North American Regional Action Plan for Mercury Close-out Report

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Executive Summary

The North American Agreement on Environmental Cooperation (NAAEC), which was signed by Canada, Mexico, and the United States in 1994, established the Commission for Environmental Cooperation (CEC) to address and advance cooperation among the three countries regarding environmental issues related to the North American Free Trade Agreement (NAFTA). To further the aims of NAAEC, the CEC Council of Ministers approved a resolution (#95-05) in 1995 regarding the Sound Management of Chemicals (SMOC), establishing a trinational working group to implement the decisions and commitments set out in this resolution.

The focus of the SMOC Working Group (WG) was on trilateral cooperation in the management and control of risks associated with selected substances that are persistent and toxic, including mercury. The CEC Council mandated the development of a North American Regional Action Plan (NARAP) for a trilateral program to significantly reduce the risk of exposure to anthropogenic sources of mercury in North America.

Under the general direction of the SMOC Working Group, the North American Task Force on Mercury (Task Force) had the primary responsibility for developing and implementing the NARAP. Following public comment and subsequent revision, the mercury NARAP was adopted as a formal agreement among the Parties to proceed with implementation of the plan. When adopted in final form in 2000, the NARAP was envisioned as a 10-year plan to reduce mercury in North America.

This report summarizes the activities related to the North American Regional Action Plan on Mercury from inception in 1995 until formal close-out in 2010. The activities were summarized in six key action items:

1. Management of atmospheric emissions of mercury.
2. Management of mercury in processes, operations and products.
3. Mercury waste management approaches.
4. Research, monitoring, modeling, assessment and inventories.
5. Communication activities—to increase public awareness and share best management practices.
6. Implementation and compliance—implementation of NARAP objectives and compliance with national commitments.

It is important to note that this report also contains reference to products or projects that started under or stemmed from the NARAP that were completed between the closure of the NARAP and publication of this document.

In general, the Task Force believes that the mercury NARAP framework has been an important instrument to facilitate action in the region. The Task Force identifies benefits of NARAP implementation shared by all three countries as well as areas where Mexico, in particular, has

benefited. In addition, the Task Force identifies implementation shortfalls and suggestions for possible future continued action.

A notable accomplishment has been the collaborative efforts among Canada, Mexico and the United States on improved inventories of mercury waste sites and releases in each country. Capacity building in Mexico has been a strong element of this NARAP. As a result, Mexico has significantly advanced its understanding of mercury uses, releases, supply and trade and has upgraded its capacity for mercury monitoring and analysis. It has also undertaken projects in hospitals to replace mercury-containing equipment and is investigating options for long-term management of mercury-containing wastes. In addition, there has been collaboration between the CEC and the United Nations Environment Programme (UNEP) in presenting a joint workshop on mercury in Mexico for the benefit of the Latin American region.

There were also lessons learned from the work under the mercury NARAP. For example, trilaterally, the NARAP relied on significant voluntary actions; however, it was found that in most instances these voluntary measures were less successful than anticipated.

While much has been achieved under the mercury NARAP, the Task Force believes that trilateral cooperation should continue to focus on reducing uses and releases of this chemical. Mercury is now recognized as a global problem and UNEP is managing international negotiations to develop a global, legally-binding mercury instrument. Work is also underway under the Basel Convention related to waste management and within the United Nations Economic Commission for Europe (UNECE) under its Protocol on Heavy Metals to the Convention on Long-range Transboundary Air Pollution (LRTAP). It is anticipated that a new CEC mercury strategy will be prepared that will be complementary to and supportive of these other regional and global efforts. However, in order to improve effectiveness in addressing the risks associated with mercury, the Task Force recommends that only a limited number of high priority projects be undertaken each year.

Chapter I: Introduction

The North American Agreement on Environmental Cooperation (NAAEC), which was signed by Canada, Mexico, and the United States in 1994, established the Commission for Environmental Cooperation (CEC) to address and advance cooperation among the three countries regarding environmental issues related to the North American Free Trade Agreement (NAFTA). To further the aims of NAAEC, in 1995 the CEC Council of Ministers approved Resolution #95-05 on the Sound Management of Chemicals (SMOC), which established a trinational working group to implement the decisions and commitments set out in this resolution. The focus of the SMOC Working Group (WG) was on trilateral cooperation in the management and control of risks associated with selected substances that are persistent and toxic.

Council Resolution #95-05 specifically called for the development of four North American Regional Action Plans for selected persistent and toxic substances as a first priority in the Parties' common desire to address national and regional concerns associated with the sound management of chemicals. Mercury, as well as DDT, chlordane and PCBs, was one of the four priority substances identified by the Parties for Action Plan development.

Historically, mercury has been known to exhibit characteristics of toxicity, and most of its inorganic salts are toxic to some degree. In occupational settings, inhaled elemental mercury vapor has produced toxicity. In the mid-1950s and again in the mid 1960s, research showed that methylmercury, an organic mercury compounds was also found to be highly toxic, bioaccumulating in the food chain, persisting in fish tissue for an extended period of time, and causing the development of "Minamata disease" in humans consuming tainted fish.[1]

Methylmercury accumulates in fish at levels that may harm the fish and the birds and mammals that eat them. Effects of methylmercury exposure on wildlife can include mortality, reduced fertility, slower growth and development of abnormal behavior that affects survival, depending on the level of exposure.[2]

While both natural and anthropogenic sources of mercury contribute to increased mercury levels in the environment, scientific experts and government decision makers are mainly concerned about mercury releases from human activity. Historical evidence indicates that a very significant increase of mercury in lake sediments occurred simultaneously with the beginning of the industrial age in the 1800s.

[1] Japan Public Health Association. 2001. Understanding of Minamata Disease: Methylmercury Poisoning in Minamata and Niigata, Japan. Chapter 1: A Brief Introduction to Minamata Disease (Y. Takizawa and M. Osame, editors).
[2] US Environmental Protection Agency. 1997. The Mercury Study Report to Congress. <epa.gov/mercury/report.htm>.

The CEC Council mandated the development of a North American Regional Action Plan (NARAP) to undertake a trilateral program to significantly reduce the risk of exposure to anthropogenic sources of mercury in North America. Under the general direction of the SMOC Working Group, the North American Task Force on Mercury (Mercury Task Force) had the primary responsibility for developing and then implementing the NARAP.

Following public comment and subsequent revision, the mercury NARAP was adopted as a result of formal agreement among the Parties to proceed with implementation of the plan. When adopted in final form in 2000, the NARAP was envisioned as a 10-year plan to reduce mercury in North America.

Strategic Framework for the Mercury NARAP

The purpose of the North American Regional Action Plan (NARAP) on Mercury was "to provide the governments of Canada, Mexico and the United States with a path forward in their joint and differentiated efforts to reduce the exposure of North American ecosystems, fish and wildlife, and especially humans, to mercury through the prevention and reduction of anthropogenic releases of mercury to the North American environment."

The plan provided a strategic framework and approach that the three governments could use to promote the general regional adoption of regulatory and non-regulatory best practices for preventing and reducing anthropogenic releases of mercury to the North American environment and for the sound management of mercury. The plan reflected a belief that public-private and stakeholder partnerships for sharing and transferring best practices was likely to be the most efficient and effective means of strengthening national abilities to make substantial progress toward achieving the purpose and objectives outlined in the NARAP. The Mercury NARAP Strategic Framework is summarized in Figure 1.

Figure 1. Strategic Framework for the Mercury NARAP

Strategic Framework for the Mercury NARAP

Ultimate Goal

Reduce anthropogenic releases of mercury to the North American environment, through appropriate national and international initiatives, to amounts that can be attributed to naturally occurring levels and fluxes.

Overarching Objectives

- *General Ambient Mercury Objective:*
  Reduce mercury levels in, and fluxes among, selected indicative environmental media in order to approach naturally occurring levels and fluxes, thereby preventing or minimizing exposure of North American ecosystems, fish and wildlife, and humans to levels in excess of those that can be attributed to naturally occurring levels and fluxes of mercury in environmental media.
- *General Mercury Release Objective:*
  Recognizing that mercury is a naturally occurring element that can never be eliminated from the environment, reduce or, when warranted, target for reduction through a life cycle management approach, the sources of anthropogenic mercury pollution so as to achieve naturally occurring levels.
- *General Mercury Use Objective:*
  Consider initiatives such as promotion and use of products and technologies that pose less risk than those used at present. Facilitate product stewardship, product labeling, extended product responsibility, use limitations, economic incentives, recycling, and where there is an unreasonable or otherwise unmanageable risk of release to the environment or risk to human health, phase-out or ban specific mercury uses.

Implementation Strategies

1. *Building upon Existing Initiatives*: support and build upon commitments to existing mercury-related programs at the international, bilateral, national and local levels of government.
2. *Promoting North American Regional and Global Activities*: promote regional actions on mercury that will serve as an example for initiatives under development throughout the region and globally.
3. *Best Practices*: promote the sharing, transfer and general adoption across North America of "best practices" for the prevention and reduction of anthropogenic releases of mercury and for the sound management of mercury, including waste management strategies.
4. *Challenging Stakeholders to take Cooperative Action on Mercury*: challenge stakeholders to take a leading role in exchanging "best practices" information and technology for specific industries or geographic areas.
5. *Improving Scientific Understanding*: work with stakeholders to identify and implement research, development and monitoring programs to advance the scientific and technological state-of-knowledge for mercury.
6. *Capacity Building in Mexico*: work cooperatively to build Mexico's capacity to prevent and reduce anthropogenic releases of mercury and provide sound management of mercury. Mexican governments, industries and institutions would be encouraged to take advantage of, and adapt as appropriate, Canadian and US regulatory and non-regulatory experiences.
7. *Extended Americas*: promote cooperation with other Latin American and Caribbean nations so that processes and actions initiated under the mercury NARAP will be useful to these other governments.

Specific Actions in the Mercury NARAP

Upon submission of the Phase I NARAP to the CEC Council of Ministers, further instruction was given to the Mercury Task Force for developing "additional specific actions that the Parties shall undertake to further reduce anthropogenic releases of mercury generated within North America, together with specific targets and time frames for meeting these actions."[3]

As a consequence of this directive, Phase II of the mercury NARAP was developed, including new, more specific strategies for meeting the objectives. [4] These action-oriented strategies were to:

- Reduce mercury releases from specific human activities. This includes, but is not limited to, reductions of mercury releases from combustion sources, commercial processes, operations, products and waste streams;
- Develop an enhanced capacity to measure and manage mercury, assess its impacts and communicate concerns and successes;
- Establish an equitable implementation and compliance protocol; and
- Promote continued appropriate and responsible mercury management initiatives on behalf of the governments, the industries and the citizens of North America.

The Phase II NARAP also specified six key action areas for implementation:

- Management of atmospheric emissions of mercury;
- Mercury management in processes, operations and products;
- Mercury waste management approaches;
- Research, monitoring, modeling, assessment and inventories;
- Communication activities; and
- Implementation and compliance.

Within these action areas the Phase II NARAP provides some specificity by making approximately 80 recommendations for complying with the directions from the CEC Council.

[3] North American Regional Action Plan on Mercury: <www.cec.org/Page.asp?PageID=924&ContentID=1297#5.5>.
[4] North American Regional Action Plan on Mercury–Phase II: <www.cec.org/Page.asp?PageID=1325&SiteNodeID=312>.

Chapter II: Mercury NARAP Implementation

Establishing the Mercury NARAP Implementation Task Force

In accepting the Phase I Mercury NARAP in 1997, the CEC Council of Ministers also accepted the recommendation of the Mercury Task Force that it be reconstituted as an Implementation Task Force to assist the SMOC Working Group in undertaking the various tasks and initiatives recommended in the proposals for action.[5]

The function of the resulting North American Implementation Task Force on Mercury[6] was to oversee and promote the NARAP as it was put into effect, through the involvement of knowledgeable scientific, environmental and health representatives from the three countries. The Mercury Task Force received technical and administrative support from the CEC Sound Management of Chemicals Program, and, whose chairmanship (a national government representative) rotated amongst the three countries, coordinated its actions by means of annual face-to-face meetings, regular conference calls and topic-specific collaboration. It was also provided with the option of calling on additional stakeholder expertise on an *ad hoc* basis.

The SMOC Working Group agreed that the Mercury Task Force would include experts with experience in implementing other bilateral plans. As a consequence, the body created regional linkages by including one member from the New England Governors and Eastern Canadian Premiers (NEG/ECP) Mercury Task Force and one member from the Great Lakes Binational Toxics Strategy (GLBTS) Mercury Workgroup from the United States and Canada. In the spirit of cooperation and in order to build a comprehensive knowledge base of North American mercury management potentials, representatives of the CEC's Mercury Task Force were also invited to attend workshops sponsored by these bilateral groups.

Country-Specific Context for the NARAP Implementation

By the time the Phase II Mercury NARAP was approved in 2000, the US and Canada had already undertaken concerted federal efforts to identify mercury releases, biological and health effects, and had begun to implement comprehensive reduction programs. For example, under the terms of the GLBTS, Canada and the US had individually agreed to seek significant reductions in anthropogenic mercury releases. The US sought a national reduction of 50 percent in mercury uses and releases by 2006 and Canada a 90 percent reduction in releases from its Great Lakes area.

[5] Mercury NARAP (Phase I), section 5.5.3.

[6] Although its duties had now largely changed from NARAP development to implementation, the composition of the Task Force had remained unchanged and we will retain reference to it by the original name: Mercury Task Force—editors.

In Mexico, however, little was documented about mercury sources, impacts and fate other than some site-specific concerns. The Mercury Task Force recognized that early efforts were needed with Mexico to improve understanding of mercury sources and impacts and to build capacity for mercury awareness raising, monitoring and reduction initiatives.

Phase I Implementation: Information Development, Capacity Building and Program Recommendations

The Mercury Task Force undertook three workshops as recommended in Phase I of the NARAP. Recommendations emerging from the workshops were taken into consideration by the Task Force in the development of additional, more specific actions for the CEC Council's consideration in 1998. The workshops, held in February, September and October 1998, had the following specific goals:

- Building a capacity for assessment, implementation and management of mercury control programs based on sound science and appropriate communications techniques;
- Promoting partnerships and voluntary initiatives in an "extra-regulatory" framework, while recognizing the need for appropriate regulatory tools; and
- Addressing the current state and future direction of science as it relates to assessment and control of anthropogenic sources of mercury, with suggestions for future research needs.

Mercury Assessment Workshop, Zacatecas, Zacatecas State, Mexico, February 1998

The Mercury Assessment Workshop, held in Zacatecas, Mexico, 25–27 February 1998, was co-sponsored by the CEC Mercury Task Force and Mexico, through its National Institute of Ecology. The workshop, attended by about 60 participants, focused on information exchange regarding a potential pilot project at this site and provision of advice with regard to Mexico's development of its national heavy metals program. The pilot project emphasized capacity building with respect to assessing the level of contamination in the region and demonstrating the feasibility of reducing mercury levels in an environment of extensive and long-term mining activity. It was anticipated that options for addressing contamination would primarily assist Mexico but would also strengthen the capacity of Canada and the US to address contaminated mining sites.

The site chosen for the pilot project was centered on the city of Zacatecas and the town of Guadalupe in the State of Zacatecas in north central Mexico. This area was one of extensive precious metals mining originating in the time of the Spanish Conquistadors. An amalgamation process that employed mercury to extract silver was used from around the mid-1500s through the mid-1900s at this site, and throughout other areas of Mexico and the western United States. Literature suggests that in the pilot project area more than 5000 tons of mercury was used in the first one hundred years of mining activity. A similar quantity may have been used since the 1600s. Mercury is also a natural constituent of the ores.

Voluntary Initiatives/Partnerships Workshop, Mexico City, Mexico, September 1998

The purpose of this workshop, held 9–11 September 1998, was to promote North American best practices for mercury through formation of partnerships and linkages among industries that use mercury in products or processes, or which emit mercury as a byproduct. Objectives included promotion of near-term initiatives, consideration of remediation and control strategies, identification of likely 'motivators,' development of communications tools, and encouragement of stakeholder stewardship. To this end, the workshop brought together 95 representatives from government, industry, academia, and environmental groups from all three NAFTA partners. Participants also provided the Mercury Task Force with recommendations for goals and actions that could be included in the second phase of the NARAP.

Science Experts Workshop on Mercury, Las Vegas, Nevada, United States, October 1998

This workshop was held 6–8 October 1998, at the US EPA National Exposure Research Laboratories located on the University of Nevada, Las Vegas campus. It brought together more than 100 participants with expertise on mercury to discuss recent research on fate and transport of mercury and mercury compounds (atmospheric, aquatic and terrestrial) within North America, monitoring, control technologies that apply to industrial emissions of mercury such as those that result from coal burning for electrical-generation, and recent information on the effects of mercury on wildlife, the environment and human health.

This workshop resulted in recommendations for a North American research and development strategy for mercury, inclusive of a trinational North American baseline on mercury. The workshop was co-sponsored by the CEC Mercury Task Force and the US EPA. In recognition of the growing significance of mercury emissions from coal-fired power plants, the International Air Quality Advisory Board of the Canadian-US International Joint Commission attended and co-sponsored the session on combustion control technologies.

Phase II Development

This second phase of the NARAP built upon the actions in the first phase by providing additional guiding principles and specific actions aimed at regional elimination, reduction and sound management of mercury in North America. Following public and expert comments and subsequent approval by the CEC Council, these amendments became part of the Phase II NARAP. Council also clarified that Phases I and II were integral parts of the same North American mercury risk reduction effort under this CEC project.

Consultative/Cooperative Meeting, Montreal, Canada, March 1999

Following consultation with industry during the 1998 workshop, this meeting was held in early 1999 in Montreal with representatives of state/provincial groups that had mercury action plans underway, with nongovernmental organizations (NGOs) active on mercury issues, and with groups whose members were particularly affected by mercury. The focus was to discuss the direction of the NARAP to ensure that these groups were supportive and would build on efforts which the Task Force could support. Members of these activist groups were advised to consult with industry domestically as warranted on actions that pertain to a particular industrial sector.

Finalization of the Phase II NARAP, 2000

Beginning in 2000, the CEC's trilateral Sound Management of Chemicals Working Group began reviewing drafts of the NARAP Phase II plan developed by the Mercury NARAP Task Force. Stakeholder review took place at a SMOC Working Group public meeting in May 2000, including a one-day public session in Canada and another one-day public session in Anchorage, Alaska.

Following the stakeholder review, a broad public review of the NARAP was conducted through the CEC mailing list of about 700 from the Phase I consultation, plus workshop participants. Governments were also encouraged to consult internally with their public advisory groups, etc. The finalized plan for Ministerial approval was presented at a CEC Council meeting at end of June.

CEC Support in Mexico, Joint Activities and Accomplishments

During Phases I and II of the NARAP, the Mercury Task Force supported development of knowledge and infrastructure in Mexico including staff exchanges, site visits, workshops, investigations and reports, laboratory capacity building and monitoring equipment contributions.

Staff exchange for Identification of Mercury Uses and Options for Management of Mercury-Containing Products in Mexico

In order to begin work on NARAP activities in Mexico, an initial diagnosis related to mercury took place in Mexico City during 1999, with the support of the CEC. The project objectives were to advance the understanding of the uses, users, manufacturers and distributors of mercury and mercury-containing products in Mexico and begin to develop management systems. The project was a joint effort of the *Instituto Nacional de Ecología´s* Toxic Substances Branch and a mercury specialist on leave from the Minnesota Pollution Control Agency, the environmental regulatory agency for the state of Minnesota in the United States. The outcomes of this project were:

- Inventory of the uses of mercury in Mexico, including a listing of major manufacturers of products, suppliers and use sectors.
- Establishment of the bases for voluntary agreements with manufacturers and suppliers of mercury-containing products to participate in the end-of-life management of products sold in Mexico.
- Options to reduce recycle and manage products that contain mercury in Mexico.
- Guidelines and procedures for management and recycling of mercury wastes.
- A summary of selected voluntary initiatives in the management and reduction of mercury use in products and processes in North America and Europe that could be applied to the Mexican context to achieve the objectives of the NARAP.
- An initial listing of likely air emission sources and references for quantification.

Analytical/Technical Staff Exchanges

Other staff exchanges related to mercury analytical issues included Environment Canada's support to staff of Mexico's *Centro Nacional de Investigación y Capacitación Ambiental* (National Environmental Research and Training Centre—Cenica), with training on analytical methods on metal and organic mercury in fish and total mercury in hair. Also, one person from Cenica was trained at the University of Michigan on mercury analysis in air.

Status of Mercury in Mexico, June 2000

Building on previous investigations, the purpose of this report[7] was to analyze the extraction, use, shipping and final disposal of waste contaminated with mercury throughout Mexico in order to assess the quantities of the metal in circulation and the emissions and discharges of it on Mexican territory.

Expertise Exchange Workshop on Mercury in Humans and the Environment, Mexico City, April 2000

Held in Mexico City at Cenica, on 6–8 April 2000, the objectives of the workshop were to assemble the foremost North American experts on analysis of mercury in humans and the environment to reach agreements on state-of-the-art sampling and analysis methodologies that could be used for the NARAP, and to develop links to exchange experiences and expertise. Five experts from each country were invited to participate.

Another objective was to develop a profile of extended experience in mercury assessment through analysis of environmental and human samples, and also to develop the capacity to establish fruitful cooperation exchange links and activities among the three countries.

Mexican participation in the North American Mercury Deposition Network

The objective of this project was to determine two sites in Mexico where two wet deposition collectors could be installed to extend the coverage of the Mercury Deposition Network in North America.

This project was proposed in order to help implement Action item 4 of mercury NARAP, which states that "… there is a need to develop and refine collective North American capacity and capability to assess ambient levels, exposure and toxicity of mercury to minimize human health and ecosystems effects through appropriate research, monitoring, modeling, assessment and inventory programs."[8]

The strategy was to work with key agencies in Mexico and liaise with appropriate Canadian and US authorities and private sector contractors to:

- Identify the requirements for the establishment of mercury monitors in Mexico as a pilot project;

[7] *Instituto Nacional de Ecología*. 2000. Status of Mercury in Mexico. First draft. <www.cec.org/Storage/45/3745_Hgmex-e.PDF>.

[8] North American Regional Action Plan on Mercury–Phase II: <www.cec.org/Page.asp?PageID=1325&SiteNodeID=312>.

- Identify appropriate Mexican agencies/institutes or universities to be proponents for or participants in the initiative;
- Identify capacity in terms of expertise, facilities, human and financial resources to launch a successful pilot project;
- Identify Canadian and US expertise to lend support to the project;
- Identify Mexican capacity to support ongoing monitoring once a pilot project is launched;
- Identify opportunities for the exchange of experts between countries to build capacity and enhance cooperation;
- Provide support in arranging meetings / conference calls, taking notes at meetings, following up on action items, etc;
- Prepare a budget for setting up monitoring equipment and for operating the system for one year; and
- Prepare a report on activities, findings and recommendations suitable for use as a capacity building document.

This action was supported in its initial stage by the CEC and performed by the Hydro Geochemistry Laboratory, Mexican Institute for Water Technology (IMTA), during July-December, 2003. Once the sites were determined (in Puerto Angel, Oaxaca State and Huejutla, Hidalgo State) collected samples were sent for analysis to the MDN Laboratory in the United States during one year.

