



Distr.: General
12 May 2010

English only



**United Nations
Environment
Programme**

**Intergovernmental negotiating committee
to prepare a global legally binding
instrument on mercury**

First session

Stockholm, 7–11 June 2010

Item 4 of the provisional agenda*

**Preparation of a global legally binding
instrument on mercury**

Update of information on the supply and trade of mercury

Note by the secretariat

1. At its twenty-fourth session the Governing Council of the United Nations Environment Programme (UNEP) considered a report on the global supply of, trade in and demand for mercury, which was set out in annex II to document UNEP/GC/24/INF/17. At that session the Governing Council adopted decision 24/3, by which it committed itself to increased efforts to address the global challenges posed by mercury, established the ad hoc open-ended working group on mercury and requested the Executive Director of UNEP to undertake a range of activities.
2. As part of its response to decision 24/3, UNEP began a project on reducing mercury supply and investigating mercury storage solutions, in connection with which it commissioned consultants to update and supplement the information contained in annex II to document UNEP/GC/24/INF/17 by preparing reports on mercury supply, trade and demand at the regional level. To date, two such reports have been completed: one for Latin America and the Caribbean and one for Asia and the Pacific.
3. At its meeting in Bangkok from 19 to 23 October 2009, the ad hoc open-ended working group to prepare for the intergovernmental negotiating committee on mercury agreed on a list of information that the secretariat would provide to the committee at its first session to facilitate its work. Among other things, the secretariat was requested to provide an update of the report on mercury supply, trade and storage set out in annex II to document UNEP/GC/24/INF/17.
4. In response to that request the secretariat is making available the reports on regional mercury supply, trade and demand for Latin America and the Caribbean and Asia and the Pacific referred to above, each of which comprises an executive summary and a detailed discussion. The full reports, including both the executive summary and the detailed discussion, are presented in the annexes to the present note in English only, while document UNEP(DTIE)/Hg/INC.1/20 contains the executive summary of the reports in the official languages of the United Nations. As was the case with the original report, both the executive summary and the full report are being circulated without formal editing.

* UNEP(DTIE)/Hg/INC.1/1.

Annex I

Assessment of excess mercury in Asia, 2010-2050



MAY 2009

Assessment of Excess Mercury in Asia, 2010-2050

Executive summary

1. The report is a revised version of the original report dated November 2008. It was prepared to provide information to support the work of the Asia and Pacific mercury storage project, aimed at initiating a regional process to support the sequestration of excess mercury in Asia and the Pacific. The report takes account of comments provided by China, Japan and Nepal.
2. This report provides a framework for better understanding future mercury flows within Asia and will inform discussions about managing excess mercury in the region. The original version of the report provided background information for the inception meeting of the project on the storage of mercury in Asia, that took place from 4 to 5 March 2009, in Bangkok.
3. The reduction of mercury supply and long term management of mercury, have both been identified as priorities by the Governing Council of the United Nations Environment Programme. It is imperative that Governments and other stakeholders consider how to deal with excess mercury, since elemental mercury, apart from being toxic, cannot be destroyed or degraded, and hence must be managed over the long term in order to avoid its re-entry into the global marketplace.
4. Importantly, mercury flows in Asia need to be better understood before subsequent steps are taken – which may include planning for the necessary storage capacity, discussing regional coordination activities, securing financial and technical support, identifying technical criteria (including site assessments) that constitute environmentally sound long-term storage, and developing the basic design of such a facility or facilities.
5. Present information suggests that future sources of mercury in the Asian region will include principally mercury recovered as a by-product from various mining and smelting activities, from the cleaning of natural gas, from the closure or conversion of mercury cell chlor-alkali plants, and from other significant sources such as end-of-life products. Regional sources of mercury are correlated in this analysis with regional uses, such as lamps, measuring devices, and dental amalgam over the same time period in order to estimate excess mercury that will be generated in the region.
6. The report illustrates that the Asian region is a significant net importer of mercury at the present time. The vast majority of the imported mercury is used for small-scale gold mining, and lesser amounts are used for product manufacturing, with China consuming much of its own mined mercury producing vinyl chloride monomer to be used in the production of polyvinyl chloride. Therefore, the timing of the generation of excess mercury in Asia depends to a large extent on the timing and magnitude of demand reduction in these key sectors.
7. Experts from the United Nations Industrial Development Organization and other entities have determined that mercury supply restrictions can contribute to significant demand reductions in small-scale gold mining through increased prices and more difficult access to mercury supply. Subsequently, measures to influence supply and demand can be mutually reinforcing, and to some extent supply restrictions must precede demand reductions to be effective. Planning for the diversion of mercury supply into storage may be especially important as an initiative to further encourage demand reduction.
8. Currently, demand for mercury in Asia exceeds supply. According to the scenarios assessed in the report, mercury supply and demand in Asia are projected to reach a rough equilibrium beginning about 2014 or 2015, after which is it anticipated that supply will exceed demand. This time frame could be shorter if stricter requirements for the collection of by-product mercury released from ores in metal processing and currently emitted or released to the environment result in substantial additional by-product mercury being made available to the market. This would produce an excess of mercury which is either available for use, or would be required to be stored. On the other hand, this time frame could be longer if demand reduction in small-scale gold mining proves to be more difficult to achieve relative to the goals set out in the artisanal and small scale gold mining partnership area of the UNEP Global Mercury Partnership.
9. Furthermore, after 2017 the urgency of developing an Asian mercury storage capability is likely to depend on the rate of further demand reductions (contributing to excess mercury supply), the extent to which countries in the region wish to encourage these further demand reductions through supply restrictions such as increased regulation or controls on access to mercury, and the extent to which a solution which is suitable for all countries in the region is achieved (even though net supplies of excess mercury may occur in a relatively small number of countries).

10. In any case, substantial excess mercury can be expected in Asia after 2030, based on an assessment of current declines in use of mercury as a result of increasing legislation and voluntary controls on the use of mercury, as well as the assessment of mercury available through recycling, by-produce mercury and liberation of stockpile, the quantity of excess mercury, mostly accumulated between 2030 and 2050, would likely amount to just over 5,500 tonnes (around 400 m³). According to an alternative policy scenario, in which regional authorities may decide to move the storage of excess mercury to an earlier timepoint than 2030, the quantity of mercury accumulated may be as high as 7,500 tonnes (around 560 m³).

Contents

Update of information on the supply and trade of mercury	1
<i>Note by the secretariat</i>	1
Assessment of Excess Mercury in Asia, 2010-2050	3
Assessment of Excess Mercury in Asia, 2010-2050	7
Background	7
<i>Aims</i>	7
<i>Context</i>	7
<i>Scope</i>	7
The Asian region	7
Methodology	8
Regional mercury consumption for products/processes	9
<i>Present mercury consumption in the Asian region</i>	9
Artisanal gold mining.....	9
VCM production.....	10
Chlor-alkali production.....	10
Batteries.....	11
Dental applications.....	12
Measuring and control devices.....	12
Lamps.....	12
Electrical and electronic equipment.....	12
Other applications of mercury.....	12
Summary of mercury consumption in Asia.....	13
<i>Future mercury consumption in Asia</i>	13
Key regional sources of metallic mercury	16
<i>Major sources of mercury supply</i>	16
Mercury mining and external trade.....	16
Mercury cell chlor-alkali facilities.....	17
By-product mercury.....	17
Mercury stocks.....	20
Recycling.....	20
<i>Asian mercury supply</i>	21
Results regarding excess Asian mercury	22
<i>China</i>	22
<i>Other Asian countries</i>	22
<i>All Asian countries combined – main scenarios</i>	22
Conclusions	24
Appendix – “Most likely scenario for excess mercury in Asia”	26
References	27

Tables

Table 2-1 Suggested Asian subregions and included countries	8
Table 4-1 Mercury cell chlor-alkali capacity in Asia, 2005	11
Table 4-2 Estimated mercury consumption in Asia, including products for export, 2005 (tonnes).....	13
Table 4-3 Basic assumptions about future mercury consumption, 2010-2050	14
Table 5-1 Estimated mercury mine production in China	16
Table 5-2 Mercury cell chlor-alkali capacity in Asia, 2005	17
Table 5-3 Selected Asian zinc smelters greater than 100,000 metric tonnes capacity (2003)	19
Table 5-4 Large primary zinc smelters in Asia, and recoverable mercury ..	19
Table 5-5 Basic assumptions regarding Asian mercury recycling 2010-2050 (tonnes)	21
Table 5-6 Asian “sources” of elemental mercury, 2005 (tonnes)	22

Figures

Figure 4-1 A vinyl chloride monomer (VCM) production plant in China	10
Figure 6-1 Asian excess mercury (assuming maximum Chinese mercury mining)	23
Figure 6-2 Asian excess mercury – most likely scenario (reduced Chinese mining)	23
Figure 6-3 Asian excess mercury (assuming special restrictions on mercury supply to ASM)	24

Assessment of Excess Mercury in Asia, 2010-2050

Background

Aims

11. The overall aim of this analysis is to provide a framework for better understanding future mercury flows within Asia – a framework necessary to feed discussions about managing excess mercury in the region. This analysis provided background information for the “Inception Meeting of the Asian Mercury Storage Project” that took place on 4-5 March 2009, in Bangkok. At that meeting, discussions focused on the possible need for a regional mercury storage facility or facilities, as the preferred – or most environmentally sound – option.

12. This research and analysis was carried out with the kind support of the Zero Mercury Working Group.¹ It is a revised version of the original assessment dated November 2008, and takes account of post-meeting comments kindly submitted by Japan, Nepal and China.

Context

13. The reduction of mercury supplies, as well as long-term management of mercury, have both been identified as priorities of the UNEP Governing Council. It is imperative, therefore, that Governments and other stakeholders consider how to deal with excess mercury, since we know that elemental mercury, apart from being toxic, cannot be destroyed or degraded, and hence must be managed over the long term in order to avoid its re-entry into the global marketplace.

14. Present trends suggest that as Asian mercury demand decreases with the gradual phase-out of mercury-containing products, there will be excess mercury generated in Asia from such sources as by-product mercury recovered from various metal mining and smelting activities, from the cleaning of natural gas, from the closure or conversion of mercury cell chlor-alkali plants, etc. Therefore, mercury flows need to be better understood before any subsequent steps are taken – such as planning for the necessary storage capacity, discussing regional coordination activities, securing financial and technical support, identifying technical criteria (including site assessments) that constitute environmentally sound long-term storage, and developing the basic design of such a facility or facilities.

Scope

15. The broader investigation into the feasibility of Asian regional capacity for the terminal storage of excess mercury has been structured in two initial phases. This assessment comprises the first phase; it responds to the need cited above by assessing the flows and quantities of mercury that may need to be stored. The second phase will focus on the location, design, financing and other practical requirements of an appropriate storage facility.

16. This assessment includes an analysis of the quantities of mercury arising over the next 40 years in the Asian region as a by-product from various mining and smelting activities, from the cleaning of natural gas, from the closure/conversion of mercury cell chlor-alkali plants, and from other significant sources such as end-of-life products. Regional sources of mercury are then compared in this analysis with regional uses, such as lamps, measuring devices, dental amalgam, etc., over the same time period in order to estimate excess mercury that will be generated in the region, and that could be stored at an appropriate facility or facilities.

The Asian region

17. In order to productively discuss mercury sources and uses in the region, it is necessary to first identify the countries that will be included in this analysis. While different groups of countries may be considered, this project will cover the subregions of East Asia and South Asia as indicated in Table 0-1.

¹ The Zero Mercury Working group (www.zeromercury.org) is an international coalition of more than 55 public interest environmental and health non-governmental organizations from around the world, formed in 2005 by the European Environmental Bureau and the Mercury Policy Project/Ban Mercury Working Group. The aim of the group is to strive for ‘zero’ emissions, demand and supply of mercury, eventually eliminating the risks posed by mercury in the environment at EU level and globally.

It should be noted that these are merely convenient geographical groupings and should not in any way be interpreted as regional groupings endorsed by the United Nations.

Table 0-1 Suggested Asian subregions and included countries

<i>East and Southeast Asia</i>	<i>South Asia</i>
Brunei Darussalam	Afghanistan
Cambodia	Bangladesh
China	Bhutan
Democratic People's Republic of Korea	India
Indonesia	Maldives
Japan	Nepal
Lao People's Democratic Republic	Pakistan
Malaysia	Sri Lanka
Mongolia	
Myanmar	
Papua New Guinea	
Philippines	
Republic of Korea	
Singapore	
Thailand	
Viet Nam	

18. It should be noted that the countries of the Middle East, Australia, New Zealand and Oceania are outside the scope of this assessment.

Methodology

19. As described in detail in the UNEP Global Mercury Assessment (UNEP 2002), mercury is intentionally added to a great number of products such as thermometers and dental amalgams, and processes such as the mercury-cell process for the production of chlorine. In the case of the products, many of these can be eventually collected and recycled to recover the mercury. Likewise, mercury can be recovered from various process uses. These and other typical sources and uses of mercury are discussed further in Sections 0 and 0 below.

20. The focus of this assessment is on a 40-year time frame, specifically 2010-2050. Clearly 40-year estimates are subject to significant uncertainties, and it is understood that precision is not realistic or possible for this exercise. The purpose is to develop an order-of-magnitude estimate of the quantity of elemental mercury that may need to be stored, and a rough idea of when that mercury may become available for storage.

21. Due to the unique circumstances of China (and especially China's very large mercury supply and demand as described in various studies cited in this assessment) with regard to exports, imports, domestic mining and consumption of mercury, it is necessary to first have a good understanding of the Chinese situation, and to make certain assumptions about China for the purpose of this assessment. The following assumptions are made:

- assume that China will have no significant imports or exports of metallic mercury, unless there is a domestic excess, as described below;
- assume that the main Chinese "sources" of mercury include VCM catalyst recycling and mercury recovered as a by-product from zinc smelting and mercury mining;
- assume that domestic mercury production from primary (i.e. mercury) mining declines as domestic demand declines, as long as domestic demand is less than domestic sources of mercury;
- this implies that China will not generate excess mercury until domestic sources (without primary mining – see previous bullet) of mercury eventually exceed domestic demand;
- assume that when and if China generates excess mercury (without primary mining), it may be made available (exported) to other countries in Asia, as necessary to meet demand.

22. After the mercury flow situation of China has been considered, any excess mercury from China may be assumed to be an additional supply to the rest of Asia. The other countries in the region may then be analysed in one combined group or in two separate groups – the rest of East & Southeast Asia (i.e., without China), and South Asia – for which the following assumptions are made:

- assume that there may be transfers of mercury among these countries, as there are already (UNEP 2006);
- assume that there are no imports of metallic mercury except from China, should China have an excess supply;
- assume that there are no exports of metallic mercury or by-product mercury wastes outside the Asian region, although continued exports of mercury-containing products would be expected;
- assume that the main sources of mercury are imported products, chlor-alkali facilities, by-product mercury from non-ferrous metal smelting and natural gas cleaning, and some recycling of mercury-containing products;
- accept that if and when the region generates excess mercury, the mercury should go to terminal storage.

Regional mercury consumption for products/processes

23. Unless otherwise noted, the basic document sources for chapters 0 and 0 are the UNEP Trade Report (UNEP 2006), which presents an overview of global mercury uses and sources; an extensive analysis of mercury product life-cycles published in the US (Cain 2007); and a detailed analysis of mercury applications carried out recently for the European Commission (2008).

Present mercury consumption in the Asian region

24. The main groups of mercury-containing products and mercury processes assessed in this study are described below. The base year for “current” data is assumed to be 2005. It should be kept in mind that the determination of mercury consumption in different countries and regions, and for different applications, is difficult even in the best of cases. Therefore, the figures presented below are the best estimates that have been made based on information and research that may vary greatly in quality and depth, depending on the sources of the information and the resources devoted to the research.

Artisanal gold mining

25. With the possible exception of VCM production (see Section 0), artisanal and small-scale gold mining (ASM), an activity inextricably linked with issues of poverty and human health, remains the largest global user of mercury. The use of mercury in this sector reportedly continues to increase with the upward trend in the price of gold. Because nearly all of the mercury used in ASM is eventually released to the air, water and soil, ASM is also the largest source of releases from intentional use of mercury.

26. According to the UNIDO/UNDP/GEF Global Mercury Project, at least 100 million people in over 55 countries depend on ASM – directly or indirectly – for their livelihood, mainly in Africa, Asia and South America.² ASM is responsible for an estimated 20-30% of the world’s gold production, or approximately 500-800 tonnes per annum. It directly involves an estimated 10-15 million miners, including 4.5 million women and 1 million children. This type of mining relies on rudimentary methods and technologies, and is typically performed by miners with little or no economic capital, who operate in the informal economic sector, often illegally and with little organization. Due to inefficient mining practices, mercury amalgamation in ASM results in the consumption (and subsequent release) of an estimated 650 to 1000 tonnes of mercury per annum (Telmer 2008; UNEP 2008a).

² It should be noted that not all artisanal/small scale gold miners use mercury. Some use cyanide, permitting more gold to be recovered than when using mercury. Others use gravimetric methods without mercury or cyanide.

27. In Section 0, regional estimates of mercury use in ASM have been derived from country estimates based on personal communications with a number of experts directly involved in the UNIDO/UNDP/GEF Global Mercury Project.³

VCM production

28. The large and increasing use of mercuric chloride as a catalyst in the production of vinyl chloride monomer (VCM), mostly in China, is another area of major concern. Investigations in China estimated that 610 metric tonnes of mercury were used for this application in 2004. This use of mercury was estimated to increase 25-30% per year as the Chinese economy grew rapidly, and as Chinese demand for PVC end-products increased up to 2008. Two reports have confirmed that mercury consumption for VCM production in China would significantly surpass the estimated 700-800 metric tonnes consumed in 2005 (NRDC 2006; Tsinghua 2006).

Figure 0-1 A vinyl chloride monomer (VCM) production plant in China



29. However, it may be expected that the global economic slowdown has tempered the growth of this industry, and that increasing efforts will be undertaken to reduce mercury consumption in this industry, and to further increase mercury recovery. It has been reported in China that less than half of the mercury consumed for VCM is later recovered from the spent catalyst. The rest of the mercury goes mainly into the hydrochloric acid (HCl) by-product, from where mercury is not normally recovered as a standard practice at present (ACAP, 2005).

Chlor-alkali production

30. The chlor-alkali industry is the third major mercury user worldwide. Many plant operators have phased out this technology and converted to the more energy-efficient and mercury-free membrane process, others have plans to do so, and still others have not announced any such plans. In many cases governments have worked with industry representatives and/or provided financial incentives to facilitate the phase-out of mercury technology. Recently governments and international agencies have created

³ It should be noted that in a more recent paper (Telmer and Veiga, 2008) attempting to improve past estimates of ASM activity worldwide, the authors have referred to ASM activity in as many as 70 countries, but have suggested even less certainty in estimates of global mercury consumption, for which they now claim the upper range may well exceed 1000 tonnes per year.

partnerships with industry to encourage broader industry improvements with regard to the management and releases of mercury.

