



NATIONAL ENVIRONMENTAL AUTHORITY

DEPARTMENT OF ENVIRONMENTAL QUALITY PROTECTION

**PILOT PROJECT ON STRENGTHENING THE DEVELOPMENT OF AN
INVENTORY AND RISK MANAGEMENT IN MAKING DECISIONS ON**

MERCURY

Summary of the Final Report

**“National Emissions Inventory of Mercury in
Panama”**

With the cooperation of

**United Nations Institute For Training and Research
(UNITAR)**

U. S. Environmental Protection Agency (US EPA)

JANUARY 2009

1. INTRODUCTION

According to several reports, including the Global Mercury Assessment (GMA) developed by the United Nations Environmental Programme (UNEP) in 2002, levels of mercury in the environment have increased considerably from the beginning of the industrial era. It has been determined with great exactitude, that mercury is a persistent and accumulative pollutant, which enters trophic levels of food chain in a well-known dangerous form known as methylmercury. Mercury contamination has global character and circulates around the planet, affecting as distant places as the Arctic.

Because of the high mercury levels reported worldwide, the Governing Council of the United Nations Environment Programme (UNEP), through GC decision 21/5, requested UNEP Executive Director undertake a global assessment of mercury and mercury compounds, in cooperation with other members of the Inter-Organization Programme for the Sound Management of Chemicals (IOMC), to be presented to the Governing Council at its 22nd session in 2003. In this context, UNEP established the Global Mercury Program to assist countries to identify, understand and implement actions to mitigate mercury problems; to develop guidance materials and toolkits; and to support Governments and other stakeholders to develop and implement partnerships, in a clear, transparent and accountable manner.

In the last two years, Panama has had significant progress concerning the sound chemicals management, becoming a pioneer country in the Central American Region in topics such as the implementation of the Strategic Approach for the Integrated Chemical Management (SAICM). In addition, the country counts with a National Chemicals Management Profile and has recently finished the national inventories regarding the implementation of the Stockholm Convention (for COP's pesticides, PCB's, dioxins and furans).

In June 2006 our country was chosen to be one of the five pilot countries to develop a national project related to SAICM implementation, along with Pakistan, Belarus, Mongolia and Tanzania. The project *Strengthening of Governance, Civil Society Participation and Partnerships for Chemicals and Waste Management* receives technical support of the United Nations Institute for Training and Research (UNITAR) and the financial assistance from the Government of Switzerland, as a contribution to the SAICM Quick Start Programme (QSP).

Starting in early 2007, three Latin American countries - Chile, Ecuador, and Panama - were selected to participate in a pilot project to provide information on the magnitude of mercury emissions at national level by developing National Mercury Emissions Inventories and linking them to national PRTR systems.

A Letter of Understanding was signed between the National Authority of the Environment (ANAM) of Panama and the United Nations Institute for Training and Research (UNITAR) in June 2007 to develop this project. In this context, the following outcomes were expected to be completed by the end of the project:

- A National Mercury Releases Inventory including the main categories of country emission sources, emission pathways within each category and emission quantification.
- A National Strategy to address the integration of the National Mercury Inventory within a national PRTR system.
- A National Mercury Risk Management Plan outlining options to reduce mercury releases and exposures, taking into account national conditions.

2. PROJECT OBJECTIVES

- Developing a mercury emissions inventory report
- Developing a strategy to institutionalize a mercury emissions reporting system within the framework of a national PRTR system
- Designing a plan for mercury risk management taking into account emission inventory data (and mercury containing products); and
- Engaging stakeholders in partnerships for mercury emission reporting and risk reduction

3. PROJECT RESULTS

3.1 Preparatory activities

Since March 2007, ANAM had led several informative meetings and workshops in order to facilitate the implementation of the “Reinforcing Pilot Project for the Development of a Mercury Emissions Inventory and Risk Management Decision-Making on Mercury”, as follows:

- (i) **A meeting for divulgence of the Project** was held in the Assembly Hall of the Research and Postgraduate Office of the University of Panama on March 8 of 2007. At the event were representatives of the National Authority of the Environment (ANAM), UNITAR, Ministry of Health (MINSAs), University of Panama (UP), the electric company Union FENOSA, Ministry of Commerce and Industry (MICI), Ministry of Agricultural Development (MIDA), Green Panama and the Central American Commission for Environment and Development (CCAD).
- (ii) **The National Launching of the Mercury Emissions Inventory** was held in the Regional Office of ANAM in the Province of Chiriqui on October 12 of 2007.