Workshop on the Mercury Situation in the Region of the Zacatecana Dam, Zacatecas, Zacatecas State, Mexico, 19–20 September 2002

The workshop objectives were to present the mercury situation in the region of the Zacatecana dam, to discuss the Strategic Plan for the Control of Heavy Metals, and to present the results from soil and crop analysis in the zone around the Zacatecana dam by Barenco Services, Canada. An initial demonstration of the Tekran mercury analyzer (see below) in Mexico and proposals from Health Canada for future work on mercury in Zacatecas were made. The Mercury Task Force had a meeting in order to inform the public of the progress of mercury NARAP initiatives.

Preliminary Inventory of Atmospheric Emissions of Mercury in Mexico, 2002

Atmospheric emissions of mercury from the sources of interest in Mexico were estimated in this inventory based on annual process throughputs for these sources, using commonly acceptable emission factors or available data on mercury content in feedstock or products. This project contributed to the development of a map, Mercury Hot Spots of North America,[9] according to Action Item 4e(v) of the mercury NARAP: "initiate the development of a North American inventory of sites where elevated levels of mercury may occur due to either human activities or natural geological influences, (e.g., former mercury cell chlor-alkali facilities, former weapons production facilities, mercury stockpiles, mercury/precious metal amalgamation sites, mining sites that have used or produced mercury." This inventory was prepared by Acosta y

[9] CEC. 2002. Mercury Hotspots of North America (map). See: <www.cec.org/Storage/49/4186_hotspots_en.pdf>.

Asociados (AyA). The Mercury Hot Spots of North America map was also compiled with data provided by the United States and Canada.

Assessment of Mechanisms in Mexico for Tracking Imports and Exports of Mercury for Use and Disposal, 2002

In accordance with the actions established in Phase II of the mercury NARAP, pertaining to transboundary movements of mercury and products containing mercury and mercury waste, this project set forth the following objectives:

- Identify and assess existing methodologies and processes in Mexico for tracking imports and exports of mercury designated for manufacture or use in processes and products.
- Identify and assess national reporting mechanisms in Mexico used to track the ultimate fate of mercury-containing wastes within North America, particularly waste transported across national boundaries for storage, handling, processing, disposal or long-term containment.
- Assess whether, and to what extent, it is possible to track from "cradle-to-grave" imports and exports of mercury, mercury-bearing products and mercury-containing waste, including an assessment of existing gaps and barriers for adequate tracking and control.

Official statistics were reviewed and interviews were conducted with the personnel of appropriate official agencies, to assess the functionality of such procedures and the completeness and reliability of the information generated.[10]

Feasibility Study to Explore Potential Environmental Contamination in the Vicinity of Mining Operations, Zacatecas, Mexico, July 2002

This study, supported by CEC and performed by Barenco Inc., considered the following objectives:

- To undertake a literature review and scoping investigation related to the environmental impact of historical silver and gold mining operations in the Zacatecas area on agricultural activities as well as on ecological and human health.
- To undertake a preliminary sampling program involving the collection of a limited number of soil and vegetation samples from a field located as close to the edge of the Zacatecana lagoon as possible to represent a maximum potential for contamination in this initial area of study, for exploratory analysis of mercury and other environmental parameters.
- To develop a more comprehensive sampling program for consideration by the CEC, based on the results of the soil and vegetation sampling program and on information gathered pertaining to the potential receptors and exposure pathways.

[10] <www.cec.org/Storage/51/4348_Hg-Tracking-Mexico_en.pdf>

Preliminary conclusions from the study were that:

- Mercury and other related contaminants are present in soils of some farm fields in the Zacatecana dam area at concentrations in excess of risk-based human and ecological criteria;
- Concentrations of methylmercury in vegetation were very low in comparison to dietary exposure levels reported in a study of health impacts; and
- Concentrations of mercury and other related contaminants in vegetation from the field where soil quality criteria were exceeded and warrant further investigation in terms of the risks posed by consumption.

Deployment of an Automatic Gaseous Mercury Analyzer, 2003–2004

The Government of Canada loaned the government of Mexico an Automatic Mercury Vapour Analyzer made by Tekran Instrument Corporation and trained technical personnel from Cenica in the operation of the equipment. The loaned analyzer allowed various studies monitoring atmospheric gaseous mercury at some selected Mexican sites to be carried out.

Technical training related to the operation and maintenance of the Tekran instrument for the measurement of Total Gaseous Mercury was provided by Environment Canada, from its Atlantic Region office in Dartmouth, NS to Cenica Staff in 2003. A team of C. Green, R. Tordon, and S. Beauchamp visited Mexico two times in order to conduct surveys on atmospheric total gaseous mercury in Mexico.

CEC–Americas Workshop to Reduce Mercury Use in Products, Merida, Yucatan, Mexico, 21–23 February 2006

This workshop was a capacity-building initiative under the *Global Partnership for Mercury Reduction in Products,* established under the auspices of the UNEP Mercury Programme and hosted by the Governments of the United States, Canada, and Mexico, and the Commission for Environmental Cooperation (CEC) of North America.

The UNEP Governing Council, in Decision 23/9, Chemicals Management, Part IV, urged governments, intergovernmental and nongovernmental organizations and the private sector to develop and implement partnerships as one approach to reducing the risks to human health and the environment from the release of mercury and its compounds.

The workshop is designed to inform and engage governmental environment and health officials, nongovernmental organizations, and product manufacturers in the Americas, to build capacity towards establishing and implementing programs and procedures to: 1) reduce and eliminate the use of mercury, where there are effective substitutes; and 2) achieve better control of existing uses of mercury in products and processes in order to minimize environmental impacts.

Key workshop objectives were:

- Exchanging information on successful mercury reduction programs in various product sectors; and
- Identifying participating country needs, priorities, and next steps for reducing mercury use in products in the Americas.

CEC Support to CAATA-Health Care Without Harm, 2007–2009

This project was supported by the CEC and conducted by Health Care Without Harm (HCWH) and its Mexican partner, the Center for Analysis and Action on Toxics and their Alternatives (*Centro de Análisis y Acción en Tóxicos y sus Alternativas*—CAATA). Its objective was to develop pilot projects related to the elimination of mercury uses in two hospitals: The *Hospital Infantil de México "Federico Gómez"* (HIMFG), a children's hospital, and the National Institute of Pediatrics (*Instituto Nacional de Pediatría*—INP).

For this project, a team was created to coordinate training and awareness activities within the hospital composed of the heads of the waste management department, nursing, dentistry, maintenance, communications, research and administration areas. Among the outcomes of this project were the complete replacement of mercury thermometers in these two hospitals, and the development and printing of educational materials, such as pamphlets and videos, which were distributed to other Mexican hospitals. Workshops to share the results with other interested hospitals were also conducted.

Workshop on the Mexican Mercury Market Report, 28–29 October 2008

The purpose of this workshop was to present the preliminary conclusions of the *Mexican Mercury Market Report* study in order to strengthen mercury risk perception and promote the participation of sectors linked with mercury products manufacturing; industrial and governmental sectors that consume or generate discarded mercury-containing products. Objectives also included encouragement of near-term initiatives related to mercury management plans.

Partnership to Establish a Mercury Product Management Infrastructure in Mexico

Stemming from the Mexican Mercury Market Report study and the need to dispose of products removed from hospitals, this project sought to explore management options suitable to the Mexican context. In 2009, the CEC supported the development of a management plan for mercury products generated by the health care sector.

Mercury Emissions Inventory Workshop, Mexico City, May 2010

With the support of the CEC, Cenica organized this workshop, held on 18–19 May 2010. Its objectives, were to: 1) submit, analyze and compare (with previous information) data on mercury releases calculated according to the *UNEP Toolkit for Identification and Quantification of Mercury Releases* methodology, 2) integrate stakeholders, industry representatives and experts concerned with this issue, and 3) assess generated information related to priority sources. The Inventory considered data on emissions sources from 2004. Other invited Latin American countries (Ecuador, Panama and Chile) made presentations on their respective inventories.

Mexican Mercury Market Report, August 2011

The purpose of this report[11] supported by the CEC was to collect and analyze available information in Mexico, in order to describe supply, demand, trade, market characteristics, and trends of elemental mercury and mercury-containing products in commerce. The report also identifies market actors, consumers, producers and institutions. Data on production, imports, exports, supply and demand are presented. Among the 25 recommendations proposed in this report were the following:

- Design a strategy that takes into consideration costs and technology for mercury-containing waste recycling, as well as legislative and economic factors.
- Develop a midterm study to develop capacity for final retirement and storage of excess mercury that considers which entities (state or private companies) could be allowed to store mercury, who should pay initial and ongoing costs of storage, what should be the technical standards for safe, long-term storage, and what legislative/regulatory changes may be needed.
- Undertake an urgent, high-priority action by the health authorities to ban the sales of elemental mercury in drugstores. In Mexico, mercury for dental amalgams is sought for uses other than those in the oral care and health sector.

[11] CEC. 2011. Mexican Mercury Market Report. August.
<www.cec.org/Page.asp?PageID=30101&ContentID=25056&SiteNodeID=403>.

Chapter III: Country-Specific Activities under the Phase II NARAP

This chapter describes country-specific activities during the term of the Phase II NARAP from 2000 to 2010. Both the US and Canada had national action plans in force during the latter part of the NARAP term but Mexico did not. These national action plans proved to be valuable mechanisms for accomplishing specific objectives related to the mercury NARAP.

The Mercury Phase II NARAP specified six key "action items" to address during its 10-year term:

- Action Item 1: Management of atmospheric emissions of mercury.
- Action item 2: Management of mercury in processes, operations and products.
- Action item 3: Mercury waste management approaches.
- Action Item 4: Research, monitoring, modeling, assessment and inventories.
- Action item 5: Communication activities to increase public awareness and share best management practices.
- Action item 6: Implementation of NARAP objectives and compliance with national commitments

In addition to each country's accomplishments in meeting objectives contained in the Phase II Mercury NARAP, there have also been accomplishments as a result of two unique binational collaborations. These are briefly described below.

Canada-US Binational Collaborations on Mercury

Two major regional, binational plans were developed to maximize mercury pollution reduction efforts across political borders. The Great Lakes Binational Toxics Strategy,[12] developed jointly by Canada and the United States and signed in 1997, provided a framework for actions to reduce persistent toxic substances, including mercury. This strategy contained the first specific pollution reduction targets to be set jointly by these two countries. At about the same time, the Conference of New England Governors and Eastern Canadian Premiers developed a Mercury Action Plan (NEG-ECP MAP)[13] for the northeast region, which was adopted in 1998.

Both the Conference of New England Governors and Eastern Canadian Premiers and the Great Lakes Binational Toxics Strategy have made major contributions to reducing mercury in the environment during the term of the NARAP.

Great Lakes Binational Toxics Strategy

The *Canada-United States Strategy for the Virtual Elimination of Persistent Toxic Substances in the Great Lakes Basin*, known as the Great Lakes Binational Toxics Strategy, was developed

[12] US EPA. 1997. *Canada-United States Strategy for the Virtual Elimination of Persistent Toxic Substances in the Great Lakes Basin*, 1997. <www.epa.gov/bns/>.
[13] The Conference of New England Governors/Eastern Canadian Premiers. 1998. *Mercury Action Plan 1998.* <www.mass.gov/dep/toxics/priorities/negecp.pdf>. June.

jointly by Canada and the United States and signed in 1997. Recognizing the long-term nature of virtual elimination, the Strategy provided a framework for actions from 1997 to 2006 to achieve quantifiable reduction "challenges" for specific toxic substances, including mercury. These milestones were to be achieved through voluntary efforts and through regulatory actions under environmental laws in both countries. This was the first time that specific pollution prevention targets had been set jointly by these two countries, although the goals applied to each country separately.

The Great Lakes Binational Toxics Strategy established a mercury reduction workgroup of federal, state, provincial and local government staff, together with members from industry and environmental groups. This workgroup followed a four-step process: developing information on mercury in the Great Lakes environment, reviewing existing programs and regulations, identifying opportunities for cost-effective reductions, and implementing actions.

United States: Challenge and Activities, 1997–2006

The US challenge under the Strategy was to reduce both mercury air emissions and mercury use nationally by 50 percent by 2006 using its national emissions inventory from 1990 as a baseline. By 1997 the US had already reduced industrial use of mercury by 83 percent from 1980 levels, with the largest remaining national use of mercury to be found in chlorine production. The US reduction goals under this challenge were met ahead of the target date. Mercury air emissions in the US declined 57 percent from 1990 to 2005, the chlor-alkali industry reduced its use of mercury by 97 percent between 1995 and 2008, and use of mercury in all other productive sectors dropped 47 percent between 2001 and 2007.

The reduction in mercury air emissions between 1990 and 2005 resulted primarily from compliance with national regulatory requirements. In 1990 the top three US sources of mercury emissions were coal-fired power plants, municipal solid waste combustors and medical waste incinerators. During the next fifteen years, EPA issued rules to limit mercury emissions from large and small municipal solid waste combustors, medical waste incinerators, mercury-cell chlor-alkali manufacturing plants, and commercial and industrial solid waste incinerators. By 2005, municipal waste incinerators had reduced mercury emissions by 96 percent and medical waste incinerators, 99 percent. The rules for commercial and industrial solid waste incinerators were issued in 2000 and implemented in 2005, but updated rules with more stringent mercury limits for these commercial and industrial incinerators are expected to be published in 2012.[14]

Significant voluntary efforts were also initiated under the Great Lakes Binational Toxics Strategy in two industry sectors: chlorine manufacturers and health care facilities. Through the Chlorine Institute, the US chlor-alkali industry committed itself to reducing its use of mercury by 50 percent between 1995 and 2005, a goal that it more than surpassed. The Chlorine Institute's

[14] See <www.epa.gov/airquality/combustion/actions.html>. For other sources, see: <www.epa.gov/wastes/nonhaz/municipal/wte/airem.htm>, <www.epa.gov/wastes/hazard/tsd/td/combustion.htm - emissions>, and <www.epa.gov/ttn/atw/129/mwc/rimwc.html>.

final annual report to EPA shows a drop in total annual mercury use of 97 percent between 1995 and 2008, and a 94 percent reduction in mercury use per ton of chlorine produced.[15] A voluntary program called Hospitals for a Healthy Environment (H2E) began under the Strategy as a partnership among EPA, the American Hospital Association (AHA), the American Nurses Association, and Health Care Without Harm. This partnership encouraged hospitals to eliminate the use and purchase of mercury-containing products such as measurement and control devices, and to properly dispose of mercury-containing products currently in health care facilities. EPA financially supported the highly successful H2E Program through 2006; at that time, this partnership group evolved into an independent, nongovernmental organization called Practice Greenhealth, which has continued to grow.[16]

Canada: Challenge and Activities, 1997–2006

The Canadian Challenge was to seek a 90-percent reduction in the release of mercury by 2000, or where warranted, in the use of mercury, from polluting sources resulting from human activity in the Great Lakes Basin. In Ontario, releases of mercury were reduced by more than 90 percent from the 1988 baseline to 2006 levels, thus achieving the Canadian reduction target.[17] The Ontario 2006 mercury inventory shows that a total of 1.38 tons of mercury was released from a number of anthropogenic sources. These sources include coal-fired power plants, iron and steel production, cement and lime industry, municipal sectors, incineration, the use of mercury-containing products, etc. This represents a reduction in releases of approximately 12 tons since 1988.

The significant reductions of mercury releases are the results of regulatory and voluntary initiatives. Mercury emissions from coal-burning power plants in Ontario have decreased by approximately 55 percent between 1988 and 2006.[18] Many factors contributed to the significant reduction: the closure of some coal-fired power plants; installation of emission control technologies; the reduced use of coal and the increased use of alternative energy sources, etc. The Province of Ontario promulgated Regulation 496/07 that requires the four power plants to cease using coal for electricity generation after 31 December 2014.[19]

It is worth noting that there have been mercury reductions from a few other industrial sectors. Canada-wide Standards for mercury exist for some source sectors, such as mercury-containing lamps, base metal smelting, incinerators, and coal-fired electric power generation. As a result,

[15] Chlorine Institute, Inc. 2009. Chlor-Alkali Industry. 2008 Mercury Use and Emissions in the United States (Twelfth Annual Report). August. pp. 2–3. See: <www.epa.gov/region5/mercury/pdfs/12thcl2report.pdf>.
[16] <practicegreenhealth.org/>
[17] Great Lakes Binational Toxics Strategy, 2009 Biennial Report, Environment Canada <publications.gc.ca/site/eng/383918/publication.html>, p. 3.
[18] Op. cit., p. 8.
[19] Ontario Regulation 496/97 made under the Environmental Protection Act, 22 August 2007.

the mercury content in fluorescent lamps has decreased by more than 74 percent and mercury emissions from incineration have decreased by over 70 percent between 1988 and 2006.[20]

The Province of Ontario's Amalgam Waste Disposal Regulation 196/03 requires all dental offices to comply with the *Standard of Practice of the Profession for Amalgam Waste Disposal* as published and amended from time to time by the Royal College of Dental Surgeons of Ontario. As a result, all the dental offices in Ontario have installed amalgam separators as of 2008. Furthermore, Environment Canada published final Pollution Prevention Notice in May 2010 that requires all Canadian dental offices to prepare and implement pollution prevention plans for mercury releases from dental amalgam waste. The plans must take into consideration the Best Management Practices for Dental Amalgam Waste, including installing and maintaining an amalgam separator and arranging a carrier for the waste. The majority of the dental offices in Ontario have not only installed the amalgam separators but also implemented all the Best Management Practices for the proper management and disposal of the contact amalgam waste (that found in dental restorations), non-contact (scrap) amalgam waste, and free elemental mercury.

The extended recycling programs in Ontario make it more convenient for consumers to drop off certain used mercury-containing products, thus promoting reduction of mercury releases from products. Two examples are the "Take Back the Light" and the "Switch the 'Stat" programs. The "Take Back the Light" program, administered by the Recycling Council of Ontario, had recycled a total of 3,060,310 fluorescent lamps as of early November 2011.[21] In addition, Canadian Tire participates in the Take Back the Light program. Consumers in Ontario can drop off used compact fluorescent lights to 200 Canadian Tire locations in Ontario, beginning in June 2010. A few other return-to-retail programs for compact fluorescent lamps are operated in Ontario, such as Home Depot, Rona and IKEA. The "Switch the Stat Program" run by Summerhill Impact in British Columbia, Ontario, and Manitoba has recycled a total of 45,872 thermostats to date.[22] Besides the above recycling programs, certain municipalities in Ontario accept used fluorescent light bulbs, thermometers, thermostats, and other mercury-containing devices from residents.

GLBTS Mercury Workgroup Closeout

The Great Lakes Binational Toxics Strategy mercury workgroup remained active through 2008, and helped coordinate significant efforts in Canada and the US to eliminate the use of mercury thermometers, to promote best mercury waste management practices for dental offices, and to promote better management of automobile mercury switches.

Conference of New England Governors and Eastern Canadian Premiers

In 1998 the Conference of New England Governors and Eastern Canadian Premiers (NEG-ECP) adopted a northeast regional, binational Mercury Action Plan (MAP) that established a 50-

[20] See Great Lakes Binational Toxics Strategy [see fn 17], p. 8 and *passim* for data cited in this and the following section.
[21] See: <www.takebackthelight.ca>.
[22] As of early November 2011. See: <www.switchthestat.ca>.

percent air emissions reduction target to be achieved by 2003.[23] A Mercury Task Force (MTF) was established to oversee the implementation of the regional mercury program; initiate and coordinate research, policy and technical work to achieve the goals of the MAP; report regularly to the region's political and environmental agency leaders on the status of mercury initiatives in the region and on needed refinements to the MAP; address new mercury issues; and otherwise lead the regional discussion on policy and science related to mercury. In 2002 a second milestone goal was established for the MAP, calling for a 75-percent reduction in regional mercury air emissions by 2010. In addition to these broad goals, the MAP included commitments to specific air emission limits for municipal solid waste combustors and medical waste incinerators that were considerably more stringent than federal requirements at the time, and also directed the jurisdictions to develop and implement strategies to promote maximum economically and technically feasible reductions in mercury air emissions from the utility sector.

The plan also addressed commercial products containing mercury and was a catalyst for extensive legislative efforts in the northeastern states that have required: labeling of products to which mercury has been added; manufacturer support for recycling programs; restrictions and phase-outs of many unnecessary uses of mercury in products; notification of continuing sales of products to which mercury has been added; among other provisions. The MAP also addressed issues related to the presence of mercury in schools, with extensive educational and mercury clean-out activities in the participating jurisdictions. Mercury pollution attributable to the dental sector was also targeted, with the MTF developing specific targets for amalgam separator use. Legislative and regulatory requirements were subsequently established in all the northeast states and more than 95 percent of dentist offices that generate amalgam-contaminated wastewater now have pollution controls installed.

Substantial reductions have now been achieved in mercury air emissions from most of the major point sources in the northeast region. By 2003, estimated regional mercury emissions in New England and eastern Canada were reduced by approximately 55 percent compared to a mid-1990s baseline, thus exceeding the 50-percent reduction target set for 2003. These reductions were achieved primarily from three major source categories: municipal solid waste combustors (a 84-percent reduction); medical waste incinerators (a 98-percent reduction); and coal-fired utility boilers (a 10-percent reduction). In addition, emissions from regional chlor-alkali facilities have been reduced by 93 percent. Currently, all jurisdictions in the region are also implementing efforts to significantly reduce mercury emissions from power plants. For example, Massachusetts' regulations require emissions control systems that will achieve levels of 85 percent control by 2008 and 95 percent by 2012, and Connecticut legislation requires 90-percent emissions control to have been achieved by 2008. The MTF currently estimates that overall the region has achieved the 2010 75-percent reduction target, with some states achieving levels of 80–90 percent.

[23] More details on the MAP and accomplishments can be found at <www.ncbi.nlm.nih.gov/pubmed/15931956> and <www.newmoa.org/prevention/mercury/>.

At the direction of the New England Governors and Eastern Canadian Premiers (NEG-ECP) Mercury Task Force, and with funding from state agencies in Massachusetts, Maine and New York, the Northeast States for Coordinated Air Use Management (NESCAUM) collected additional data to be used in refining mercury air emission factors for calculating emission levels from distillate and residual fuel oil combustion in the northeast states. New York State provided the majority of the funding for sample collection and analysis. This effort was deemed a priority because the existing oil combustion emission factors were based on very few samples and were considered inaccurate. The oil combustion emission factor project began in 2008 and a final report was recently published.[24] This assessment concluded that the initial mercury emission factors for these fuels in the northeast US were significantly overestimated. The regional emission inventory update is now underway using these revised estimates as well as current data on emissions from major point sources. A preliminary assessment completed in 2010 indicated that the region had likely achieved the 75 percent 2010 air emission reduction goal. A more up-to-date and refined inventory update is underway.