Table 0-1 Mercury cell chlor-alkali capacity in Asia, 2005

	Approx. chlorine production capacity (tonnes per annum)	Approx. cellroom mercury inventory (tonnes per annum)	Approx. mercury consumption* (tonnes per annum)
China	<i>none confirmed</i>	--	--
Other East & Southeast Asia			
Indonesia	24,000	48	incl. below
Myanmar	3,000	6	incl. below
Peoples' Dem. Rep. of Korea	25,000	50	incl. below
Philippines	14,000	28	incl. below
<i>Subtotal</i>	<i>66,000</i>	<i>132</i>	<i>4-8</i>
South Asia			
Bangladesh	5,000	10	incl. below
India	428,000**	856	incl. below
Pakistan	127,000	254	incl. below
<i>Subtotal</i>	<i>560,000</i>	<i>1,120</i>	<i>35-40</i>
Total Asian region	626,000	1,252	40-50
<p>* The convention here is to calculate mercury "consumption" before any recycling of wastes. Some of the waste at some facilities may be recycled in order to recover the mercury, although most mercury waste is sent for disposal.</p> <p>** As various Indian facilities have been closed in recent years, this paper considers a lower production capacity figure in the actual analysis.</p> <p>Sources: UNEP 2006; EEB 2006; Euro Chlor 2007; WCC 2006; SRIC 2005</p>			

Batteries

31. The use of mercury in batteries, while still considerable, continues to decline as many nations have implemented policies to deal with the problems related to diffuse mercury releases related to batteries.

32. While mercury use in Chinese batteries was confirmed to have been high through 2000, most Chinese manufacturers have reportedly now shifted to lower mercury technologies, following international legislative trends and customer demand in other parts of the world. However, there are still vast quantities (tens of billions) of batteries with relatively low mercury content produced in China, and lesser quantities in other countries as well.⁴

33. There also remain a large number of button cell batteries manufactured in many different countries, most containing up to 2% mercury, but some containing more. These will eventually be replaced by mercury-free button cells,⁵ but for the moment these batteries, also produced in the tens of billions, consume significant amounts of mercury. Therefore, the global consumption of mercury in

4 NRDC (2006) noted that for just one type of battery, the D-size "paste battery," the reported Chinese production in 2004 was 9.349 billion batteries. The authors estimated mercury chloride consumption for these batteries at 47.11 tonnes, with an estimated mercury content of 34.91 tonnes. The battery label claims less than 250 ppm mercury content.

5 For example, the National Electrical Manufacturers' Association (NEMA) in the USA has called for a phase-out of all mercury in button cell batteries in the USA by 2011. In October 2008, Energizer announced sales of new zero-mercury hearing aid batteries – the first of their kind in the world.

batteries still appears to number in the hundreds of metric tonnes annually. Asian regional demand presented in Section 0 has been estimated in UNEP (2008a).

Dental applications

34. In some countries and income groups (especially higher-income) the use of mercury in dental amalgams is now declining. The main alternatives are composites (most common), glass ionomers and compomers (modified composites). However, the speed of decline varies widely, so that dental amalgam use is still significant in most countries, while in some countries (e.g., Sweden, Norway) it has almost ceased. In many lower-income countries, changing diets and better access to dental care have actually led to an increase in dental mercury use.

35. Asian consumption of mercury for dental use is presented in Section 0, based on estimates provided to the author by EU manufacturers and exporters.

Measuring and control devices

36. There is a rather wide selection of mercury containing measuring and control devices, including thermometers, barometers, manometers, etc., still manufactured, although thermometers and sphygmomanometers dominate with regard to mercury use. As market awareness has improved, most international suppliers now offer mercury-free alternatives. European legislation, among others, is being implemented to phase out such equipment and to promote mercury-free alternatives since the latter are available for nearly all applications.

37. Total mercury consumption in these applications is based primarily on Chinese production of sphygmomanometers and thermometers. Chinese authorities calculated that over 270 tonnes of mercury were used in the production of these two types of devices in 2004, while Chinese production is estimated to represent 80-90% of world production of these two products (SEPA 2008). Likewise, thermometers and sphygmomanometers are considered to represent around 80% of total mercury consumption in the product category of “measuring and control devices.” Asian regional demand presented in Section 0 has been drawn from UNEP (2008a).

Lamps

38. Mercury containing (fluorescent tubes, compact fluorescent, high-intensity discharge – HID, etc.) lamps remain the standard for energy-efficient lamps, where ongoing industry efforts to reduce the amount of mercury in each lamp are countered, to some extent, by the ever-increasing number of energy-efficient lamps purchased and installed in Asia. There is no doubt that mercury-free alternatives such as light-emitting diodes (LEDs) will increasingly become available, and technological developments point to the marketing of a comparable mercury-free alternative to the CFL in 2009 or 2010 (VU1 2008). Nevertheless, at present, for most lighting applications the mercury-free alternatives are very limited and/or more expensive, and separate collection and recycling of mercury-containing lamps in Asia are rare.

39. The ranges of mercury consumption presented in Section 0 include significant mercury use in backlighting (typically using small-diameter fluorescent tubes) of liquid crystal displays (LCDs) of all sizes – from electronic control panels to computer and television monitors. For China alone, mercury used in the production of fluorescent tubes and CFLs was estimated at 64 tonnes for 2005 (CRC 2007b). Chinese production has increased since then, but the average mercury content of lamps has likely declined during this period as well. Many of these lamps were exported outside the Asian region, but are clearly still relevant in the calculation of Asian regional demand for mercury.

Electrical and electronic equipment

40. Following the implementation of the European Union’s Restriction on Hazardous Substances (RoHS) Directive, and similar initiatives in Japan, China and Korea, among others, mercury-free substitutes for mercury switches, relays, etc., are being encouraged, and overall mercury consumption for these applications appears to have declined in Asia in recent years.

41. In Section 0, the ranges of mercury consumption in electrical and electronic equipment are drawn from estimates by UNEP (2008a).

Other applications of mercury

42. This category has traditionally included the use of mercury and mercury compounds in such diverse applications as pesticides, fungicides, laboratory chemicals, pharmaceuticals, paints,

applications in Chinese and Indian traditional medicine, cultural and ritual uses in India, cosmetics, etc. However, there are some further applications that have recently come to light in which the consumption of mercury is also especially significant.

43. In particular, the continued use of mercury in the production of artificial rubber is one such use that is rather widespread.⁶ Likewise, the use of significant quantities of mercury in some research and testing devices has until recently escaped special notice. A recent study for the European Commission (2008) has also identified substantial mercury consumption in compounds used in a broad range of applications such as chemical intermediates. In Section 0, the ranges of mercury consumption in other applications of mercury are drawn from estimates by UNEP (2008a).

Summary of mercury consumption in Asia

44. Global mercury demand is strongly influenced by China's domestic consumption and production of mercury products, indicated in Table 0-2 below. However, because China's mercury supply is mostly sourced domestically, China's domestic mercury situation does not seriously affect the supply vs. demand equilibrium of the rest of the world. Likewise, just as domestic mercury mining has increased in response to Chinese demand in the past, it may be assumed that as China works to reduce its mercury consumption, then its domestic mercury supply will decline in parallel.

45. For comparison, Japan claims to consume about 13 tonnes of mercury per year in batteries, lamps, measuring devices, electrical and electronic equipment, dental applications, etc. (Japan 2008). Table 0-2 also summarises the key applications of elemental mercury in the Asian region as a whole for the reference year, 2005. It should be noted that this table indicates "gross" mercury consumption in Asia, i.e., before any recycling or recovery is counted, and including mercury used to manufacture goods that are later exported (especially batteries, measuring and control devices, lamps and electrical and electronic equipment). Largely for the convenience of this assessment, recycling and recovery are addressed as mercury "sources" in Section 0 below.

Table 0-2 Estimated mercury consumption in Asia, including products for export, 2005 (tonnes)

	China		East and South-east Asia, excl. China		South Asia	
	<i>min.</i>	<i>max.</i>	<i>min.</i>	<i>max.</i>	<i>min.</i>	<i>max.</i>
Small-scale gold mining	120	240	288	384	3	12
VCM/PVC production	700	800	0	0	0	0
Chlor-alkali production	--	--	4	8	35	40
Batteries	150	250	50	70	30	50
Dental applications	45	55	25	31	22	32
Measuring and control devices	280	310	20	30	40	50
Lamps	60	70	20	25	20	25
Electrical and electronic equipment	30	40	15	20	25	30
Other*	40	80	30	40	20	30
Totals	1425	1845	452	608	195	269

* "Other" applications include uses of mercury in pesticides, fungicides, catalysts, paints, chemical intermediates, laboratory and clinical applications, research and testing equipment, pharmaceuticals, cosmetics, traditional medicine, cultural and ritual uses, etc.

Sources: UNEP 2006; NRDC 2006; CRC 2007a; consultant estimates.

Future mercury consumption in Asia

46. The objective of this section is to describe the evolution of Asian mercury consumption between 2010 and 2050, reflecting existing and reasonably anticipated national and global initiatives, as

⁶ Mercury "catalysts" (basically hardening or curing agents) are sometimes used in the production of polyurethane elastomers, used as artificial "rubber" for roller blade wheels, etc., in which the catalysts remain in the final product.

specified in partnership business plans, and related UNEP and UNIDO global mercury activities, where available.

47. The concentration of mercury product manufacturing especially in China, India, Vietnam, Taiwan and Malaysia during the last 10-15 years (Lowell 2008) is already on the decline as countries and regions in many parts of the world implement increasingly strict and comprehensive legislation, in addition to many voluntary initiatives, to phase out various uses of mercury, and to restrict global supplies.

48. In the near to medium term, the rate of decline in mercury consumption will depend primarily upon reductions in the small-scale gold mining, battery, electrical equipment, and measuring device manufacturing sectors; dental use; and chlor-alkali facilities. These sectors represent the greatest potential for decreases in consumption during this time period because the alternative mercury-free technologies or products are readily available, they are of equal or better quality and prices are often competitive. For these sectors, the challenges are not technical, but are rather related to the extent of encouragement offered by countries or regions through awareness-raising, legal or voluntary mechanisms, etc.

49. For this analysis, the objectives for future reductions in mercury consumption are based on those agreed in the Mercury-Containing Products Partnership Area Business Plan (UNEP 2008b), which is also based on the "Focused Mercury Reduction Scenario" of UNEP's *Summary of Supply, Trade, and Demand Information on Mercury* (UNEP 2006). These objectives are applied to Asian regional mercury consumption during the period 2010-2050, and are summarized in Table 0-3.

Table 0-3 Basic assumptions about future mercury consumption, 2010-2050

	China	East & Southeast Asia, excl. China	South Asia
<i>Processes</i>			
Small-scale gold mining	Reduce mercury consumption in small-scale gold mining globally by 50% over the next 10 years, with a subsequent decline after that of 5% per year. According to UNIDO, the 50% reduction can be met by eliminating whole ore amalgamation and encouraging greater mercury reuse (UNEP 2006). Supply restrictions are expected to help achieve this objective by raising mercury prices and otherwise encouraging greater efficiencies in mercury use.		
VCM/PVC production	An increase in mercury-free VCM production is problematic due to limited availability of ethylene supplies. It is assumed here that there is continued growth in mercury consumption to 1000t/y until 2010, stabilized consumption until 2015, and then a gradual phase-out of the mercury process from 2015-2030.	Not applicable	Not applicable
Chlor-alkali production	Assume no new mercury cell facilities will be constructed in any region.	Assume mercury cell capacity will be phased out by 2020, in line with voluntary EU industry objectives, which holds the majority of the world's mercury cells.	Assume Indian mercury cell capacity will be phased out by 2012, and others by 2020.
<i>Products</i>			
Batteries	Assume a 75% decrease in mercury consumption by 2015, and the remaining demand phased out gradually thereafter until 2025.		
Dental uses	Assume a 15% reduction by 2015, and a gradual reduction thereafter to 2050.		
Measuring and control devices	Assume a 60% reduction of mercury consumption by 2015, the phase out of mercury fever thermometer and blood pressure cuff manufacturing by 2017, and the phase out of remaining demand by 2025.		
Lamps	Assume a 20% reduction by 2015 and a gradual reduction of 80% overall by 2050.		
Electrical	Assume gradual 55% reduction of mercury consumption by 2015, and a gradual		

	China	East & Southeast Asia, excl. China	South Asia
and electronic equipment	reduction thereafter to 2050.		
Other applications	Assume a gradual 25% reduction of mercury consumption by 2020, and another 50% by 2050.		

Key regional sources of metallic mercury

Major sources of mercury supply

50. If recycled or recovered mercury is considered a “source,” there are typically five main regional sources of mercury supply:

- a. Mining and processing of primary mercury ores;
- b. Collection of process mercury from decommissioned mercury cell chlor-alkali plants (MCCAPs);
- c. By-product mercury from the refining or processing of some ferrous and most non-ferrous metals; and from the cleaning of natural gas;
- d. Stocks of mercury accumulated from previous years (typically the original source would have been from mercury mining or a by-product of other mining, chlor-alkali decommissioning, or other large sources).
- e. Mercury recovered or recycled from products containing mercury and from processes using mercury.

51. In this sense, mercury imported from outside the region (as metallic mercury or in products) would not be considered a regional source.

Mercury mining and external trade

52. Mercury mining refers to the extraction of mercury from ores typically containing between 0.1 and 3% mercury. There is no significant mercury mining in Asia except in mainland China, primarily in the region of Guizhou.

53. Chinese mercury imports in 2004 were reported as 354 tonnes, with no exports registered in that year or in later years. In line with increased mercury consumption in China in recent years, domestic production has increased. According to the Non-Ferrous Industry Yearbook, China’s mercury mine production was 1140 tonnes in 2004, the highest since 1990.

54. In 2005, Chinese mine production was reported at 1094 tonnes and imports at 180 tonnes. In 2006 no imports were formally registered, consistent with increased government restrictions on import permits for mercury imports (SEPA 2008; CRC 2007a). Nevertheless, there have been possible informal imports of mercury in recent years from neighbouring countries such as Viet Nam (CRC 2006).

Table 0-1 Estimated mercury mine production in China

Mercury mine production (metric tonnes)	2000	2001	2002	2003	2004	2005
China	203	193	495	612	1,140	1,094

Sources: CRC (2006) data, not including a modest amount of mercury reported to come from “informal” mining operations, i.e., small groups of miners not necessarily respecting the regulations on protecting the health of workers.

55. It should also be mentioned that only one mercury mine in China currently produces more than 100 tonnes per year. In 2004, this mine produced 312.54 tonnes of mercury. Due to limited reserves, it has been suggested that this mine may have an estimated remaining lifespan of only 5-6 years. Furthermore, if the total output of Chinese mercury mines remains in the range of 1000 tonnes per year, it has been estimated that China’s mercury mines may be able to maintain that level of production for only about 10 more years (CRC 2007a; SEPA 2008).

56. Forecasting future mine output is difficult, and may be expected to fluctuate to some extent with domestic demand. It is assumed here that output of not more than 1000-1100 tonnes/year is possible until 2015, after which output may be expected to decline to not more than about 300 tonnes/year between 2015 and 2025. During this period, if the domestic demand for mercury significantly exceeds

supply, this could put pressure on the authorities to relax import restrictions, and the imbalance may also encourage possible informal imports.

57. Alternatively, the authorities could encourage the exploitation of other sources of mercury such as by-product sources from zinc smelting, as discussed further below.

Mercury cell chlor-alkali facilities

58. There is a large quantity of process mercury at the bottom of the electrolytic “cells” that is necessary for the chlor-alkali production process to function properly. When a mercury cell facility is closed or converted (also called “decommissioning”) to the membrane process, the mercury may be removed. In the past this mercury has typically been reused within the industry, or it has been sold outside the industry on the international market.

59. The mercury process is considered to be old technology (not BAT) with a variety of mercury releases and losses, some of which have proven impossible to control. No new mercury cell facilities have been constructed in Asia for at least 20 years. The Indian chlor-alkali producers have announced plans to phase out their remaining mercury facilities by 2012.

Table 0-2 Mercury cell chlor-alkali capacity in Asia, 2005

	Approx. chlorine production capacity (tonnes/yr.)	Approx. cellroom mercury inventory (tonnes)	Assumed phase-out period	Mercury consumption (tonnes/yr.)	Mercury in wastes (tonnes/yr.)
China	<i>none confirmed</i>				
Other East and Southeast Asia	66,000	132	2015-2020	4-8	3-5
South Asia	560,000	1,120	800 tonnes Hg by 2012 320 tonnes Hg 2015-2020	35-40	20-30
Total Asian region	626,000	1,252		40-50	25-35
* The convention here is to calculate mercury “consumption” before any recycling of wastes, with the knowledge that, as in many industries, some waste is recycled in order to recover the mercury, while most mercury waste is sent for disposal.					
Sources: UNEP 2006; EEB 2006; Euro Chlor 2007; WCC 2006; SRIC 2005					

60. Since there is no indication when other facilities will close or convert to a mercury-free process, it is assumed that general international pressure will encourage them to phase out more or less as indicated in Table 0-2 above. At that time the mercury inventory held in the electrolytic cells will be recovered, and for the purpose of this analysis, the recovered mercury is allocated over the indicated years.

61. Apart from the metallic mercury in the electrolytic cells, mercury waste is also generated by chlor-alkali facilities, which may account for 50-75% of the mercury consumed (see Table 0-2). It is possible to retort and recover most of the mercury from the waste, but until now this is not common practice in Asia.

By-product mercury

62. Zinc ores may contain significant trace quantities of mercury, especially in those regions of the world, such as parts of China, where the appropriate geological conditions exist. World zinc production grew by 4% to 10.7 million tonnes in 2006. A 6% rise in total output to 11.3 million tonnes has been estimated for 2007, with a further increase of 6.4% to over 12 million tonnes estimated for 2008, driven by strong growth in Asia. Among other countries, new capacity is coming on line in China, India (Hindustan Zinc’s second 170,000 tonnes/year refinery at Chanderiya was commissioned in December

2007), Japan, the Republic of Korea, and Indonesia (Herald Resources' 220,000 tonnes/year Dairi mine) (IMSG 2008).

63. Gold, copper and lead ores also contain trace mercury, though typically in lower quantities than zinc ores (NRDC 2007). While the mercury content may vary greatly from one region or mine to another, it is often significant enough that it should be removed from the flue gases or wastewater during the processing of the ores.

64. Several technologies are available to control and capture mercury emissions from thermal processes at ore processing facilities. The Boliden-Norzink process uses mercuric chloride to precipitate metallic mercury as calomel (mercurous chloride). In the Outokumpu process, mercury is removed with sulphuric acid and then precipitated with selenium to produce mercury-selenium sulphate sludge. Importantly, the products of these two processes can be reprocessed to recover metallic mercury.

65. Other processes for mercury removal from ore processing gases include the Bolchem process (which uses thiosulfate to precipitate mercury), the sodium thiocyanate process, activated carbon filters, selenium scrubbers, selenium filters and lead sulphide filters.

66. At present, the only significant recovery of by-product mercury in the Asian region appears to be from zinc smelting in Japan, amounting to some 67 tonnes of mercury per year.⁷ In other countries in Asia most mercury appears to be released to the environment, or disposed of with the processing waste.