Representatives of ANAM, MINSA, UP, MIDA, clinics and hospitals, and mercury related industries attended the event.

- (iii) **A Workshop to Strengthen Capacities on Risk Management Decision-Making on Mercury** was organized in the Bristol Hotel of Panama City during February 18 and 19 of 2008. Among attendees were representatives of ANAM, UNITAR, MINSA, MIDA, MICI, National Authority of Customs (ANA), Non-Governmental Organizations (NGOs), Cement Manufacturing Industries, Electric Companies (Union FENOSA and Elektra Noreste), Municipal authorities (Mayors) of different provinces, General Audit of the Republic, Recycling Companies.
- (iv) **Workshops to Strengthen Capacities on Risk Management Decision-Making on Mercury** were held in different provinces of the country (Los Santos, Herrera and Veraguas) from May 12 to 16 of 2008. Representatives of several governmental and academic institutions participated as well as leaders of the community.
- (v) **A workshop on the endorsement of the National Risk Management Plan for Decision-Making on Mercury** and the strategy to institutionalize a mercury emissions reporting system within the framework of a national PRTR system was organized in the Metropolitan Natural Park of Panama City on September 22 of 2008. The event was attended by representatives of ANAM, MINSA, ANA, MIDA, MICI, Ministry of Economy and Finances (MEF), General Audit of the Republic, NGOs, UP and Recycling Companies.

3.2 Development of the Mercury Emissions Inventory Report

The results of the Mercury Emissions Inventory Report reflect country diagnosis for year 2005. Seven categories were identified, which corresponded mainly to mining, commercial and health sectors. Data of significant magnitude are mainly concentrated in the commercial and health sectors, particularly under the source category of wastes disposal. Although, there are not suitable controls and information on informal mining and other medical activities, they should not be discarded as potential risks.

Panama is not an industrial manufacturing country and all mercury containing products are exported from other countries. As Table N°1 shows, mercury release pathways have been catalogued as potential; this because during life cycle of mercury, liberation is zero (0) for the use phase (product) but not for the final disposal. Nevertheless, this consideration is limited since it cannot be applied for the health and commercial sectors, where potential risk of mercury emissions is significant during the use stage. Thus, categories with greater magnitude of mercury emissions are: (1) Production of other minerals and materials with mercury impurities, (2) Consumer products with

intentional use of mercury and (3) Wastes deposition/landfilling and waste water treatment.

Table N°1. Total Mercury Emissions by Identified Source Category

Main source category	Total mercury emissions/year				
	Air	Water	Land	Products	Wastes/residues
Extraction and use of fuels/energy sources	2.69 Kg	0.0	0.0	0.0	0.0
Production of other minerals and materials with mercury impurities	54.60 - 2.77x10 ³ Kg	0.0	0.0	0.0	0.0
Consumer products with intentional use of mercury	14.64 - 278.60Kg	5.54 - 221.78Kg	12.68 - 204.30Kg	0.0	114.60 - 1.81x10 ³ Kg
Other intentional products/process uses	57.34 Kg	234.56Kg	0.0	13.24 - 466.77Kg	13.24 - 172.93Kg
Waste and residue incineration	0.73 - 7.30Kg	0.0	0.0	0.0	0.08 - 0.82Kg
Wastes deposition/landfilling and waste water treatment	172.40 - 1.72x10 ³ Kg	2.40x10 ⁻⁵ - 4.81x10 ⁻⁷ Kg	0.0	0.0	0.0
Crematoria and cemeteries	0.65-2.6Kg	0.0	13.98-53.92Kg	0.0	0.0
Total Quantified Releases	243.02 - 4.84x10 ³ Kg	5.54 - 456.34Kg	26.66 - 258.22Kg	13.24 - 466.77Kg	127.92 - 1.98x10 ³ Kg

The previous table shows that main mercury releases occur through air, ranging from 243.02 to 4.84 x10³ kilograms. Therefore air is presumably the more contaminated release pathway.