The northeast states also completed a regional total maximum daily load (TMDL) assessment for mercury, a calculation of the maximum amount of mercury pollution that water bodies can receive and still maintain a fish population that is safe to eat.[25] This assessment, required under the US Clean Water Act, concluded that anthropogenic mercury inputs to many of the region's lakes and ponds will need to be reduced more than 87 percent to restore safe levels in fish for human consumption. TMDLs completed for the states of New Jersey and Minnesota reached similar conclusion.[26] Encouragingly, ongoing strategic environmental monitoring of mercury levels in freshwater fish in Massachusetts over the past decade are demonstrating significant improvements that have occurred coincident with regional and national efforts to reduce mercury emissions.[27] Despite these improvements, however, levels remain too high and all northeastern US jurisdictions continue to post mercury fish consumption advisories covering thousands of lakes, ponds and reservoirs, and tens of thousands of river miles. These findings support the aggressive reduction goals of the NEG-ECP MAP and emphasize the continuing need for mercury pollution reductions, in particular, for further national and international actions.

[24] NYSERDA and NESCAUM. 2010. Determination of Sulfur and Toxic Metals Content of Distillates and Residual Oil in the State of New York. New York State Energy Research and Development Authority and New England States for Coordinated Air Use Management. December. See: <www.nescaum.org/topics/emissions-inventories>.

[25] G. Rice and J.K. Hammitt. 2005. Economic Valuation of Human Health Benefits of Controlling Mercury Emissions from US Coal-Fired Power Plants. February. NESCAUM. Section 3.3, *passim.* <www.nescaum.org/documents/rpt050315mercuryhealth.pdf>.

[26] TMDLs for these states can be accessed through many sources, among them: <www.nj.gov/dep/wms/bear/tmdls.html> and <www.pca.state.mn.us/index.php/water/water-types-and-programs/minnesotas-impaired-waters-and-tmdls/phosphorus-and-mercury-issues/statewide-mercury-tmdl-pollutant-reduction-plan.html?menuid=&redirect=1>.

[27] See Northeast Regional Mercury Total Maximum Daily Load. 2007. <www.mass.gov/dep/water/resources/mertmdl.pdf>, pp. 38 and 42.

Action Item 1: Management of Atmospheric Emissions of Mercury

NARAP goals:

- Aim for a 50-percent reduction nationally in mercury emissions by the year 2006 from existing major stationary sources based on 1990 or equivalent emissions inventories;
- By 2005, implement maximum achievable atmospheric reduction technology or strategy for new major stationary sources;
- Investigate options and strategies to reduce emissions from the electric power generating sector, consistent with the 50 percent overall reduction target; and
- Develop data collection and reporting protocols to determine the significance of atmospheric mercury emissions from other sources.

CEC Trinational Reports

Great Lakes Long-Range Transport Workshop

In September 2003, together with the EPA, Environment Canada, and the US/Canada International Joint Commission (IJC), the CEC co-sponsored the "Great Lakes Binational Toxics Strategy Long-Range Transport workshop: The Atmospheric Pathway of Toxic Substances to the Great Lakes." The workshop reviewed the latest research on the global fate and cycling of persistent toxic substances, identified critical knowledge gaps, and provided recommendations on future activities necessary to adequately address long-range transport. Although the workshop wasn't exclusively about mercury, the workshop recommendations were relevant for future mercury activities in the Great Lakes basin.

North American Power Plant Air Emissions

In 2004, the CEC report, "North American Power Plant Air Emissions," provided a snapshot of air pollutant information for individual fossil fuel-fired power plants across North America for the year 2002.[28] This report provided the first region-wide compilation of information on the environmental performance of individual power plants in each country, including mercury emissions. The report found that power plants in Canada, Mexico and the United States contributed 25, 3, and 40 percent, respectively, of the countries' total industrial mercury emissions in 2002.

In October 2011, the CEC published an updated version of this report.[29] The aim of both reports was to present, in condensed form, updated, publicly available information on the release of specific air pollutants and greenhouse gases from individual plants burning fossil fuels for

[28] Paul J. Miller and Chris Van Atten. 2004. North American Power Plant Air Emissions. Commission for Environmental Cooperation. See <www.cec.org/Storage/56/4876_PowerPlant_AirEmission_en.pdf>.

[29] The new updated CEC report was published in October 2011. See <www.cec.org/temp/power_plants_english_web.pdf>.

electricity generation in North America, in order to improve the data collected and increase the comparability and public availability of North American environmental information. The most recent year for which data from the three countries were available was 2005; therefore, all the information presented in the updated report is for 2005 unless otherwise specified. This report further improves our understanding of North American power plant emissions and their associated environmental and human health impacts for the region, and supports decision-making relative to reducing and preventing pollution from this sector.

Canada

Guidelines/Regulations for Major Stationary Source Emission

Over the past several decades, Canada has implemented a wide range of regulatory and non-regulatory initiatives in collaboration with provincial and territorial governments, industry and other stakeholders. A summary of these initiatives is included below in Figure 2.

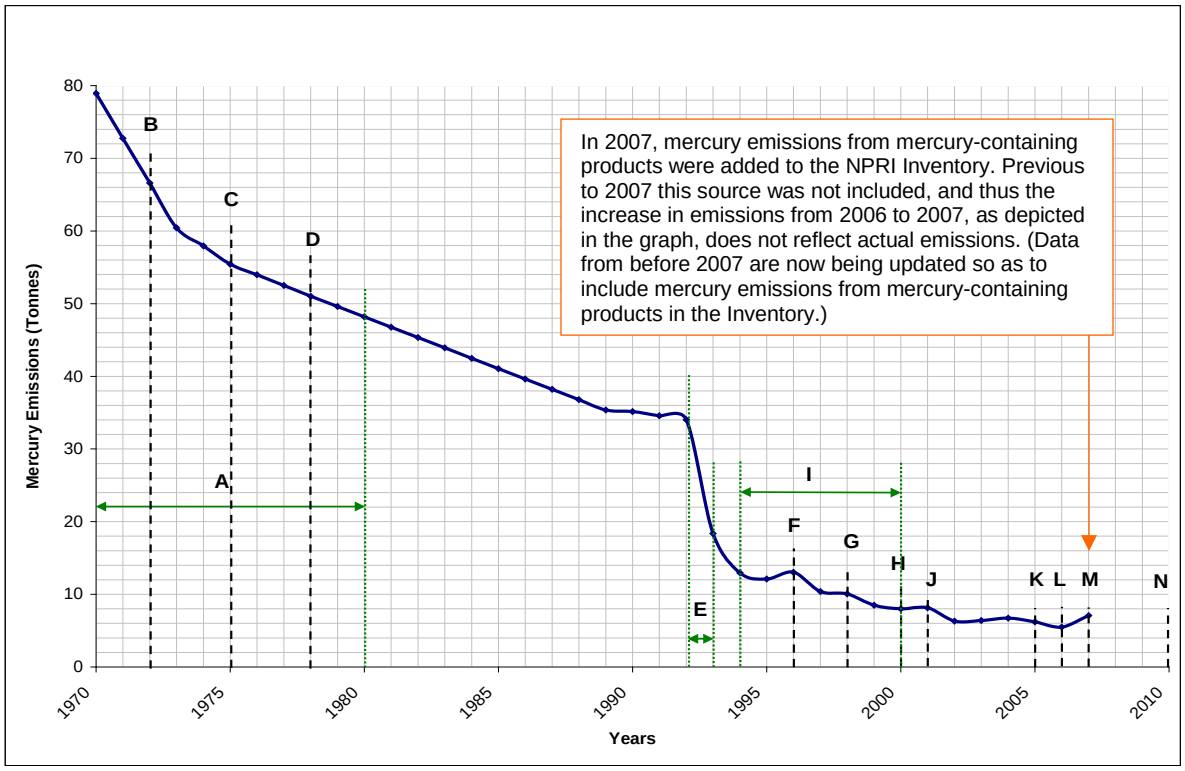
As a result of these actions, domestic mercury emissions have been reduced by approximately 90 percent since the 1970s and by more than 80 percent between 1990 and 2006.

Electric Power Generation

The coal-fired electric power generation sector is the largest remaining anthropogenic source of mercury emissions in Canada. In 2006, the Canadian Council of Ministers of the Environment (CCME) established the *Canada-wide Standards for Mercury Emissions from Coal-Fired Electric Power Generation Plants*, which set both provincial caps on emissions from existing plants (capture levels that will amount to a 60 percent national capture of mercury from coal combustion, or 70 percent that includes recognition for early action), and capture rates or emission limits for new plants based on best available technology.[30]

[30] CCME. 2006. October. Canadian Council of Ministers of the Environment. See <www.ccme.ca/ourwork/air.html?category_id=86>.

Figure 2. Canadian mercury emissions trend from 1970 to 2007



A	• 1970–1980: Closure of 10 of 15 mercury cell chlor-alkali facilities
B	• 1972: *Alkali Mercury Liquid Effluent Regulations* (*Fisheries Act*)
C	• 1975: Closure of the Pinchi Lake primary mercury mine in 1975
D	• 1978: *Chlor-Alkali Mercury National Emissions Standards Regulations* (*Clean Air Act*)
E	• 1992–1993: Process change by the Hudson Bay Mining and Smelting Co. facility in Flin Flon, Manitoba
F	• 1996: *National Guidelines for the Use of Hazardous and Non-Hazardous Wastes as Supplementary Fuels in Cement Kilns*
G	• 1998: *National Emission Guideline for Cement Kilns* • 1998: Mercury-based pesticide active ingredients no longer registered for use
H	• 2000: *Canada-wide Standards for Mercury Emissions from Incineration and Base Metal Smelting*
I	• 1994–2000: Accelerated Reduction/Elimination of Toxics program
J	• 2001: *Environmental Code of Practice for Integrated Steel Mills* and *Environmental Code of Practice for Non-Integrated Steel Mills* • 2001: *Canada-wide Standard for Mercury-Containing Lamps* • 2001: *Canada-wide Standard on Mercury for Dental Amalgam Waste*
K	• 2005: *Surface Coating Materials Regulations* (*Hazardous Products Act*)
L	• 2006: *Canada-wide Standards for Mercury Emissions from Coal-Fired Electric Power Generation Plants* • 2006: *Environmental Code of Practice for Base Metals Smelters and Refineries* • 2006: *Notice Requiring the Preparation and Implementation of Pollution Prevention Plans in Respect of Specified Toxic Substances Released from Base Metals Smelters and Refineries and Zinc Plants* • 2006: Cosmetic Ingredient Hotlist (2006) of the *Cosmetic Regulations* under the *Food and Drugs Act*
M	• 2007: *Notice Requiring the Preparation and Implementation of Pollution Prevention Plans in Respect of Mercury Releases from Mercury Switches in End-Of-Life Vehicles Processed by Steel Mills*
N	• 2010: *Notice Requiring the Preparation and Implementation of Pollution Prevention Plans In Respect of Mercury Releases from Dental Amalgam Waste*

Source: Environment Canada and Health Canada. 2010. Risk Management Strategy for Mercury, Figure 7. <www.ec.gc.ca/doc/mercure-mercury/1241/index_e.htm>.

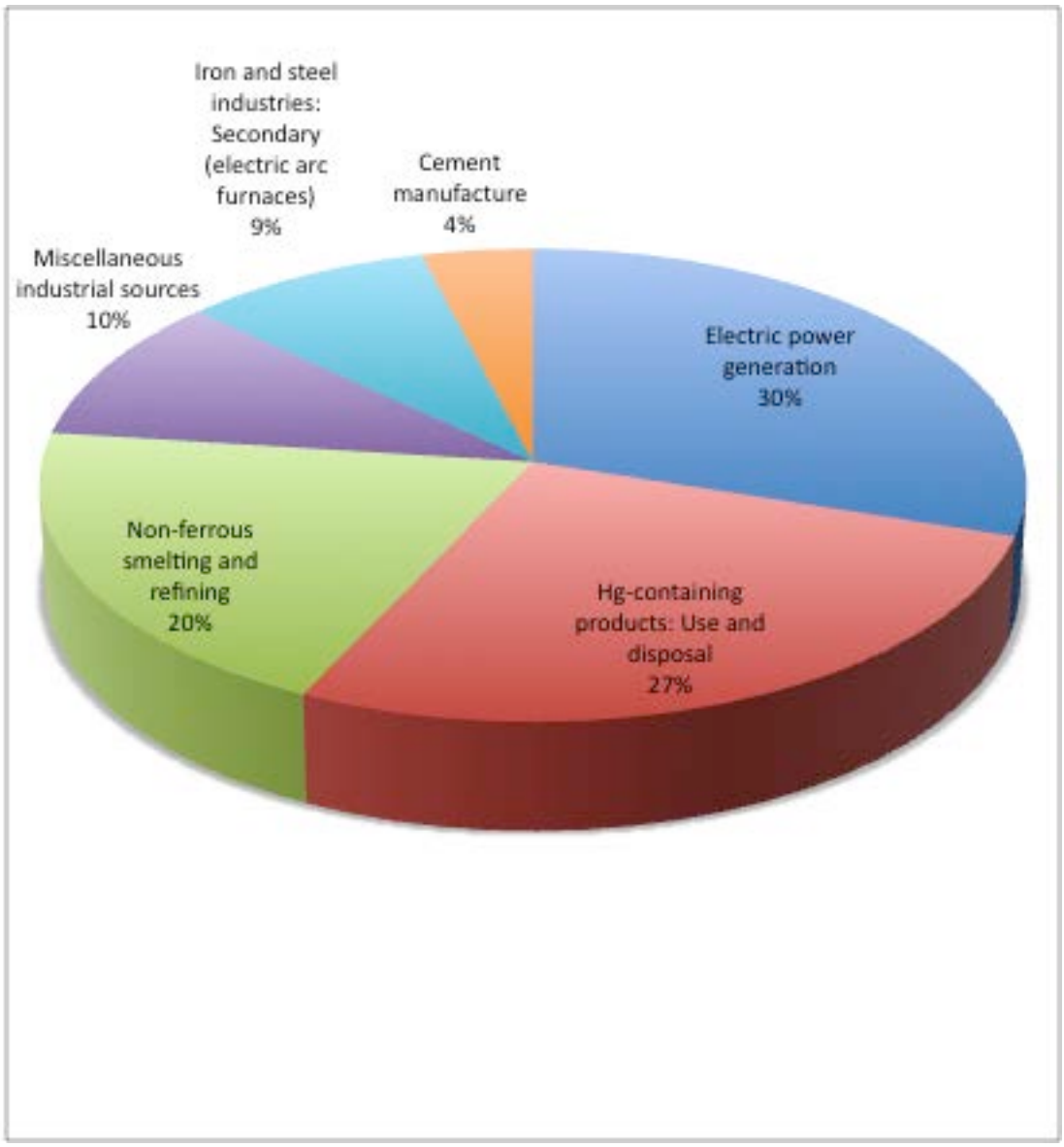
Reporting

The National Pollutant Release Inventory (NPRI) is Canada's legislated, publicly accessible inventory of pollutant releases (to air, water and land), disposals, and transfers for recycling. Releases of mercury have been reported since 1995 for the 1993 reporting year onward. For reporting to the NPRI in 2010, Environment Canada is collecting new information on mine tailings and waste rock releases for the years 2006 through 2009. This reporting will continue annually. With the new requirements, facilities must now report not only the quantities of NPRI substances released to the environment from the mine, but also the quantities of NPRI substances contained in the waste rock and tailings disposed of at the mine or transferred off-site for disposal (NPRI 2010).

In 2000, a lowering of the NPRI reporting threshold for mercury (from 10 tons down to 5 kg per year) resulted in a 20-fold increase in the number of facilities reporting mercury releases to air, water, and land. These facilities include many lesser source categories.

The pie chart below (Figure 3) illustrates the source profile of Canadian mercury emissions in 2007.

Figure 3. Anthropogenic Sources of Canadian Atmospheric Mercury Emissions, 2007 (year total = 7 metric tons)



Source: Environment Canada and Health Canada. 2010. Risk Management Strategy for Mercury, Figure 5. <www.ec.gc.ca/doc/mercure-mercury/1241/index_e.htm>.

Provincial and Regional Activities

In addition to federal regulations, the provinces and territories of Canada have legislation, regulations and guidelines for mercury, covering liquid effluent, drinking water and emissions

from industrial sources. Many of the regulations and acts are very similar. However, as a result of Canada's differing geographic considerations, the provincial and territorial regulations surrounding mercury tend to differ slightly between jurisdictions.

An example of a provincial initiative is the Ontario's work to phase out coal combustion in power plants by 2014. Ontario Power Generation currently has four coal-fired power stations in operation. Ontario provincial regulation ON 496/07 requires that plants stop burning coal for electricity generation after 31 December 2014.[31]

Quebec has compiled an annual inventory of atmospheric emissions of mercury since 1995.

Mexico

Although the mercury NARAP enshrined a 50-percent mercury emissions reduction target from 1990 levels for each of the three countries, to date Mexico has not able to determine the percentage reduction it has achieved for its emission sources due the absence of a 1990 mercury emissions baseline. In addition, the process of developing and validating information sources that would enable an adequate emissions characterization has been gradual. Nonetheless, during the last ten years, three important initiatives to characterize mercury releases have been completed. These are:

- The Preliminary Atmospheric Emissions Inventory of Mercury in Mexico, referenced to the year 1999.[32] It includes estimates for 24 source sectors that emitted approximately 31.29 metric tons of mercury to the atmosphere in 1999, although more than 82 percent of the total emissions came from only three sectors: (1) mining and refining of gold, (2) secondary mercury production, and (3) chlor-alkali plants.
- A more comprehensive mercury releases national inventory was completed in 2008,[33] based on 2004 data (to which UNEP's standardized "Toolkit" was applied[34]). According to this inventory, air emissions were estimated to be 50.46 metric tons from 31 emission sources. It also provides estimates of emissions to water (6.13 metric tons), land (185.66 metric tons), waste (185.33 metric tons) and mercury-containing products (20.35 metric tons) for a total of 447.97 metric tons. It is important to note that these numbers are provisional, as they were calculated with UNEP Toolkit emission factors and INE and some industrial sectors in Mexico are currently discussing possible revisions to them.

[31] Additional provincial and territorial environmental legislation pertaining to mercury is available at <www.ec.gc.ca/mercure-mercury/default.asp?lang=En&n=18223A2F-1>.

[32] Acosta y Asociados. 2001. Preliminary Atmospheric Emissions Inventory of Mercury in Mexico. Final Report. Prepared for: Commission for Environmental Cooperation. Available at: <www.cec.org/Storage/55/4762_MXHg-air-maps_en.pdf>.

[33] INE- SEMARNAT. Inventario Nacional de Liberaciones de Mercurio 2004, Informe Final. México. 2008 México 2004 Prepared by: Pablo Maíz, La Dirección General del Centro Nacional de Investigación y Capacitación Ambiental,
INE -SEMARNAT

[34] United Nations Environmental Programme. Toolkit for Identification and Quantification of Mercury Releases. Pilot Draft. November 2005. Issued by UNEP Chemicals. Geneva, Switzerland.

There are significant differences between these two inventories:

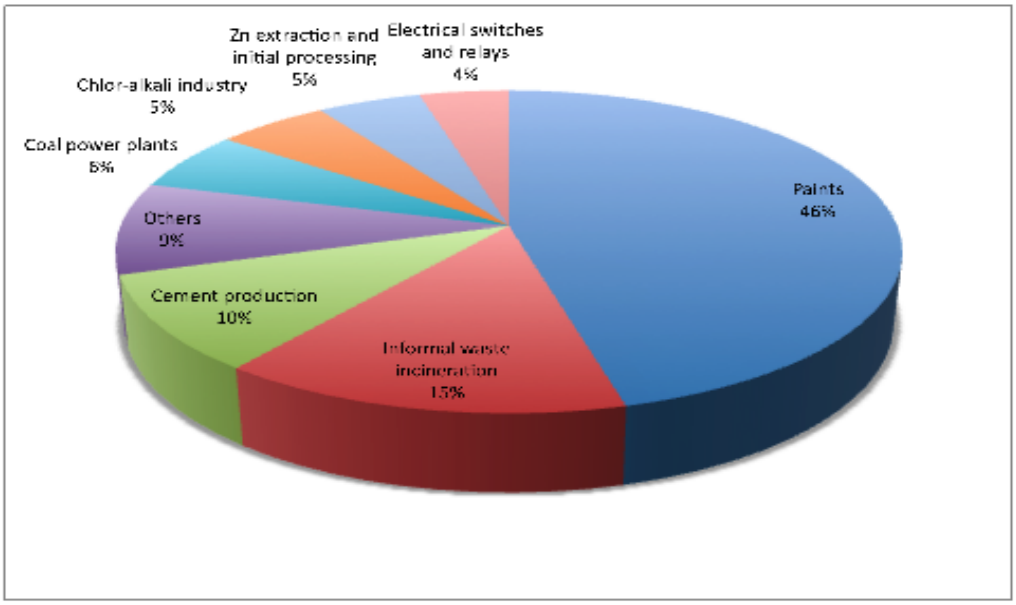
- The selected year (1999 versus 2004).
- The input, distribution and/or emission factors and/or calculation methods differ. The 2004 Inventory is based on the UNEP Toolkit while the 1999 inventory is mostly based on US EPA emission factors and estimating methods.
- The 1999 Mercury Inventory included only emissions to air, while the 2004 Inventory includes releases to all possible media.
- The 1999 Mercury inventory does not include estimation of uncertainty.

- The third important initiative is the release of 2004 data from Mexico's *Registro de Emisiones y Transferencia de Contaminantes*—RETC),[35] published in 2008, which represents a stage in the continuing development of a national pollutant release and transfer register that Mexico has conducted with CEC support. To produce the RETC report, Semarnat compiles and validates data on 104 [78] substances reported by facilities to the Register, including mercury and its compounds.[36]

Sectoral mercury emissions reported to the 2008 Mexican RETC inventory, based on 2004 data, are given in Figure 4.

[35] At the time of this writing the most recent data available were from 2004 (released in 2005) and published in: Semarnat, 2008. *Informe Nacional del Registro de Emisiones y Transferencia de Contaminantes*, RETC, 2005. Mexico. Available at:. Currently, the most recent data available (published in December 2010) are for 2008. See: <app1.semarnat.gob.mx/retc/index.html>.
[36] RETC regulations list 104 substances for mandated reporting. In practice, however, the number actually reported by the facilities is more typically about 78, as shown on the RETC website (link in previous footnote).

Figure 4. Mexican Atmospheric Emissions, 2004 (year total = 50 metric tons)



Source: 2008 Mexican RETC Inventory, based on 2004 data.

As previously mentioned, these results are being discussed with each of the sectors involved in significant emissions, and therefore their individual participation might vary in the resulting version of the Mexican inventory.

Comparability and analysis of emissions sources among the three mentioned information sources is difficult. However, the main emission sectors were identified and they should be encouraged to consider an adequate characterization and assessment in order to determine a reduction rate, considering that Mexico has not established any percentage of reduction for its mercury atmospheric emissions to date.

With regard to regulations, Mexico has passed atmospheric emission standards only for the cement production and hazardous waste incineration sectors. There are no guidelines or equivalent for major stationary sources such as power plants, ferrous/non-ferrous metal smelters, and others.

