. Also, please provide a reasonable estimate, based on professional judgment, of the percentage of country estimates that are currently based on this method. Ideally it would be very helpful to have a table (in an Annex) with an indication of which countries have recent, relatively solid estimates and which have older and/or less robust data, as this would provide a basis for focusing priorities for further information collection.

Finally, on line 566 of page 19, “Questions” shouldn’t be capitalized.

On page 20, we recommend the following minor edits:

- Line 570, please modify this question to read “What percentage of miners routinely use retorts or recycle mercury in any way?”
- Line 572, some guidance on what is “reasonable” would be helpful. For instance, which of the following does “reasonable” mean in this instance?
 - In comparison to like countries with similar size mining communities;
 - Production does not exceed typical capacity of the amount a normal miner can produce in a day; or
 - Does not exceed large scale production levels (at least on a per mine/per miner basis).
- Paragraph beginning on line 576, the Burkina Faso example is very helpful as a model but again, it would be good to understand how frequently this method has been used for various countries and to what extent the global estimate contained in this document relies on this method or less reliable methods.
- Line 581, please delete “They-“.
- Line 588, please elaborate more on this phrase to improve clarity: “through a geological and processing lens.”
- Lines 595-605, this information is interesting but not obviously relevant to methodology used to generate the mercury emissions estimates, which is the topic of this section. This may confuse readers. These paragraphs should be deleted.
- Lines 604 – 605, although we recommend cutting this section, if it is retained, please clarify the conclusion “so they rarely manage to save.” It is not clear from context: do they save US\$ 500, or don’t they?
- Line 606, the point about the change in the estimate for Burkina Faso is an important one and speaks to the uncertainties in the overall estimate. A sentence should be added at the end of the paragraph, to the effect that the Burkina Faso experience illustrates the uncertainties in the estimates. This point is highlighted again on page 43. Note Table L on page 44 does **not** include Burkina Faso even though Burkina Faso is used as an example in the text. Is that table up to date? Also, is there information from any other ASGM using countries that could be added as another example? Are other countries with ASGM similar, or are there notable differences?

Estimating mercury emissions from wastes associated with intentional use sectors - methodology

On pages 21-22, Table B: Please explain why the “other” category has the highest numbers for the EU and North America, and what “other” consumption is that makes it so high. The explanation of what ‘other’ includes in the text (line 629) does not make it clear why this would make the usage numbers so high for the EU and North America.

Also, on page 21, the global estimates of mercury consumption and in particular, estimates for China seem much lower than what we would expect, according to several reports.² For instance, Table B reports 98 tons of mercury from measuring devices in East and SE Asia (China), and 250 tons globally. Using survey data collected in China on mercury thermometers and blood pressure monitors produced in 2010, and the average mercury content of these devices, yields at least 300 tons of mercury consumed by measuring devices in China alone.³ We would therefore expect global consumption to exceed 400 tons. The large discrepancy in the estimates for East and SE Asia warrants a review of the methods and underlying data for all the consumption estimates.

Another potential underestimate of mercury emissions from products containing mercury is the emissions associated with manufacturing those products. Presumably, some mercury emissions will occur during production; however, in the description of the methods used to assess mercury emissions from consumption (starting at line 640, page 22), it is not clear whether or where those emissions during production are accounted for.

On page 23, lines 661 – 667, It would be good to see how the regional estimates have been done. For example in Canada, have the differing situations in the remote regions been taken into account?

On page 24, Table C, how do the numbers account for wide variations in different products?

Estimating mercury emissions from use in dental amalgam and human cremation - methodology

On pages 25 – 26, lines 719 – 721: This estimate seems very low; please include the source for that information. Is this estimate (“It is estimated that ca. 20-30% of total Hg consumption for dental uses (that is 70-100 t of the estimated 340 t of mercury used in dental uses) likely enters the solid waste stream. In addition, mercury in removed fillings goes to recycling, solid waste and wastewater”) included in the other report (mercury sources to water/land)?

² The China Council for International Cooperation on Environment and Development, Executive Report, Special Policy Summary of Mercury Management in China, November 2011.

Chemical Registration Center of MEP (with assistance from the Chinese Association of Medical Devices Industry), Socio-economic Analysis on Mercury Thermometer and Sphygmomanometer Transition towards Mercury Free Products in China —Hypothetical Transition Scenarios Analysis and Socio-economic Cost Estimation, March 2012.

Chemical Registration Center of State Environmental Protection Administration of China (SEPA) and Natural Resources Defense Council (NRDC), Research Analysis Report on Mercury Use in China 2003 – 2005 - The Measuring Devices Industry of China, May 2007.

³ According to a 2012 survey undertaken by the China Association for Medical Devices Industry (CAMDI), 150,000,000 mercury fever thermometers and 3,250,000 mercury blood pressure monitors were produced in 2010 (p. 8 of CRC, March 2012). In a previous 2007 report prepared by the same China agency in collaboration with NRDC, the average amount of mercury consumed per thermometer (including losses during manufacturing) was 1.1-1.3 g/unit, depending upon the size of the factory (p. 14, CRC & NRDC, May 2007). Using the mid-point 1.2 grams/unit, the total mercury consumption for thermometer production in China during 2010 was roughly 180 tons. Similarly, 37 grams of mercury were used to produce the average blood pressure monitor (p. 21, CRC & NRDC, May 2007), resulting in 120 tons of mercury consumption. Accordingly, in 2010, China’s consumption alone was about 300 tons – three times the estimate reported here.