3.3 Establishment of high-priority areas

As showed in Table N°2, the subcategories of major importance were: (1) Cement production, (2) Informal dumping of general waste and (3) Electrical switches and relays with mercury. In relationship to the estimated high values for the subcategory of electrical switches and relays with mercury, it is important to take into account that estimations were based on country actual population, which would represent a high error margin for calculations of mercury emissions.

Table N°2. Total Mercury Emissions by Identified Source Subcategory.

Main Source Subcategory	Total mercury emissions/year				
	Air	Water	Land	Product	Wastes/residues
Extraction and use of fuels/energy sources					
Mineral oils - extraction, refining and use	2.64Kg	0.0	0.0	0.0	0.0
Biomass fired power and heat production	0.048Kg	0.0	0.0	0.0	0.0
Production of other minerals and materials with mercury impurities					
Cement production	54.6 - 2,775.5Kg	0.0	0.0	0.0	0.0
Production of lime and light weight aggregates kilns	0.491Kg	0.0	0.0	0.0	0.0
Consumer products with intentional use of mercury					
Thermometers with mercury	1.84 - 73.92Kg	5.54 - 221.78Kg	0.0	0.0	11.1 - 443.56Kg
Batteries with mercury	45.68Kg	0.0	45.68Kg	0.0	91.36 Kg
Light sources with mercury	0.12 - 0.38Kg	0.0	0.0	0.0	1.98 - 7.25Kg
Electrical switches and relays with mercury	12.68 - 158.62Kg	0.0	12.68 - 158.62Kg	0.0	101.52 - 1.27x10 ³ Kg
Other intentional products/process uses					
Dental mercury-amalgam fillings	6.18Kg	4.33Kg	0.0	370.84Kg	74.16Kg
Manometers and gauges	0.0		0.0	13.24 - 95.93Kg	13.24 - 95.93Kg
Laboratory chemicals and equipment	51.16Kg	230.23Kg	0.0	0.0	2.84Kg
Mercury metal use in religious rituals and folklore medicine	I	I	I	I	I
Waste and residue incineration					
Incineration of municipal/general waste	0.46 - 4.6Kg	0.0	0.0	0.0	0.052 - 0.52Kg
Incineration of hazardous waste	0.27 - 2.7Kg	0.0	0.0	0.0	0.030 - 0.30Kg
Incineration of medical waste	0.0013 - 0.0048Kg	0.0	0.0	0.0	0.0004 - 0.00072Kg

Main Source Subcategory	Total mercury emissions/year				
	Air	Water	Land	Product	Wastes/residues
Wastes deposition/landfilling and waste water treatment					
Controlled landfills/deposits	39.9 – 399Kg	0.0	0.0	0.0	0.0
Informal dumping of general waste	132.5 – 1,325Kg	0.0	0.0	0.0	0.0
Waste water system/treatment	0.0	2.4x10 ⁻⁵ - 4.81x10 ⁻⁷ Kg	0.0	0.0	0.0
Crematoria and cemeteries					
Crematoria	0.65 - 2.6Kg	0.0	0.0	0.0	0.0
Cemeteries			13.98 - 53.92Kg		

I: pending further research

The analysis of the previous table pointed out that commercial and health sectors in Panama are those that generate the major amount of residues with mercury content. The following sectors have been defined of high priority to develop future strategies towards reduction of mercury emissions:

1. Laboratory chemicals and equipment (Health and Commercial sectors).
2. Production of other minerals and materials with mercury impurities (Mining and Commercial sectors).
3. Integrated waste management (waste reuse, treatment and disposal of wastes/residues with mercury content).
4. Products/process with mercury content (Health sector).
5. Mercury metal use in religious rituals and folklore medicine (Health and Commercial sectors).

The complete document of the Mercury Emissions National Inventory in Spanish, is being included in Annex 1.

3.4 Development of the National Plan for Mercury Risk Management in Panama

The Strategic National Plan for Mercury Risk Management in Panama covers a five-year period from 2008 to 2012. Therefore, institutions in charge of different products and activities must prepare annual operative plans and budgets in order to implement it.