Electric Power Generation

In 2004, the CEC published a report on North American Power Plant Air Emissions for the year 2002.[37] It includes atmospheric emissions of mercury for the only three coal-fired power plants in Mexico. According to this report, each plant emitted over 300 kg of mercury in 2002, for a

[37] Paul J. Miller and Chris Van Atten. 2004. (See fn. 27.)

total of 1.02 metric tons. Nevertheless, the media informed in May 2010 that the *Comisión Federal de Electricidad* (CFE), the Mexican state-owned power company, would be building three new coal-fired power plants before 2024 in Mexico (one 678 MW and two 700 MW plants), which will increase coal combustion from 10.8 million metric tons/year in 2010 to 25.6 million metric tons/year in 2024.

United States

Mercury air emissions from US domestic sources have declined substantially since 1990 due to both regulatory and non-regulatory measures. Total estimated mercury emissions were reduced by 58 percent between 1990 and 2005, from 224 metric tons to 95 metric tons respectively, according to the version of the 2005 National Emissions Inventory (NEI) updated for the new Mercury and Air Toxics Rule for coal-fired power plants. This decline in mercury air emissions has also continued beyond 2005. Data from the EPA Toxics Release Inventory (TRI) show an eleven percent decrease in mercury air emissions from major US industry sectors between 2005 and 2008, from 63 metric tons to 56 metric tons. Although the TRI and NEI databases are not directly comparable because they cover different emission sources, they both show a consistent trend of decreasing mercury air emissions from sources in the United States. Mercury air emissions in the US can be expected to continue to decrease as EPA and the states develop new rules to strengthen existing mercury limits and control additional sources of mercury emissions.

During the past two decades, EPA has focused most of its mercury reduction efforts on large point sources of air emissions. In 1990 the top three sources of mercury emissions were coal-fired utility plants, municipal solid waste combustors and medical waste incinerators. The significant overall decline in mercury emissions since 1990 has been primarily due to reductions at medical waste incinerators and municipal solid waste combustors, which by 2005 had decreased by 99 percent and 96 percent respectively.

Regulations for Major Stationary Source Emissions

Federal regulatory limits on mercury air emissions have been established for numerous US industries. The list below indicates the promulgation dates for EPA regulations and amendments for each type of industry source.

- Large municipal waste combustors: 1995 (amended 2006)
- Hospital/medical/infectious waste incinerators: 1997 (amended 2009)
- Commercial and industrial solid waste incinerators: 2000
- Small municipal waste combustors: 2000
- Mercury-cell chlor-alkali manufacturing plants: 2003
- Hazardous waste combustors: 2005
- “Other” solid waste incinerators: 2005
- Electric arc furnaces at steelmaking facilities: 2007*
- Portland Cement manufacturing: 2010
- Gold mines: 2011

- Sewage sludge incinerators: 2011
- Industrial, commercial and institutional boilers: 2011
- Commercial and industrial solid waste incinerators: 2011
- Coal-fired electric power plants: 2011
- Industrial, commercial and institutional boilers: 2011
- Commercial and industrial solid waste incinerators: 2011
- Coal-fired electric power plants: 2012

*The 2007 rule for electric arc furnaces included a work practice to reduce mercury emissions but did not include an air emissions limit for mercury.

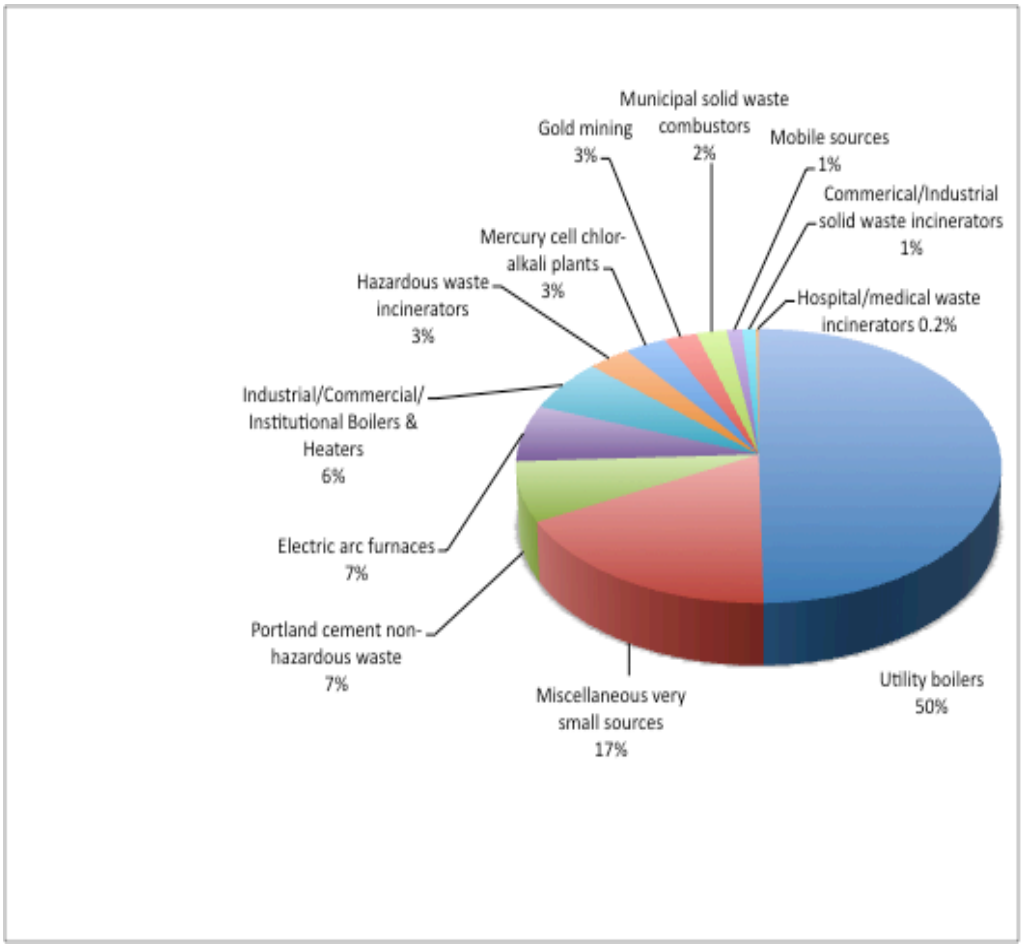
During the next few years, EPA plans to revise existing limits, or create new limits, for mercury air emissions from the following sources:

- Industrial, commercial and institutional boilers (revised): 2012
- Commercial and industrial solid waste incinerators (revised): 2012
- Mercury-cell chlor-alkali manufacturing plants
- Electric arc furnaces at steelmaking facilities
- Integrated iron and steel facilities
- Taconite iron mines

Electric Power Generation

Coal-fired electric utilities remain by far the largest US source of mercury air emissions. This industry sector alone accounted for about 50 percent of all anthropogenic air emission sources of mercury in 2005. In 2005 EPA issued a regulation to reduce mercury emissions from coal-fired power plants using a market-based cap-and-trade strategy, but this rule was overturned in 2008 by a US federal court. In February 2012, EPA promulgated a new facility-specific performance standard to reduce emissions of mercury and other hazardous air pollutants from power plants. This rule is referred to as the Mercury and Air Toxics (MATS) rule. Figure 5 summarizes the most recent data on US atmospheric mercury emissions that have been updated for the MATS rule.

Figure 5. US Atmospheric Mercury Emissions, 2005 (year total = 95 metric tons)



Source: 2005 US National Emissions Inventory, updated for the Mercury and Air Toxics Rule (MATS) development.

Reporting

EPA manages two important national databases that provide data on mercury air emissions: the National Emissions Inventory (NEI) and the Toxics Release Inventory (TRI). However the use and scope of these two databases are very different. The NEI is a national database of air emissions information designed to support EPA's scientific modeling and risk-assessment activities, whereas the TRI is a right-to-know database that serves primarily to inform communities and citizens of releases and other waste management practices of toxic chemicals where they live. The NEI contains air emission data for both stationary and mobile sources of hazardous air pollutants. The TRI primarily covers facilities in the manufacturing sector, and therefore does not contain all of the NEI categories. Requirements to submit data to the TRI are based on the quantities of a toxic chemical manufactured, processed or otherwise used annually, not on air emission thresholds as in the NEI.

The NEI is the primary source for air emissions data for the US. It is a national repository of emissions inventory data for all hazardous air pollutants listed in the 1990 Clean Air Act, including mercury and mercury compounds. The emissions data include estimates for stationary sources, fires, and mobile sources (including on-road and non-road equipment, commercial marine vessels, rail, and airport sources). The NEI is under constant review to improve data quality, and data are compiled and released to the public every three years. The NEI considers data from various sources, primarily State, Tribal and local government inventories, supplemented by other sources such as the TRI and data collection in the process of regulation development. As mentioned earlier, the latest available data on US mercury air emissions, shown in Figure 5, are based on 2005 NEI data updated for the MATS rule. Newer data on mercury air emissions, based on the 2008 NEI and other data sources, are expected to be released to the public in early 2012.

The TRI contains information on the quantities of certain toxic chemicals released annually from facilities to air, water and land, or otherwise managed as waste. The TRI was established by Congress in 1986 to increase the public's access to information on toxic chemicals released or managed as waste in local communities. In 2000, EPA lowered the reporting threshold amount for mercury from 25,000 pounds (11,343 kg) for manufacturing or processing and 10,000 pounds (4537 kg) for otherwise using mercury or a mercury compound to 10 pounds (4.5 kg) for manufacturing, processing or otherwise using mercury or a mercury compound within a calendar year. EPA makes the most recent TRI data and information available each year.

State and Regional (Multi-State) Initiatives

Many states have adopted mercury emission control regulations that are more stringent than federal requirements. These state rules cover a number of source categories such as municipal waste incinerators, electric arc furnaces, sewage sludge incinerators, medical waste incinerators and mining operations. At least thirteen states have passed laws or regulations addressing mercury emissions from coal-fired utilities.

The Great Lakes Regional Collaboration, a special national initiative, has developed a basin-wide strategy to further reduce mercury emissions in the Great Lakes region.[38] The focus of this effort is to reduce mercury emissions from sources not currently regulated and from regulated sources where additional reductions can be achieved. Examples of potential sources include manufacturing processes that produce mercury emissions and disposal processes for mercury-containing products. The strategy was drafted by staff from each of the Great Lakes states, US EPA, and interested tribes and cities, while also soliciting input from nongovernmental stakeholders. Work on the strategy began in 2008 and the result was made final on 7 December 2010. The Strategy includes a recommendation that each of the Great Lakes states consider requiring best available technology for all sources of annual mercury emissions of ten pounds or more.

[38] See <www.glrc.us/documents/MercuryEmissionsPhaseDownStrategy12-07-10.pdf>.

States in the northeast and Great Lakes areas have also participated in the binational activities of the Conference of New England Governors and Eastern Canadian Premiers and the Great Lakes Binational Toxics Strategy that were discussed at the beginning of this chapter.

Action Item 2: Management of Mercury in Processes, Operations and Products

CEC Trinational Reports

NARAP Goals:

- Stimulate life-cycle management practices and substitution options for mercury use in manufacturing processes and products, in order to minimize mercury releases to the environment; and
- Reduce and, where warranted, eliminate mercury use in the following specific sectors: automotive vehicle and equipment manufacturing; mercury cell chlor-alkali; dry cell battery manufacturing; electrical switches and relays; lamp manufacturing; health and dental care sector; cultural and artisanal uses; and analytical, testing, measurement, calibration and education sector.

In 2003, the CEC published a report titled *Mechanisms for Tracking Mercury Imports and Exports for Use and Disposal in Canada, Mexico and the United States.*[39] The report reviews and assesses the adequacy of existing methodologies and processes for tracking imports and exports of mercury products and wastes, with the goal of stimulating life-cycle management practices at the national level in each country.

Canada

Reports and Life-Cycle Management

Environment Canada's 2004 *Mercury-containing Product Stewardship: Manual for Federal Facilities* provides guidance on several aspects of managing mercury-containing products over their life cycle.[40] The 2005 document *Municipal Actions to Reduce Mercury*, published by the governments of Canada and Ontario, provides guidance on how to develop and implement municipal actions to reduce mercury releases from mercury-containing products. Both documents promote the development of facility mercury inventories that reflect the requirements of ISO 14011.[41]

In Canada, the proposed regulations prohibiting mercury-containing products in Canada will prohibit the import, manufacture and sale of all such products, with some exceptions for essential products with no viable alternatives such as dental amalgam and lamps.[42] The proposed regulations, anticipated to come into force in 2015, will also require annual reporting

[39] <www.cec.org/files/pdf/ECONOMY/Hg-tracking-Summary_en.pdf>
[40] <www.ec.gc.ca/Mercury/ffmis-simif/Manual/index.aspx?lang=E>
[41] <www.ec.gc.ca/MERCURY/MM/municipalActions/EN/main.cfm>
[42] Regulations Respecting Products Containing Certain Substances Listed in Schedule 1 to the Canadian Environmental Protection Act, 1999. See <www.ec.gc.ca/mercure-mercury/default.asp?lang=En&n=7EB39FAC-1>. Published 26 February 2011. Current status and comments at: <www.ec.gc.ca/default.asp?lang=En&n=714D9AAE-1&news=759D1A79-02BE-4A64-9E7F-6456F06D4385>.

and labeling for exempt products. Earlier actions include the 2000 phase-out of mercury use in domestic appliances manufactured in Canada.

Environment Canada's *Mercury and the Environment* website contains information on mercury-containing products, available substitutes and management options.[43]

Automotive Industry

For the automotive vehicle and equipment manufacturing sector, Canada's main initiative is the 2007 Notice, published under the *Canadian Environmental Protection Act, 1999*, requiring the preparation and implementation of pollution prevention plans in respect of mercury releases from mercury switches in end-of-life vehicles processed by steel mills.[44]

Chlor-alkali Industry

In 2008, the last remaining mercury cell chlor-alkali plant in Canada ceased operation and no new plants using the mercury cell process are expected to open. Federal-provincial cooperation continues with the province of New Brunswick on environmental impact and site assessments related to decommissioning this last mercury cell chlor-alkali plant.

Batteries

There are no domestic battery manufacturing facilities in Canada. However, it is not certain whether manufacturers of batteries imported from outside of North America have eliminated mercury use in alkaline batteries. The proposed regulations on mercury-containing products mentioned previously will prohibit the import, manufacture and sale of mercury-containing batteries, regardless of their point of origin.

Electrical Switches and Relays

The use of mercury switches in automotive manufacturing has been voluntarily phased-out in Canada, and the 2007 Notice cited above requires the preparation and implementation of pollution prevention plans for mercury switches in end-of-life vehicles that will be recycled in steel mills.[45] The import, manufacture and sale of mercury switches and relays will be regulated by the proposed regulations on mercury-containing products that are expected to enter into force in 2015.[46]

Lamps

The 2001 *Canada-Wide Standard for Mercury-containing Lamps* called for the average content of mercury in all mercury-containing lamps sold in Canada to be reduced by 70 percent in 2005 and 80 percent in 2010 from a 1990 baseline.[47] The proposed regulations on mercury-

[43] <www.ec.gc.ca/mercure-mercury>.
[44] Notice Requiring the Preparation and Implementation of Pollution Prevention Plans in Respect of Mercury Releases from Mercury Switches in End-of-Life Vehicles Processed by Steel Mills. 29 December 2007. See: <www.ec.gc.ca/planp2-p2plan/default.asp?lang=En&n=E8AFAE92-1>.
[45] See under "Automotive industry" and footnote 43.
[46] See footnote 41.
[47] <www.ec.gc.ca/MERCURY/MM/EN/mm-cws.cfm>.

containing products will also establish mercury content limits for various types of lamps and will require labeling to inform consumers and recyclers about the mercury content of lamps.[48]

The 2009 *Technical Recommendations Document on the Management of End-of-life Mercury-containing Lamps in Canada* makes recommendations on a national recycling framework for all end-of-life mercury-containing lamps.[49] Recommendations cover extended producer responsibility (EPR); responsibilities for financing, developing and operating recovery programs; and recovery rate targets. Canada expects to have the federal EPR regulations for mercury-containing lamps enter into force at the same time as Canada's proposed *Regulations Amending the Energy Efficiency Regulations*.

Health and Dental Care Sector

In the dental care sector, the 2001 *Canada-wide Standard on Mercury for Dental Amalgam Waste* calls for the installation of ISO 11143-certified separators and other best management practices to reduce releases of mercury from dentistry in Canada by 95 percent by 2005, from a 2000 baseline year.[50] In response to a 2007 Survey of Dentists indicating that the Standard had not been achieved, the *Notice Requiring the Preparation and Implementation of Pollution Prevention Plans in Respect of Mercury Releases from Dental Amalgam Waste* was published in May 2010 to ensure national implementation of the principles put forth in the 2001 Standard.[51]

In addition, the proposed regulations on mercury-containing products would prohibit mercury-containing thermometers, with an exemption for thermometers used for scientific research. Mercury-containing sphygmomanometers would also be prohibited unless they are required for calibration or as a reference in a clinical validation study.

Provincial and Regional Activities

In 2005, Environment Canada collaborated with Ontario's dental community and the Ontario Ministry of the Environment to develop the *Dental Wastes Best Management Practices Guide for the Dental Community*.[52]

Provincial programs related to the lamp manufacturing sector include Ontario's *Take Back the Light* program, which aims to recover and recycle the 30 million fluorescent lamps disposed of in the province each year from the industrial, commercial and institutional sectors.[53]

Other relevant initiatives undertaken in the Province of Ontario include developing dental best management practices and a mercury take-back, a mercury take-back for schools, a "white goods" recycling and collection program for appliances with mercury switches, a memorandum

[48] ibid.
[49] <www.ec.gc.ca/mercure-mercury/default.asp?lang=En&n=6213CB91-1 - techdoclamp>
[50] <www.ccme.ca/assets/pdf/cws_merc_amalgam_e.pdf>
[51] <www.ec.gc.ca/planp2-p2plan/default.asp?lang=En&n=EB42EEDF-1>
[52] This Guide seems to be no longer available while Environment Canada considers public comments on the Proposed Notice for Dental Amalgam Waste (January 2010). See: <http://www.ec.gc.ca/mercure-mercury/default.asp?lang=En&n=A9CC5880>.
[53] <http://www.takebackthelight.ca>.

of understanding and case studies with hospitals for replacing mercury-containing medical equipment, a survey of mercury reductions and replacement of laboratory equipment containing mercury.

Quebec adopted its Regulation Respecting the Recovery and Reclamation of Products by Enterprises for mercury batteries and lamps in 2011.[54]

Mexico

Mercury Life-cycle Management

In 2002 an *Assessment of Mechanisms in Mexico for Tracking Imports and Exports of Mercury for Use and Disposal* was developed for the CEC.[55] Its scope included the identification of existing national control and reporting mechanisms (manual or computerized) for imports and exports of mercury: a) used for processing and b) destined for recycling or final disposal. A conclusion of the report is that a variety of legal provisions in Mexico do establish procedures for regulation and control of operations involving mercury as well as for mercury-containing products and hazardous waste. This document represents an important starting point for the NARAP, especially for tracking possible movements of these mercury-containing materials from cradle to grave.

An important advance from the legal perspective is the issuance of the *General Act on Prevention and Comprehensive Management of Waste*, which entered into force 6 January 2004.[56] In its Title Four: *Policy Instruments for the Prevention and Comprehensive Management of Waste*, considers the development of *Handling Plans* for several hazardous wastes listed in its Article 31, including florescent lights and other mercury wastes, and requires that all mercury-containing products, when they are discarded, must be subject to collection and recycling programs organized by consumers, retailers, producers and recyclers.

Another document that will facilitate the assessment of mercury as a commodity and of the wastes containing it is the Mexican Mercury Market Report.[57] The CEC supported the development of this report, which compiled information on the historical and current supply of mercury, and the demand, trade, market characteristics, and trends in the quantities of elemental mercury and mercury-containing products in commerce. The report also identifies

[54] See Sections 2 and 3 at:
<http://www2.publicationsduquebec.gouv.qc.ca/dynamicSearch/telecharge.php?type=3&file=/Q_2/Q2R40_1_A.HTM>.

[55] Acosta y Asociados. 2002. *Assessment of Mechanisms in Mexico for Tracking Imports and Exports of Mercury for Use and Disposal.* Commission for Environmental Cooperation. Available at:
<http://www.cec.org/Storage/51/4348_Hg-Tracking-Mexico_en.pdf>.

[56] *Ley General para la Prevención y Gestión Integral de los Residuos, Título Cuarto: Instrumentos de la Política de Prevención y Gestión Integral de los Residuos.* Última reforma 19-06-2007.
<http://www.diputados.gob.mx/LeyesBiblio/doc/263.doc>.

[57] CEC. 2011. Mexican Mercury Market Report. August. Commission for Environmental Cooperation.
<http://www.cec.org/Page.asp?PageID=30101&ContentID=25056&SiteNodeID=403>.

market actors, consumers, producers and institutions and provides an estimate and status of mercury consumption in Mexico during 2007 for most of the sectors listed in NARAP Action Item 2.

Automotive Vehicle and Equipment Manufacturing Sector

Letters were sent to auto manufacturers in Mexico in 2004, requesting information on the use and phase-out of mercury switches in cars imported to or assembled in Mexico. No answers were received to these letters and there has been no follow-up since. No other actions have taken place in this sector.

Mercury Cell Chlor-alkali Sector

Mexico has reduced mercury usage in the mercury cell chlor-alkali industry by some 12.25 percent. In 2008, one Mexican chlor-alkali plant (MEXICHEM) in Santa Clara, State of Mexico, switched from mercury to membrane technology. Currently, the industrial group Cydsa operates two plants using mercury cells in the states of Veracruz and Nuevo León. The company has expressed interest in replacing its current technology, although it is looking for the necessary financial resources. This has been referred to the UNEP Global Mercury Partnership for the chlor-alkali sector. Estimated yearly consumption of mercury for this sector is around five metric tons and no new plants using the mercury cell process are expected to open.

Dry Cell Battery Manufacturing Sector

Mexico does not manufacture any dry cell batteries; thus no action has been taken in Mexico on control measures for determining mercury content in batteries. Also, no uniform sampling or standardized analysis protocol to determine mercury content levels has been developed; however, the Mexican standard that establishes the characteristics of hazardous wastes, as well as the procedure for identifying and classifying them, and lists them, also establishes a procedure to determine if a waste is hazardous. Mercury and mercury-containing wastes are regulated under this standard.[58]

Electrical Switches and Relays Sector

Mercury switches and relays are widely used in Mexico in different sectors and to date there are no regulations or guidelines to control or prohibit their sale and use. According to the Mexican Mercury Market Report, it is estimated that imports of these devices to Mexico, just in the period between July 2007 and June 2008, contained some 1.56 metric tons of mercury in switches and 10.7 metric tons in relays.[59] Absent proper recycling and disposal options, these quantities (yearly basis) may be released to the environment when these devices are discarded.

Lamp Manufacturing Sector

No action on establishing a uniform standard for maximum mercury concentration in lamps has been carried out in Mexico; the main lamp manufacturing companies (General Electric, Osram, and Philips) comply with environmental standards but major dealers and importers introduce poor quality fluorescent lamps into the country whose mercury contents should be evaluated.

[58] NOM-052-SEMARNAT-2005.
[59] Mexican Mercury Market Report, op. cit., pp. 63–65.