67. In an effort to estimate the mercury potentially recoverable worldwide from primary zinc ores (UNEP 2006), Boliden company officials calculated the waste generated by their own mercury removal equipment already installed, based upon the design capacity of the units, the amount of gas managed in the units, and the typical mercury content of the gas. Globally, they estimated about 260 tonnes of mercury in calomel produced at zinc smelters in 2004 (with a margin of error of 50%, in light of uncertainties about individual plant operations, unit operating status, etc.). It should be noted that in 2004, China alone accounted for over one-quarter of world primary zinc production. While two Chinese smelters have installed equipment to control mercury emissions, according to Boliden, no by-product mercury production has yet been documented there.

In 1996 the Newmont Mining Corporation opened the Minahasa Raya (NMR) gold mine at Buyat Bay on the northern Indonesian island of Sulawesi. Several years later an audit determined that the mine was annually emitting about 17 tonnes of mercury into the air and 16 more tonnes into the bay. The company installed a scrubber but it did not operate as planned. In 2004 the mine began closing down its operations in North Sulawesi, but a Newmont-operated gold and copper mine, Batu Hijau, located close to Senunu Bay on the remote island of Sumbawa in the south-central portion of the Indonesian archipelago, is expected to remain operational until at least 2025. Meanwhile, the company has plans to develop a copper deposit at Elang, 60 kilometres from Batu Hijau, that is expected to "add to the life of Batu Hijau."



Newmont Indonesia's Minahasa Raya and Batu Hijau gold mines.

Minahasa Raya mine with Buyat Bay in the distance (2004).

Source: Map and photo courtesy Newmont Mining Corporation.

⁷ Average 70-74 tonnes mercury content, of which about 67 tonnes was recovered (Japan 2008).

68. Understanding that mercury removal technology is most cost-effective (and most likely to be installed in the future) on the largest smelters, which carry out some 50% of Chinese primary zinc smelting, Table 0-3 identifies the larger zinc smelters (those with production capacity >100,000 tonnes per year) in Asia and their capacities in 2003.

Table 0-3 Selected Asian zinc smelters greater than 100,000 metric tonnes capacity (2003)

	Company	Location	Construction	Capacity (tonnes)
China	Baiyin Zinc	Baiyan, Gansu	1991	200,000
	Huludao Lianshanqu Zinc	Huludao, Liaoning (vertical retorts)	1978	200,000
	Huludao Lianshanqu Zinc	Huludao, Liaoning (electrolytic)	1995	165,000
	Zhuzhou Lead/Zinc	Zhuzhou, Hunan	1959	350,000
Japan	Akita Zinc Co.	Iijima, Akita	1972	200,000
	Hachinohe Smelting Co	Hachinohe, Aomori	1969	118,000
	Toho Zinc Co.	Annaka, Gunma	1937	139,000
India	Hindustan Zinc	Chanderiya	2007	340,000
Korea	Korea Zinc Co.	Onsan, Kyoungnam	1978	420,000
	Youngpoong Corp.	Sukpo, Kyoung Buk	1970	270,000
Thailand	Padaeng Industry Public Co	Tak	1984	105,000
Source: ILZRO 2004.				

69. Recalling that the Boliden-Norzink mercury removal equipment generates calomel as the waste product, with a mercury export ban in place, one may expect mercury to be recovered from the calomel only if there is an appropriate financial incentive, i.e., if the domestic mercury market price is sufficiently high to justify recycling and sale of the mercury, or if there is a legal requirement to do so.

70. Considering the rapid economic growth in the region, along with rising commodity prices, it may be assumed that the capacity of large zinc smelters will increase over the medium term as suggested in Table 0-4, although the specifics of such increases are impossible to predict.

Table 0-4 Large primary zinc smelters in Asia, and recoverable mercury

	Est. capacity of large primary zinc smelters (thousand tonnes)		Mercury content of ores processed (grams/tonne)	Quantity of mercury that could be recovered if appropriate mercury control technology were installed (tonnes)	
	2005 est.	2030 est.		2005 est.	2030 est.
China	1000	3600	86.6*	83	312
Japan (all smelters)	540	700		72**	92
Other Asia excl. China & Japan	1000	2100	20.0***	20	42
* Streets (2005). ** Average 70-74 tonnes recoverable mercury, of which about 67 tonnes was actually recovered (Japan 2008). *** Pacyna (2002).					

71. Following the global trend, it is likely that in the future mercury will be recovered from all of the larger Asian zinc smelters, as they have been implicated in major mercury emissions to the environment. For this assessment, it is assumed that appropriate control equipment will be installed on these smelters during 2010-2015 in China, and during 2010-2020 for other Asian countries. It is also assumed – in order to have an outside estimate of the mercury supply available – that all of the calomel waste will then be processed to recover mercury.

72. As mentioned above, in addition to zinc ores Asian countries mine and/or process gold, lead and copper ores that also contain varying trace amounts of mercury. Based on the Indonesian example, it may be reasonably assumed that, whatever mercury is recovered from zinc smelting in Asia, at least 25% more mercury may also be recovered from other non-ferrous metal (especially gold, lead, copper) processing activities in Asia.

Mercury stocks

73. In the past, reserve stocks of mercury held by governments or their proxies have been traded on the world market. While this no longer seems to be the case, and the recent US mercury export ban specifically forbids the government from selling its stocks, there remain various mercury inventories that may be available to the market.

74. Other than some stocks held on-site in storage rooms by chlor-alkali producers, it is likely there are other commercial stocks remaining as well, especially in light of increased speculation by brokers, fuelled by the volatility of mercury prices since 2004. It is estimated that most commercial mercury users maintain inventories of two to six months' expected consumption.

75. The global metals trader Lambert Metals, based in the UK, has long maintained mercury storage facilities at the ports of Antwerp and Rotterdam (WSJ 2006), from where shipments frequently go to Asia, although storage by Lambert Metals in Asia has not been confirmed. The largest Indian mercury broker, Beri Mercurio Limited, has been especially active in the market in recent years, and logically maintains stocks in Mumbai and elsewhere in Asia, although there is no precise information regarding quantities.

76. It is likely that the Chinese government may also be in the process of accumulating a stockpile of mercury to guard against eventual shortages. While the stockpiling of mercury has not been confirmed by Chinese authorities in the case of mercury, it is not an unusual practice. The Chinese government manages stocks of other commodities, and regularly buys and sells inventories in order to prevent prices from rising too high or falling too low. Recently, for example, Chinese zinc smelters called on the central government to launch a similar national policy with regard to zinc stocks, or reserves.

77. In any case, for this analysis mercury stocks may not be considered in the same manner as other mercury supplies that are generated every year. Rather, stocks should be considered as inventories held in reserve, and brought out only as needed under special circumstances – to dampen or to take advantage of price fluctuations, to meet sudden surges in demand, etc.

78. While it may be assumed that various Asian mercury stocks will be made available to meet modest shortfalls in supply, there are no reliable regional data on the quantities involved. Therefore, merely for the purposes of this analysis, it is assumed that the region presently maintains mercury stocks of some 1,000-2,000 tonnes.

Recycling

79. In order to facilitate this analysis, recycling is considered as a “source” of mercury that may be exploited or managed through a variety of policies that deal with mercury-containing products as they enter the waste stream, and/or residual mercury and wastes from industrial processes.

80. With regard to the use of mercury in artisanal gold mining, since this is a rather special and diverse area of mercury use, we will not estimate how much mercury used in the process may be subsequently retorted or otherwise recovered. Instead, such instances are included in this analysis as merely a decrease in the consumption of mercury in ASM, which is already accounted for in the projections presented in Table 0-3.

81. With regard to VCM, we note that the quantity of mercury remaining in the spent catalyst is slightly less than half of the total mercury consumed in the production process. As concerns the recycling of the spent catalyst at present and into the future, it is simply estimated that nearly all of the mercury remaining in the spent catalyst is recycled.

82. In the chlor-alkali industry, very little of the mercury in the waste stream is presently recycled in Asia. Due to the time frame during which most of the mercury cell facilities will probably be phased out (see Table 0-3), and the limited amount of waste that may be recycled until the phase-out dates, it is suggested to ignore this relatively small source of mercury.

83. Various mercury products are collected for recycling in different parts of the world, especially measuring devices (mainly thermometers and sphygmomanometers), batteries, lamps, dental amalgam, etc. Japan has reported that it recovers an average of 15 tonnes of mercury annually from recycled products. For all of Asia it is estimated that about 3% of the mercury consumed in products is presently recycled, particularly some sphygmomanometers used in health clinics, some dental wastes and some button cell batteries.

84. Estimating how the recycling rate for products will evolve in the future is highly dependent on government policies not only for dealing with end-of-life products, but also concerning the disposal of hazardous wastes. It has been observed that as hazardous waste disposal becomes more costly, more mercury waste is diverted to recycling and less to other forms of disposal. Of course, this shift assumes that there remains a viable demand for mercury. At such point as the supply of mercury exceeds the demand, the financial incentive for recycling becomes much less compelling.

85. With the knowledge that the EU and US have reportedly achieved an overall 15% mercury product recycling rate, it is here assumed that Asia could achieve at least 10% by 2020 and 25% by 2040. We note that collection, recycling, and recovery of mercury from products may continue for several years after phase-out of a mercury containing product. However, such details have little influence on the outcome of this analysis.

86. Combining all recycling efforts, the baseline recycling data for 2005 and basic assumptions regarding future mercury recycling in Asia during the period 2010-2050 are summarized in

87. Table 0-5 below.

Table 0-5 Basic assumptions regarding Asian mercury recycling 2010-2050 (tonnes)

	Consumption 2005	Recycling 2005	Forecast 2010-2050
<i>Processes</i>			
Artisanal and small-scale gold mining	410-530	Included simply as reduced consumption.	Included simply as reduced consumption
VCM/PVC production	700-800	~47% of consumption	~47% of consumption
Chlor-alkali production	40-50	Minimal	Too small to influence the analysis
<i>Products</i>			
All products combined	920-1240	3% of consumption	10% of consumption by 2020, and 25% by 2040

Asian mercury supply

88. Overall, the main Asian regional sources of mercury are summarised in Table 0-6 below. These are purely domestic sources, i.e., generated within the region. The evolution of these sources during the period 2010-2050 has been discussed in the previous Sections 0 through 0.

Table 0-6 Asian “sources” of elemental mercury, 2005 (tonnes)

	China	East & Southeast Asia, excl. China	South Asia
Mercury mining (formal)	1094	0	0
Mercury mining (informal)*	0-200	0	0
Decommissioned chlor-alkali	See Table 0-2		
By-product mercury	0	67	0
Recycled Hg from VCM	350	0	0
Recycled Hg from products	18-24	10-15	
<i>Inventory (not a “source”):</i>			
Mercury stocks	500-1000	500-1000	
* Informal or artisanal mining is typically carried out by individuals or small groups outside the normal commercial and legal system; as such, it is very difficult to obtain good information on the extent of these activities.			

Sources: Derived from NRDC (2006), CRC (2006) and personal communications.

Results regarding excess Asian mercury

China

89. Based only on domestic sources and uses of mercury, assuming that China’s mercury mines continue working at full capacity, and assuming recovery of mercury from the major metal smelters, this analysis indicates that China will have a “formal” mercury supply shortage only until around 2013. The word “formal” is used to suggest that informal sources of mercury, such as informal imports and illegal mercury mining, may serve to fill some of this supply deficit. Alternatively, formal imports and/or stocks of mercury could also serve to fill this gap.

90. The anticipated near-term gap between domestic mercury supply and demand may be addressed through demand-side policies as well, of which the most effective would be further restrictions on the soaring consumption of mercury for VCM/PVC production, which could also include further measures to recycle mercury from this process. Over the longer term, however, China could expect to see a considerable excess of domestic mercury supply over demand.

Other Asian countries

91. With regard to the other countries of East Asia, Southeast Asia and South Asia, this analysis shows a much longer period during which domestic demand may be expected to exceed the domestic supply of mercury. This is not surprising because these countries are not endowed with the significant mineral mercury reserves China is able to exploit. They have mostly had to rely on mercury imports. Nevertheless, the demand for mercury is expected to decrease over time, while more by-product mercury becomes available, so that by about 2030 these other Asian countries could expect to generate an excess of mercury.

All Asian countries combined – main scenarios

92. For all of Asia together, Figure 0-1 demonstrates to what extent the rest of Asia could benefit from transfers of excess mercury from China, still assuming that China’s mercury mines continue working at full capacity. In this “All-Asia Maximum Mining” scenario, Asia would probably see mercury supply roughly equal to demand beginning in 2014, and a substantial excess of mercury emerging soon after 2025.

93. However, it is reasonable to assume that China would have no desire to continue operating its mercury mines at full capacity if there is no corresponding Asian demand for mercury, and especially if China would be obliged to store any excess mercury. Therefore, Figure 0-2 presents the case in which Chinese mercury mine production is reduced as much as possible during each year in which the overall Asian mercury supply would otherwise exceed demand.

94. According to this “All-Asia Reduced Mining” scenario, as Figure 0-2 indicates, regional demand and supply would be roughly equal from about 2014, and continue that way for some years until excess supplies are projected to become significant around 2030. Based on the preceding assumptions and analysis, this “All-Asia Reduced Mining” scenario is considered the most likely basis for more detailed discussions of an Asian mercury storage strategy.

95. Since this is the most likely scenario for mercury excesses generated in the Asian region during the period 2010-2050, the detailed calculations supporting Figure 0-2 are included in the Appendix – “Most likely scenario for excess mercury in Asia.”

Figure 0-1 Asian excess mercury (assuming maximum Chinese mercury mining)

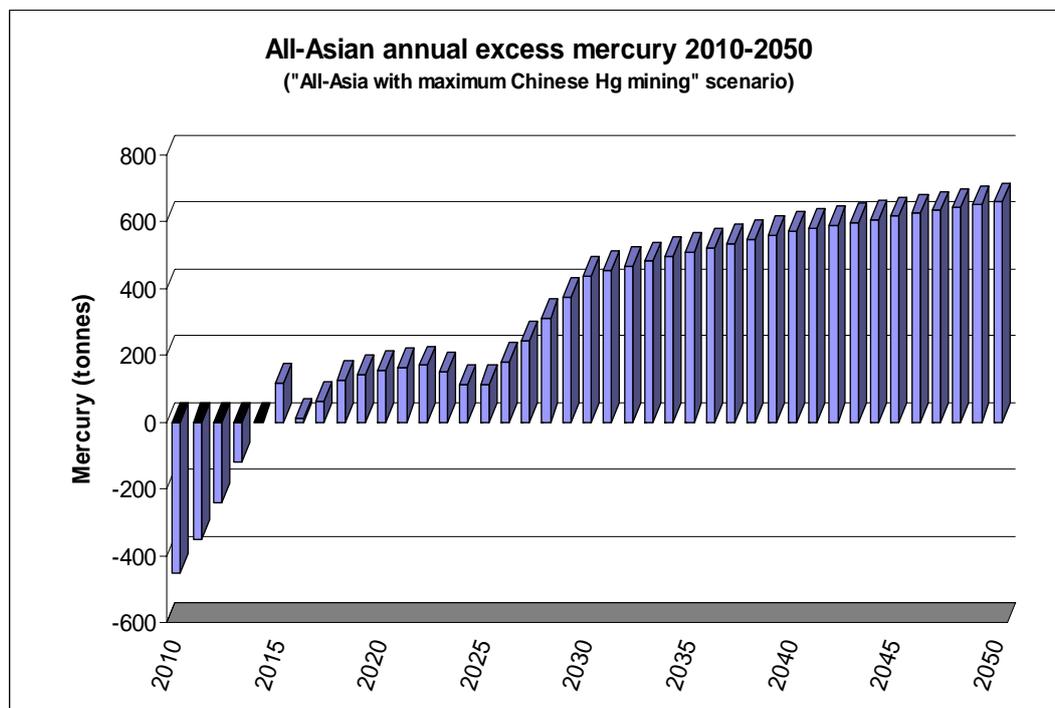
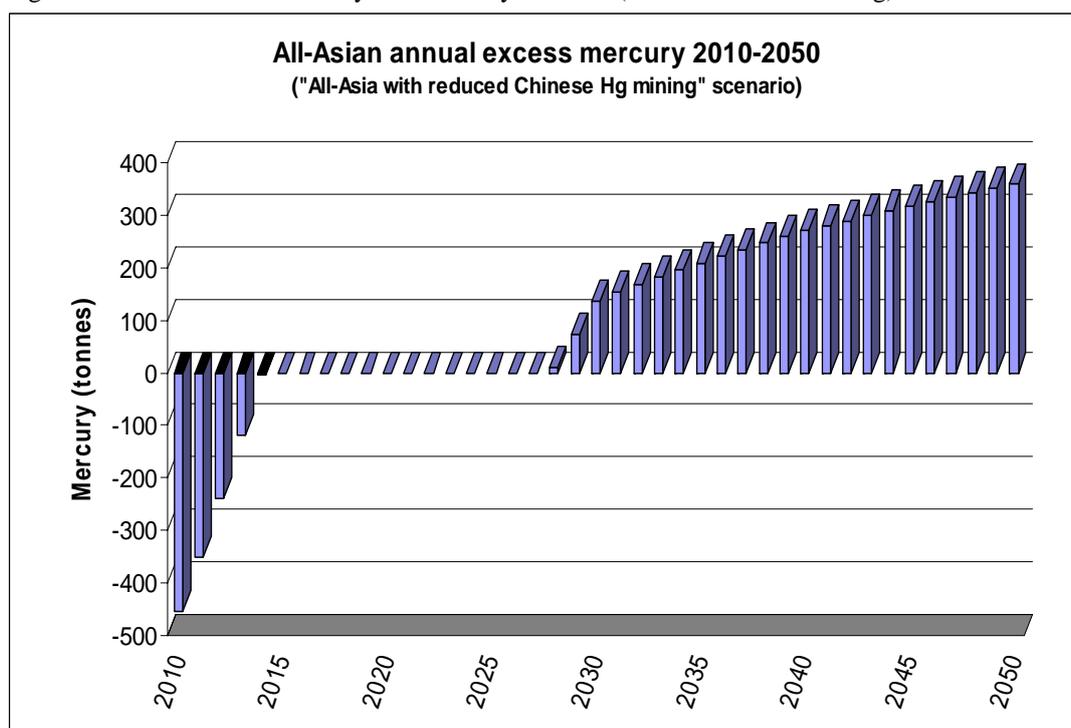


Figure 0-2 Asian excess mercury – most likely scenario (reduced Chinese mining)

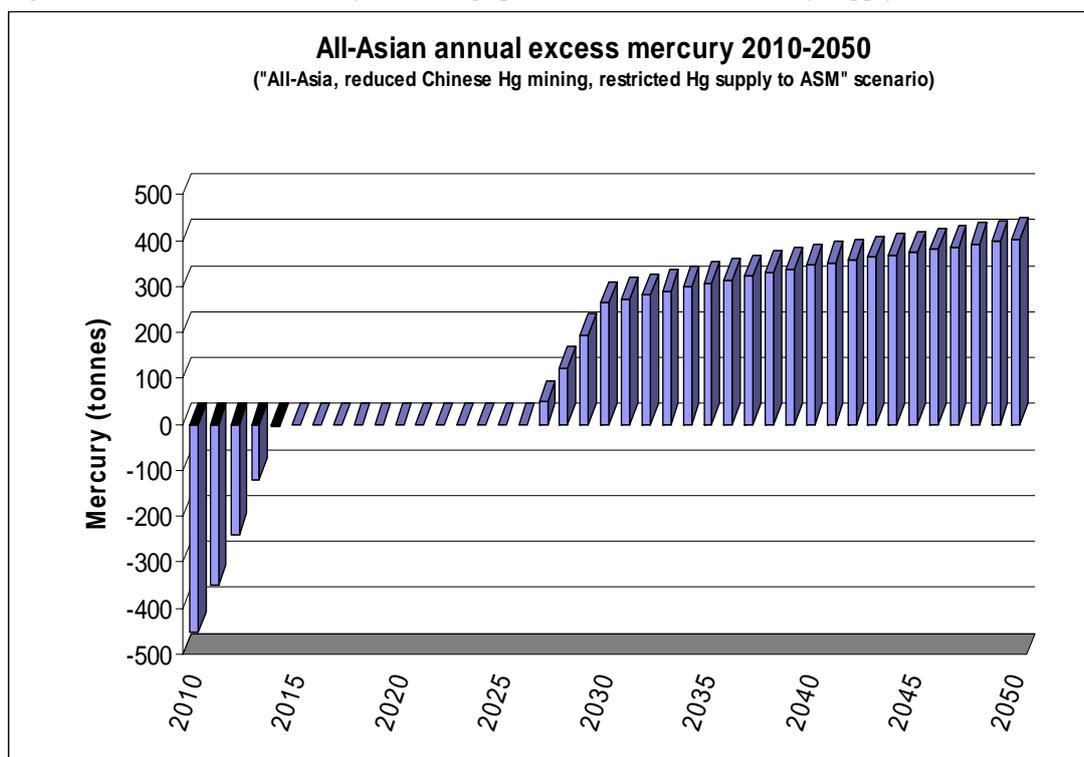


96. The quantity of excess mercury requiring storage, as accumulated between 2029 and 2050 in the most likely “reduced Chinese mining” scenario, amounts to just over 5,500 tonnes.