This National Plan was reviewed and validated by relevant actors of the public and private sectors and the civil society, during a workshop carried out on September 22 of 2008. Using a validation instrument, the plan was first discussed widely in working groups and later, in a plenary session.

Table N°3 compiles in detail products, activities, indicators and responsible institutions of the National Plan for Mercury Risk Management in Panama. Coordinating institutions directly in charge of the different products and activities are bold and underlined in the respective column.

Table N°3. National Plan for Mercury Risk Management in the Republic Of Panama, Period of implementation: 2008-2012

AIM: Protection of health and environment from risks related to mercury.

PURPOSE (GOAL): Strengthening of mercury risk management in the Republic of Panama.

OBJECTIVES	PRODUCTS	INDICATORS	ACTIVITIES	RESPONSIBLES ORGANIZATIONS*
1. Establishing national legal framework, coordination mechanisms and surveillance systems for the integrated management of mercury.	<ul style="list-style-type: none"> • Import and use of mercury and consumer products with intentional use of mercury reduced and/or eliminated. 	<ul style="list-style-type: none"> • At least two (2) legal instruments approved and published in the Official Journal at the end of 2012. 	1.1. Elaboration, approval and implementation of the legal framework for the control and surveillance of mercury and consumer products with intentional use of mercury.	<u>ANAM</u> , MINSAs, MICI, ANA, ACODECO, General Audit of the Republic, Colon Free Zone, importers/ distributors, salesman and consumers.
	<ul style="list-style-type: none"> • A National Plan for mercury risk management implemented. 	<ul style="list-style-type: none"> • A legal instrument approved and published in the Official Journal before the end of 2009. • Annual plan reports and evaluations. 	1.2. Establishment of responsibilities and coordination of working groups (governmental institutions, private companies and civil society) throughout a legal instrument. 1.3. Monitoring and evaluation of the plan during the five-year period.	<u>ANAM</u> , MINSAs, MICI, ANA, General Audit of the Republic, and other governmental agencies, importers/ distributors, private companies and consumers.
	<ul style="list-style-type: none"> • An epidemiological surveillance system for mercury established. 	<ul style="list-style-type: none"> • Epidemiological annual reports, once the system is established. 	1.4. Establishment of an epidemiological surveillance system for mercury.	<u>MINSAs</u> , CSS, private hospitals and clinics.

* Coordinating institutions directly in charge of the different products and activities are bold and underlined.

2. Improving register mechanisms, as well as the information exchange and diffusion of the Mercury Emissions Inventory.	<ul style="list-style-type: none"> • An initiated National PRTR. 	<ul style="list-style-type: none"> • Meeting resumes, workshops reports and lists of participants during the five-year period. 	2.1. Technical assistant and financial support to the establishment of a National PRTR.	Public institutions (<u>ANAM</u> , <u>MINSA</u> , ANA, MICI), private companies and international agencies.
	<ul style="list-style-type: none"> • A suitable toolkit for identification and quantification of mercury releases. • An institutionalized mercury emissions Inventory. 	<ul style="list-style-type: none"> • Toolkit document adjusted, published and available at the end of 2009. 	2.2. Adjustment of the Toolkit and institutionalization of the Mercury Emissions Inventory.	<u>ANAM</u> , other public institutions and private sector that may provide data related to mercury emissions.
	<ul style="list-style-type: none"> • Relevant national information systems harmonized. 	<ul style="list-style-type: none"> • Alternated information systems, which are exchanging and incorporating data on mercury at the end of 2012. 	2.3. Identification and to harmonization with other existing environmental information systems and/or data bases (such as INEE, SIA), to incorporate or to exchange relevant data on mercury.	<u>ANAM</u> , MINSA, MICI, ANA, General Audit of the Republic, and other governmental agencies.
		<ul style="list-style-type: none"> • An approved normative instrument in mid-2010. • Number of companies that provide waste disposal services at the end of 2011. 	3.1. Establishment of minimum requirements for the proper handling, collection, transport, treatment and final disposal of mercury wastes.	<u>MINSA</u> , <u>Municipalities</u> , ANAM and other public institutions, as well as service companies for waste disposal.