Because of concern about climate change, the Mexican Chamber of Representatives is in process of approving a law to eliminate use of incandescent bulbs. Considering that the most feasible replacement technology is the compact fluorescent light bulb (CFL), this project also considers the implementation of standards for mercury content in fluorescent lamps and modifications to the *General Act on Prevention and Comprehensive Management of Waste* related to the establishment of mandatory waste management plans for these lamps. The project is entitled "Sustainable Light Program," and it aims to replace 22.9 million incandescent lamps with CFLs in 2011 and a similar quantity in 2012. CFLs will be delivered at no cost in exchange for incandescent lamps.

According to the Mexican Mercury Market Report, it is estimated that mercury content in lamps manufactured in and imported into the country during 2007 represented approximately 0.5 metric tons.[60] To date, an adequate infrastructure for lamp recycling has not been developed yet in Mexico. Nevertheless, the lamp-manufacturing sector in Mexico has already presented a waste management plan to the environmental authorities.

Health and Dental Care Sectors

In Mexico, programs dedicated to encourage use of mercury alternatives and to mercury reduction or elimination started in 2007 under the initiative of two NGOs: Health Care Without Harm (HCWH) and the Center for Analysis and Action on Toxics and their Alternatives (CAATA), with the support of CEC. As a result of this initiative, on 5 November 2009, the municipal government of Mexico City announced the beginning of the mercury thermometer and sphygmomanometer substitution program in the entire heath care sector.[61] The CAATA initiative also has developed training materials on how to recover mercury spills due to thermometer breakage, and extended its substitution program to other Mexican states.

Mercury-free sphygmomanometers are being substituted in hospitals and other health facilities, although exact numbers in each type of facility is unknown.

In 2009, also with CEC support and under the initiative of Semarnat's General Bureau for Comprehensive Management of Hazardous Materials and Activities,[62] a national Comprehensive Management Plan for Mercury and Mercury-containing Waste in the Health Sector was developed and approved by the Working Group for the Mercury Retirement Project. This group includes representatives of the health and dental sector, academy, NGOs and the private sector, and was created specifically to deal with the mercury waste management issue.

In the dental sector, an unsuccessful initiative to address mercury releases from dental facilities in Mexican schools was implemented. Issues related to economic (high cost) and logistical problems precluded the development of this initiative.

[60] ibid., p. 66, Table 4-9.
[61] See <http://www.caata.org/mercurio.html>.
[62] *Dirección General de Gestión Integral de Materiales y Actividades Riesgosas*

An important issue is that commodity-grade, triple-distilled mercury for use in dentistry is also sold in pharmacies and in other stores that sell dental products. Besides being used in the oral health care sector, this mercury also has cultural and artisanal uses (see below).

Estimates compiled for the Mexican Mercury Market Report show that 15.2 metric tons of mercury are consumed in the health sector (2.4 metric tons in thermometers; 3.8 metric tons in sphygmomanometers, and approximately 9.0 metric tons in amalgam applications).[63]

Cultural and Artisanal Uses

As mercury is sold in pharmacies and in other stores that sell dental products, its sale for uses other than oral health care is a common practice, such as in neon sign workshops, traditional cures in botanical stores, jewelry and fireworks. However, no detailed study has been performed to identify the populations whose cultural and artisanal activities involve risks stemming from the use and exposure to mercury.

In 2000, the National Institute of Ecology developed two drafts related to cultural uses of mercury and a proposal for an official rule related to the retirement from market of mercury-containing products based on Chapter IV of the Health General Law. No follow-up on this matter has been performed.

Analytical, Testing, Measurement, Calibration and Education Sector

According to the Mexican Mercury Market Report, approximately 1.6 metric tons of mercury are used in this sector. No action has been taken in Mexico related to this NARAP Action Item.

No life-cycle management practices have been developed in Mexico as a result of recognized environmental management systems such as ISO 14000, nor actions under the mercury NARAP in this sector.

In the international context, it is important to note that, according to the 2006 UNEP *Summary of Supply, Trade and Demand Information on Mercury,* small-scale/artisanal gold mining is the most important area of mercury consumption worldwide, representing 650–1,000 metric tons of mercury yearly to produce some 500–800 tonnes of gold, or 20–30 percent of the world's yearly production of the metal.[64] It is not known if artisanal gold mining activities are taking place in Mexico, or if Mexican mercury exported to Latin American countries is used for gold artisanal mining purposes. However, Mexican mercury imports and exports (see Table 1 below) have been increasing, probably due to demand for its use in gold amalgamation.

[63] Mexican Mercury Market Report, op. cit., pp. 73, Table 5-2.

[64] UNEP (United Nations Environment Programme). 2006. Chemicals. Summary of Supply, Trade and Demand Information on Mercury. November. Geneva. p. 52. Available at: <http://www.chem.unep.ch/mercury/HgSupplyTradeDemandJM.pdf>.

Mexico has been assessing this import-export scenario, considering the UNEP Legally Binding Instrument on Mercury now in preparation,[65] and the US and EU mercury export-ban initiatives due in 2013 and 2011, respectively.

Table 1

Exports from Mexico (to Latin American countries*)	**Imports to Mexico (from the United States)**
2005: 5.9 metric tons **2006: 8.1 metric tons** **2007: 21.3 metric tons** **2008: 58.5 metric tons** **2009: 36.7 metric tons**	**2005: 26.2 metric tons** **2006: 21.5 metric tons** **2007: 4.0 metric tons** **2008: 15.3 metric tons** **2009: 26.1 metric tons**
***Total:* 139.5 metric tons**	***Total:* 93.1 metric tons**

*The main countries to which Mexico exported mercury were Peru, Colombia, Argentina, and Brazil.
Source: *Sistema de Información Arancelaria vía Internet* (Tariff Information System via the Internet) SIAVI (capítulo 28, partida 2805, subpartida 280540, fracción 28054001). Revised on May 7, 2010 at: <http://www.economia-snci.gob.mx:8080/siaviWeb/fraccionAction.do?tigie=28054001>.

United States

Life-cycle Management and Reduction in Mercury Use

The long-term goal of US federal and state environmental agencies is to reduce the use of mercury where cost-effective substitutes exist, and to reduce risks associated with such use where cost-effective substitutes do not exist.

During the last thirty years there has been a dramatic drop in mercury use by industries in the United States. Between 1980 and 1997, annual mercury use dropped by 83 percent, from 2,225 metric tons to 381 metric tons.[66] In 1980, the three largest US industrial uses of mercury were in batteries, paint, and chlor-alkali manufacturing. The subsequent reduction through 1997 was due primarily to federal limits on mercury use in batteries and paint, closure of some mercury-cell chlor-alkali manufacturing plants, and state regulatory and voluntary efforts to reduce mercury in numerous products and manufacturing processes.

Use of mercury in products sold in the United States has continued to decline in recent years. Between 2001 and 2007 reported mercury use in products dropped 46 percent, from 117

[65] See <http://www.chem.unep.ch/mercury/OEWG/Meeting.htm> and <http://www.unep.org/hazardoussubstances/Mercury/Negotiations/tabid/3320/Default.aspx>.
[66] US EPA. 2006. *EPA's Roadmap for Mercury*, July. <http://www.epa.gov/mercury/roadmap.htm>.

metric tons to 63 metric tons.[67] The largest percentage declines in mercury use have been for measuring devices and thermostats. Significant declines in mercury use have also occurred for other mercury-containing products, with the exception of light bulbs. Although the average amount of mercury per light bulb has decreased over the past few years, the number of fluorescent light bulbs (especially compact fluorescent bulbs) purchased has increased.

EPA has legal authority to regulate mercury use in non-medical products under the Toxic Substances Control Act (TSCA), including some ability to prevent new mercury-containing products from entering commerce. However, EPA's this authority to regulate mercury use in products under TSCA is limited in many respects and at this time only a few products have been specifically addressed through regulation. EPA is currently focusing its mercury reduction efforts on switches, relays and measuring devices because these types of products represent the majority of mercury use in products in the United States, and cost-effective alternatives are available for many uses in these categories. Mercury-containing medical devices, such as dental amalgam, fever thermometers and sphygmomanometers (blood pressure cuffs), are regulated for safety and effectiveness by the US Food and Drug Administration.

EPA also has authority to regulate mercury use in pesticides under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). In 1990 EPA prohibited the use of mercury as a fungicide in latex paint, and there are currently no mercury-containing pesticides registered for sale or distribution in the United States. Most mercury-containing batteries are prohibited from sale in the United States by the federal Mercury-Containing Rechargeable Battery Management Act of 1996.

Reductions in mercury use during the past decade can be linked to states' mercury reduction programs, including laws restricting sales, voluntary reduction programs, and outreach efforts to manufacturers, retailers and consumers to encourage production, sale and use of non-mercury alternatives. Numerous states are adopting and implementing laws to reduce the use and disposal of mercury attributable to various products. State laws and regulations often require that manufacturers label their mercury-added products, provide consumers with information about proper handling and disposal options, and support programs to collect and recycle end-of-life mercury products that are currently being sold. Some states also require manufacturers to support the collection and recycling of mercury–added products previously sold, such as mercury thermostats and tilt switches in vehicles.

The Great Lakes Regional Collaboration, a special national initiative, has developed a basin-wide strategy to phase-down the use of mercury-containing products in the Great Lakes region.[68] The goal of this effort is to reduce the use of the remaining mercury-containing products, and to manage wastes so as to minimize mercury releases to the environment in the Great Lakes region. The 2008 strategy recommends a wide range of product-targeted policies for states to

[67] Northeast Waste Management Officials' Association (NEWMOA). 2009. Interstate Mercury Education and Reduction Clearinghouse (IMERC) Mercury-Added Products Database, November.
[68] See <http://www.glrc.us/documents/MercuryPhaseDownStrategy06-19-2008.pdf>.

adopt, including sales bans and phase-outs, disposal regulations, public awareness and education programs, collection/end-of-life management for products, purchasing preferences, and labeling requirements. Some will require legislative action; others can be implemented directly by state, municipal or tribal agencies. States are encouraged to take the recommended actions as early as is practical, with implementation of mercury sales bans no later than 2015.

Reliable and publicly available data on mercury use in the United States are needed to design and evaluate mercury-use reduction initiatives. Prior to 1998, the US Geological Survey (USGS) provided annual reporting of mercury use by US industries; however, this voluntary reporting was discontinued in 1998 due to low input from mercury-using manufacturers. In 2001, the Northeast Waste Management Officials' Association (NEWMOA), a regional interstate association of state environmental programs, launched the Interstate Mercury Education and Reduction Clearinghouse (IMERC). IMERC has developed a database of mercury use information of national scope. This "Mercury-added Products Database" contains data (beginning in 2001) required from manufacturers by Connecticut, Louisiana, Maine, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont on mercury-containing products that are sold in these states, including the total mercury contained in these products sold nationwide during a calendar year in the United States. These total mercury data are updated every three years. The IMERC database is the best source of current information on mercury use in products sold in the United States, but the data will gradually become less comprehensive over time as IMERC-member states ban the sale of specific products and no longer require reporting of those banned products.

Automotive Vehicle and Equipment Manufacturing Sector

Mercury use in vehicles

Prior to model year 2003, US automakers were still using mercury switches in convenience lighting, anti-lock braking systems and active ride control systems, although most foreign automakers did not. A voluntary phase-out was completed with cars and light-duty trucks sold in the United States beginning with the 2003 model year.

In 2007, EPA issued a federal rule to require notice prior to significant new use of mercury-containing switches in new vehicles. This regulation requires notification of EPA prior to manufacturing, importing, or processing elemental mercury for use in convenience light switches, anti-lock brake system switches, and active ride control system switches in certain motor vehicles.

The use of other mercury-added components in automobiles and recreational vehicles has increased over the last few years. In addition to high-intensity discharge (HID) headlamps, many automobiles now come with entertainment systems, navigation systems, and instrument panels that utilize LCD screens with backlighting that contains mercury light bulbs. Many recreational vehicles offer option packages that include flat panel televisions that contain fluorescent bulbs and linear fluorescent bulb fixtures. However, such uses of mercury-

containing light bulbs in vehicles will likely decline in the future. Recent data on such components compiled by the Interstate Mercury Education and Reduction Clearinghouse (IMERC) show that their use is declining. Electronic display screens are beginning to use non-mercury LED backlights and most auto manufacturers are actively pursuing these alternatives.

Mercury-containing waste from vehicles

Recycling old vehicles is also a significant source of mercury emissions to the air. While automakers have phased out the use of mercury-containing switches in new models, older vehicles are still on the road or off the road and headed to scrap yards. When cars are retired, automotive dismantlers shred the vehicles to produce scrap metal. Steelmakers then purchase and melt the scrap metal in electric arc furnaces (EAFs) to make new steel and steel products. If mercury switches are not removed before the car is recycled, a significant amount of mercury can be released into the environment. Electric arc furnaces are the third-largest source of mercury air emissions in the United States.

In 2006, EPA announced a national voluntary program to recover mercury-containing switches from scrap automobiles. The National Vehicle Mercury Switch Recovery Program (NVMSRP) provides incentives for dismantlers to remove mercury-containing switches from scrap vehicles before they are shredded. The program, which complements existing state mercury switch reduction efforts, was intended to help to reduce up to 68 metric tons of mercury emissions over the next 15 years. It was the result of a two-year collaboration involving auto and steel makers, scrap and auto recyclers, EPA, states and environmental organizations. As part of the NVMSRP, the automotive industry formed a non-profit company, the End-of-Life Vehicle Solutions Corporation (ELVS),[69] to carry out program responsibilities for the vehicle manufacturers.

The National Vehicle Mercury Switch Recovery Program (NVMSRP) partnership agreement set a vehicle mercury switch recovery goal of eighty percent. For the three calendar years (2008–2010) that the program was fully implemented nationwide, the actual recovery rate was 21 percent. From the program's inception in mid-2006 through December 2010, approximately 3.45 million switches were recovered, representing about 9,100 pounds (4140 kg) of mercury at 1.2 grams/switch. The recovery rate may be less than expected because, in part, the national financial incentive being offered to auto dismantlers was discontinued in 2009 when the fund was depleted. However, incentive payments have continued in those states where they are required by law to be paid by vehicle manufacturers (AR, IL, IA, MD, MA, NJ, RI, UT) or there is a state-funded program (IN, NC, SC, WA). All other aspects of the NVMSRP switch collection program will continue under the agreement through the end of 2017, based on a 2006 estimate that approximately 90 percent of installed vehicle mercury switches will be collected by that time. Until then, vehicle mercury switches will continue to be recovered, recycled and transported at no cost to participants, regardless of whether switch incentive payments are available.

[69] More information can be found at <http://www.elvsolutions.org/index.htm>.

In 2007, EPA issued a regulation to limit air pollution from EAFs in steel manufacturing.[70] This rule reduces mercury emissions by requiring that EAF steel makers buy motor vehicle scrap from providers that participate in the National Vehicle Mercury Switch Recovery Program. To ensure that mercury reductions are being made, however, EPA is now developing an amendment to this rule to establish a specific mercury emission limit for EAFs. This revised rule, to be proposed in 2012, will provide an additional incentive for steel makers to continue to buy auto scrap only from suppliers that participate in the NWSMRP, as a pollution prevention practice to help them meet any future mercury emissions limit. Some facilities may need to install activated carbon adsorption systems for mercury control in order to meet the new limit.

Mercury Cell Chlor-alkali Manufacturing Sector

The largest remaining user of mercury in the US is the chlor-alkali industry, although there has been a dramatic drop in mercury use by this industry over the past three decades. In 1980, US chlor-alkali manufacturers used 358 metric tons of mercury, but by 2001, their annual mercury use had decreased to approximately 38 metric tons.[71]

Under a voluntary commitment to mercury reduction made by the US Chlorine Institute under the Great Lakes Binational Toxics Strategy, the chlor-alkali industry has made further significant progress in reducing its mercury use. The US Chlorine Institute's Twelfth Annual Report[72] to EPA shows a drop in annual mercury use of 97 percent between 1995 and 2008, from 145 metric tons to 4 metric tons. The industry's annual consumption of mercury per ton of chlorine produced also dropped by 94 percent between 1995 and 2008. Some of this reduction in mercury use has resulted from closure or conversion of mercury-cell facilities. Since 2003, three facilities have converted to non-mercury processes and three have closed. Four mercury-cell facilities remain in operation in 2011. However, in December 2010, the Olin Corporation announced plans to close or convert its two mercury-cell facilities by the end of 2012. When that happens, only two operating mercury-cell facilities will remain in the US.

In 2009, Congress began considering proposals to ban mercury use in chlor-alkali manufacturing, but no final action has been taken.

Dry Cell Battery Manufacturing Sector

In the US, the use of mercury in batteries has declined sharply over the past two decades. In the early 1980s, US battery manufacturing was the largest domestic use of mercury, estimated at over 900 metric tons annually.[73] In the 1990s, state and federal laws were enacted in the 1990s that required the removal of mercury from widely used alkaline batteries, resulting in a substantial reduction in the use of mercury in battery manufacturing in the United States. The

[70] For more information, see EPA fact sheet at <http://www.epa.gov/ttn/oarpg/t3/fact_sheets/eaf_fs_121707.html>.
[71] US EPA, *EPA's Roadmap for Mercury*, July 2006, page 36, <http://www.epa.gov/hg/roadmap.htm>.
[72] The Chlorine Institute, *Chlor-alkali Industry: 2008 Mercury Use and Emissions in the United States (Twelfth Annual Report to EPA)*, August 2009.
[73] Northeast Waste Management Officials' Association (NEWMOA), *Trends in Mercury Use in Products*, June 2008.

federal Mercury-Containing and Rechargeable Battery Management Act of 1996 (Battery Act)[74] prohibits the sale of most mercury-added batteries in the US, whether manufactured domestically or imported. The two exceptions are some mercuric oxide batteries and most button cell batteries.

Mercuric oxide batteries are still produced for use in military and medical equipment where a stable current and long service life are essential. Federal law allows these batteries to be sold, but only if the manufacturer has established a system to collect the waste batteries and ensure that the mercury is properly managed.

Button cell batteries are miniature batteries in the shape of a coin or button that are used to provide power for small portable electronic devices. Currently, the four major technologies used for button cell batteries are lithium, zinc air, alkaline, and silver oxide.[75] Lithium batteries contain no intentionally-added mercury, but they may pose a fire risk. Small amounts of mercury are still added to most zinc air, alkaline and silver oxide batteries in order to prevent the formation of internal gases that can cause leakage. Zinc air batteries are used mainly in hearing aids; silver oxide batteries are used in watches and cameras; and alkaline manganese batteries are used in digital thermometers, calculators, toys and a myriad of other products requiring a compact power source.

While the Battery Act prohibits the sale of mercuric oxide button cells, it specifically allows the sale of alkaline manganese button cells containing mercury content of up to 25 milligrams. At that time, the technology did not exist to control the formation of gas in miniature batteries without using mercury. The Battery Act is silent regarding the mercury content of silver oxide and zinc air button cell batteries.

US manufacturers continue to pursue the development of reliable “no mercury” formulas to eliminate mercury altogether from button cell batteries. Three states—Maine, Connecticut and Rhode Island—have recently passed legislation to ban the sale of button cell batteries, including zinc air, silver oxide, and alkaline manganese oxide batteries sold individually or as a component in another product. The compliance date for the state-wide ban in both Connecticut and Rhode Island was 1 July 2011. In Maine, the ban takes effect for most button-cell batteries on 1 January 2012, with a later compliance date of 1 January 2015, for a remaining category of silver oxide batteries.[76] EPA plans to propose a federal rule in 2012 to address mercury use in button cell batteries.

Electrical Switches and Relays Sector

Mercury switches are used in a myriad of consumer, commercial, and industrial applications, including space heaters, ovens, air handling units, security systems, leveling devices, pumps, and on/off switches. Mercury-added electrical relays are used in telecommunication circuit boards, electric ranges, and other cooking equipment.

[74] Battery Act: <http://www.epa.gov/mercury/regs.htm#laws>.
[75] Northeast Waste Management Officials’ Association (NEWMOA), *Trends in Mercury Use in Products*, June 2008.
[76] See < www.newmoa.org/prevention/mercury/imerc/banphaseout.cfm >.

In the US, overall use of mercury in switches and relays sold in products decreased by 49 percent between 2001 and 2007, from 54.5 metric tons to 27.9 metric tons. These amounts do not include the mercury in tilt switches used in thermostats. Including the sale of new thermostats, the overall use of mercury in this sector decreased 54 percent, from 67.8 metric tons in 2001 to 31.5 metric tons in 2007. Mercury use in new thermostats alone decreased 73 percent, from 13.2 metric tons in 2001 to 3.5 metric tons in 2007. It is expected that the next available IMERC data on mercury use in thermostats in 2010 will be close to zero, since the three primary thermostat manufacturers—GE, Honeywell and White-Rogers—have all stopped manufacturing mercury-containing thermostats.

With a growing number of states implementing legal restrictions on the sale of mercury switches and relays and products containing these mercury components in recent years, total mercury use in this sector will likely continue to decline. For example, manufacturers of pumps have reduced their use of mercury switches dramatically since 2001. By 2008, five pump makers had reported the complete elimination of the use of mercury switches in their pump systems. Together, these companies had used approximately 805 pounds of mercury in their pump products sold in the US in 2001 and 745 pounds in 2004.[77]

EPA plans to propose a federal rule to address mercury use in relays and switches, including thermostats and flame sensors, in 2012.

There are a number of states that have implemented programs to promote collection and recycling of mercury thermostats. Many of these states are working with the Thermostat Recycling Corporation (TRC). TRC is an industry-sponsored private corporation, originally established by thermostat manufacturers—Honeywell, White-Rodgers, and General Electric. The group facilitates the collection of all brands of used, wall-mounted mercury switch thermostats so that the mercury can be separated and purified for re-use. Collection takes place through Heating Ventilation and Air Conditioning (HVAC) wholesale outlets, HVAC contractors, and local household hazardous waste facilities throughout the United States. Participation is voluntary, and the organizations collecting the thermostats pay a one-time fee of $25.00 to obtain a collection bin. The elemental mercury from the thermostats collected through this program is reclaimed and recycled.[78]

Lamp (Light Bulb) Manufacturing Sector

Mercury use in light bulbs

Mercury is used in a wide variety of light bulbs (typically called lamps), in both indoor and outdoor applications, from fluorescent tubes to neon signs. Fluorescent and other mercury-added lamps are increasingly popular, as they are more energy efficient and typically last longer

[77] Northeast Waste Management Officials' Association (NEWMOA). 2008. *Trends in Mercury Use in Products*, June, p. 9.
[78] ibid., p. 10.

than incandescent lamps. Mercury is an essential component in allowing these bulbs to generate light.

Lamp manufacturers and distributors sold lamps in the United States that contained a total of 9.7 metric tons of mercury in 2001, 9.2 metric tons in 2004, and 9.6 metric tons in 2007.[79] The slight decline in mercury use in 2004 is likely due to manufacturers' efforts to reduce mercury content per bulb, while the slightly higher total use by 2007 is probably due to increased sales of fluorescent bulbs, especially compact fluorescent light (CFL) bulbs.