97. Finally, to test the sensitivity of the overall Asian analysis to a change in one of the important assumptions, the category of mercury consumption in ASM was selected. The original assumption was that the considerable use of mercury in ASM would be cut by 50% over the next 10 years, and after that it would be further reduced by 5% per year until 2050.

98. The alternative policy option considered here is that, following the initial 50% reduction in mercury consumption, mercury supplies are further restricted so that ASM consumption of mercury will be nearly completely phased out between 2020 and 2030. The impact of this “ASM supply restriction” scenario, shown in Figure 0-3, is that excess mercury in Asia would appear a few years earlier than demonstrated in Figure 0-2, and lead to a somewhat greater accumulation of mercury up to 2050.

Figure 0-3 Asian excess mercury (assuming special restrictions on mercury supply to ASM)



99. The quantity of excess mercury requiring storage, as accumulated between 2027 and 2050 in this “ASM supply restriction” scenario, amounts to around 7,500 tonnes. Moreover, since this scenario assumes that a policy of enhanced mercury storage is implemented expressly to reduce regional supplies, development of some limited storage capability would be required by 2017, or shortly thereafter.

100. It is obvious that many other assumptions integral to this assessment may be modified in various ways. However, due to the many elements that are already included in this analysis, it is evident that such alternative assumptions would have relatively little impact on the basic observations and conclusions of this assessment.

Conclusions

101. With the possible exception of China and Japan, the Asian region is a significant net importer of mercury at the present time. The vast majority of the imported mercury is used for small-scale gold mining, and lesser amounts for product manufacturing. China, on the other hand, consumes much of its mercury in the production of VCM/PVC, and provides for a large part of its mercury requirements from

domestic mercury mining. Therefore, the timing of an anticipated mercury excess in Asia depends greatly on the timing and magnitude of demand reduction in these key sectors.

102. Since UNIDO and other experts have determined that mercury supply reductions can contribute to significant demand reductions in small-scale gold mining, supply and demand reductions for this sector are mutually reinforcing, and to some extent supply reduction must precede demand reduction to be effective. Therefore, for this region, planning for mercury storage may be especially important as an initiative to further encourage demand reduction.

103. According to the scenarios assessed in this report, mercury supply and demand in Asia are projected to reach a rough equilibrium beginning about 2014-2015. This time frame could be shorter if substantial additional by-product mercury is generated in response to stricter requirements imposed on the metal processing sector. On the other hand, this time frame could be longer if the reduction in mercury demand in small-scale gold mining proves to be more difficult to achieve than the goals set out in the UNEP partnership.

104. The scenarios assessed in this report generally assume gradual reductions in mercury demand post-2017. For example, reduced mercury demand for small-scale gold mining, especially as a result of intentionally restricting the mercury supply, would bring forward the date at which a mercury storage capability is needed. Furthermore, after 2017 the urgency of an Asian mercury storage capability is likely to depend on the rate of further demand reductions, the extent to which countries in the region wish to encourage these further demand reductions through supply restrictions, and the extent to which a regional solution is achieved (even though net supplies of excess mercury may occur in a relatively small number of countries).

105. In any case, substantial excess mercury may be expected in Asia as a whole post-2030. The quantity of mercury requiring storage, as accumulated between 2029 and 2050 in the most likely "All-Asia Reduced Mining" scenario, amounts to just over 5,500 tonnes.

106. As mentioned, in order to help reduce mercury consumption, regional authorities may decide to accelerate the storage of excess mercury. In this case they would likely follow the hierarchy established by the European Union, whereby any mercury recovered from decommissioned chlor-alkali facilities would be stored first, and then by-product mercury recovered from metal ore processing and the cleaning of natural gas would be stored as a second priority. This option would result in the generation of excess mercury while restricting the supply of mercury that now goes to less acceptable uses, as shown in the more aggressive "ASM supply restriction" scenario (Figure 0-3) above. In this case, the quantity of excess mercury that may be accumulated between 2027 and 2050 is estimated at nearly 7,500 tonnes.

Appendix – “Most likely scenario for excess mercury in Asia”

107. The table in this appendix provides 5-year snapshots of the calculations behind the most likely scenario (see Figure 0-2) for future mercury sources and uses in Asia, showing the excess mercury that would likely be generated in the region during the period 2010-2050.

All-Asia elemental mercury excess and accumulation, 2010-2050 (tonnes)

Zinc and other smelting - mercury source	2010	2015	2020	2025	2030	2035	2040	2045	2050
Hg available large zinc smelters (LZS) (China)	129	175	220	266	312	312	312	312	312
% LZS w/ Hg controls	0%	100%	100%	100%	100%	100%	100%	100%	100%
Hg captured LZS w/ controls (93% eff.)	0	162	205	248	290	290	290	290	290
Hg recovered from calomel (max.) - China	0	162	205	248	290	290	290	290	290
Hg available LZS (Japan)	76	80	84	88	92	92	92	92	92
% LZS w/ Hg controls	100%	100%	100%	100%	100%	100%	100%	100%	100%
Hg captured at LZS w/ controls (93% eff.)	71	74	78	82	86	86	86	86	86
Hg recovered from calomel (max.) - Japan	71	74	78	82	86	86	86	86	86
Hg available LZS (other Asian countries)	24	29	33	38	42	42	42	42	42
% LZS w/ Hg controls	0%	50%	100%	100%	100%	100%	100%	100%	100%
Hg captured at LZS w/ controls (93% eff.)	0	13	31	35	39	39	39	39	39
Hg recovered from calomel (max.) – other Asia	0	13	31	35	39	39	39	39	39
Total Hg recovered by all Asian LZS (max)	71	250	314	364	415	415	415	415	415
Other smelting adds +25%	18	63	78	91	104	104	104	104	104
Total Hg recovered by Asian smelting (max)	88	313	392	455	518	518	518	518	518
Uses of mercury including product exports									
Batteries (excluding China)	63	25	13	0	0	0	0	0	0
Dental applications (excluding China)	51	47	44	40	37	34	31	28	25
Measuring and control devices (excluding China)	49	28	11	0	0	0	0	0	0
Lamps (excluding China)	41	36	32	28	24	21	17	13	9
Electrical & electronic equipment (excl. China)	33	20	19	18	16	15	14	13	11
Other* (excluding China)	55	50	45	40	35	30	25	20	15
Products and “other” (China)	546	387	307	238	213	188	163	138	113
VCM	1000	1000	667	333	0	0	0	0	0
ASM	380	290	213	164	127	98	76	59	46
Chlor-alkali	26	15	4	0	0	0	0	0	0
Total uses	2243	1898	1354	862	453	386	326	270	218
Sources of mercury including smelting									
Product recycling - Japan (tonnes Hg)	15	15	15	15	15	15	15	15	15
Product recycling - China (tonnes Hg)	29	30	31	33	37	40	41	34	28
Product recycling - others (tonnes Hg)	15	16	16	17	20	21	22	18	15
VCM recycling	467	467	311	156	0	0	0	0	0
Chlor-alkali decommissioning	125	125	67	0	0	0	0	0	0
Total Hg recovered from zinc & other smelting - see above	88	313	392	455	518	518	518	518	518
Formal Hg mining (maximum)	1050	1050	675	300	300	300	300	300	300
Mercury stocks 1000-2000t?	?	?	?	?	?	?	?	?	?
Total sources	1789	2015	1508	976	890	895	896	886	877
All-Asia annual excess (-deficit) mercury - max. Chinese Hg mining									
IMPACT - reduced Chinese Hg mining	0	-117	-154	-114	-300	-300	-300	-300	-300
All-Asia annual excess (-deficit) mercury - reduced Chinese Hg mining	-453	0	0	0	137	209	270	316	358
Cumulative excess mercury (tonnes Hg)	0	0	0	0	221	1125	2357	3848	5556

References

- ACAP (2005) – “Assessment of Mercury Releases from the Russian Federation.” Arctic Council Action Plan to Eliminate Pollution of the Arctic (ACAP), Russian Federal Service for Environmental, Technological and Atomic Supervision & Danish Environmental Protection Agency. Danish EPA, Copenhagen. See http://www.mst.dk/udgiv/Publications/2005/87-7614-539-5/html/helepubl_eng.htm
- Cain (2007) – A Cain, S Disch, C Twaroski, J Reindl and CR Case, “Substance Flow Analysis of Mercury Intentionally Used in Products in the United States,” *Journal of Industrial Ecology*, Volume 11, Number 3, copyright Massachusetts Institute of Technology and Yale University.
- CRC (2006) – “Research Report on Mercury Production and Use in China,” Chemical Registration Center (CRC) of State Environmental Protection Administration of China (SEPA) and Natural Resources Defense Council (NRDC), 2006.
- CRC (2007a) – “Research Analysis Report on Mercury Use in China 2003 – 2005 - The Measuring Devices Industry of China,” Chemical Registration Center (CRC) of State Environmental Protection Administration of China (SEPA) and Natural Resources Defense Council (NRDC), May 2007.
- CRC (2007b) – “Survey and Research Report on the Status of Use of Mercury in China’s Electric Light Source Industry,” Chemical Registration Center (CRC) of State Environmental Protection Administration of China (SEPA) and Natural Resources Defense Council (NRDC), 2007.
- EEB (2006) – “Status report: Mercury cell chlor-alkali plants in Europe,” Concorde East/West Sprl for the European Environmental Bureau, Brussels, October 2006.
- Euro Chlor (2007) – “Chlorine Industry Review 2006-2007,” Euro Chlor, Brussels, August 2007. See www.eurochlor.org.
- European Commission (2008) – “Options for reducing mercury use in products and applications, and the fate of mercury already circulating in society,” COWI A/S and Concorde East/West Sprl for the Commission of the European Communities, September 2008, Brussels.
- ILZRO (2004) – “World Directory 2003: Primary and Secondary Zinc Plants,” International Lead and Zinc Research Organization (ILZRO).
- IMSG (2008) – “Metals Despatch,” Newsletter of the International Metals Study Groups, Issue No. 5, June 2008.
- Japan (2008) – Result of research on material flow of Hg in Japan. Ministry of the Environment. Available at http://www.env.go.jp/chemi/tmms/2001/mat04_2.pdf (only in Japanese).
- Lowell (2008) – “Report on the major mercury-containing products and processes, their substitutes and experience in switching to mercury-free products and processes,” Lowell Center for Sustainable Production for the United Nations Environment Programme, Chemicals Branch, Geneva, October 2008.
- NRDC (2006) – “NRDC submission to UNEP in response to March 2006 request for information on mercury supply, demand, and trade,” Natural Resources Defense Council, Washington, DC, May 2006; and Comments submitted by NRDC to the 1 September 2006 draft report, “Summarizing Supply, Trade and Demand Information on Mercury.” Both available at <http://www.chem.unep.ch/mercury/Trade-information.htm>
- NRDC (2007) – “Mercury Releases from Industrial Ore Processing,” Natural Resources Defense Council, Washington, DC, June 2007.
- Pacyna (2002) – Pacyna, EG and JM Pacyna, “Global Emissions of Mercury from Anthropogenic Sources in 1995,” *Water, Air, and Soil Pollution 137*: 149–165, 2002.
- SEPA (2008) – “Strategy Proposal for International Actions to Address Mercury Problem - Mercury Situation in China,” State Environmental Protection Administration of China (SEPA), submitted to UNEP 28 January 2008.
- SRIC (2005) – E Linak, S Schlag and K Yokose, “Chlorine/Sodium Hydroxide,” CEH Marketing Research Report, SRI Consulting, Zurich, August 2005.
- Streets (2005) – Streets DG, J Hao, Y Wu, J Jiang, M Chan, H Tian, and X Feng (2005), “Anthropogenic mercury emissions in China,” *Atmospheric Environment* 39 (2005) 7789–7806.

Telmer (2008) – Personal communications with experts Telmer (School of Earth and Ocean Sciences, University of Victoria, Canada), Veiga and Spiegel (both with the Norman B. Keevil Institute of Mining Engineering, University of British Columbia, Canada) – all involved in the UNIDO/UNDP/GEF Global Mercury Project.

Telmer and Veiga (2008) – K Telmer and M Veiga, “World emissions of mercury from artisanal and small scale gold mining and the knowledge gaps about them,” Final draft, paper prepared for UNEP FT, Rome, 23 May 2008.

Tsinghua (2006) – “Improve the Estimates of Anthropogenic Mercury Emissions in China,” Tsinghua University, October 2006.

UNEP (2002) – “Global Mercury Assessment.” United Nations Environment Programme, Chemicals Branch, Geneva, December 2002. Available in English, French and Spanish at <http://www.chem.unep.ch/mercury/>.

UNEP (2006) – “Summary of supply, trade and demand information on mercury.” Report prepared by Concorde East/West Sprl in response to UNEP Governing Council decision 23/9 IV, United Nations Environment Programme – Chemicals. Geneva, November 2006.

UNEP (2008a) – The challenge of meeting mercury demand without mercury mining: An assessment requested by the Ad Hoc Open-Ended Working Group on Mercury, report prepared by Concorde East/West Sprl for the United Nations Environment Programme – Chemicals. Geneva, November 2008.

UNEP (2008b) – “Mercury-Containing Products Partnership Area Business Plan,” US Environmental Protection Agency in coordination with UNEP, Washington DC, 1 July 2008.

VU1 (2008) – See <http://www.vu1.com/technology/technology.htm>

WCC (2006) – “Submission [to UNEP] on Global Mercury Partnership for the Reduction of Mercury in the Chlor-alkali Sector,” World Chlorine Council, undated, no address, see <http://www.worldchlorine.com>

WSJ (2006) – J Fialka, “Backfire: How Mercury Rules Designed for Safety End Up Polluting,” *Wall Street Journal*, New York, NY, 20 April 2006.

Annex II

Assessment report – Excess mercury supply in Latin America and the Caribbean, 2010-2050

FINAL REPORT



APRIL 2009

UNEP CHEMICALS

Assessment report: Excess mercury supply in Latin America and the Caribbean, 2010-2050

Executive summary

1. Decision 24/3 IV of the UNEP Governing Council identified seven priority areas for action to reduce the risks from releases of mercury, two of which are:
2. To reduce the global mercury supply, including considering curbing primary mining and taking into account a hierarchy of sources; and
3. To find environmentally sound storage solutions for mercury.
4. In its decision GC 25/5 the Governing Council agreed to take further international measures including the elaboration of a legally binding instrument on mercury, which could include both binding and voluntary approaches, as well as a range of interim activities, to reduce risks to human health and the environment.
5. In the Latin American and Caribbean region, the increasing capture of by-product mercury from mining operations, and the increasing use of alternatives to replace mercury, will result in excess mercury in the region. In addition, the management of mercury supply is now seen as a valuable policy tool with which to help reduce the demand for mercury in sectors where there are viable mercury-free alternatives.
6. If not needed for acceptable applications, mercury must be managed properly and stored, thereby preventing its re-entry into the global market. Identifying environmentally sound storage solutions for mercury is therefore recognized as a priority.
7. Places to sequester safely the excess mercury are needed, since elemental mercury, apart from being toxic, cannot be destroyed or degraded. Governments and other stakeholders need to understand how to manage this mercury over the long term in order to avoid its re-entry into the global market place. This understanding includes planning for the necessary storage capacity, discussing regional coordination activities, securing financial and technical support, identifying technical criteria for environmentally sound long-term storage, and developing the basic design of such a facility or facilities. As a first step in the planning process, the report on excess mercury supply estimates the quantities of mercury that may become available in the region for sequestration, and time horizons for taking appropriate action.
8. The report confirms that the Latin American and Caribbean region imports and exports significant quantities of mercury. The vast majority of mercury consumed in the region is used for small-scale gold mining, and lesser amounts for industrial use in the production of chlor-alkali using the mercury process, as well as use in mercury containing product applications.
9. This analysis observes that future sources of mercury in the Latin American and Caribbean region will include mainly mercury recovered as a by-product of mining operations, and mercury recovered from the closure or conversion of mercury cell chlor-alkali plants. Such regional sources of mercury are correlated in this analysis with the regional uses mentioned above in order to better understand the mercury supply and demand equilibrium in the region.
10. Accordingly, the report presents a framework for better understanding future mercury supply and demand within Latin America and the Caribbean, a framework necessary to inform discussions about managing and storing mercury in the region. The analysis provided background information for the inception meeting of the project on the storage of excess mercury in the Latin American and Caribbean region, held in April 2009, in Montevideo, Uruguay.
11. Experts from the United Nations Industrial Development Organization and other entities have determined that mercury supply restrictions, such as mercury storage, can contribute to significant demand reductions in small-scale gold mining through increased prices and more difficult access to

mercury supply. Subsequently, measures to influence supply and demand can be mutually reinforcing, and to some extent supply restrictions that precede demand reductions can be even more effective. Planning for diversion of mercury supply into mercury may be especially important as an initiative to further encourage demand

12. According to the base case scenario assessed in the report, the mercury supply in Latin America and the Caribbean may exceed demand even before 2015, which could imply a need for storage of the excess mercury. This scenario assumes that stricter requirements will be imposed on the industrial mining sector that will lead to the recovery of additional by-product mercury. On the other hand, this time frame could be a few years longer if certain international gold mines in South America continue to export their by-product mercury to the United States.

13. The urgency of a Latin American and Caribbean mercury storage capability will depend on the rate of further demand reductions (contributing to excess mercury supply), the extent to which countries in the region wish to encourage these further demand reductions through supply restrictions such as increased regulation or controls on access to mercury, and the extent to which a regional storage solution is achieved (even though net supplies of excess mercury may occur in a relatively small number of countries).