3. Optimizing integrated management of hazardous wastes and residues, particularly of mercury.	<ul style="list-style-type: none"> • A suitable mercury waste and residues treatment and disposal. • Environmental impact caused by mercury in landfills and garbage dumps reduced. 	<ul style="list-style-type: none"> • Pilot Program for collection and recycling of mercury-containing light bulbs developed and initiated in 2009. • Number of industries or institutions participating in the pilot program at the end of 2010 and 2012. • Amount (by units or weight) of lamps collected and recycled at the end of 2012. 	3.2. Development of a pilot program for collection and recycling of mercury-containing fluorescent light bulbs/lamps.	<u>ANAM, National Secretariat of Energy,</u> MINSA and other institutions participating in the program, municipalities, private companies, etc.
		<ul style="list-style-type: none"> • A program of mercury free hospitals established in mid-2009. • Number of hospitals that achieve the objectives of the program at the end of the five-year period. 	3.3. Elaboration and implementation of a Mercury Free Hospital Program to promote suitable recovery, storage and final deposition of mercury residues and wastes, as well as replacement by mercury free supplies.	<u>MINSA,</u> CSS, Hospitals, hospital distributors and suppliers, users.
4. Sensitizing and training of relevant	<ul style="list-style-type: none"> • Groups of interest sensitized and informed 	<ul style="list-style-type: none"> • Type and amount of developed informative material developed at the end of 2009. • Number of NGOs, industries and population included in the mercury campaign. 	4.1. Development of a campaign on mercury for the different groups from interest, which includes production and massive diffusion of informative materials (posters, guides, videos, spots, among others).	<u>ANAM, MINSA</u> and other institutions, NGOs, industries, consumers, general population.

<p>stakeholders and other groups of interest about potential risks associated to mercury use and disposal.</p>	<ul style="list-style-type: none"> Public and private sectors trained. 	<ul style="list-style-type: none"> Training program developed and established at the beginning of year 2010. Number of courses, workshops, or seminars organized until the end of 2012. Amount public employees trained until the end of 2012. 	<p>4.2. Development and establishment of a training program on mercury for public and private sectors.</p>	<p>ANAM, <u>MINSA</u> and other institutions, NGOs, industries, universities, etc.</p>
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3.4 Development of the strategy for the institutionalization of the mercury inventory in a national PRTR system

The proposed strategy consists of three (3) steps, which are:

Step 1: Establishment of an institutional coordination for the implementation of a national PRTR, through a MINSAs-ANAM Technical Working Group, and using existing resources and data in the country (among others, Mercury National Inventory and ANAM Register of Environmental Pollutant Emitting Facilities).

Step 2: Establishment of a national PRTR, using data of the mercury inventory and the electronic platform of the Registry of Environmental Pollutant Emitting Facilities.

Step 3: Dissemination of the information generated by Mercury National Inventory to the different groups from interest, within the framework of a national PRTR system.

Long term actions would be taken, since the information that appears in the inventory must be updated within the registry system. At this moment, Panama does not have a PRTR system, but a national PRTR proposal is being evaluated to be implemented this year, so mercury will be considered within the chemical agent list to register; and this will entail new actions for its institutionalization.

The strategy should be completed by the end of year 2010, through different supporting activities such as institutional meetings, technical workshops, and awareness sessions, among others.

4. Obstacles and lessons learned

Incomplete and/or missing data in the Mercury National Inventory belong to the following categories:

- Other intentional products/processes use (subcategories of laboratory chemicals and equipment, mercury metal use in religious rituals and folklore medicine and, manometers and gauges).
- Consumer products with intentional use of mercury, subcategory of electrical switches and relays with mercury.

These missing data includes weights, volumes, sizes or other product specifications entering our country, which are necessary to quantify mercury emissions using procedures and formulas in UNEP toolkit.

Currently, there are limitations for quantification of mercury emissions from some mercury-containing products, mainly related to procedures in the Customs System, which create bias in estimation of mercury emissions. This is considered an opportunity to strengthen specificity of the national tariff system in the near future.

Panama counts on a poor waste management system at national level. Sites for informal dumping of general waste cannot be accurately determined, since most of them are garbage dumps without much sanitary control. This fact might be affecting, negatively or positively, the magnitude of estimations under this subcategory.