As mentioned above, mercury lamps are also components of larger products, such as liquid crystal displays (LCDs), flat-panel televisions, projectors, and a variety of other applications. Since 2004, there has been a significant increase in the number of electronics utilizing fluorescent lamps, often a series of small bulbs used for illumination in displays. Stand-alone LCD monitors are now standard with many new computers, and a wide variety of home and office equipment now utilize LCD screens, including televisions, global positioning system (GPS) units, hand-held communications and entertainment systems, and digital cameras.

In recent years, government agencies, companies, and environmental organizations in the United States have heavily promoted the use of energy-efficient linear and compact fluorescent bulbs. In addition, the cost of compact fluorescent bulbs has decreased dramatically making them more affordable for consumers. These efforts and the growing sale of products with LCD screens will likely increase total mercury use in lamps in the future.

Consumer labeling for mercury content in light bulbs

There are no federal or state required maximum limits on the amount of mercury that can be used in fluorescents or any other mercury-containing bulbs sold in the United States. However, there are two voluntary programs with identical recommended mercury limits of 5 mg for compact fluorescent light bulbs: one is sponsored by the EPA ENERGY STAR program and the other by the National Electrical Manufacturers Association. Compliance with the voluntary mercury limit in these programs is determined by a company's self-certification.

There are, however, new federal requirements for labeling to inform consumers and recyclers about the presence of mercury in compact fluorescent light bulbs. In July 2010, the US Federal Trade Commission issued new labeling requirements for certain general-use light bulbs. For CFLs, new packaging labels must prominently show the following information: "Contains Mercury. For more on clean up and safe disposal, visit epa.gov/cfl." The individual CFL bulbs must also show the following information: "Mercury disposal: epa.gov/cfl." The compliance date for manufacturers to begin using the new labels is 1 January 2012. At this time the mercury labeling requirements apply only to CFLs and not to other mercury-containing light bulbs.

[79] NEWMOA. 2009. Interstate Mercury Education and Reduction Clearinghouse (IMERC) database, November.

Mercury-containing waste from light bulbs

Under US federal waste rules, fluorescent and other mercury-containing lamps must be managed as hazardous waste under the Universal Waste Rule unless the bulb passes the TCLP test.[80] The Universal Waste Rule is an EPA regulation designed to reduce hazardous waste in the municipal solid waste stream by making it easier for universal waste handlers to collect these items and send them for recycling or proper disposal.

At least fourteen states have adopted the Universal Waste Rule. These states require businesses and other non-residential organizations to recycle mercury-containing lamps or dispose of them as either universal or hazardous waste. In most cases, residential households are exempt from these regulations. However, in some states, households must properly recycle or dispose of all mercury-containing lamps, including compact fluorescent lamps (CFLs). EPA encourages consumers to properly recycle all burned-out mercury-containing light bulbs, including fluorescent bulbs, rather than disposing of them in regular household trash.[81] EPA is working with manufacturers and major US retailers to develop, implement or expand recycling options for consumers.

Health Care Sector

EPA and states have for many years actively encouraged hospitals and other health care facilities to voluntarily reduce their use of mercury-containing products. A voluntary national program, called Hospitals for a Healthy Environment (H2E), grew out of an initial effort under the 1997 Great Lakes Binational Toxics Strategy. In 1998, EPA and the American Hospital Association (AHA), in consultation with Health Care Without Harm, reached a landmark agreement that launched the H2E program. The AHA is a national organization that represents and serves nearly 5,000 hospitals, health care networks, and their patients and communities.

A key goal of the H2E program was to work with hospitals to eliminate essentially all mercury waste generated by hospitals by 2005. To meet that goal, the program was designed to encourage hospitals to eliminate the use and purchase of mercury-containing products and to properly dispose of mercury-containing products and waste in health care facilities. The program created a national training program for hospitals, worked with states to provide hospitals with pollution prevention assistance, and developed a national awards program to recognize the accomplishments of hospitals participating in the H2E program.

In 2006, the H2E Program was declared a success, and was closed out as EPA's signature mercury reduction program for healthcare facilities. However, additional pollution prevention activities with hospitals have continued under the auspices of an independent, nongovernmental organization called Practice Greenhealth. Practice Greenhealth is the nation's leading membership and networking organization for institutions in the healthcare community

[80] The Toxicity Characteristic Leaching Potential (TCLP) is a federal EPA test method used to characterize waste as either hazardous or non-hazardous for the purpose of handling and disposal. The TCLP test measures the potential for mercury to seep or "leach" into groundwater from waste potentially disposed in a landfill.

[81] For more information, go to the EPA site on "Recycling Mercury-Containing Light Bulbs": <http://www.epa.gov/epawaste/hazard/wastetypes/universal/lamps/index.htm#1>.

that have made a commitment to sustainable, eco-friendly practices. Members include hospitals, healthcare systems, businesses and other stakeholders engaged in the greening of healthcare to improve the health of patients, staff and the environment

Dental Sector

Mercury use in dental amalgam

Amalgam manufacturers and distributors have reported that the amount of mercury in dental amalgam sold in the United States decreased 46 percent between 2001 and 2007, from 27.9 metric tons to 14.9 metric tons.[82] Use of dental amalgam in the US is declining, both because the incidence of dental decay is decreasing and because substitute materials with an improved appearance are now available for most applications. Increased consumer awareness of the presence of mercury in amalgam fillings may also drive future declines in mercury amalgam use; however, the higher cost of non-mercury fillings can affect patients' preferences for dental restorative materials.

Dental amalgam use is regulated by the US Food and Drug Administration as a medical device subject to the Federal Food, Drug, and Cosmetic Act (FDCA) and, therefore, is excluded from regulation by EPA. In July 2009, FDA issued an updated regulation that requires manufacturers of dental amalgam and its components (elemental mercury and metal alloy powder) to provide dentists with performance data and use recommendations intended to provide assurance of safety and effectiveness. There are no state restrictions on the sale or distribution of dental amalgam.

Mercury-containing waste from dental amalgam

Mercury from dental amalgam is a significant source of controllable mercury pollution. Mercury from dental amalgam is released primarily to wastewater and secondarily to air as emissions from incineration of solid waste containing dental amalgam and cremation of bodies containing dental amalgam fillings.

(1) Wastewater

In the United States, dental amalgam waste that is discharged from dental offices to wastewater passes to treatment plants, where it is sequestered in sewage sludge, which may then be landfilled, heat-treated, or incinerated. Most dental offices use chair-side traps designed to capture large particles of amalgam and other materials that are removed during dental procedures, thus reducing the amount of mercury solids passing into the sewer system. In addition, some state and local governments have for several years actively promoted the use of dental amalgam waste separation equipment that will capture much smaller amalgam

[82] NEWMOA, Interstate Mercury Education and Reduction Clearinghouse (IMERC) Fact Sheet: "Mercury Use in Dental Amalgam," June 2010. See <http://www.google.ca/search?q=Fact+Sheet+Mercury+Use+in+Dental+Amalgam&ie=utf-8&oe=utf-8&aq=t&rls=org.mozilla:en-US:official&client=firefox-a>.

particles. As of 2008, eleven states and numerous municipalities required dental offices to install and operate amalgam separators and to use additional best management practices to reduce mercury releases.[83]

EPA plans to issue a federal rule in 2012 to reduce discharges of mercury waste from dental offices to wastewater systems.[84] As with existing state rules, the new rule will require those dental offices that deal with amalgam to use existing technology to meet the new requirements, including amalgam separators and other best management practices.

Although sewage treatment facilities are highly efficient at removing amalgam from wastewaters (around 90 percent), a small amount of waste amalgam is discharged into surface waters around the plants. Past analytical methods could not detect low-level mercury discharges to water. To address this critical data gap, in 2001 EPA issued a new, more sensitive analytical method for use in wastewater discharge permits.[85] As permits are reissued, use of this more sensitive method provides the necessary data for EPA and states to determine whether surface water discharge permits need to include mercury effluent limits.

(2) Solid waste

If mercury-containing sewage sludge from a wastewater treatment plant is sent to an incinerator for disposal or otherwise heat treated, the mercury can be released as air pollution. In addition, if waste amalgam solids are improperly disposed of in medical waste containers, these amalgam solids will be incinerated or autoclaved, causing mercury air emissions. Dental offices can avoid such mercury air emissions by sending amalgam solid waste to an RCRA-permitted mercury retort facility.

In March 2011, EPA published a federal rule that sets new source performance standards and air emission guidelines for sewage sludge incinerators, which includes standards for mercury air emissions.

(3) Cremation

Dental amalgam also contributes to mercury emissions through the cremation of bodies containing dental amalgam fillings, although there is a lack of good empirical data on the magnitude of mercury emissions from crematoria. At this time, no federal or state regulations restrict mercury emissions from crematoria. Although EPA has authority under the federal

[83] Quicksilver Caucus, *Dental Mercury Amalgam Waste Management White Paper*, April 2008. <http://www.ecos.org/files/3260_file_Final_Twice_Corrected_Dental_Amalgam_White_Paper_April_2008.pdf>, Quicksilver Caucus, *Case Studies of Five Dental Mercury Amalgam Separator Programs*, May 2008. <http://www.ecos.org/files/3193_file_case_studies_dental_amalgam_paper_052808.pdf>.

[84] See <http://yosemite.epa.gov/opa/admpress.nsf/e77fdd4f5afd88a3852576b3005a604f/a640db2ebad201cd852577ab00634848!OpenDocument>

[85] See <http://cfpub.epa.gov/npdes/docs.cfm?view=allprog&program_id=45&sort=date_published>.

Clean Air Act to regulate solid waste incineration units, human bodies are not considered to be solid waste and therefore it has been deemed inappropriate to regulate human crematoria under this authority.

Cultural and Artisanal Uses

Mercury is used in some folk remedies and cosmetics. In Latino communities in the United States, mercury is sometimes used as a folk remedy for indigestion. This practice is most common among Mexican-Americans, and surveys have found that more than one out of 12 Latinos in New Mexico mention mercury as a cure for indigestion. Doctors have documented individual cases of children becoming ill, even requiring hospitalization, from the use of mercury for indigestion.[86]

Some cosmetics that are advertised for their skin-lightening properties or as an acne treatment may contain large amounts of mercury. A beauty cream imported from Mexico caused an outbreak of mercury poisoning among Latinas in Texas, New Mexico, Arizona, and California in 1996. The problem is not unique to one product. Since 1996, several other creams and soaps sold in New Mexico and near Washington, DC, have been found to be contaminated with mercury.[87] It is illegal to sell mercury-containing cosmetics in the US, but these products nevertheless find their way into the country.

Liquid mercury is used in the religious practices of some Latino and Afro-Caribbean communities. Practitioners of *Espiritismo* and *Santería* (religious traditions most commonly found among people of Puerto Rican and Cuban origin, respectively), *Voodoo,* and *Palo* use mercury. This involves a variety of uses, including wearing in amulets, sprinkling around the home, burning in a candle or oil lamp or adding to perfumes. In the United States, mercury is sold in most *botánicas,* stores that sell remedies and religious items. Studies show that more than 85 percent of *botánicas* around the country sell mercury and that in some areas the percentage is even higher.[88]

Vapors from the ritual use of mercury are dangerous to people, and the vapors continue to be emitted for some time after mercury is released in an indoor environment. In 1993, EPA began warning state and local health officials of the threat from the use of mercury in many Hispanic communities, and the Agency also produced educational materials for use by state and local agencies. However mercury exposure from cultural uses remains a problem. Studies in 2003 by state and local health departments in Massachusetts, New Jersey, New York City and Chicago indicated that the use of mercury for religious, spiritual, or health purposes was relatively common in Latino and Caribbean communities.[89]

[86] Natural Resources Defense Council, *Hidden Danger: Environmental Health Threats in the Latino Community,* October 2004, <http://www.nrdc.org/health/effects/latino/english/contents.asp>.
[87] Ibid.
[88] Ibid.
[89] Ibid.

While regulating such use might technically be possible under an existing federal law, EPA believes that regulations would be inappropriate and counterproductive, because starting the process to establish regulations is likely to drive the practice underground and be viewed as an infringement upon freedom of religion. State and local agencies are continuing to provide community education and outreach to Latino populations, conduct research and environmental monitoring, and respond to mercury releases.

Artisanal, or small-scale, gold mining no longer occurs in the United States except as a recreational activity around old abandoned gold mining sites in the western states.

Analytical, Testing, Measurement, Calibration and Education Sectors

Mercury-containing measuring devices include thermometers, sphygmomanometers (blood pressure cuffs), barometers, hydrometers, manometers, psychrometers and other measuring equipment. The amount of mercury used in measuring devices sold in the United States is now relatively small. A total of 4.6 metric tons of mercury were sold in measuring devices in 2001, which by 2007 had decreased 75 percent to 1.0 metric ton.[90] Many states have passed legislation banning the use and sale of mercury-added measuring devices, including fever thermometers and blood pressure cuffs. As more of these state laws go into effect, mercury use in measuring devices will continue to decline. Many states also encourage voluntary reductions in the use of mercury-containing medical devices in the education and health sectors and by the general public. At the federal level, medical devices such as fever thermometers and blood pressure cuffs are regulated by the US Food and Drug Administration via the Federal Food, Drug, and Cosmetic Act (FDCA), and are therefore excluded from regulation by EPA.

EPA is using federal authorities under the Toxic Substances Control Act (TSCA) to prevent new mercury-containing products from being sold in the United States. In July 2010, EPA published a TSCA regulation that requires notification of EPA prior to significant new use of mercury in three types of measuring devices: pyrometers, flow meters, and natural gas manometers.[91] In April 2011, EPA proposed a similar notification rule for significant new mercury use in three additional types of measuring devices: barometers, manometers and psychrometers/hygrometers.[92]

EPA and states continue to encourage schools to remove elemental mercury, mercury reagents, and mercury waste products from school laboratories; replace mercury-containing devices with safer non-mercury-containing devices in all school facilities; and educate school maintenance workers and decision-makers about potential health and environmental hazards from mercury in schools and ways to reduce them.

[90] NEWMOA, Interstate Mercury Education and Reduction Clearinghouse (IMERC) database, November 2009.

[91] Concerning modification to TSCA, Section 5(a)(2), see <http://www.federalregister.gov/articles/2010/07/21/2010-17718/elemental-mercury-used-in-flow-meters-natural-gas-manometers-and-pyrometers-significant-new-use-rule>.

[92] <http://www.federalregister.gov/articles/2011/05/06/2011-11025/elemental-mercury-used-in-barometers-manometers-hygrometerspsychrometers-significant-new-use-rule>.

In 2007, EPA launched a new initiative with other federal agencies, states, industry and nongovernmental organizations to reduce the use of mercury-containing thermometers in industrial and laboratory applications and to promote non-mercury alternatives. Currently the initiative has three components: (1) Petroleum Industry: EPA is working with the National Institute of Standards and Technology (NIST), the American Society for Testing and Materials (ASTM) International and the American Petroleum Institute to expedite phase-out of mercury thermometers by developing protocols to test alternatives to mercury thermometers in petroleum field operations. (2) EPA Regulatory Requirements: EPA is developing rules to incorporate into EPA regulations the most recent versions of ASTM International standards that will allow the use of non-mercury alternatives in certain field and laboratory applications previously impermissible as part of compliance with EPA regulations. (3) EPA Laboratories: EPA is working to phase-out the use of mercury-containing thermometers in EPA labs.

In February 2011, the National Institute of Standards and Technology (NIST) announced that it would no longer provide its calibration service for mercury thermometers. The 110-year service has ensured the accuracy of instruments used to monitor temperatures in chemical, pharmaceutical and petroleum facilities. This action by NIST supports the joint efforts of federal and state agencies to help phase out the use of mercury thermometers in laboratories and industrial processes.

Action Item 3: Mercury Waste Management Approaches

NARAP Goals:

- Develop appropriate policies and programs and other initiatives to address wastes from combustion and industrial processes and pollution-control operations; incinerator waste streams and wastewater treatment;
- Assess the adequacy of national reporting mechanisms used to track the ultimate fate of mercury-containing wastes within North America (note: directed at SMOC Working Group);
- Address mercury waste collection and handling and mercury retirement; and
- Encourage the development and adoption of new and emerging release reduction and remediation techniques.

CEC Trinational Reports

Wastes from Combustion and Industrial Processes and Pollution Control Operations

The mercury NARAP directs the SMOC Working Group to "undertake a review of national programs to determine the adequacy of national programs to track the ultimate fate of mercury-containing wastes within North America, particularly waste transported across national boundaries for storage, handling, processing, disposal or long-term containment, and to make recommendations to improve such mechanisms."[93]

Following discussions between the CEC's Enforcement Working Group (EWG) and the Mercury Task Force it was agreed that the EWG would undertake an examination of the national regulatory/policy frameworks in the three CEC countries respecting elemental mercury imports and exports for processing, and elemental mercury and mercury waste for recycling or final disposal. A report, entitled "Mechanisms for Tracking Mercury Imports and Exports for Use and Disposal in Canada, Mexico and the United States: Summary," was released in March 2003, which identified activities, information sources and gaps within each country.[94] No recommendations were made regarding CEC follow-up. As the report neared completion there was a turnover of membership on the Mercury Task Force and the EWG. Also, new personnel were hired at the Secretariat. As a result, no follow-up work was undertaken.

Mercury Retirement Program

The NARAP directs the SMOC Working Group to "evaluate and assess the technical and socio-economic feasibility of consolidating and permanently retiring quantities of mercury removed from commerce in North America."

[93] Mercury Phase II NARAP, Action Item 3a(iv).
[94] See <http://www.cec.org/Storage/51/4342_Hg-tracking-Summary_en.pdf>.

The Mercury Task Force had several discussions on this topic in 2002 and 2003. At that time none of the Parties had a mercury retirement policy in place. Task Force members agreed to await US policy developments to use as context for their further deliberations. As a result, no further trinational work was undertaken under this action item.

In 2008, the US Congress passed the Mercury Export Ban Act. This legislation bans the export of elemental mercury from the US as of 1 January 2013, and requires the federal government to develop secure long-term storage capacity for surplus domestic supplies of elemental mercury as of the same date. Research continues in the United States and other countries on development of effective and affordable mercury waste-stabilization and disposal techniques and methods.

Canada

Wastes from Combustion and Industrial Processes and Pollution Control Operations

The 2006 *Canada-wide Standard for Mercury Emissions from Coal-fired Electric Power Generation Plants* includes a monitoring protocol that commits provinces to reporting plant-submitted data for emissions to air and other media (for example, fly ash and scrubber effluent streams).[95]

While not specific to mercury, Environment Canada's 2006 *Environmental Code of Practice for Base Metals Smelters and Refineries* contains recommendations for the disposal and management of waste and wastewater generated by this sector.[96]

Incinerator Waste Streams

The Canada-wide Standards for Mercury Emissions (2000) identify limits for the concentration of mercury in exhaust gas for municipal, medical, hazardous waste and sewage sludge incinerators.[97] The Standard acknowledges the importance of waste diversion and the application of best available pollution prevention and control techniques.

Wastewater Treatment

Other initiatives cited previously also contribute to this Action Item. For example, the *Canada-wide Standard of Mercury for Dental Amalgam Waste* and the *Notice Requiring the Preparation and Implementation of Pollution Prevention Plans in Respect of Mercury Releases from Dental Amalgam Waste* have been instrumental in reducing the amount of mercury entering wastewater treatment facilities.[98]

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[95] See <http://www.ccme.ca/assets/pdf/hg_epg_cws_w_annex.pdf>.
[96] See: <http://www.ec.gc.ca/lcpe-cepa/default.asp?lang=En&n=9233A7E7-1>.
[97] See: <http://www.ccme.ca/ourwork/air.html?category_id=87>.
[98] See fn. 47 and 48, *supra.*

Through *Environmental Technology Verification Canada*, a new procedure was developed to test equipment that removes mercury from dental amalgam waste prior to its discharge to sewer systems. This Canadian method is equivalent to the ISO 11143 method currently available in Europe.[99]

Mercury Waste Collection

The 2007 *Proposed Risk Management Strategy for Mercury-containing Products: Consultation Document* states that potential end-of-life management programs will include requirements for importers and manufacturers of mercury-containing products to participate in the development and implementation of programs to recover and safely dispose of end-of-life products.[100]

Mexico

Wastes from Combustion and Industrial Processes and Pollution Control Operations

There are three authorized confinement sites in Mexico for the storage, handling, processing and disposal of hazardous wastes from industrial processes and pollution-control operations, including mercury-containing wastes (except mercury in liquid form).[101] Hazardous wastes are regulated by the General Act for the Prevention and Comprehensive Management of Waste (*Ley General para la Prevención y Gestión Integral de los Residuos*—LGPGIR).

Information related to mercury consumption by the industrial sector is compiled and reported by the individual facilities on the Annual Certificate of Operations (*Cédula de Operación Anual*—COA), which was implemented in Mexico in 2004. Filing these waste generation and management records is mandatory and they are publicly accessible, according to the provisions of the Regulations underlying the Pollutant Release and Transfer Registry (*Reglamento en Materia de Registro de Emisiones y Transferencia de Contaminantes*). Information on mercury releases can be obtained through the online retrieval tools of this registry.

Another information source for mercury-containing waste generation is the registry and control forms required to transportation companies and compiled by Semarnat.

Incinerator Waste Streams

Mexican Official Standard NOM-098-SEMARNAT-2002 on waste incineration, operating specifications, and emission limits for pollutants was published in the Official Gazette of the Federation on 1 October 2004. This standard provides allowable emission limits to air for waste incineration plants. LGPGIR requires waste generators to implement waste management plans in conjunction with the incineration companies.[102]

[99] <http://www.ec.gc.ca/scitech/default.asp?lang=En&n=9682E240-1>.

[100] <http://www.ec.gc.ca/CEPARegistry/documents/part/wmd-dgd/pro-ris.cfm>.

[101] Relying on the prohibition in LGPGIR Artículo 67(II) against storing hazardous waste in liquid or semi-solid form, Mexico does not allow storage, handling, processing and disposal of liquid *residual* mercury unless it has been solidfied through treatment. This prohibition would not apply to liquid mercury as a commodity or raw material. [ed: clarifications from Jorge Jiménez Pérez and Gustavo Solorzano Ochoa via e-mail, 24 November 2011.]