14. The base case scenario shows that the quantity of mercury that may need to be stored in the Latin American and Caribbean region between 2015 and 2050 could amount to over 8,000 tonnes. According to an alternative minimum storage scenario, in which it is assumed that some by-product mercury continues to be exported, and it is assumed there is a generally slower increase in the generation of by-product mercury, the quantity of mercury accumulated may be closer to 2,000-3,000 tonnes. These scenarios do not reflect the possible adoption of an immediate or near-term regional strategy of sequestering mercury as a way of encouraging reduced mercury demand. Adoption of such a strategy would require development of storage capacity as soon as possible.

Contents

1 Background	34
1.1 Aims.....	34
1.2 Context.....	34
1.3 Scope	35
2 The Latin American and Caribbean region.....	35
2.1 Recent regional initiatives.....	36
2.1.1 Inventories	36
2.1.2 Artisanal and small-scale gold mining (ASGM).....	36
2.1.3 Mercury-added products and wastes.....	37
3 Methodology	38
4 Regional mercury consumption for products/processes	38
4.1 Present mercury consumption in the LA&C region.....	38
4.1.1 Artisanal and small-scale gold mining	38
4.1.2 Chlor-alkali production.....	41
4.1.3 Batteries	41
4.1.4 Dental applications	42
4.1.5 Measuring and control devices	42
4.1.6 Lamps	42
4.1.7 Electrical and electronic equipment.....	43
4.1.8 Other applications of mercury	43
4.1.9 Summary of mercury consumption in LA&C.....	43
4.2 Future mercury consumption in Latin America and the Caribbean.....	46
5 Regional sources of metallic mercury.....	49
5.1 Major Latin American and Caribbean sources of mercury supply	49
5.1.1 Mercury mining and/or processing of mine tailings	49
5.1.2 Mercury cell chlor-alkali facilities	49
5.1.3 By-product mercury	50
5.1.4 Recycling	52
5.1.5 Mercury stocks.....	54
5.2 Future Latin American and Caribbean mercury supply.....	55
6 Excess mercury in Latin America and the Caribbean.....	56
6.1 Latin American and Caribbean Base Case Scenario	56
6.2 Latin American and Caribbean Minimum Storage Scenario.....	57
6.3 Key observations regarding the scenarios.....	58
7 Observations and conclusions	58
References	60
Appendix	62

Tables

Table 1	Latin American and Caribbean subregions and population (2008)	35
Table 2	Mercury cell chlor-alkali capacity in Latin America and the Caribbean, 2005 41	
Table 3	Mercury consumption in Latin America and the Caribbean, reference year 2005 (tonnes).....	46
Table 4	Basic assumptions regarding LA&C mercury consumption 2010-2050	48
Table 5	Mercury cell chlor-alkali capacity in Latin America and the Caribbean, 2005 50	
Table 6	Latin American mine and primary zinc smelter production ~2004.....	51
Table 7	Basic assumptions regarding LA&C mercury recycling 2010-2050 (tonnes)	54
Table 8	Latin American and Caribbean “sources” of elemental mercury (tonnes) .	55

Figures

Figure 1	Main elements of LA&C mercury consumption, 2010-2050	48
Figure 2	Shipping container with flasks of by-product mercury in preparation for transport from Yanacocha.....	52
Figure 3	Main elements of LA&C mercury supply (sources), 2010-2050	55
Figure 4	LA&C mercury supply and demand, 2010-2050 – Base Case Scenario...	56
Figure 5	LA&C excess mercury, 2010-2050 – Base Case Scenario.....	56
Figure 6	LA&C mercury supply and demand, 2010-2050 – Minimum Storage Scenario 57	
Figure 7	LA&C excess mercury, 2010-2050 – Minimum Storage Scenario	58

Assessment report:

Excess mercury supply in Latin America and the Caribbean, 2010-2050

1. Background

1.1 Aims

15. The overall aim of this analysis is the identification of sources and quantification of metallic mercury for storage from the Latin American and Caribbean region, i.e., to provide a better understanding of future mercury supply and demand within Latin America and the Caribbean – a framework necessary to inform discussions about managing excess mercury in the region. This analysis provides background information for the “Inception Meeting of the Latin American and Caribbean Storage Project” that is scheduled to take place in April 2009, in Montevideo, Uruguay. At this meeting, discussions are expected to revolve around the possible need for a regional mercury storage facility or facilities, as the preferred option, or the most environmentally sound option.

16. Therefore, mercury supply and demand needs to be better understood before any subsequent steps are taken – which may include planning for the necessary storage capacity, discussing regional coordination activities, securing financial and technical support, identifying technical criteria (including site assessments) that constitute environmentally sound long-term storage, and developing the basic design of such a facility or facilities.

17. Once basic estimates of excess mercury flows have been generated, governments, regional development organisations, and non-governmental organisations (NGOs) can use this information as a basis for taking the next steps toward planning for the necessary storage capacity, including regional coordination activities, securing financial and technical support, identifying a suitable location, and the basic layout of the facility. As the first step, excess or surplus mercury from identified sources will be estimated and projections will be made for the next 40 years in the Latin American and Caribbean region.

18. This report is the first part of the UNEP project, “Reduce Mercury Supply and Investigate Mercury Storage Solutions”, and will feed into the subsequent feasibility study that will evaluate options for the long term management (such as safe long term storage) of mercury in Latin America and the Caribbean.

1.2 Context

19. UNEP Governing Council decision GC 24/3 IV identified seven priority areas for action to reduce the risks from releases of mercury, two of which are:

20. To reduce the global mercury supply, including considering curbing primary mining and taking into account a hierarchy of sources; and

21. To find environmentally sound storage solutions for mercury.

22. Even more recently, the UNEP Governing Council decision GC 25/5 (paragraph 34) mandated member governments to take further international measures including the elaboration of a legally binding instrument on mercury, which could include both binding and voluntary approaches, as well as a range of interim activities, to reduce risks to human health and the environment.

23. The increasing recovery of mercury as a by-product of mining activities, and the mercury that becomes available when chlor-alkali facilities are closed add to the global supply. Meanwhile, the increasing use of alternatives to replace mercury-added products results in decreased regional demand for mercury. As a result, the management of mercury supplies is now seen as a valuable policy tool with which to help reduce the demand for mercury in sectors where there are viable mercury-free alternatives.

24. The reduction of mercury supplies, and long term management of mercury, have both been identified as priorities of the UNEP Governing Council. If not needed for acceptable applications, mercury must be managed properly and stored, thereby preventing its re-entry to the global market.

Identifying environmentally sound storage solutions for mercury is therefore recognized as a priority. Repository/storage facilities are needed to isolate the mercury indefinitely to avoid it leaking into the environment. Since we know that elemental mercury, apart from being toxic, cannot be destroyed or degraded, governments and other stakeholders need to understand how to manage this mercury over the long term in order to avoid its re-entry into the global marketplace.

25. Present information suggests that there will be excess mercury generated in Latin America and the Caribbean as a result of phasing out mercury-containing products, the recovery of mercury used in chlor-alkali production, mercury recovered from smelting of metallic ores, etc. Therefore, mercury flows need to be better understood before any subsequent steps are taken – such as planning for the necessary storage capacity, discussing regional coordination activities, securing financial and technical support, identifying technical criteria (including site assessments) that constitute environmentally sound long-term storage, and developing the basic design of such a facility or facilities.

1.3 Scope

26. The investigation into the feasibility of Latin American and Caribbean regional capacity for the terminal storage of excess mercury has been structured in two initial phases. The first phase would assess the quantities of mercury that may need to be stored. Should such quantities be significant, the second phase would focus on the location, design, financing and other practical requirements of an appropriate storage facility.

27. This assessment addresses Phase I, and includes an analysis of the quantities of mercury arising over the next 40 years in the Latin American and Caribbean region as a by-product of mining operations, from the closure/conversion of mercury cell chlor-alkali plants, and from end-of-life products. The regional sources of mercury are then compared with regional uses over the same time period to have a better idea of the impact of mercury storage on the mercury market, and to estimate quantities of mercury that may need to be stored in the region.

2. The Latin American and Caribbean region

28. In order to fully assess mercury sources and consumption in the region, it is necessary to first identify the countries that will be included in this analysis. While the Latin American and Caribbean countries may be grouped in various ways, this project identifies three main subregions as indicated in Table 7:

- a. South America,
- b. Central America, including Mexico, and
- c. the Caribbean.

29. The total population of the region under study, of which 67% belongs to South America, 26% to Central America and 7% to the Caribbean, comes to 576 million persons, as in Table 7.

Table 7 Latin American and Caribbean subregions and population (2008)

<i>South America</i>	<i>Population (million)</i>	<i>Central America</i>	<i>Population (million)</i>	<i>Caribbean</i>	<i>Population (million)</i>
Argentina	40.7	Belize	0.3	Anguilla	0.01
Bolivia	9.2	Costa Rica	4.2	Antigua and Barbuda	0.07
Brasil	191.9	El Salvador	7.1	Aruba	0.10
Chile	16.5	Guatemala	13.0	Bahamas	0.31
Colombia	45.0	Honduras	7.6	Barbados	0.28
Ecuador	13.9	Mexico	110.0	British Virgin Islands	0.02
French Guiana	0.2	Nicaragua	5.8	Cayman Islands	0.05
Guyana	0.8	Panamá	3.3	Cuba	11.42
Paraguay	6.8			Dominica	0.07
Perú	29.2			Dominican Republic	9.51
Suriname	0.5			Grenada	0.09
Uruguay	3.5			Guadeloupe	0.44

<i>South America</i>	<i>Population (million)</i>	<i>Central America</i>	<i>Population (million)</i>	<i>Caribbean</i>	<i>Population (million)</i>
Venezuela	26.4			Haïti	8.92
				Jamaica	2.80
				Martinique	0.40
				Montserrat	0.01
				Netherlands Antilles	0.22
				Puerto Rico	3.94
				St. Barthélemy	0.01
				Saint Kitts and Nevis	0.04
				Saint Lucia	0.17
				Saint Martin	0.03
				St. Vincent & Grenadines	0.12
				Trinidad and Tobago	1.05
				Turks and Caicos Islands	0.02
				U.S. Virgin Islands	0.11
Total	384.6	Total	151.3	Total	40.2

30. Other than occasional references in the following assessment to one of these sub-regions or to individual countries, the entire Latin American and Caribbean region is generally treated here in its entirety.

2.1 Recent regional initiatives

2.1.1 Inventories

31. Several United Nations Institute for Training and Research (UNITAR) pilot projects for the development of mercury inventories (and risk management) have been completed recently, including those for Ecuador (2008) and Panamá (2009). These documents focus mainly on atmospheric emissions but provide some useful information about different aspects of mercury supply and demand as well. Other UNITAR/UNEP sponsored inventories and related documents have recently been completed for Chile (Chile 2007; Chile 2008) and Perú, not to mention the broader USGS study of mercury in Perú published in 2007 (USGS 2007).

32. A mercury emissions inventory was completed in Mexico in 2008, and a mercury products inventory, prepared for the North American Commission for Environmental Cooperation (NACEC) and managed by the National Institute of Ecology in Mexico and the United States Environmental Protection Agency (USEPA)

33. Mercury emissions and products inventories are being carried out in the Dominican Republic and Nicaragua, while an expanded assessment of mercury in health care, mercury reduction and substitution efforts is going on in Costa Rica and Honduras.

34. There is underway a multi-country project funded by the Strategic Approach to International Chemicals Management (SAICM) Quick Start Programme (QSP) to develop preliminary inventories of domestic sources of mercury in Argentina, Chile, Paraguay, Uruguay, Bolivia and Perú.

35. Finally, U.S. EPA has commissioned an update of mercury trade between Latin America and the United States in order to better understand any impacts of the U.S. mercury export ban that will take effect in 2013.

2.1.2 Artisanal and small-scale gold mining (ASGM)

36. In Perú and Bolivia, the above-mentioned UNEP “country strategic plan” projects funded by SAICM under its QSP are also focused on reducing mercury consumption in the ASGM sector. In each case, a national working group will be formed and a national strategic plan will be prepared. Regional collaboration and coordination will be enhanced, awareness of governments and stakeholders will be raised.

37. The Association for Responsible Mining (ARM) – Standard Zero proposes a process to support miners' organisations to minimise the use of mercury and cyanide over an agreed period of time, through implementation of responsible practices and technologies to mitigate the impact on the environment and human health. ARM is working on field-testing the Standard Zero in Bolivia (two cooperatives in Cotapata), Colombia (Choco – two community councils, and Nariño – two cooperatives), Ecuador (Bella Rica), and Perú (Central Perú – three community mining companies). Both Nariño and Perú have demonstrated important mercury reductions. Choco does not use it at all.

38. The United States, UNIDO and UNEP, along with local governments in Brasil, have partnered to reduce mercury emissions from gold processing shops in the Amazon region. The U.S. Environmental Protection Agency and Argonne National Laboratory supported local manufacture and construction of retorting installations to capture mercury vapour released during gold processing, and global dissemination of information on this retorting technology. The Partnership has verified baseline measurements in the Amazon. A prototype technology was installed in six gold shops in two cities in the Brazilian Amazon and achieved over 80% efficiency of mercury vapour capture. A report of the Brasil technology demonstration is available online, including case study information and a manual for building and installing the technology. A site assessment for gold refining shop applications in the Peruvian Amazon was undertaken in May 2008, with follow-up. An outreach workshop in Brasil occurred in the September/October timeframe.

39. A workshop of Communities and Artisanal & Small Scale Mining (CASM) was held in Brasilia on 7 October 2008 with approximately 40 participants representing a cross-section of miners and mining associations, government officials and academics. This was coordinated by NRDC and supported by UNEP's Mercury Trust Fund. The purpose of the workshop was to promote awareness and adoption of cleaner production techniques for ASGM operations.

40. In the Suriname Training Project, the University of Bremen, UNIDO, the government of Suriname and UNEP partnered to train small-scale gold miners in clean technology, and training of personnel to quantify atmospheric mercury emissions and their impact on health. This project was funded through the UNEP Mercury Trust Fund.

2.1.3 Mercury-added products and wastes

41. With financial and other support from UNEP, the World Health Organization (WHO), the United States, the North American Commission for Environmental Cooperation (NACEC), national governments, Health Care Without Harm (HCWH), the University of Massachusetts at Lowell and others, health-care projects aimed at reducing the use of mercury-containing devices – especially thermometers and blood pressure measuring instruments – have been or are being carried out in Argentina, Brasil, Chile, Costa Rica, Ecuador, Honduras and Mexico:

42. Chile, Costa Rica and Honduras are developing and implementing assessments in hospitals in order to reduce and eliminate mercury-containing products.

43. The Mexican government is developing a health care facility pilot project in Mexico that may be used as an example for other mercury reduction initiatives in other health care facilities.

44. A regional workshop for local/regional health care associations was held in Latin America to promote alternatives to mercury in the health care sector.

45. The Buenos Aires City Government is delivering mercury-free training for all city-run hospitals, and has completely eliminated mercury from two hospitals and fourteen neo-national units.

46. A Health Care Cooperative Agreement is now in place to provide technical support for mercury reduction in hospitals in Brasil, Costa Rica, Ecuador and Mexico. This is a multi-year initiative to expand existing projects and launch new pilot projects in health care mercury reduction, product inventories, waste management and relevant training.

47. Two projects are being implemented to develop waste management strategies for mercury. The one coordinated by UNEP Chemicals will include Chile, along with other countries to be determined; the one coordinated by the Secretariat of the Basel Convention will include Argentina, Costa Rica, and Uruguay.

48. With support from the U.S. and NACEC, the Mexican government is finishing an inventory of mercury-containing products and alternatives, and updating existing product databases.

49. Similarly, the Central American Commission on Environment & Development (CCAD), the United Nations Institute for Training and Research (UNITAR) and the United States government are

supporting an initiative to develop mercury emissions and products inventories in the Dominican Republic and Nicaragua, while expanding health care mercury assessment, reduction, and substitution efforts in Costa Rica and Honduras.

3. Methodology

50. As described in detail in the UNEP Global Mercury Assessment (UNEP 2002), mercury is intentionally added to a great number of products such as thermometers and dental amalgams, and processes such as the mercury-cell process for the production of chlorine. In the case of the products, many of these can be collected and recycled to recover the mercury. Likewise, mercury can be recovered from various process uses. These and other typical sources and uses of mercury are discussed further in Sections 0 and 0 below.

51. The focus of this assessment is on a 40-year time frame, specifically 2010-2050. Clearly, 40-year estimates are subject to significant uncertainties, and it is understood that great precision is not realistic or possible for this exercise. The main goal is to develop an order-of-magnitude estimate of the quantity of elemental mercury that may need to be stored, and a rough idea of when that mercury might start being collected for storage.

52. All of the countries in the Latin American and Caribbean region will be analysed together as a closed system, considering the generally close commercial and political links. For the initial analysis and projections of mercury supply and demand into the future, the following assumptions are made:

- a. assume there are continuing transfers of mercury among the Latin American and Caribbean countries, as at present (UNEP 2006);
- b. assume there are no imports of metallic mercury into the region;
- c. assume there are no exports of metallic mercury or by-product mercury outside the Latin American and Caribbean region, although continued exports of mercury-containing products would not be prevented, under this assumption;
- d. assume that the main regional “sources” of mercury, other than imported mercury-added products, are closing chlor-alkali facilities, by-product mercury recovered from mining operations or from old mine tailings, eventual removal of mercury from the flue gases of large non-ferrous metal smelting operations, removal of mercury from natural gas cleaning facilities, and some recycling of mercury-added products;
- e. assume that if and when regional policies dictate that mercury should be removed from the market, the mercury should go to terminal storage.

4. Regional mercury consumption for products/processes

53. Unless otherwise noted, the main sources for this chapter are the UNEP Trade Report (UNEP 2006), which presents an overview of mercury uses globally and regionally; an extensive analysis of mercury product life-cycles published in the US (Cain 2007); and a detailed analysis of mercury applications carried out recently for the European Commission (2008). To these reference documents were added information sources regarding specific countries in the Latin American and Caribbean (LA&C) region, especially documents on Chile (Chile 2007), Perú (Peru 2007), Mexico (CEC 2008) and two UNEP-sponsored Regional Awareness-Raising Workshops on Mercury Pollution – in Buenos Aires, Argentina (UNEP 2004) and in Port-of-Spain, Trinidad (UNEP 2005).

4.1 Present mercury consumption in the LA&C region

54. The main groups of mercury-containing products and mercury processes assessed in this study are described below. The base year for “current” data is assumed to be 2005. In various cases more recent data is available, but future projections are not precise enough to reflect a significant difference between using 2005 or 2007, for example, as the base year.

4.1.1 Artisanal and small-scale gold mining

55. Artisanal and small-scale gold mining (ASGM), an activity inextricably linked with issues of poverty and human health, remains the largest user of mercury in South and Central America. The extent of ASGM activities is further encouraged by the upward trend in the price of gold. Because nearly all of the mercury used in ASGM is eventually released to the air, water and soil, ASGM is also the largest source of releases from intentional use of mercury.