On the other hand, medical activities should also be taken into consideration for estimation of mercury emissions from products, since some of them involve handling and use of mercury containing products, which could represent potential risks to health workers and environment. For example, there is no data on the amount of mercury in dental amalgams used in public and private clinics by dentists, neither on the quantities of mercury in dental wastes. Quantities reported in the inventory refer to overall bulk volume or weight at the time of entrance to the country (amount generally provided by the suppliers); reason why data may underestimate the total amount of mercury emissions to air and water pathways.

It is important to emphasize that the Mercury Inventory Toolkit had also proven to have limited application to our country reality in some cases. The provided rates and factors for calculations are mainly based on developed countries, whose realities as far as sound management of final deposition of wastes referred, are very different. Therefore, factors were adjusted for some of the reported results, as in the cases of wastes deposition/landfilling and waste water treatment, consumer products with intentional use of mercury and dental mercury-amalgam fillings. In the near future, UNEP should consider an extensively review of the Toolkit in the light of the different countries that had already applied it, but also based on economic, commercial and industrial conditions of developing countries.

Thanks to this Project, the National Authority of Environment, as focal point, has succeeded to consolidate coordination and develop communication mechanisms with many governmental institutions, universities, private companies and NGOs.

5. Follow-up activities

If necessary, Risk Management Plan and strategy to institutionalize the mercury inventory in a PRTR system might be reviewed and adjusted in the light of the final mercury emissions report.

The Mercury Emissions Inventory Report is a document which must be updated every year; therefore, following activities need to be implemented in the next months to maintain and improve quality of the information collected and processed:

- 1) The use, commercialization and origin of mercury (*azogue*) for ritual and spiritual purposes among Panamanian residents should be assessed because it could be an important source of mercury emissions in this subcategory. A field research is been developed with pharmacies and pharmaceutical companies to obtain valuable information; nevertheless, results will be completed in year 2009.
- 2) The implementation of the National Policy for the environmentally sound management of non-hazardous and hazardous wastes, approved by Executive Decree N° 34 of February 26, 2007, is requiring immediate action and sustainable governmental support.
- 3) The Republic of Panama is a container load centre with high transit from and towards different parts of the world, storing temporary mercury-containing products and other hazardous substances, which suggests urgent development of monitoring and surveillance systems to ensure adequate control of the international trade of these goods.
- 4) The Inventory indicated the need to set a program in hospitals and clinics to control entrance, handling and final disposition of mercury containing equipment and materials. In that regard, an inventory form, developed by US EPA and implemented in the State of California, is being introduced in clinics and hospitals of the country. Further actions associated with mercury in the health care sector will include hazardous waste training, waste storage and disposal, control of potential health risks to staff, patients and visitors and introduction of mercury-free alternatives that are viable, cost-effective and safe.
- 5) At the end of year 2008, the National Secretariat of Energy, in collaboration with the National Authority of the Environment, began a energy-saving campaign "Operation Bulb" in the capital city, which is aimed at substituting 6 million power-saving lamps for incandescent bulbs. These power-saving lamps contain a minimum

amount of mercury (2mg); therefore, future actions will be dealing with their adequate handling and final disposition.

ACRONYMS

ACODECO Competition	Authority for Protection of the Consumer and Defense of the
ANA	National Authority of Customs
ANAM	National Authority of the Environment
COPs	Persistent Organic Pollutants
CSS	Social Security Agency
EPA	Environmental Protection Agency
GMA	Global Mercury Assessment
INEE	National Inventory of Environmental Pollutant Emitting Facilities
IOMC Chemicals	Inter-Organization Programme for the Sound Management of
Kg	kilograms
MEF	Ministry of Economy and Finances
MICI	Ministry of Commerce and Industry
MIDA	Ministry of Agricultural Development
MINSA	Ministry of Health
NGOs	Non-Governmental Organizations
PCBs	Polychlorinated biphenyls
PRTR	Pollutant Release and Transfer Registries
QSP	SAICM Quick Start Programme
SAICM Management	Strategic Approach for the Integrated Chemical
SIA	National Environmental Information System
UNEP	United Nations Environmental Programme
UNITAR	United Nations Institute for Training and Research
UP	University of Panama