We note that the recent CCICED report (November 2011) reports a lower estimate of 227 tons of mercury due to consumption from medical devices in China in 2008. However, this estimate is based on much lower production levels of thermometers and blood pressure monitors (without explanation for the sudden drop in production; see table 5, p.15 for estimates). Still, they report a value more than twice that stated here.

In the paragraph beginning at line 723, it would be good to get more details on what the groups mean, and how they are defined. For example, it is unlikely that Arctic Canada should be in the same region category as the rest of Canada, as the realities in the two areas are very different.

On emissions from this sector and cremation please also consider the recent report from the European Commission “Study on the potential for reducing mercury pollution from dental amalgam and batteries”, 11 July 2012⁴

A2.6 Uncertainties

On page 31, lines 841 – 843, this is somewhat problematic, due to major differences within assigned regions as outlined above (e.g. Arctic Canada vs. the rest of Canada).

A3. Trends in mercury emission to the atmosphere

On page 43, table K and page 45, table M, please include the units of the mercury emissions.

On page 46, please include the units on the y-axis of both graphs in Figure K. Also please clarify what NB means and replace “lower had” with “lower hand”.

On page 49, the graphs in Figure N are hard to read. Please enlarge them by using two columns.

A4. Conclusions

It would be helpful if the key findings could be cross-referenced to the respective section in the report.

On page 50, lines 1288 – 1290, it is important to clarify the estimated anthropogenic part of the re-emissions. For some countries, 35% anthropogenic emissions are too little to act on, which may lead to a false claim that the majority of mercury emissions are natural.

On page 51, we have the following comments:

- Lines 1304 – 1309 are confusing. First it says the greatest emissions are from Asia, with 75% of that being from China, and later going on to say that if ASGM is excluded, emissions on a per capita basis are highest in Europe, North America and Oceania. We assume for the second sentence, only the emissions compared to South America and Sub-Sahara are intended? This should be in a separate bullet. We also recommend separate bullets for total Hg emissions versus per capita emissions.
- Lines 1308-1309, given that ASGM constitutes the largest release sector in the world, it is strange to consider per capita mercury emissions excluding ASGM. We recommend the following phrase in place of those lines: Although Europe, North America and Oceania do not

⁴ http://ec.europa.eu/environment/chemicals/mercury/pdf/Final_report_11.07.12.pdf

have significant ASGM activity and fossil fuel emissions have become increasingly controlled, those regions still have quite high mercury emissions on a per capita basis.

- Lines 1322 – 1329: This would be good to see in a graph in the respective section. For example, showing the estimated global emissions as a bar graph and the activity numbers from the major emitters in a line graph in the same plot would be helpful.
- Line 1334, please add “vary” or “range” after “can”.

Annex 2: Emission Factors and Technology Profiles used in the calculation of emission estimates

Please provide the source references for the unabated coal and power plant emission factors on page 5-6 (fill in the blank column of this table). We look forward to seeing the additional information slated to be added beginning on line 2057 of page 7 and throughout the following pages. It is important to provide as much information as possible on the assumptions and data sources used to derive abated emission factors. In particular, it is important to use the latest data sources available. For example, the December 2011 U.S. EPA mercury and air toxics rule (“MATS”) for power plants contains more up to date information on the control technologies currently utilized by power plants in the U.S. than the NESCAUM 2010 source listed in the table on page 9.⁵

The abated emission factors must be very carefully considered as there may be a tendency to overstate the level of controls in official reports. To the extent that monitoring and reporting can be done to verify that these controls are truly in place, would strengthen these factors. In some cases, for example in the non-ferrous smelting sectors, where lead and zinc are important, high levels of controls have been assumed (90% mercury reductions due to acid gas controls in this case), yet these controls may not be applied to the many smaller facilities. Any supporting data available to support the estimates of controls used would be very helpful to include.

Finally, the revised provisional results for individual countries listed on pages 61-64 do not make clear which set of estimates were chosen for inclusion in the global inventory: National estimates or those estimated by UNEP. There are significant discrepancies between the two that should be explain further; a source for national estimates should also be provided. Also, not all the numbers in the table of US emissions on page 64 match the emissions reported in Annex 4.⁶

In closing, we appreciate the opportunity to participate in the development of the global mercury emissions inventory and look forward to continued involvement.

Best regards on behalf of the Zero Mercury Working Group.

⁵ For more information see: EPA, Regulatory Impact Analysis for the Final Mercury and Air Toxics Standards, December 2011. <http://www.epa.gov/ttn/ecas/regdata/RIAs/matsriafinal.pdf>

⁶ For example, NFMP for copper, lead and zinc total 668 ton in 2008 in the national reported data in the table on page 64 vs. 6,079 tons for NFMP-Zn in Annex 4.