56. According to the UNIDO/UNDP/GEF Global Mercury Project, at least 100 million people in over 55 countries depend on ASGM – directly or indirectly – for their livelihood.⁸ ASGM is responsible for an estimated 20-30% of the world's gold production, or approximately 500-800 tonnes per annum. It directly involves an estimated 10-15 million miners, including 4.5 million women and 1 million children. This type of mining relies on rudimentary methods and technologies, and is typically performed by miners with little or no economic capital, who operate in the informal economic sector, often illegally and with little organisation. Due to inefficient mining practices, mercury amalgamation in ASGM results in the consumption (and subsequent release) of an estimated 650 to 1350 tonnes of mercury per annum (Telmer 2008; UNEP 2008a).

57. ASGM activity in South America has been reported in Bolivia, Brasil, Chile, Colombia, Ecuador, Perú, Suriname, French Guiana, Guyana and Venezuela. In Central America and the Caribbean, ASGM activity has been reported in Costa Rica, the Dominican Republic, Guatemala, Honduras, Nicaragua and Panamá (Telmer and Veiga 2008).

58. In Section 0, regional estimates of mercury use in ASGM are based on the work of Telmer and Veiga (2008), based on their long involvement in the UNIDO/UNDP/GEF Global Mercury Project.⁹

⁸ It should be noted that not all artisanal/small scale gold miners use mercury. Some use cyanide, which typically requires a greater up-front investment but permits more gold to be recovered than when using mercury. Some use both, which can be especially hazardous. Others use gravimetric methods without mercury or cyanide.

⁹ In Telmer and Veiga (2008), improving on past estimates of ASGM operations worldwide, the authors have reported ASGM activity in as many as 70 countries, but have also broadened previous estimates of global mercury consumption in ASGM, for which they now estimate the range may be 650-1350 tonnes per year.



Altino Machado às 10:14 am, 17 March 2009. Elas correspondem ao Rio Guacamayo, no trecho situado na altura do km 100 da Estrada Interoceânica, que liga o Brasil ao Perú, contando de Puerto Maldonado em direção a Cusco. *Blog da Amazônia pelo biólogo e consultor ambiental Peruano Enrique Ortiz, <http://blogdaamazonia.blog.terra.com.br/>*

4.1.2. Chlor-alkali production

59. The chlor-alkali industry is the third largest mercury user worldwide. Many chemical companies have phased out this old technology and converted to the more energy-efficient and mercury-free membrane process, and others have plans to do so. For example, one of the facilities (34 thousand tonnes per year chlorine capacity) in Mexico has just converted to the membrane process, and one in Brasil has recently converted as well. In many cases governments have worked with industry representatives and/or provided financial incentives to facilitate the phase-out of mercury technology. Recently governments and international agencies have created partnerships with industry (for example, UNEP's Chlor-Alkali Partnership) to encourage broader and faster industry improvements with regard to mercury management and releases of mercury. Table 8 below summarizes the main characteristics of the mercury cell chlor-alkali production facilities believed to be still operating in Latin America and the Caribbean. It is possible that some additional small mercury cell chlor-alkali plants integrated with pulp and paper mills are not included on this list.

60. The most recent and detailed discussion of mercury consumption by world chlor-alkali facilities was presented in UNEP (2006). According to that reference, even considering that over 70% of world chlor-alkali capacity is based in the U.S. and Europe, which are reputed to have the lowest unit emissions in the world, the global average mercury consumption is on the order of 45-55 g of mercury per tonne of chlorine capacity. With regard to chlor-alkali facilities in Latin America and the Caribbean, no mercury emissions have ever been reported for plants other than those in Brasil, and there is no indication that the other plants have received much scrutiny. Therefore, a broader and somewhat higher range of consumption (~35-75 g mercury per tonne of chlorine capacity) appears to be warranted, which suggests total mercury consumption of 25-55 tonnes for all of the plants listed in Table 8.

Table 8 Mercury cell chlor-alkali capacity in Latin America and the Caribbean, 2005

	Approx. chlorine production capacity (tonnes Cl ₂ per year)	Approx. cellroom mercury inventory (tonnes Hg per year)	Approx. mercury consumption* (tonnes Hg)
South America			
Argentina (up to 5 plants)	max. 120,000	240	incl. below
Brasil (5 plants)	est. 347,000	700	incl. below
Colombia (1 plant)	16,000	32	incl. below
Uruguay (1 plant)	15,000	30	incl. below
Perú (4 plants)	max. 70,000	140	incl. below
<i>Subtotal</i>	<i>max. 570,000</i>	<i>max. 1,140</i>	<i>20-40</i>
Central America and the Caribbean			
Mexico (2 plants)	135,000	270	incl. below
Cuba (1 plant)	16,000	30	incl. below
<i>Subtotal</i>	<i>150,000</i>	<i>300</i>	<i>5-15</i>
Total	max. 720,000	max. 1,440	25-55
The convention here is to calculate mercury "consumption" before any recycling of wastes. Some of the waste at some facilities may be recycled in order to recover the mercury, although most mercury waste is sent for disposal.			
Sources: UNEP 2006; WCC 2007; SRIC 2005			

4.1.3. Batteries

61. The overall consumption of mercury in batteries, while still significant, continues to decline as many nations have implemented policies to deal with the problems related to diffuse mercury releases related to batteries.

62. However, there remain a large number of button cell batteries manufactured in many different countries, most containing up to 2% mercury, but some containing more. These will eventually be replaced by mercury-free button cells,¹⁰ but for the moment these batteries, produced in the tens of billions, consume significant amounts of mercury.

63. Furthermore, the global trade in mercuric oxide batteries has still not been satisfactorily explained (see discussion in UNEP 2006). In Mexico, for example, according to SIAVI, from July 2007 to June 2008 net imports of mercuric oxide batteries (Harmonized Tariff System (HTS) code 85063001) totalled over 197 tonnes. Other countries also show trade in these batteries, which are banned by many countries from commercial marketing and use – but not necessarily banned from military applications. Some explanations of a possible error are suggested by CEC (2008) because, if accurate, the mercury content of these batteries entering Mexico would be 60-70 tonnes.

64. It is beyond the scope of this report to investigate such details further, but the global consumption of mercury in batteries still appears to number in the hundreds of metric tonnes annually. Latin American and Caribbean regional consumption of mercury in batteries has been estimated in UNEP (2008a), and this is the basis for the estimates in Section 0.

4.1.4. Dental applications

65. In some countries and (especially higher) income groups the use of mercury in dental amalgams is now declining. The main alternatives are composites (most common), glass ionomers and compomers (modified composites). However, the speed of decline varies widely, so that dental amalgam use is still significant in most countries, while in some countries (e.g., Sweden, Norway) it has almost ceased. In many lower-income countries, changing diets and better access to dental care have actually led to an increase in dental mercury use.

66. Latin American and Caribbean consumption of mercury for dental use is presented in Section 0, based on regional estimates provided by manufacturers and exporters. This includes estimated mercury use by Macrodent S.A., an amalgam producer based in Buenos Aires, Argentina (Lowell 2008).

4.1.5 Measuring and control devices

67. There is a rather wide selection of mercury-added measuring and control devices, including thermometers, barometers, manometers, etc., on the market, although thermometers and sphygmomanometers dominate with regard to mercury use. As market demand has increased for mercury-free alternatives, most international suppliers now offer them as well. National and regional legislation are increasingly being considered in order to promote the shift to mercury-free alternatives since the latter are available for nearly all applications. Health Care Without Harm has been especially active in getting mercury-added devices out of the healthcare sector. In one of the most recent examples, in response to HCWH initiatives, the Argentine government has passed legislation to phase out the use of mercury-added devices in hospitals.

68. Thermometers and sphygmomanometers are considered to represent around 80% of total mercury consumption in the product category of “measuring and control devices.” Latin American and Caribbean regional demand presented in Section 0 is based on UNEP (2008a).

4.1.6 Lamps

69. Mercury-added lamps (fluorescent tubes, compact fluorescent, high-intensity discharge – HID, etc.) remain the standard for energy-efficient lamps, where ongoing industry efforts to reduce the amount of mercury in each lamp are countered, to some extent, by the ever-increasing number of energy-efficient lamps purchased and installed around the world. There is no doubt that mercury-free alternatives such as light-emitting diodes (LEDs) will increasingly become available. Nevertheless, at present, for most lighting applications the alternatives are very limited and/or quite expensive.

70. In addition to lamps used for normal lighting applications, a great number of fluorescent lamps are also used for backlighting of liquid crystal displays (LCDs) of all sizes – from electronic control panels to computer and television monitors.

10 For example, the National Electrical Manufacturers’ Association (NEMA) in the USA has called for a phase-out of all mercury in button cell batteries in the USA by 2011. In October 2008, one of the major battery manufacturers announced the launch of new zero-mercury hearing aid batteries – the first of their kind in the world.

71. The ranges of regional mercury consumption presented in Section 0 take account of these applications, including mercury consumption by production facilities in Brasil – Sunlc Technology produces high-intensity discharge (HID) lamps in Baueri, while Wonry Tech Co. Ltd. produces HID commercial and automotive lamps in Saude (Lowell 2008).

4.1.7 Electrical and electronic equipment

72. Following the implementation of the European Union’s Restriction on Hazardous Substances (RoHS) Directive, and similar initiatives in Japan, China and Korea, among others, there has been a marked shift to mercury-free substitutes for mercury switches, relays, etc., and overall mercury consumption for these applications appears to have declined in Latin America and the Caribbean in recent years.

73. In Section 0, the ranges of mercury consumption in electrical and electronic equipment are based on estimates prepared for UNEP (2008a).

4.1.8. Other applications of mercury

74. This category has traditionally included the use of mercury and mercury compounds in such diverse applications as pesticides, fungicides, laboratory chemicals, pharmaceuticals, paints, traditional medications, certain cultural and ritual uses, cosmetics, etc.

75. However, there are some further applications that have recently come to light in which the consumption of mercury is also especially significant. In particular, the continued use of mercury in the production of artificial rubber is one such use that appears to be widespread.¹¹ Likewise, the use of mercury in some research and testing devices may be more significant than previously suspected. A recent study for the European Commission (2008) has also identified substantial mercury consumption in compounds used in a broad range of applications. For example, a large part of the global production of the mercury-based preservative and disinfectant known as thimerosal or thiomersal (possibly up to 5 tonnes) takes place in Argentina, and is exported to all parts of the world (European Commission 2008).

76. In Section 0, the estimates of mercury consumption in “other applications” of mercury are based on UNEP (2008a).

4.1.9 Summary of mercury consumption in LA&C

77.

¹¹ Specifically, mercury “catalysts” (basically hardening or curing agents) are sometimes used in the production of polyurethane elastomers, used as artificial “rubber” for roller blade wheels, etc., in which the catalysts remain in the final product.

Table 9 below summarises the key applications of elemental mercury in the Latin American and Caribbean region, including mercury consumption for the manufacture of products for export (notably batteries, lamps and electrical and electronic equipment). It should be noted that

Table 9 indicates “gross” mercury consumption, i.e., prior to any mercury recycling or recovery. Recycling and recovery are addressed separately as mercury “sources” in Section 0 below.

Table 9 Mercury consumption in Latin America and the Caribbean, reference year 2005 (tonnes)

	South America		Central America & Caribbean		Latin America and Caribbean total	
	<i>min.</i>	<i>max.</i>	<i>min.</i>	<i>max.</i>	<i>min.</i>	<i>max.</i>
Small-scale gold mining	150	300	15	30	165	330
VCM/PVC production	0	0	0	0	0	0
Chlor-alkali production	20	40	5	15	25	55
Batteries	10	15	5	10	15	25
Dental applications	40	50	20	25	60	75
Measuring and control devices	20	25	10	15	30	40
Lamps	5	10	5	10	10	20
Electrical and electronic equipment	5	10	5	10	10	20
Other*	10	20	5	15	15	35
Totals	260	470	70	130	330	600

* "Other" applications include uses of mercury in pesticides, fungicides, catalysts, paints, chemical intermediates, laboratory and clinical applications, research and testing equipment, pharmaceuticals, cosmetics, traditional medicine, cultural and ritual uses, etc.

4.2 Future mercury consumption in Latin America and the Caribbean

78. The objective of this section is to forecast the evolution of Latin American and Caribbean mercury consumption between 2010 and 2050, reflecting existing and reasonable expectations of national and global initiatives, as specified in partnership business plans and related UNEP and UNIDO global mercury initiatives, where available.

79. The production of most mercury-added products is in general decline as countries and regions in many parts of the world implement legislation or voluntary initiatives to reduce or phase out various uses of mercury.

80. In the near to medium term, the rate of decline in mercury consumption will depend primarily upon reductions in use by artisanal and small-scale gold miners; in the battery, electrical equipment, and measuring device manufacturing sectors; in dental applications; and in chlor-alkali facilities.

81. Artisanal and small-scale gold mining will be the greatest challenge – not because of the lack of alternative methods for decreasing mercury use, but because mercury is too readily available, too cheap and too easy to use. In the present circumstances there is not enough incentive for miners to seriously consider alternatives that use less or no mercury. Soon, however, the mercury supply will be greatly reduced, and miners will be obliged to change their habits.

82. The mercury-added product sectors also represent significant potential for decreases in consumption during this time period because alternative mercury-free products are readily available, they are of equal or better quality, and prices are generally competitive. For these sectors, the challenges are not technical, but are rather related to the extent of encouragement offered by countries or regions through awareness-raising, legal or voluntary mechanisms, etc.

83. For the chlor-alkali sector as well, a more energy-efficient and mercury-free technology is in widespread use around the world, but short-term profits are higher as long as chlor-alkali plants are permitted to continue using the old mercury technology. If no pressure is applied, they will take a long time to make the shift.

84. For this analysis, the objectives for future reductions in mercury consumption are based on those agreed in the Mercury-Containing Products Partnership Area Business Plan (UNEP 2008b), which is also based on the "Focused Mercury Reduction Scenario" of UNEP's Mercury Trade Report (UNEP 2006). These objectives are applied to Latin American and Caribbean regional mercury consumption during the period 2010-2050, and are summarized in

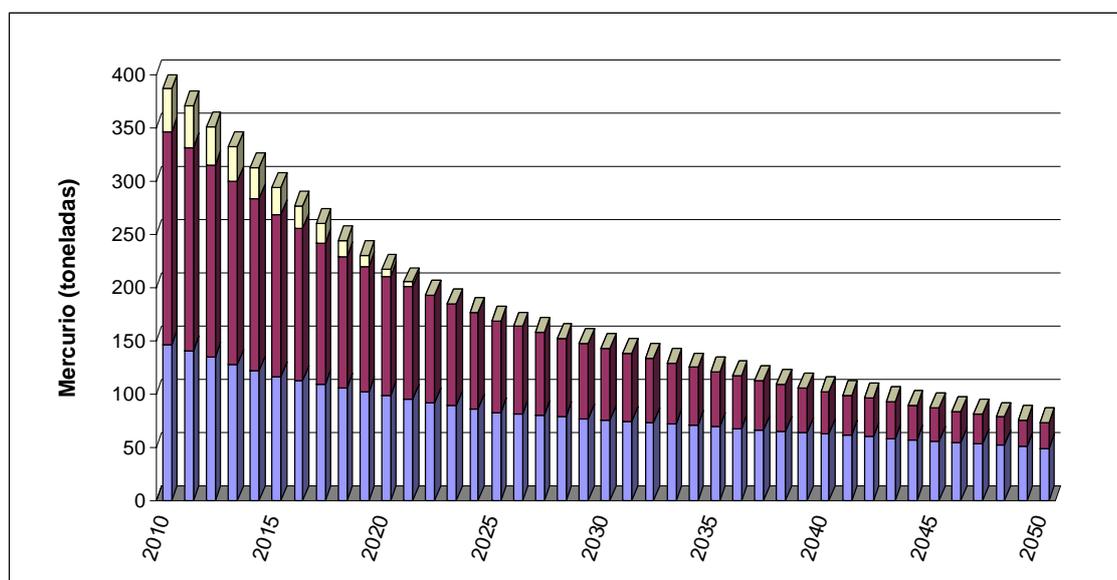
Table 10.

Table 10 Basic assumptions regarding LA&C mercury consumption 2010-2050

<i>Processes</i>	<i>Assumptions regarding future consumption</i>
Small-scale gold mining	Reduce mercury consumption in small-scale gold mining globally by 50% over the next 10 years, with a subsequent decline after that of 5% per year. According to UNIDO, the 50% reduction can be met by eliminating whole ore amalgamation and encouraging greater mercury reuse (UNEP 2006). Supply restrictions are expected to help achieve this objective by raising mercury prices and otherwise encouraging greater efficiencies in mercury use.
Chlor-alkali production	Assume no new mercury cell facilities will be constructed in any region. Assume mercury cell capacity will be gradually phased out between 2010 and 2022. Therefore, industry consumption of 25-55 tonnes/yr. will gradually disappear during this period.
<i>Products</i>	<i>Assumptions regarding future consumption</i>
Batteries	Assume a 75% decrease in mercury consumption by 2015, and the remaining demand phased out gradually thereafter until 2025.
Dental applications	Assume a 15% reduction by 2015, and a gradual reduction thereafter to 50% of present consumption by 2050.
Measuring and control devices	Assume a 60% reduction of mercury consumption by 2015, the phase-out of mercury fever thermometer and blood pressure cuff manufacturing by 2017, and the phase-out of remaining demand by 2025.
Lamps	Assume a 20% reduction by 2015 and a gradual reduction of 80% overall by 2050.
Electrical and electronic equipment	Assume gradual 55% reduction of mercury consumption by 2015, and a gradual reduction thereafter to 2050.
Other applications	Assume a gradual 25% reduction of mercury consumption by 2020, and another 50% by 2050.

85. All of these assumptions are included as well in Figure 4 below, which shows that mercury-added products and artisanal and small-scale mining are by far the major consumers of mercury in Latin America and the Caribbean.

Figure 4 Main elements of LA&C mercury consumption, 2010-2050



Key: blue = products and other applications; mauve = ASGM; yellow = chlor-alkali

5. Regional sources of metallic mercury

5.1 Major Latin American and Caribbean sources of mercury supply

86. If recycled or recovered mercury is considered a “source,” there are typically five main regional sources of mercury supply:

- a. Mercury mining and/or processing of mine tailings;
- b. Collection of process mercury from decommissioned mercury cell chlor-alkali plants (MCCAPs);
- c. By-product mercury from the refining or processing of non-ferrous metals; and from the cleaning of natural gas;
- d. Mercury recovered or recycled from products containing mercury and from processes using mercury.
- e. Stocks of mercury accumulated from previous years (typically the original source would have been from mercury mining or a by-product of other mining, chlor-alkali decommissioning, or other large sources).

87. Following the methodology used here, mercury imported from outside the region (as metallic mercury or in products) would not be considered a regional source.

5.1.1. Mercury mining and/or processing of mine tailings

88. Approximately 20 mercury occurrences are known in Perú. The most well known, the former Santa Barbara Mine in Huancavelica, is now closed. There are also occurrences in southern Ecuador, near Cuenca and Azoguinés (Petersen 1970, as cited in USGS 2007), but there is no evidence they are being exploited at present.

89. According to CEC (2008) the *Servicio Geológico Mexicano* (SGM—Mexican Geological Service) reported that three mines may be producing mercury intermittently, but no data are available about production volumes.