[102] <siscop.ine.gob.mx/descargas/legislacion/**nom**_incineracion.pdf>

Wastewater Treatment

Mexican regulations for mercury-containing wastewater discharges and sludge management include:

- Mexican Official Standard NOM-001-SEMARNAT-1996, published in the Official Gazette of the Federation on 6 January 1997, establishes the maximum permissible limits of contaminants in the discharges of wastewater into national water bodies and resources. Mercury is included in this NOM.[103]

1. Mexican Official Standard NOM-002-SEMARNAT-1996, published in the Official Gazette of the Federation on 3 June 1998, establishes the maximum permissible limits of contaminants in the discharges of wastewaters to the urban or municipal sewer systems. Mercury is included in this NOM.[104]

2. Mexican Official Standard NOM-004-SEMARNAT-2002, published in the Official Gazette of the Federation on 15 August 2003, establishes specifications and the maximum permissive limits for contaminants in sludges and biosolids resulting from the unclogging activities from the urban or municipal sewer systems, as well as in those corresponding to the operation of the water purification plants and the plants for treatment of wastewaters. Mercury is included in this NOM.[105]

Mercury Waste Management

Mexican Official Standards for soils and hazardous wastes include:

3. Mexican Official Standard NOM-147-SEMARNAT/SSA1-2004, published in the Official Gazette of the Federation on 2 March 2007, establishes the criteria to determine the concentrations of remediation of soil contaminated by arsenic, barium, beryllium, cadmium, hexavalent chromium, mercury, nickel, silver, lead, selenium, thallium, and/or vanadium. This standard establishes a Total Reference Concentration (CRT) of mercury by type of soil use, as follows: for agricultural, residential and commercial soils the CRT is 280 mg/kg and for industrial soils it is 310 mg/kg.[106]

- Mexican Official Standard NOM-052-SEMARNAT-2005, published in the Official Gazette of the Federation on 23 June 2006, establishes the characteristics, the identification procedure, classification, and the lists of hazardous wastes. It also establishes the classification of hazardous wastes by specific source; non-specific source; hazardous waste resulting from waste of chemical products outside of specifications or material life (Acute Toxics); hazardous wastes resulting from the wastes of chemical products

[103] See <http://www.semarnat.gob.mx/leyesynormas/Pages/resultados.aspx?liga=http://biblioteca.semarnat.gob.mx/janium-bin/janium_login_opac.pl?scan=1&ubicacion=18&keyword=NOM-001-SEMARNAT>.
[104] ibid.
[105] ibid.
[106] <faolex.fao.org/docs/texts/mex70009.doc>

outside of specifications and material life (Chronic Toxics) and the classification by type of wastes, subject to Particular Conditions of Handling. Mercury is considered under this NOM.[107] The Regulations for the General Act for the Prevention and Comprehensive Management of Waste (LGPGIR), effective 30 December 2006, provide general and specific criteria for the handling of hazardous wastes, and also contain provisions requiring all generators of hazardous wastes to develop plans for their safe handling.

Mercury Waste Collection and Handling

In 2009 Mexico started to develop a stewardship program for the collection, recovery, recycling and permanent retirement of mercury and mercury-containing waste generated in the health care sector. This sector initiated the implementation of procedures for mercury waste collection and handling small spills in the hospitals. This program is part of the *Comprehensive Management Plan for Mercury and Mercury-containing Waste in the Health Sector*,[108] carried out by Environmental and Healthcare sectors in Mexico, which also considers reduction and substitution of mercury usages and mercury-containing instruments, such as thermometers, sphygmomanometers, amalgam, lamps, electrical and electronic accessories using mercury, etc.

Mercury Retirement Program

As mentioned above, the LGPGIR prohibits storage of residual mercury in its liquid form.[109] Instead, liquid residual mercury should be treated in order to transform it into a solid. For this reason, Mexico is considering the development of solidification-stabilization technologies.

This is the one of the most important actions that should be considered into the North American Region in the future, as this commitment is a long-term responsibility. It is also important to consider in the global context, especially the UNEP initiative related to the Mercury Storage Project at regional and global scales.

The UNEP initiative initially specifies the following tasks for the North American region. Mexico has made progress on the following issues:

- Developing an inventory of the hazardous mercury-containing waste from different sectors. To date, Semarnat is compiling data related to mercury-containing waste allocated in the warehouses of the hospitals within the Mexico City Metropolitan Area;

- Developing a national Master Management Plan (MMP) for mercury, considering Mexican legislation, with the objectives of sharing resources, organizing transport for mercury and mercury-containing waste, sharing temporary storage, and reducing treatment and/or final retirement cost;

[107] <www.cicese.mx/diradmon/recmat/seg/**NOM**-**052**-ECOL-**2005**.doc>
[108] See fn 52, *supra.*
[109] See fn 101, *supra*, and <http://www.diputados.gob.mx/LeyesBiblio/ref/lgpgir/LGPGIR_orig_08oct03.pdf>.

- Submitting the MMP to the authorities for its authorization, following the General Act for the Prevention and Comprehensive Management of Waste;

- Assessing the technical and socio-economic feasibility of consolidating and permanently retiring quantities of mercury and mercury-containing waste, generated by discarded products in commerce, abandoned sites, collection programs, etc;

- Assigning technical and economic resources to develop the best appropriate technology for recovering mercury from waste; and

- Considering technical, economic, political aspects related to liquid mercury treatment-stabilization versus final storage.

Continuation of reduction measures

Progress on research related to reduction technologies, emerging technologies and remediation has been not important during the first five years in Mexico after the Phase II NARAP came into effect. However, in 2009, with the release of the *Comprehensive Management Plan for Mercury and Mercury-containing Waste in the Health Sector*, more stakeholders are contributing to mercury risk communication, risk reduction and risk management activities.

United States

Wastes from Combustion and Industrial Processes and Pollution Control Operations

The primary federal statute for regulating waste management and disposal in the United States is the Resource Conservation and Recovery Act (RCRA). Under RCRA, wastes (including mercury-containing wastes) are regulated and managed as either hazardous or non-hazardous wastes. Mercury-containing hazardous wastes are generally required to be retorted and recycled as elemental commodity mercury, which is a management strategy that has been considered preferable to disposal in landfills.

When wastes are managed as non-hazardous, the laws and regulations of the individual states apply. The exceptions are municipal solid waste landfills and incinerators, which are required to operate under national design and operation standards. Many states have developed restrictions on mercury waste management that go beyond the federal regulations, including bans on disposal of mercury wastes in landfills or requirements to recycle these wastes.

The US requires certain industrial facilities to submit reports each year on the amounts of toxic chemicals released or otherwise managed as waste. The reported information is compiled and presented annually as EPA's Toxics Release Inventory (TRI). "Releases" of mercury compound-bearing wastes include all quantities disposed of in landfills, surface impoundments, and via underground injection.

Hazardous waste generation is also tracked as part of the reporting systems that supply data to RCRAInfo and the National Biennial RCRA Hazardous Waste Report. With certain exceptions

waste generators are required to report hazardous waste generated, including hazardous waste codes, on a biannual basis. Reports go back as far as 1991. The resulting database can be searched for waste codes related to mercury wastes, and the data compiled to assess generation and trends over time.

Incinerator Waste Streams

EPA has established federal limits on mercury air emissions from incinerators that handle wastes, including municipal waste combustors, medical waste incinerators, commercial and industrial solid waste incinerators, and hazardous waste combustors. EPA has no requirements or policies that address source separation, leaving it up to the incinerator operators to decide how to meet the federal air emissions limits for mercury.

A number of states have reduced the amount of mercury-containing wastes entering the waste stream by banning the sale of many types of mercury-added products for which non-mercury alternatives exist. Some states also require manufacturers to support the collection and recycling of mercury–added products such as mercury thermostats and tilt switches in vehicles.

Wastewater Treatment

Publicly-owned municipal wastewater treatment agencies and states are working to minimize the amount of mercury discharged to the wastewater collection system. Dental clinics, and other facilities such as hospitals, have been identified as sources of mercury to the sanitary sewer. Dental clinics are by far the largest remaining source of mercury in wastewater, accounting for about 50 percent of the mercury entering municipal treatment facilities. Dental clinics discharge mercury in the form of amalgam, along with some dissolved mercury.[110] Wastewater treatment plants can remove as much as 95 percent of the mercury from wastewater influent.

Some state and local governments have for several years actively promoted the use of dental amalgam waste separator equipment.[111] Currently more than eleven states require dental offices to install and operate amalgam separators and use additional best management practices to reduce mercury releases. In addition, some states and wastewater treatment districts have subsidized the purchase of separators.

EPA plans to issue a federal rule in 2012 to reduce discharges of mercury waste from dental offices to wastewater systems.[112] Similarly to existing state rules, dental offices will be able to use existing technology to meet the new requirements, including amalgam separators and other best management practices.

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[110] National Association of Clean Water Agencies, *Controlling Mercury in Wastewater Discharges from Dental Clinics: White Paper*, January 2006.

[111] Quicksilver Caucus, *Dental Mercury Amalgam Waste Management White Paper*, April 2008. <www.ecos.org/files/3260_file_Final_Twice_Corrected_Dental_Amalgam_White_Paper_April_2008.pdf>, Quicksilver Caucus, *Case Studies of Five Dental Mercury Amalgam Separator Programs*, May 2008. <www.ecos.org/files/3193_file_case_studies_dental_amalgam_paper_052808.pdf>.

[112] See fn 84.

In March 2011, EPA published a new air emissions regulation for sewage sludge incinerators, which includes a Maximum Achievable Control Technology (MACT) standard for mercury. The rule applies to sewage sludge incinerators located at wastewater treatment facilities designed to treat domestic sewage sludge.

Mercury Waste Collection and Handling

EPA encourages the recycling of mercury-containing products rather than disposing of them in regular household trash. Federal regulations under RCRA include specific requirements for handling and disposing of mercury-containing equipment under the Universal Waste Standards.[113] Mercury-containing equipment that is classified as hazardous waste can be collected under the streamlined collection standards for universal waste. These universal waste standards were created to make it easier to collect certain mercury-containing products, including batteries, pesticides, light bulbs and thermostats, and send them for recycling (or proper treatment and disposal). States can choose to have more stringent standards for handling and disposal of mercury-containing equipment.

Many states, tribes and local agencies have developed collection/replacement programs for businesses and households for mercury-containing[114] products such as thermometers, manometers, and thermostats, and recycling programs for fluorescent light bulbs.[115] In addition, states, tribes, and local governments have played a key role in educational outreach to the business community and to the general public about the importance of properly disposing of mercury-containing products and about alternatives to such products. State and local governments have also encouraged businesses that sell mercury-containing products to establish in-store collection and recycling programs for the public.

Mercury Retirement Program

Research continues in the United States and other countries on development of effective and affordable mercury waste-stabilization and disposal techniques and methods. Currently, the US government believes that the only practical, safe method of "retiring" elemental mercury through long-term, aboveground storage.

In 2008 Congress passed the Mercury Export Ban Act (MEBA), which bans the export of elemental mercury from the US as of 1 January 2013. To accommodate surplus elemental mercury in the United States once exports stop, the law requires the US Department of Energy (DOE) to develop a secure long-term storage and management facility. Private holders of mercury, such as mercury recycling businesses, will be able to pay the government to permanently store their mercury as waste under RCRA regulations. However, without the ability to sell as much mercury and having to pay to store it instead, mercury recycling businesses will have less incentive to recover mercury from wastes. MEBA requires DOE to

[113] <www.epa.gov/epawaste/hazard/wastetypes/universal/mce.htm>
[114] <http://www.epa.gov/mercury/pdfs/II_HgUses.pdf>
[115] <www.epa.gov/epawaste/hazard/wastetypes/universal/lamps/index.htm>

provide Congress with information by 1 July 2014, on the impact of the government's long-term storage program on mercury recycling activities in the United States.

Continuation of Reduction Measures

The US government, states, tribes and local governments continue to pursue research, regulatory and voluntary activities, as resources allow, that promote further reduction of anthropogenic mercury releases to the environment.

Action item 4: Research, Monitoring, Modeling, Assessment and Inventories

NARAP Goals: Develop and refine a collective North American capacity and capability to assess ambient levels, exposure and toxicity of mercury in order to minimize human and ecosystem effects. Specifically, the SMOC Working Group will:

- Improve comparability of data and information on mercury;
- Implement a North American Regional Action Plan on monitoring that includes mercury;
- Promote collaborative research and development programs;
- Increase North American co-operation on modeling of atmospheric transport, deposition and cycling of mercury;
- Increase comparability of mercury release and waste management reporting standards and criteria;
- Compile a North American inventory of sites where elevated levels of mercury may occur; and
- Assess whether environmental impact assessments processes for new major construction initiatives include criteria that evaluate potential mercury releases and consequent impacts.

The goal of this Action Item was to develop a collective North American capacity for research, monitoring, modeling, assessment and inventories, with the support of the CEC. During the past ten years, successful collaborative trinational efforts have been pursued in three major areas: environmental and human health monitoring, comparability of reporting standards for mercury releases and waste disposal, and identification of sites with elevated levels of mercury. However, no trinational work has been done regarding research, air transport modeling or the impact of major new construction initiatives. Activities in these areas were pursued on a country-specific basis during this time period.

CEC Trinational Reports and Activities

North American Mercury Monitoring Networks

CEC work related to environmental monitoring in North America has taken place under formal longer-term arrangements, as well as contaminant-specific activities and short-term campaigns. It has also included human biomonitoring as and when appropriate. The following paragraphs provide a summary of these activities.

A *North American Regional Action Plan on Environmental Monitoring and Assessment (EM&A)* was adopted by Council Resolution #02-08 in 2002. CEC work related to environmental monitoring has taken place using formal, long-term arrangements as well as contaminant-specific activities and short-term campaigns. It has also included human biomonitoring, as appropriate. Mercury-related activities under the environmental monitoring NARAP include the following:

- A trinational maternal blood contaminant study has been completed by the three countries and mercury was included as one of the contaminants monitored.[116] This study was published by the CEC in 2011.
- CEC has provided financial support for the development of a number of multimedia index monitoring sites in Mexico under the auspices of Mexico's national environmental monitoring program entitled "*Proyecto de Evaluacion y Monitoreo Ambientales"* (Proname). Three sites were established to 2010. Three more sites are anticipated to be set up by 2012.

In 2000, Mexico began its participation in the North American Mercury Deposition Network (MDN). With CEC support, two monitoring locations were established by the Mexican Institute of Water Technology (IMTA) during 2003–2004.[117] These sites—one in Huejutla, Hidalgo and other in Puerto Angel, Oaxaca—were accredited and the data were included in the North American Mercury Wet Deposition Network. Canada donated the monitoring equipment for this program. With US support for a period of one year, wet-deposition samples of total mercury were taken weekly and sent monthly to the MDN-contracted laboratory for analysis. Results for this period were included in the MDN database, although it is not known whether these data were included in the network by Canada/US modelers or if there is a model that has included these data. Unfortunately, due to financial reasons, Mexico was not able to continue in this project. A project included in the 2011–2012 Operational Plan reestablishes the capacity to conduct mercury wet deposition monitoring at one of Mexico's index monitoring stations.

Development of Consistent/Comparable Data

Since 1996, representatives of the Canadian National Pollutant Release Inventory (NPRI), the Mexican RETC, and the United States' Toxics Release Inventory (TRI), with CEC support, have been working together in order to enhance the comparability of North American pollutant release and transfer registers (PRTRs) on short- and long-term bases. Mercury is one of the pollutants that are listed on each country's PRTR. The result of this trinational collaboration has been the creation of the CEC's integrated North American PRTR, which brings together data from the Canadian, Mexican and US PRTR programs. Information on mercury releases and transfers can be accessed via an online query builder.[118]

[116] CEC. 2011. Trinational Biomonitoring Study: Assessment of Persistent Organic Pollutants and Selected Metals in the Blood of First-Birth Mothers in Southern Canada and Mexico and in Women of Reproductive Age in the United States. See <www.cec.org/Page.asp?PageID=122&ContentID=25118>.

[117] A.M. Hansen, M. van Afferden, N. Chapelain Lemire, A. López-Mancilla and U. López Rodríguez. 2004. Monitoring pilot project for wet deposition of mercury in Mexico. 2004 MDN Scientific Symposium & Annual Technical Committee Meeting, Halifax, Nova Scotia, Canada.

[118] See <http://takingstock.cec.org/QueryBuilder.aspx>.

Compilation of a North American Inventory of Sites with Elevated Levels of Mercury

In 2001, the CEC report, entitled North American Mercury Database, was prepared. It consolidated previously compiled national inventories from the three countries related to mercury mining, industrial/commercial processing sites, mercury rich geological zones and mercury in tailings associated with Cu, Zn, Pb mining and put them in a geographic information system (GIS) format. The combined database contains approximately 123,000 individual records. A mercury 'hot spots' map was created from the data contained in the report.[119]

Canada

Canada has compiled and published national air emission inventories and trends for mercury (1990 to 2007) using estimation methods that are comparable to those used in the United States.

International Cooperation on Modeling of Atmospheric Transport, Deposition and Cycling of Mercury

Canada participates in collaborative studies with the United States and Europe on monitoring and modeling programs:

- The Arctic Monitoring and Assessment Program report, AMAP Assessment 2011: Mercury in the Arctic (Oslo, Norway), which describes the transport, fate and effects of mercury in the Arctic.
- Mercury Air Transport and Fate Research Partnership under UNEP's Global Mercury Programme
- United Nation's Economic Commission for Europe (UNECE) Convention on the Long-Range Transport of Air Pollution (LRTAP)
- Pan-Pacific Transport of Mercury Project conducted under the International Polar Year
- Environmental Monitoring and Assessment Program under the Commission for Environmental Cooperation's Sound Management of Chemicals initiative

Canada's Mercury Monitoring Activities

Air emissions

- The National Pollutant Release Inventory (NPRI) is Canada's legislated, publicly accessible inventory of pollutant releases (to air, water and land), disposals, and transfers for recycling. Releases of mercury have been reported since 1995 for the 1993 reporting year onward.

Ambient air and air deposition

- The Global/Regional Atmospheric Heavy Metals Model (GRAHM) provides estimates of the contribution of domestic and foreign sources of mercury emissions to the Canadian atmosphere, global simulations of the atmospheric transport of mercury, and levels of deposition of mercury in the Canadian environment.

[119] See <www.cec.org/Storage/49/4186_hotspots_en.pdf>.

- The Clean Air Regulatory Agenda Mercury Science Program (2007–2011) supports development of the GRAHM model, and integration of the model with two nongovernmental modeling activities: the terrestrial model, which predicts the concentration of mercury in lakes and rivers from atmospheric deposition on the watershed, and the aquatic models, which predict the levels of mercury in fish based on levels of mercury in lakes and rivers. Environment Canada is also funding research into the processes governing the transport and fate of mercury emissions in the atmosphere.
- The Integrated Atmospheric Deposition Network[120] measures levels of mercury in the atmosphere and deposition at two sites in the Great Lakes Basin.
- The Canadian Air and Precipitation Monitoring Network[121] supports the long-term monitoring of mercury in the atmosphere and deposition at sites across Canada. This network is designed to provide answers to a number of key questions related to emissions origin, spatial and temporal distribution, atmospheric transformation and fate, and the relationships between mercury and other atmospheric pollutants.
- The Mercury Experiment to Assess Atmospheric Loading in Canada and the United States is a multi-agency, binational study producing new knowledge on the processes governing the transport and fate of atmospheric mercury deposited on terrestrial and aquatic ecosystems.

Water quality / Fish tissue

- The Water Quality Monitoring and Surveillance Program and the Great Lakes Fish Contaminants Surveillance Program measure mercury in water, sediment and fish in the Great Lakes Basin and other transboundary watersheds across Canada.
- Environment Canada's Wildlife and Landscape Science Directorate and Water Science and Technology Directorate study mercury deposition in lake sediments, emission sources, and biological effects in relation to acid deposition.
- Environment Canada, in support of specific studies, measures mercury in selected reservoirs, downstream of pulp and paper mills, at mining sites, and in lakes.

Wildlife monitoring

- Canada's Seabird Egg Monitoring programs track the concentration of mercury in seabird colonies located along Canada's east, west and arctic coasts, and the Great Lakes.
- The Wildlife Toxicology Program monitors levels of mercury in, and studies its effects on, selected predatory aquatic wildlife (e.g., loons, mink) and their prey, at high-risk sites across Canada.
- Environment Canada's Wildlife Toxicology Program supports research on the mechanisms governing the toxicity of mercury to fish and wildlife.

[120] See <www.ec.gc.ca/rs-mn/default.asp?lang=En&n=BFE9D3A3-1>.
[121] See <http://www.ec.gc.ca/rs-mn/default.asp?lang=En&n=752CE271-1>.

Human biomonitoring

- The Canadian Health Measures Survey[122] is an ongoing nationally representative survey that is collecting important health information through household interviews and direct physical measures at a Mobile Examination Clinic. The Survey is tracking levels of mercury in the blood of Canadians.
- The Northern Contaminants Program[123] supports human risk assessment of mercury in the North via the monitoring of trend data for environmental contaminants, including mercury, in human tissues; food consumption patterns of people in the North; and the levels of mercury found in commonly consumed fish and wildlife.
- Health's Canada's chemical surveillance program monitors the concentrations of various chemicals, including mercury, in foods of through its ongoing Total Diet Study surveys. It also undertook a survey on fish and seafood. Health Canada is also committed to reviewing the data that are routinely generated by the Canadian Food Inspection Agency as part of its compliance monitoring program.
- The Maternal-Infant Research on Environmental Chemicals (the MIREC study) is a national five-year research study that is recruiting approximately 2000 women from Canadian cities. Women will be recruited during the first trimester of pregnancy, and followed through pregnancy and up until eight weeks after birth.
- Health Canada conducts surveys and testing to assess if samples taken from the marketplace comply with the mercury requirements for paints and other surface-coating materials, and for surface-coating materials applied to children's toys.

Mexico

Development of Consistent/Comparable Data

Mexico's pollutant release and transfer register (*Registro de Emisiones y Transferencia de Contaminantes*—RETC) is of critical importance for developing trinational capacity during the last twelve years to report, share and analyze comparable data on chemicals of concern to the environment and human health. The RETC is mandated by legislation changes approved by the Mexican Congress in 2001 that require Mexican states and municipalities to compile data on 104 toxic chemicals released into the air, land and water provided by industrial facilities into a comprehensive reporting system. One of the categories of substances considered is mercury and its compounds; the threshold reporting values for reporting are 5 kg/year for use in industrial processes or for manufacturing and 1 kg/year for emissions.

North American Mercury Monitoring Program

During the two phases of NARAP implementation, significant collaborative efforts have been made in North American research programs on mercury. These collaborations have increased

[122] See <www.statcan.gc.ca/cgi-bin/imdb/p2SV.pl?Function=getSurvey&SDDS=5071&lang=en&db=imdb&adm=8&dis=2>.
[123] See <http://www.aadnc-aandc.gc.ca/eng/1100100035611/1100100035612>.

our understanding of bio-geochemical cycles, chemical speciation, bioavailability, exposure pathways, environmental fate and transport mechanisms for mercury and its compounds, source/receptor relationships, toxic effects, environmental indicators, and risks to wildlife and humans**,** and in particular, to susceptible populations. Also important are ongoing actions on mercury risk management. These studies are listed below:

- INE's National Center for Environmental Research and Training (Cenica) participated in the trinational study and analyses of mercury, cadmium and lead in human blood. Two hundred fifty blood samples were taken in Mexico. This study included the inter-comparative test on metals in human blood that was carried out in conjunction with the National Institute of Public Health of Quebec.
- Studies of mercury in fish were carried out in 2009 and 2010. Total mercury in fish consumed in high quantities in Mexico (*Scombridae* and *Lutjanidae* families) from the Gulf of Mexico and the Pacific Coast was analyzed. At some sites, shark samples were also taken as the last link in the trophic chain. The analyses will be done annually until 2012.
- Mercury in sediments was analyzed in 2009 and 2010. Sediment samples were taken from the Coatzacoalcos River in the State of Veracruz and the Zacatecana dam in the State of Zacatecas (this site only in 2009). The Coatzacoalcos River receives the outfalls of petrochemical plant “Pajaritos” and a chlor-alkali plant that produces chlorine and caustic soda using electrolysis involving mercury electrodes. The Zacatecana dam receives the runoff from colonial-era mercury-containing mine tailings.
- A national program of environmental monitoring for persistent, bioaccumulative and toxic substances, including mercury in soil, water, air and biota matrices, is been developed as a long-term project.
- Data on total gaseous mercury from different anthropogenic activities were collected (open dumps and sanitary landfills, brick kilns, mining waste disposal sites, mercury secondary extractions plants) and analyzed using a TEKRAN mercury analyzer.
- Two people from the National Center for Environmental Research and Training (Cenica) received training for mercury analysis. One was trained for mercury analysis in environmental matrices at the University of Michigan in Ann Arbor by US experts in 2003. Another person was trained in the analysis of methylmercury in fish in 2006 by Canadian experts from the Wildlife Research Centre of Environment Canada, at Carleton University, in Ottawa, Canada.
- Two studies of metal analyses in batteries (alkaline and zinc-carbon), including mercury content, were done.

Inventories, Reporting Standards and Criteria

Mexico has compiled and published two national mercury emission inventories: the 1999 *Preliminary Atmospheric Emissions Inventory of Mercury in Mexico*, published in 2001, based on US EPA Emission Factors, and the 2004 *National Mercury Releases Inventory*, based on the UNEP Toolkit.[124] Estimation methods used in the two inventories are not comparable.

[124] See Chapter II, above.

New Major Construction Initiatives

No action has occurred in regard to this item as a trinational effort.

United States

US monitoring and research programs and activities related to mercury include the following.

International Cooperation on Modeling of Atmospheric Transport, Deposition and Cycling of Mercury

The US participates in collaborative studies with Canada and other countries under the following initiatives:

- Arctic Monitoring and Assessment Program (AMAP)
- UNEP Global Mercury Programme's Partnership, including participation in the Transport and Fate Area
- United Nations Economic Commission for Europe Convention on the Long-Range Transport of Air Pollution (LRTAP)
- National Atmospheric Deposition Program (NADP)

US Mercury Monitoring Activities and Key Reports

Air emissions

- EPA National Emissions Inventory (NEI). This is EPA's primary source for air emissions data, and considers data from various sources (primarily state, tribal and local government inventories, supplemented by other sources such as the EPA Toxics Release Inventory and data collection in the process of regulation development).
- EPA Toxics Release Inventory (TRI). EPA requires certain industrial facilities, including metal mining, electric utilities and hazardous waste treatment facilities, to submit annual reports on the amounts of toxic chemicals released to air, water or land or otherwise managed as waste. The reported information is compiled in the Toxics Release Inventory. The industrial mercury use threshold that triggers reporting of mercury releases is 10 pounds (4.5 kg) per year.
- State and regional (multi-state) emission and release inventories, which are periodically updated. For example, the New England Governors and Eastern Canadian Premiers' regional mercury emissions inventory is currently being updated.

Ambient air and air deposition

- National Atmospheric Deposition Program (NADP)[125] supports long-term monitoring of mercury in the ambient air and in deposition at sites across North America. NADP is a voluntary, cooperative effort among many different groups, including federal, state, tribal, local, and international governmental agencies, educational institutions, private companies, and nongovernmental agencies. NADP consists of five sub-networks, including two that monitor mercury: (1) the Mercury Deposition Network (MDN) monitors mercury in wet deposition at more than 100 stations, and (2) the Atmospheric Mercury Network (AMNet), which measures speciated atmospheric mercury

[125] <nadp.sws.uiuc.edu/>

concentrations at 20 stations. Data generated are used to support mercury dry/total deposition estimates, assessment of mercury source impacts, atmospheric model evaluation, and long-term trends assessment.

- NOAA's mercury atmospheric deposition program includes an integrated atmospheric mercury monitoring and modeling program, which performs speciated wet and dry atmospheric measurements as well as comprehensive atmospheric fate and transport modeling
- *NOAA Report to Congress: Mercury Contamination in the Great Lakes*.[126] This report analyzed atmospheric transport and deposition of US and Canadian anthropogenic mercury emissions to the Great Lakes. (NOAA Air Resources Lab)
- New England Mercury Monitoring Program (joint EPA/state program)

Wastes

- EPA Toxics Release Inventory (TRI)
- Waste generators are required to report hazardous waste generated, which is tracked as part of the RCRA info and Biennial Report data reporting systems.

Water quality / Fish tissue

- EPA report: *National Lake Fish Tissue Study*, 2000–2003 (one-time baseline study)[127]
- USGS report: *Mercury in Fish, Bed Sediment and Water from Streams Across the United States, 1998–2005* (baseline study, 2009)[128]
- EPA's National Listing of Fish Advisories for domestic recreational fishing
- EPA's National Coastal Assessment ecological monitoring, monitors mercury in fish tissue from US estuaries.
- FDA's national commercial fish monitoring
- State-specific fish monitoring activities, e.g., in Massachusetts, New York and Minnesota
- Regional (multi-state) fish monitoring activities, e.g., activities carried out under Northeast states regional TMDL for mercury and the Great Lakes Fish Monitoring and Surveillance Program.

Multimedia monitoring and reporting

- National Mercury Monitoring Network (MercNet[129]) is a plan for a comprehensive and integrated mercury-monitoring network, developed by US and Canadian scientists from state, federal, tribal, academic, research and monitoring institutions. The goal is to establish an integrated, national network to systematically monitor, assess, and report on policy-relevant indicators of atmospheric mercury concentrations and deposition, and mercury levels in land, water, and biota in terrestrial, freshwater, and coastal ecosystems in response to changing mercury emissions over time.

[126] <www.arl.noaa.gov/documents/reports/NOAA_GL_Hg_briefing.pdf>
[127] <www.epa.gov/waterscience/fishstudy/>
[128] <pubs.usgs.gov/sir/2009/5109/>
[129] <nadp.sws.uiuc.edu/mercnet/>

- North American Regional Syntheses is a collaborative regional, multimedia data synthesis across North America; initial efforts focused in the Northeastern US, continued to the Great Lakes region, and will begin in the West in 2012.

Human biomonitoring

- CDC's National Health and Nutrition Examination Survey (NHANES) is the only source of nationwide information on mercury in humans. NHANES began measuring mercury levels in blood, hair and urine for the first time in 1999.

US EPA's Mercury Research Program

EPA research activities support the agency's various ongoing efforts to address mercury. In recent years the major emphasis of research activities has been to support regulatory efforts to control mercury releases from coal-fired power plants, and to increase the Agency's understanding of mercury fate and transport. Power plants currently represent the most significant source of mercury release to the atmosphere in the United States. In February 2012, EPA issued a final power plant rule with facility-specific performance standards to reduce air emissions of mercury and other hazardous air pollutants.

Action Item 5: Communication Activities

NARAP goals: The SMOC Mercury Task Force will:

- Develop a trinational educational awareness strategy to inform the public about human and environmental risks related to mercury;
- Communicate best practices and success stories; and
- Generate a database of North American mercury recyclers.

This Action Item addressed the need to inform and educate all North Americans**,** particularly sensitive sub-groups such as pregnant women and subsistence fishermen, regarding the human and environmental risks associated with exposure to mercury, so that informed assessments and decisions can be made to reduce the risk of such exposures. The intent was to develop trinational strategies, mechanisms and activities under the CEC for raising awareness of risks posed by mercury and sharing information on programs, resources and technological advances.

Trinational Educational Awareness Strategy

The NARAP called for the development of a trinational educational awareness strategy that would outline options for informing the North American public on how to reduce the risks of and exposure to mercury; would build capacity to develop outreach programs, and would communicate this plan to the North American public.

An educational awareness strategy needed to reflect the facts on mercury sources, sites, exposure routes, toxic effects, risks to occupational and consumer health, environmental and risk management options. However, at the beginning of NARAP implementation in 2000, little documentation existed on mercury sources, impacts and fate in Mexico. The early efforts of the Mercury Task Force were therefore directed at improving the understanding of mercury sources and impacts in Mexico and at building capacity within the country to address mercury pollution. Given the lack of sufficient information about mercury pollution in Mexico, it was not possible to develop a trinational educational awareness strategy.

Communication of Best Practices

The NARAP called for four specific trinational activities to communicate best practices:
(i) Establish mechanisms for sharing and archiving information on mercury reduction success stories, technological advances, and other international mercury-reduction initiatives;
(ii) Establish a recognition program to publicly acknowledge entities that contributed to reducing mercury use and releases and/or to public education;
(iii) Maintain a contact list of experts and organizations who may be contacted for assistance with mercury control initiatives; and

(iv) Develop exchange programs to facilitate the advancement of technologies and techniques aimed at reducing mercury releases.

The Mercury Task Force did not pursue these four specific institutional activities; however, a great deal of effort has been made to share information, experiences and expertise with Mexico. An early and continuing focus of CEC communication activities has been the exchange of mercury information among technical experts and other stakeholders. The CEC has sponsored numerous workshops and meetings to facilitate cooperation and information exchange among the three countries, and to help inform the Mexican public about the risks associated with mercury.

Information exchange activities related to this Action Item that have been undertaken by the CEC are described in Chapter 2 of this report and are also listed below:

- Analytical/Technical Staff Exchanges
- Expertise Exchange Workshop on Mercury in Humans and the Environment, Mexico City, Mexico, April 2000
- Workshop on the Mercury Situation in the Region of Zacatecana, Zacatecas, Zacatecas State, Mexico, September 2002
- CEC-Americas Workshop to Reduce Mercury Use in Products, Merida, Yucatan, Mexico, February 2006
- Workshop on the Mexican Mercury Market Report, Mexico City, Mexico, October 2008
- Mercury Emissions Inventory Workshop, Mexico City, May 2010

Recycling Directory

Given the recognized need to establish permanent disposal/retirement options for mercury in North America, the three countries agreed that it might be desirable to maintain an inventory of those facilities that are capable of recycling mercury. Thus, the NARAP included an activity to generate a database of North American enterprises interested in ventures to recycle mercury from various sources of mercury products and processes. However, the Mercury Task Force did not pursue this activity.

Action Item 6: Implementation and Compliance

NARAP Goals:

- Develop country-specific implementation plans one year after adoption of the NARAP;
- Publicly report on progress; and
- Verify success, for example, via audit processes and a capacity building strategy.

Country-specific Implementation Plans

While the mercury NARAP provided a framework for action, most of the specific activities called for had to be implemented by the three countries within their individual, unique regulatory structures, capacities and priorities for implementation. The NARAP included the following description of activities aimed at confirming implementation by each of the three governments:

- Develop country-specific implementation plans, one year after adoption of the mercury NARAP by the CEC, to address how and when the actions described in the NARAP will be undertaken, including both regulatory and voluntary/non-regulatory actions.
- Request their respective government agencies to consider the development of regulations or guidelines for mercury use reduction and release reduction of voluntary or non-regulatory reduction programs and commitments fail to achieve their states objectives.

By the time the Phase II NARAP was approved in 2000, Canada and the United States had already undertaken concerted federal efforts to identify mercury releases and its biological and health effects and had begun to implement comprehensive reduction programs. For example, under the terms of the Great Lakes Binational Toxics Strategy (GLBTS), Canada and the United States had each agreed to seek significant reductions in anthropogenic mercury releases. The United States sought a national reduction of 50 percent in mercury uses and releases by 2006 and Canada, a 90-percent reduction in releases from its Great Lakes basin.

In Mexico, however, little was documented about mercury sources, impacts and fate other than some site-specific concerns. The Mercury Task Force recognized that early efforts were needed with Mexico to improve understanding of mercury sources and impacts and to build capacity for mercury awareness raising, monitoring and reduction initiatives.

Thus the focus of the Mercury Task Force was on capacity-building and developing cooperative links with Mexico, rather than the development of country-specific implementation plans.

Verification of Success

Based on the assumption that Canada, Mexico and the United States would each develop detailed implementation plans, the mercury NARAP called for CEC procedures to verify country "compliance" with commitments in those plans for voluntary or non-regulatory actions, and development of guidelines or regulations. The representatives of the three countries to the CEC would specifically:

- Develop an audit process to ensure that mercury reduction initiatives of the three countries are meeting the objectives of the NARAP, based at least in part on information on the amounts of mercury being used, stored, lost and replenished in processes, operations and products.
- Develop a capacity-building strategy to help each country implement the NARAP.
- Assess the effectiveness of voluntary/non-regulatory and regulatory considerations to further enhance capacities for reducing mercury releases.

Since the three countries did not, in fact, develop country-specific implementation plans, the Mercury Task Force did not directly address the three "verification" activities listed above.

The CEC Sound Management of Chemicals Working Group has reported during annual public meetings on the progress of the three countries to reduce mercury use and releases. In addition, members of the Mercury Task force have reported on the progress of such activities during the CEC-sponsored workshops described in Chapter II.

Chapter IV: Conclusions

The North American Regional Action Plan (NARAP) for Mercury—Phase II was adopted in 2000 as a formal agreement among the governments of Canada, the United States and Mexico, and was envisioned as a 10-year plan to reduce mercury releases to the North American environment.

The CEC Sound Management of Chemicals (SMOC) Working Group assigned responsibility for implementing the mercury NARAP to the North American Implementation Task Force on Mercury (Mercury Task Force), a group composed of government representatives from the three countries. The work of the Mercury Task Force was carried out under the general oversight and direction of the SMOC Working Group. CEC resources were dedicated to support implementation.

Current members of the Mercury Task Force were asked to assess the successes and shortcomings of mercury NARAP implementation, identify lessons learned, and provide the SMOC Working Group with recommendations for a potential future trinational approach to addressing mercury. The Mercury Task Force offers this concluding chapter summarizing its discussions as the CEC considers the path forward for addressing mercury pollution in North America.

Overall, the Task Force members believe that the mercury NARAP framework has been an important instrument in facilitating government action to reduce mercury releases in the North American region. Some benefits of NARAP implementation have been shared by all three countries, but Mexico in particular has benefited from early support to increase knowledge of its mercury pollution sources and to build governmental capacity to respond to mercury risks. There have also been significant shortfalls in implementation, and the lessons learned provide a basis for recommendations for possible future approaches to continued action under the CEC to reduce mercury pollution.

NARAP Benefits

The development and implementation of a NARAP for mercury has had numerous tangible and intangible benefits. Members of the Mercury Task Force have worked collaboratively and productively on implementing the NARAP, which has contributed to maintaining and enhancing working relationships among the three countries on mercury issues. Through this process, all three countries have improved their understanding of country-specific sources of mercury and their contributions to mercury pollution in North America. For example, the three countries collaborated on a North American inventory of mercury-contaminated sites, and all three countries have improved their mercury inventories. While a limited set of accomplishments can be attributed specifically to the NARAP—especially in Canada and the United States, where many actions were already underway—the fact that the three governments identified the need

to jointly develop and implement mercury reduction activities has supported each country's independent efforts.

In addition to trinational results, implementing the NARAP has greatly assisted Mexico in realizing a number of important benefits. Perhaps most importantly, Mexico has significantly advanced its understanding of mercury uses, releases, supply and trade. The Mercury Task Force and the CEC helped facilitate this through a variety of "capacity building" initiatives, including support for studies, workshops and staff exchanges. Key to this improved understanding has been an enhanced laboratory analytical capacity. Mexico's ability to measure mercury in air, water and fish has been greatly improved through direct technical assistance, equipment loans and staff exchanges made possible by the CEC and the Mercury Task Force. Increased resources dedicated to this effort by Mexico also contributed greatly.

Several specific mercury reduction projects in Mexico have also been initiated. The NARAP implementation included significant advancements in identifying and substituting mercury thermometers and blood pressure gauges in the healthcare sector, in different States but especially in Mexico City. Mexico has also developed guidelines for handling mercury-containing products and has begun to investigate options for long-term management. And finally, among government staff, industry and the general population, greater understanding of mercury issues has helped to foster action on mercury.

Countries outside of North America have also benefitted from NARAP implementation. Most notably, the CEC and UNEP collaborated to sponsor a workshop on mercury-containing products in 2006, which was attended by government staff from other Latin American countries. At this workshop and through participation in other international mercury events, Mercury Task Force members and Mexican government staff have aided other countries by sharing the NARAP implementation experience.

NARAP Implementation Shortcomings

An overarching challenge for implementing the NARAP was the broad scope and large number of expected actions that were included in the Action Plan. The large number of action items, plus very specific activities within each action item, did not seem to allow for flexibility to address changing circumstances in the three countries, and probably scattered the attention of the Mercury Task Force members. In addition, the CEC budgets have decreased over the ten years of implementation and have not been able to support such an ambitious plan. It seems clear in retrospect that the NARAP should have focused on a few strategic priorities in order to improve its success in funding and implementing CEC mercury projects.

The NARAP relied on significant voluntary actions by some mercury-release sectors to achieve reductions. In the case of mercury used in products, for example, the NARAP called for voluntary substitution and labeling by product manufacturers. Chlor-alkali plants were also called upon to voluntarily reduce mercury use. While the chlor-alkali sector in the three countries did succeed in significantly reducing mercury use without direct regulation, most

voluntary measures in the three countries had far fewer results than expected. The Mercury Task Force could have taken more initiative to periodically reflect on the progress of voluntary actions in the three countries and to share experiences regarding both successful and unsuccessful voluntary and regulatory programs to reduce mercury pollution and mercury use.

The Mercury Task Force has also identified some communication deficiencies that developed at certain times. At times, points of contact and responsible persons within the countries were sometimes difficult to determine, sometimes due to staff turnover and reassignment within government agencies and the CEC. Mercury NARAP implementation would also have been improved by better coordination within the CEC organization, especially between the Mercury Task Force and the related CEC Environmental Monitoring and Assessment Standing Committee.

The following are examples of specific shortcomings in NARAP implementation that provide valuable lessons that can help guide future CEC work.

- Action Item 3 (Waste Management) identifies a need to 'assess the adequacy of national reporting mechanisms used to track the ultimate fate of mercury-containing wastes within North America'. The Mercury Task Force worked with the CEC's Enforcement Working Group to have a report prepared on this issue. However, no follow-up action was ever taken due to the turnover of personnel within the CEC Secretariat, the Mercury Task Force and the Enforcement Working Group. There could have been a better system put in place to maintain program continuity during periods of staff turnover.
- Action Item 4 (Research, Monitoring and Inventories) identifies a need to "develop and refine a collective North American capacity and capability to assess ambient levels, exposure and toxicity of mercury" through trinational research, monitoring, modeling, assessment and inventory programs. Collaborative trinational efforts have been pursued in three major areas: environmental and human health monitoring, comparability of reporting standards for mercury releases and waste management, and identification of sites with elevated levels of mercury. However, no trinational work was done regarding research, air transport modeling, or the impact of major new construction initiatives. This action item turned out to be overly ambitious in terms of the resources available under the CEC. Going forward, greater consideration will need to be given to the continued availability of funding.
- A NARAP for Environmental Monitoring and Assessment was approved by CEC Council in 2002 and a Standing Committee was established under the SMOC Working Group to implement the EM&A NARAP. The SMOC Working Group intended for the various chemical specific task forces to work closely with the EM&A Standing Committee to identify monitoring needs and work cooperatively to ensure those needs were addressed and feedback was provided to the Task Forces. Unfortunately, this collaboration has not been as close or as consistent as might have been expected. As a result, no comprehensive mercury monitoring program has been established. Two

mercury wet deposition monitoring stations were set up in Mexico and operated for two years with CEC funding. However, when the CEC funding was terminated, Mexico was not in a position to take over and the stations were shut down.

- At the outset of NARAP implementation, a 'mercury matrix' document was put together to serve as a template for the Mercury Task Force to record annual updates on progress by the three countries and the CEC. This matrix listed all of the actions in the NARAP and identified the parties responsible for implementation. However, more recently, Task Force members have concluded that the mercury matrix has not been a useful tool for tracking progress. Thus, consideration should be given to devising an appropriate methodology for recording and reporting on progress in NARAP implementation.

The Path Forward for Addressing Mercury in North America

Recognizing the transboundary nature of mercury pollution, the Commission for Environmental Cooperation has reaffirmed the ongoing need for trilateral coordination and work projects that can help address the risks associated with mercury releases and exposure.

Mercury involves a complex set of management issues that are still being faced by all developed and developing countries. It is a naturally occurring chemical element that cannot be destroyed and is difficult to safely dispose of due to the high cost of stabilization. Improper management and disposal of mercury poses a threat to local and global environments. Once released into the environment, mercury pollution can travel long distances in air and water and affect ecosystems and human populations located far from the original point of use, release, or disposal. Methylmercury, the organic form of mercury, has been found to be a significant contaminant in freshwater fish from local lakes and streams in North America, as well as in marine fish in coastal areas.

Mercury is also transported globally through international commerce: in the form of commodity-grade elemental mercury supplies, in mercury-containing products such as medical equipment, as a contaminant in marine fish, and in mercury-containing wastes being transported for disposal across international borders.

The UN Environment Programme (UNEP)'s Mercury Programme is now managing international negotiations to develop by 2013 a global, legally-binding instrument for controlling and reducing mercury. Each of the three North American countries is currently participating in these global mercury discussions. However, the CEC can continue to add benefit by addressing mercury issues that are unique to the North American region or that need to be addressed faster than can be accomplished under the UNEP Mercury Programme or as a result of a future global agreement. CEC trilateral mercury activities will need to be closely coordinated with, and supportive of, the UNEP mercury programme's goals and activities.

It will also be important for the CEC Mercury Task Force to coordinate with and learn from other global and regional initiatives, including the Basel Convention (dealing with waste management), the UNECE Convention on Long-Range Transboundary Air Pollution (LRTAP), and the World Health Organization's Policy on Mercury in Health Care.

Operational Recommendations for Future CEC Trinational Approach

The CEC Mercury Task Force will continue to implement future mercury activities under the general direction of the CEC SMOC Working Group, taking new trilateral action to help reduce the risks associated with mercury and to assist Mexico with building its capacity.

Reflecting on the lessons learned from the NARAP implementation, the Mercury Task Force makes the following operational recommendations:

1. The Mercury Task Force should establish a limited number of priorities for CEC mercury activities and focus available government, industry and international aid resources on implementing those limited priorities.
2. Mercury Task Force members should ensure that relevant country experts are actively engaged in the provision and exchange of existing information and also participate in broader discussion of information needs.
3. The Mercury Task Force should periodically review and document progress in the three countries on priority activities, and share information and advice based on both successful and unsuccessful experiences with mercury reduction activities.
4. The CEC SMOC Working Group should support and facilitate closer coordination between the Mercury Task Force and the EM&A Standing Committee on monitoring and modeling activities.
5. The CEC Secretariat should continue to support and facilitate communication among members of the Mercury Task Force as needed to help it meet its responsibilities.

A New Strategic Approach

In order to increase its effectiveness, it is anticipated that the CEC Mercury Task Force will develop a new strategic plan or framework to guide future cooperation and collaboration among the three countries on reducing mercury releases and use in North America. The Mercury Task Force envisions that within that strategic framework, a limited number of priority projects would be undertaken each year in line with new CEC mercury goals and objectives and reflecting the reality of available CEC resources.