90. Mexico is a major producer of copper, silver, lead, zinc, and gold, whose ores are frequently contaminated by trace mercury. However, the Mexican Mining Association (Camimex) on 21 January 2008, sent a letter to Semarnat (*Secretaría de Medio Ambiente y Recursos Naturales* – Secretariat of Environment and Natural Resources) stating that none of its members produces mercury or uses the amalgamation technique for recovery of precious metals (CEC 2008). This statement does not appear to cover the practices of many smaller miners who are not members of Camimex.

91. Secondary mercury production in tailings reprocessing facilities around Zacatecas City and around El Pedernalillo Dam – arguably contributing at the same time to local land remediation – was reported to be 33.3 metric tons annually before 1996 (Profepa 1996, as cited by CEC 2008). While no official data are available, there is reason to estimate that some 30 tonnes of mercury per year are still produced from secondary tailings, and may continue to be produced into the future in the absence of restrictions. Furthermore, if there are no restrictions, there is the potential for increased mercury production from tailings and various other mine sources if the mercury price becomes substantially more attractive.

92. Future projections could therefore be somewhat complicated. It may be assumed that Mexican production will remain at some 30-40 tonnes until the EU export ban takes place in 2011, at which point the global mercury supply will tighten. By then Mexico will probably have in place a ban on primary mining of mercury, consistent with practices in the rest of the world. Production of mercury from mine tailings may then be permitted for as long as there is adequate legitimate demand in the region, but as regional demand declines (and regional exports are prohibited), this source of mercury should decline as well.

5.1.2. Mercury cell chlor-alkali facilities

93. There is a large quantity of process mercury at the bottom of the electrolytic “cells” that is necessary for the “mercury cell” chlor-alkali production process to function. When a mercury cell facility is closed or converted to the membrane process (“decommissioned”), the mercury may be removed. In the past this mercury has typically been reused within the industry, or it has been sold

outside the industry on the international market. It is anticipated that the mercury recovered from the recently closed facilities in Mexico and Brasil will be placed on the market in 2010-2012.

94. The mercury process is considered to be old technology (not BAT, according to the European *IPPC Reference Document on Best Available Techniques in the Chlor-Alkali Manufacturing Industry* – BREF 2001), with a variety of mercury releases and losses, some of which have proven impossible to control. No new mercury cell facilities have been constructed in Latin America and the Caribbean for more than 10 years, and the last mercury cell expansion anywhere in the world was put in service in Perú about five years ago. The Indian chlor-alkali producers have announced plans to phase out their remaining mercury facilities by 2012. The United States will reportedly have four plants left at the end of 2009. Among the major users, only the Europeans, who invested heavily in mercury technology into the 1960s and 1970s, are slow to phase out mercury cells, promising to do so by 2020 at the latest.

95. Since there is no timetable yet for Latin American and Caribbean facilities to close or convert to a mercury-free process, it is assumed that general international pressure will encourage them to phase out by around 2022, as indicated in Table 11 below. At that time the mercury inventory held in the electrolytic cells will be recovered, and for the purpose of this analysis, the recovered mercury is allocated over the years 2013-2025.

96. Apart from the metallic mercury in the electrolytic cells, mercury waste is also generated by chlor-alkali facilities, which may account for 50-75% of the mercury consumed (see Table 11). It is possible to retort and recover most of the mercury from the waste, but until now this is not common practice in Latin America nor in the Caribbean.

Table 11 Mercury cell chlor-alkali capacity in Latin America and the Caribbean, 2005

	Approx. chlorine production capacity (tonnes/yr.)	Approx. cellroom mercury inventory (tonnes)	Assumed phase-out period	Mercury consumption (tonnes/yr.)	Mercury in wastes (tonnes/yr.)
South America	570,000	1,140	2010-2022	20-40	15-30
Central America and Caribbean	150,000	300	2010-2022	5-15	3-10
Total Latin American and Caribbean region	860,000	1,440		25-55	18-40
* The convention here is to calculate mercury “consumption” before any recycling of wastes, with the knowledge that, as in many industries, some waste is recycled in order to recover the mercury, while most mercury waste is sent for disposal.					
Sources: UNEP 2006; EEB 2006; Euro Chlor 2007; WCC 2006; SRIC 2005					

5.1.3. By-product mercury

97. Zinc ores may contain significant trace quantities of mercury, especially in those regions of the world where the appropriate geological conditions exist. Gold, copper and lead ores also contain trace mercury, though typically in lower quantities than zinc ores (NRDC 2007). While the mercury content may vary greatly between regions, or from one zinc mine to another, it is often significant enough that it should be removed from the flue gases or waste streams during the processing of the ores.

98. Several technologies are available to control and capture mercury emissions from thermal processes at ore processing facilities. The Boliden-Norzink process uses mercuric chloride to precipitate metallic mercury as calomel (mercurous chloride). In the Outokumpu process, mercury is removed with sulphuric acid and then precipitated with selenium to produce mercury-selenium sulphate sludge. Importantly, the products of these two processes can be reprocessed to recover metallic mercury. In many South American gold mines the Merrill-Crowe Process is used to precipitate gold from a cyanide solution, followed by a filter press and then retorting of the residues to recover the mercury.

99. Other techniques for removing mercury from ore processing gases include the Bolchem process (which uses thiosulfate to precipitate mercury), activated carbon filters, selenium scrubbers, selenium filters and lead sulphide filters.

Zinc

100. World zinc production grew by 4% in 2006, an estimated 6% in 2007, and a further increase to over 12 million tonnes estimated for 2008, driven by strong growth in Asia (IMSG 2008). The opening in August 2007 of Apex Silver's San Cristobal mine (capacity 167,000 tonnes a year) significantly boosted production in Bolivia. New capacity in Perú (Cerro Lindo capacity 110,000 tonnes a year), among others, contributed to increased mine output in 2008 (IMSG 2008).

101. However, mercury is typically recovered during the smelting and refining process, which does not always take place at the mine itself. The main Latin American and Caribbean countries engaged in smelting zinc ores and concentrates are listed in Table 12. More recent increases in smelting capacity have likely taken place in Mexico and Perú, among others (IMSG 2008).

Table 12 Latin American mine and primary zinc smelter production ~2004

Country	Mine production (tonnes)	Primary zinc smelter production (tonnes)
Argentina	37,000	31,000
Bolivia	145,000	-
Brasil	200,000	260,000
Chile	36,000	-
Honduras	47,000	-
Mexico	460,000	320,000
Perú	1,250,000	196,000
Total		~800,000

Source: Mansukh (2008)

102. In estimating the mercury potentially recoverable worldwide from primary zinc ores (UNEP 2006), Boliden company officials listed the zinc smelters using Boliden mercury removal technology. While two Chilean smelters were said to have installed Boliden equipment to control mercury emissions, no by-product mercury production has been documented there. It appears that in Latin America most mercury in zinc ores is disposed of with the processing waste, or released to the environment.

103. Mercury removal technology is most cost-effective (and most likely to be installed in the future) on the largest smelters, which are responsible for 60-80% of Latin American primary zinc smelting. As a reference for the amount of trace mercury in Latin American zinc ores, it has been shown that Finland recovered .01-.04% mercury (depending on the source of the ores) compared to its smelter production of zinc, i.e., 1-4 ppm of Hg for every 10,000 ppm of zinc. If one assumes even the lower part of that range for Latin America – .01-.02% Hg/Zn x 70% x 800,000 t – one arrives at a potential mercury recovery of more than 80 tonnes per year.

104. Considering the general growth in global demand for zinc (at least until the recent economic downturn), along with increases in Latin American smelting capacity as mentioned above, it may be assumed that recoverable mercury from large smelting operations could be on the order of 80-120 tonnes per year in the near to medium term.

105. Moreover, it is likely that by 2015-2020 Latin American governments will require mercury to be recovered from all of the larger zinc smelters, as they are frequently a significant contributor of mercury emissions to the environment. It is also assumed – in order to have an overall estimate of the mercury supply available – that all of the mercury-containing waste will then be processed to recover mercury.

Gold and other ores

106. With regard to recovery of mercury as a by-product of industrial gold mining (as opposed to artisanal and small-scale gold mining) operations, the main sources are South America and the United States of America. Overall there are five gold mines in South America now recovering mercury – three in Perú (Pierina, Lagunas Norte and Yanacocha), one in Chile, and one in Argentina (Veladero). The total amount of mercury recovered from mines in Chile and Perú is estimated at 100-200 metric tonnes annually (Lawrence 2009). Yanacocha alone produced around 70 tonnes of Hg in 2000.

Figure 5 Shipping container with flasks of by-product mercury in preparation for transport from Yanacocha



a. Photograph courtesy of Newmont Mining Corporation

107. In addition to those countries, Veladero also produces mercury in Argentina, while the mercury output of the Zaldívar copper mine in Chile and the Paracatu gold mine expansion project in Brazil remain to be confirmed. Meanwhile the large Pascua-Lama gold project (which will also produce a significant amount of Hg) straddling the Argentina-Chile border is waiting for final approval, the Cerro Casale gold/copper project and the Lobo Marte gold project are under study in Chile, and the Fruta de Norte project is under study in Ecuador.

108. In total, while the present production of mercury appears to be in the range of 150 tonnes/year, the potential in the near- to mid-term is significantly higher. For the purpose of this analysis it is assumed that mercury production from Latin American mines (other than zinc) will increase to around 200 tonnes/year by 2015 and remain more or less at that level into the future.

Natural gas

109. In many countries natural gas is cleaned to remove dangerous levels of mercury. While various Latin American and Caribbean countries produce natural gas, this research did not uncover examples of mercury removal from natural gas in the region.

Recycling

110. Simply in order to facilitate the methodology described in Section 0, recycling is also considered as a “source” of mercury. Like other mercury sources, it may be exploited or managed through a variety of policies that focus on mercury-containing products as they enter the waste stream, and/or residual mercury and wastes from industrial processes.

111. With regard to the use of mercury in artisanal and small-scale gold mining (ASGM), since this is a rather special and diverse area of mercury use, it is not helpful to estimate how much mercury used in ASGM may be subsequently retorted or otherwise recovered. Instead, such instances are included in this analysis as simply a decrease in the consumption of mercury in ASGM, which is already accounted for in the projections presented in

Table 10.

112. In the chlor-alkali industry, very little of the mercury in the waste stream is presently recycled in Latin America and the Caribbean. Due to the time frame during which most of the mercury cell facilities will probably be phased out (see

Table 10), and the limited amount of waste that may be recycled during this period of time, it is suggested to ignore this relatively small source of recycled mercury for this analysis.

113. Various mercury products are collected for recycling in different parts of the world, especially measuring devices (mainly thermometers and blood pressure measuring instruments), batteries, lamps, dental amalgam, etc. For all of Latin America and the Caribbean, based on research into the waste pathways followed by mercury-added products (MPP 2008), it is estimated that about 3% of the mercury consumed in products is presently recycled, particularly blood pressure instruments used in health clinics, dental wastes and button cell batteries.

114. The future evolution of the recycling rate for products is highly dependent on government policies – not only those dealing with end-of-life products, but also those concerning the disposal of hazardous wastes. It has been observed that as hazardous waste disposal becomes more costly, more mercury waste is diverted to recycling and less to other forms of disposal. Of course, this shift assumes that there remains a viable demand for mercury. At such point as the supply of mercury exceeds the demand, the financial incentive for recycling becomes much less compelling.

Table 13 Basic assumptions regarding LA&C mercury recycling 2010-2050 (tonnes)

	Consumption	Recycling	
	2005	2005	Forecast 2010-2050
<i>Processes</i>			
Artisanal and small-scale gold mining	165-330	Included simply as reduced consumption.	Included simply as reduced consumption
Chlor-alkali production	30-65	Minimal	Too small to influence the analysis
<i>Products</i>			
All products combined	140-215	3% of consumption	10% of consumption by 2020, and 25% by 2040

115. Based on the estimates that the EU and US may have achieved an overall 15% mercury product recycling rate, it is here assumed that Latin America and the Caribbean could achieve at least 10% by 2020 and 25% by 2040. It is evident that collection, recycling, and recovery of mercury from products may continue for several years after phase-out of a mercury-added product. However, such details have little effect on the outcome of this analysis, which is predominantly influenced by the large mercury flows.

116. Combining all recycling efforts, the baseline recycling data for 2005 and basic assumptions regarding future mercury recycling in Latin America and the Caribbean during the period 2010-2050 are summarized in Table 13 above.

5.1.5 Mercury stocks

117. In the past, reserve stocks of mercury held by governments or their proxies have been traded on the world market. While this no longer seems to be the case, and the recent US mercury export ban legislation specifically forbids the government from selling its stocks, there remain various mercury inventories that may be available to the market.

118. Other than some stocks held on-site in storage rooms by chlor-alkali producers, it is likely there are other commercial stocks remaining as well, especially in light of increased speculation by brokers, fuelled by the volatility of mercury prices since 2004. Furthermore, it is estimated that most commercial mercury users maintain inventories of two to six months' expected consumption.

119. In any case, for this analysis mercury stocks may not be considered in the same manner as other mercury "supplies" that are generated every year. Rather, stocks should be considered as inventories held in reserve, and brought out only as needed under special circumstances – to dampen or to take advantage of price fluctuations, to meet sudden surges in demand, etc.

120. While it may be assumed that various Latin American and Caribbean mercury stocks may be made available to meet modest shortfalls in supply, there are no reliable regional data on the quantities involved. Therefore, merely for the purposes of this analysis, it is assumed that the region presently maintains mercury stocks of some 300-500 tonnes.

5.2 Future Latin American and Caribbean mercury supply

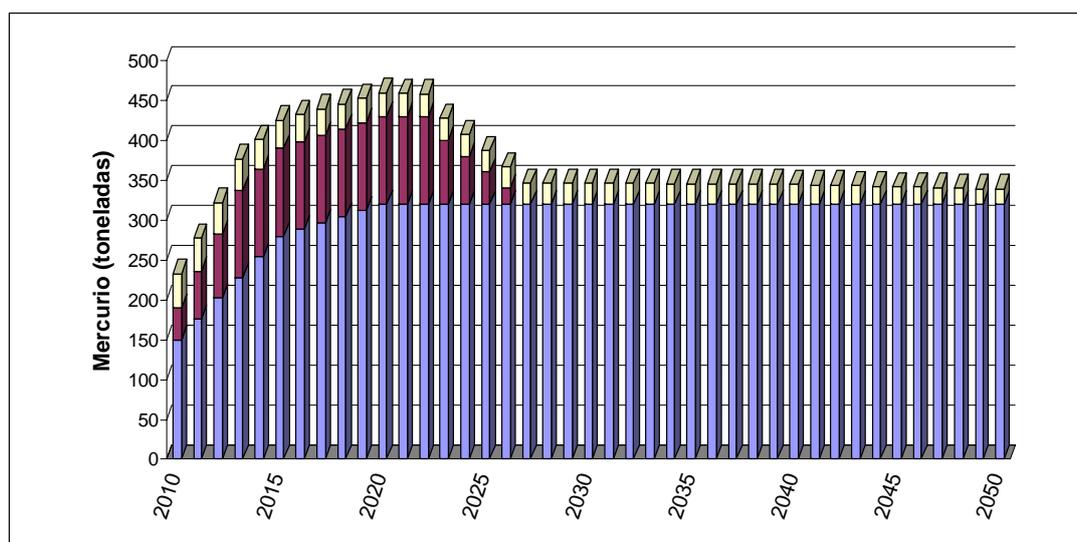
121. Overall, the evolution of the main Latin American and Caribbean regional sources of mercury during the period 2010-2050, as described in Sections 0 through 0, is summarised in Table 14 below. These are all sources generated within the region.

Table 14 Latin American and Caribbean “sources” of elemental mercury (tonnes)

“Source”	Quantity of Hg “produced” (2005)	Evolution 2010-2050
Mercury mining and/or processing of mine tailings	~30	30-40 tonnes/yr., decreasing as regional demand decreases
Decommissioned chlor-alkali facilities	unknown	1,480 tonnes of Hg from decommissioned Hg cells becomes available during 2010-2025
By-product mercury - zinc	0	80 tonnes/yr. by 2015 and 120 tonnes/yr. by 2020
By-product mercury - gold	~150	150 tonnes increasing to 200 tonnes/yr. by 2015
Recycled Hg from products	3% of 140-215	10% of consumption (evolving as in Table 10 for each product category) by 2020, and 25% by 2040
<i>Inventory (not a “source”):</i> Mercury stocks	unknown	as needed

122. The same projection is shown graphically in Figure 6 below. It is evident that by-product mercury and (for the next 15 years) mercury recovered from decommissioned chlor-alkali plants will be the main sources of mercury in the Latin American and Caribbean region.

Figure 6 Main elements of LA&C mercury supply (sources), 2010-2050



Key: blue = by-product mercury (zinc and gold ores); mauve = decommissioned chlor-alkali; yellow = other sources, esp. mercury mine tailings and recycling

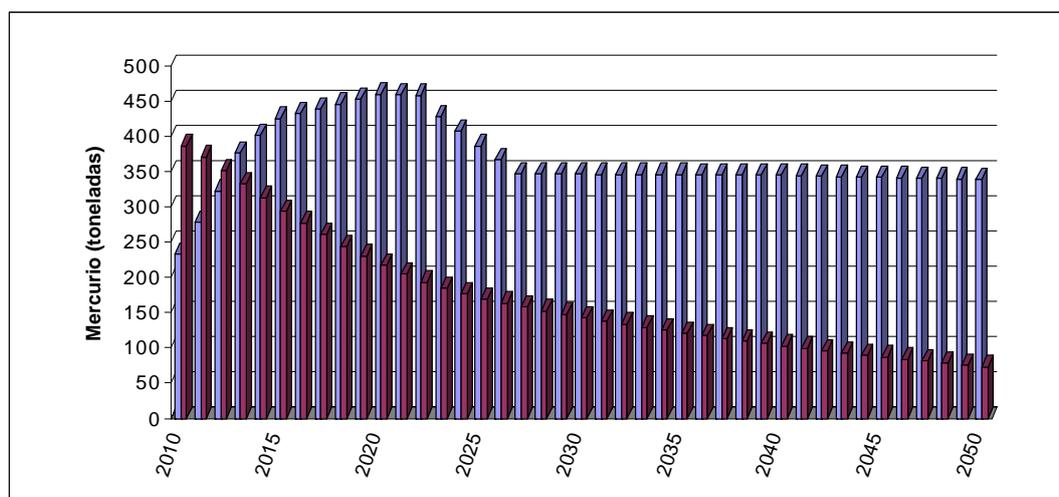
6. Excess mercury in Latin America and the Caribbean

6.1 Latin American and Caribbean Base Case Scenario

123. If one now combines the regional mercury supply with regional demand, the net or excess availability of mercury may be seen. Recalling the main assumptions, this “base case” scenario treats Latin America and the Caribbean as a “closed system.” The scenario is based only on domestic sources and uses of mercury, it assumes no exports from or imports to the region, it assumes that Mexico continues to produce a modest amount of mercury from small mines and tailings, it assumes a gradual increase in mercury recovered as a by-product from regional gold and other mining operations, and it assumes a more significant increase in recovery of mercury from the major non-ferrous metal smelters.

124. Figure 7 below combines the regional supply and demand information from the previous Figure 4 and Figure 6. It shows that the regional mercury supply may be expected to considerably outweigh regional demand in the future.

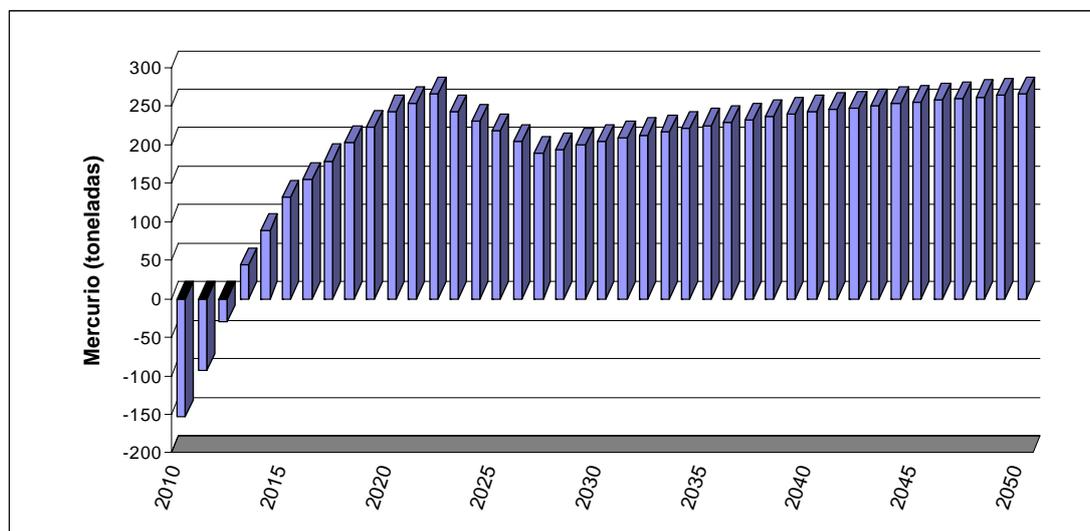
Figure 7 LA&C mercury supply and demand, 2010-2050 – Base Case Scenario



Key: blue = mercury supply; mauve = mercury demand

125. Further combining the regional mercury supply and demand quantities, Figure 8 shows only the net difference between annual supply and demand. It concludes that a regional excess of mercury may be anticipated as early as 2013. While a relatively small amount of excess mercury will not have a visible impact on the Latin American and Caribbean mercury market, after a few years of surplus (if the surplus is not stored) the mercury price, especially, would be expected to decline.

Figure 8 LA&C excess mercury, 2010-2050 – Base Case Scenario



126. Based on the preceding assumptions and analysis, the Base Case Scenario is considered the most useful basis for further discussions of a Latin American and Caribbean mercury storage strategy. Since this is the most straightforward base case for showing excess mercury generated in the Latin American and Caribbean region during the period 2010-2050, the detailed calculations supporting Figure 8 above are included in the Appendix.

127. Under this Base Case Scenario, the quantity of excess mercury accumulated between 2013 and 2050, and potentially requiring storage, amounts to just over 8,000 tonnes, as detailed in the Appendix.

6.2 Latin American and Caribbean Minimum Storage Scenario

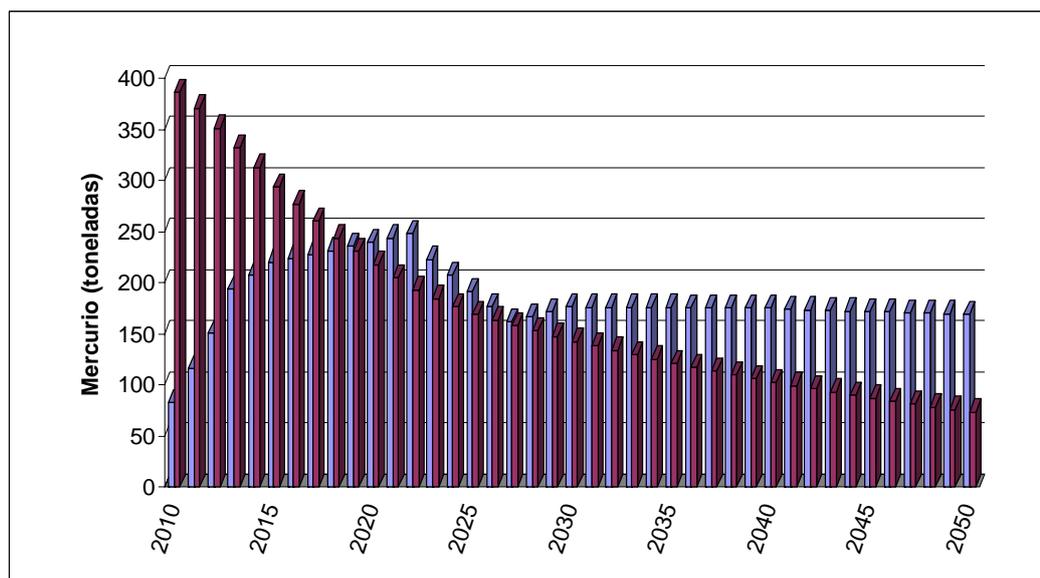
128. In order to test the sensitivity of the above analysis to a change in some of the “base case” assumptions, the following assumptions have been substantially modified:

129. The Base Case Scenario assumed that the international gold mining companies would keep their by-product mercury inside South America. The Minimum Storage Scenario assumes that they will continue to export 150 tonnes of mercury per year to the U.S., even if they are obliged to pay for storage when it cannot be re-exported.

130. The Base Case Scenario assumed that the zinc mining companies would recover 80 tonnes of mercury per year by 2015 and 120 tonnes of mercury per year by 2020. The Minimum Storage Scenario assumes that they will recover only 50 tonnes of mercury per year by 2020 and 100 tonnes of mercury per year by 2030.

131. Figure 9 below combines the modified regional supply and demand information for the Minimum Storage Scenario. It shows that even in a “limited supply” scenario, the regional mercury supply still exceeds regional demand after about 2019.

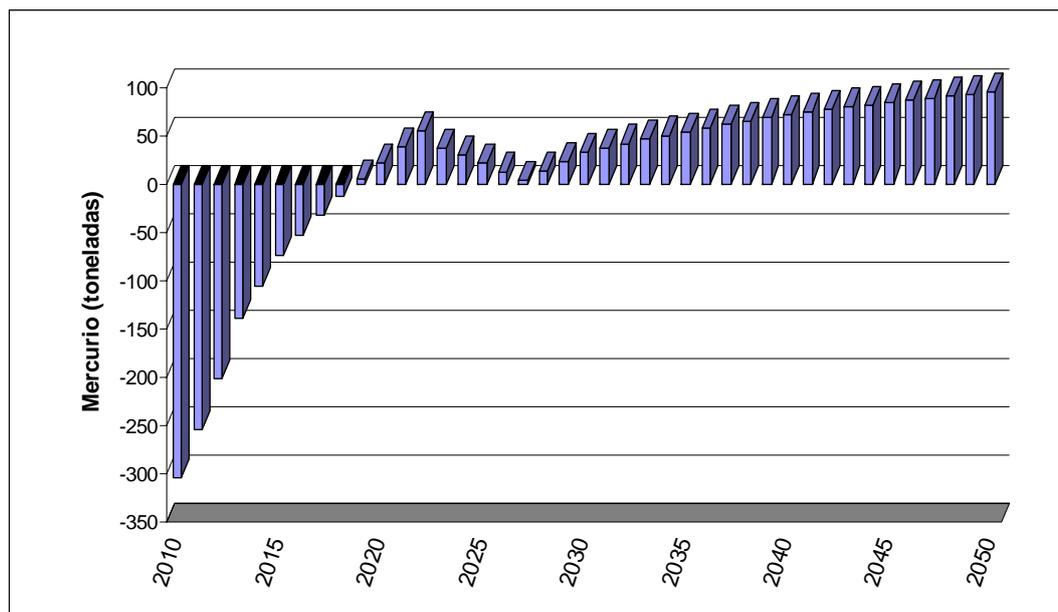
Figure 9 LA&C mercury supply and demand, 2010-2050 – Minimum Storage Scenario



Key: blue = mercury supply; mauve = mercury demand

132. Further combining the regional mercury supply and demand quantities in the Minimum Storage Scenario, Figure 10 shows only the net difference between annual supply and demand.

Figure 10 LA&C excess mercury, 2010-2050 – Minimum Storage Scenario



133. According to this Minimum Storage Scenario, the quantity of excess mercury accumulated up to 2050, and potentially requiring storage, amounts to nearly 2,000 tonnes. Moreover, as in the Base Case Scenario, it should be kept in mind that there are also stocks and other smaller sources that could add to this excess mercury.

6.3 Key observations regarding the scenarios

134. Significantly, neither storage scenario takes into account the possibility of accelerated reductions in the mercury supply as a result of a policy of intentional storage of certain sources of mercury (e.g. by-product mercury from mining, or mercury recovered from decommissioned chlor-alkali facilities). As previously noted, such a proactive storage policy could help to reduce the availability of mercury in the region, thereby helping greatly to reduce mercury demand, particularly for the ASGM sector. If this sort of policy is adopted, mercury storage could begin as soon as regional storage capacity is available, which argues for the development of storage capacity as soon as possible – even before 2013.

135. Second, it is obvious that many assumptions integral to this analysis may be modified in various ways. However, the Minimum Storage Scenario already includes such substantial modifications to the Base Case Scenario that it is difficult to imagine a realistic set of circumstances that would have any greater affect on the estimated excess of mercury supply over demand. Therefore, the Minimum Storage Scenario would appear to represent the absolute minimum “laissez-faire” storage requirement.

7. Observations and conclusions

136. Despite its potential regional mercury excess, the Latin American and Caribbean region is a significant importer of mercury at the present time. The vast majority of the imported mercury is used for small-scale gold mining, with lesser amounts in mercury-added products and for use in the chlor-alkali industry. The timing of an anticipated mercury excess in Latin America and the Caribbean depends greatly on the timing and magnitude of demand reduction in these key sectors, as well as policy decisions about recovering mercury from zinc smelting, and about whether to keep by-product mercury in Latin America and the Caribbean.

137. Since UNIDO and other experts have determined that mercury supply reductions can contribute to significant demand reductions in artisanal and small-scale gold mining, supply and demand reductions for this sector are mutually reinforcing, and to some extent supply reductions must precede demand reductions in order to work most effectively. Therefore, for the Latin American and Caribbean region, planning for mercury storage may be especially important as an initiative to further encourage demand reduction.

138. According to the scenarios assessed in this report, an excess of mercury supply over demand in Latin America and the Caribbean is expected to be seen sometime between 2013 and 2019. This time frame could be nearer 2013 if significant by-product mercury is generated in response to stricter requirements imposed on the metal processing sector, and if by-product mercury is not exported. Or the time frame could be closer to 2019 if by-product mercury exports continue.

139. The scenarios assessed in this report assume gradual demand reductions throughout the 2010-2050 period. If the mercury supply is restricted at the same time in order to reduce the demand for mercury in small-scale gold mining, this would also advance the need for storage capacity. In fact, if regional storage capacity were available before 2013, Latin American and Caribbean governments would have access to the valuable policy tool of storing mercury in order to reduce the market supply, thereby also reducing demand for mercury.

140. In any case, substantial excess mercury may be expected in Latin America and the Caribbean during the next five to ten years. The quantity of mercury requiring storage, as accumulated between 2013 and 2050 in the Base Case Scenario, may even exceed 8,000 tonnes.

141. As suggested, in order to help reduce mercury consumption, it is possible that regional authorities may decide to accelerate the storage of excess mercury. In this case they would likely follow the hierarchy established by the European Union, whereby any mercury recovered from decommissioned chlor-alkali facilities would be stored first, and then by-product mercury recovered from metal ore processing would be stored as a second priority. This option would call for the development of regional storage capacity as soon as governments can reach agreement on the form that such storage would take.

References

- BREF (2001) – “IPPC Reference Document on Best Available Techniques in the Chlor-Alkali Manufacturing Industry,” European IPPC Bureau, Institute for Prospective Technological Studies, European Commission Joint Research Centre, Seville, December 2001.
- Cain (2007) – A Cain, S Disch, C Twaroski, J Reindl and CR Case, “Substance Flow Analysis of Mercury Intentionally Used in Products in the United States,” *Journal of Industrial Ecology*, Volume 11, Number 3, © Massachusetts Institute of Technology and Yale University.
- CEC (2008) – JC Díaz, “Mexican Mercury Market Report,” Commission for Environmental Cooperation, Montreal, October 2008.
- Chile (2007) – “National Program for the Integral Management of Mercury in Chile,” Comisión Nacional del Medio Ambiente, Government of Chile.
- Chile (2008) – “Pilot Project on Strengthening Inventory Development and Risk Management-Decision Making for Mercury: A Contribution to the Global Mercury Partnership,” Comisión Nacional del Medio Ambiente, Government of Chile, December 2008.
- Ecuador (2008) – “Pilot Project on Strengthening Inventory Development and Risk Management-Decision Making for Mercury: A Contribution to the Global Alliance on Mercury,” Ministerio del Ambiente, Government of Ecuador, December 2008.
- European Commission (2008) – “Options for reducing mercury use in products and applications, and the fate of mercury already circulating in society,” COWI A/S and Concorde East/West Sprl for the Commission of the European Communities, September 2008, Brussels.
- ILZRO (2004) – “World Directory 2003: Primary and Secondary Zinc Plants,” International Lead and Zinc Research Organization (ILZRO).
- IMSG (2008) – “Metals Despatch,” Newsletter of the International Metals Study Groups, Issue No. 5, June 2008.
- Lowell (2008) – “Global Report on Mercury Use in Products and Processes, Level of Substitution, Technology Change-Over and Available Substitutes,” Lowell Center for Sustainable Production (Univ. of Massachusetts), report prepared for the United Nations Environment Programme, Chemicals Branch, Geneva, October 2008 and November 2008 (Annex I).
- Mansukh (2008) – Mansukh Investment & Trading Solutions, corporate investment monograph on the zinc industry.
- MPP (2008) – “Mercury Rising: Reducing global emissions from burning mercury-added products,” report prepared by Concorde East/West Sprl for the Mercury Policy Project, February 2008.
- NRDC (2007) – “Mercury Releases from Industrial Ore Processing,” Natural Resources Defense Council, Washington, DC, June 2007.
- Pacyna (2002) – Pacyna, EG and JM Pacyna, “Global Emissions of Mercury from Anthropogenic Sources in 1995,” *Water, Air, and Soil Pollution 137*: 149–165, 2002.
- Panama (2009) – “National Emissions Inventory of Mercury in Panama,” Summary of the Final Report, Pilot Project on Strengthening the Development of an Inventory and Risk Management in Making Decisions on Mercury, Panama National Environmental Authority, Department of Environmental Quality Protection, January 2009.
- SRIC (2005) – E Linak, S Schlag and K Yokose, “Chlorine/Sodium Hydroxide,” CEH Marketing Research Report, SRI Consulting, Zurich, August 2005.
- Telmer (2008) – Personal communications with experts Telmer (School of Earth and Ocean Sciences, University of Victoria, Canada), Veiga and Spiegel (both with the Norman B. Keevil Institute of Mining Engineering, University of British Columbia, Canada) – all involved in the UNIDO/UNDP/GEF Global Mercury Project.
- Telmer and Veiga (2008) – K Telmer and M Veiga, “World emissions of mercury from artisanal and small scale gold mining and the knowledge gaps about them,” Final draft, paper prepared for UNEP FT, Rome, 23 May 2008.

UNEP (2002) – “Global Mercury Assessment.” United Nations Environment Programme, Chemicals Branch, Geneva, December 2002. Available in English, French and Spanish at <http://www.chem.unep.ch/mercury/>.

UNEP (2004) – “Regional Awareness-Raising Workshop on Mercury Pollution: A global problem that needs to be addressed,” UNEP workshop 13–16 September 2004 in Buenos Aires (Argentina), Inter-Organisation Programme for the Sound Management of Chemicals, UNEP Chemicals, Geneva.

UNEP (2005) – “Regional Awareness-Raising Workshop on Mercury Pollution: A global problem that needs to be addressed,” UNEP workshop 18–21 January 2005 in Port-of-Spain (Trinidad), Inter-Organisation Programme for the Sound Management of Chemicals, UNEP Chemicals, Geneva.

UNEP (2006) – “Summary of supply, trade and demand information on mercury.” Report prepared by Concorde East/West Sprl in response to UNEP Governing Council decision 23/9 IV, United Nations Environment Programme – Chemicals. Geneva, November 2006.

UNEP (2008a) – The challenge of meeting mercury demand without mercury mining: An assessment requested by the Ad Hoc Open-Ended Working Group on Mercury, report prepared by Concorde East/West Sprl for the United Nations Environment Programme – Chemicals. Geneva, November 2008.

UNEP (2008b) – “Mercury-Containing Products Partnership Area Business Plan,” US Environmental Protection Agency in coordination with UNEP, Washington DC, 1 July 2008.

USGS (2007) – WE Brooks, E Sandoval, MA Yopez, H Howell, “Perú mercury inventory 2006,” U.S. Geological Survey Open-File Report 2007-1252, Virginia.

WCC (2006) – “Submission [to UNEP] on Global Mercury Partnership for the Reduction of Mercury in the Chlor-alkali Sector,” World Chlorine Council, undated, no address, see <http://www.worldchlorine.com>

Appendix: Most likely scenario for excess mercury in LA&C

142. The tables in this appendix provide 5-year snapshots of the calculations behind the Base Case Scenario (see Section 6.1) for future mercury sources and uses in Latin America and the Caribbean, showing the excess mercury that would likely be generated in the region during the period 2010-2050.

Latin American and Caribbean elemental mercury excess, 2010-2050 (tonnes) – Base Case Scenario

	2010	2015	2020	2025	2030	2035	2040	2045	2050
Sources of mercury									
Mercury mining and/or processing of tailings	35	27	20	15	13	11		8	7
Decommissioned chlor-alkali facilities	40	110	110	40	0	0		0	0
By-product mercury - zinc	0	80	120	120	120	120	120	120	120
By-product mercury - gold	150	200	200	200	200	200	200	200	200
Recycled Hg from products	8	9	10	11	13	15	9	14	12
Mercury stocks (300-500 tonnes)	?	?	?	?	?	?	0	?	?
Total Hg "sources"	233	425	460	387	346	346	345	342	339
Consumption of mercury									
Artisanal & small-scale gold mining	200	152	112	86	67	52	40	31	24
Chlor-alkali	40	25	7	0	0	0	0	0	0
Batteries	13	5	3	0	0	0	0	0	0
Dental applications	62	57	54	51	47	44	41	37	34
Measuring and control devices	25	14	7	0	0	0	0	0	0
Lamps incl. exports	14	12	11	9	8	7	6	4	3
Electrical and electronic devices	11	7	6	5	4	3	2	1	0
Other	23	21	19	18	17	16	15	14	13
Total Hg consumption products & processes	387	294	218	169	143	121	103	87	73
Annual excess (-deficit) mercury	-154	132	242	218	203	225	242		266
Cumulative excess mercury (tonnes Hg)	0	264	1263	2473	3460	4543	5721		