ENVIRONMENTAL PROTECTION
AUTHORITY

INVENTORY OF MERCURY RELEASES IN ETHIOPIA

JANUARY 2012

MERCURY INVENTORY FOR (COUNTRY NAME):	**ETHIOPIA**
General population data	
Population (number of inhabitants)	80,000,000 with growth rate of 2.6 %
Year and reference for population data	2007,CENTAL STATSTICS OFFICE OF ETHIOPIA
GDP (Gross Domestic product)	351 USD
Year and reference for GDP data	2011, IMF
Main sectors in the economy of country (list)	Agriculture,Industry
Contact point responsible for inventory	
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1 Executive summary

Introduction

This inventory is made by the Environmental Protection Authority of Ethiopia in collaborations with the Ministry of Mines, Ministry of Water and Energy, Ministry of Construction and Urban Development, Ministry of Industry and Ministry of Health with the finical support of the UNEP- Chemicals in the year 2012.

This mercury release inventory was made with the use of the "Toolkit for identification and quantification of mercury releases" made available by the United Nations Environment Programme's Chemicals division (UNEP Chemicals). The Toolkit is available at UNEP Chemicals' website:

http://www.unep.org/hazardoussubstances/Mercury/MercuryPublications/GuidanceTrainingMaterialToolkits/MercuryToolkit/tabid/4566/language/en-US/Default.aspx.

This inventory was developed on the Toolkits Inventory Level 1. The Toolkit is based on mass balances for each mercury release source type. Inventory Level 1 works with pre-determined factors used in the calculation of mercury inputs to society and releases, the so-called default input factors and default output distribution factors. These factors were derived from data on mercury inputs and releases from such mercury source types from available literature and other relevant data sources.

Results and discussion

An aggregated presentation of the results for main groups of mercury release sources is presented in Table 1.1 below.

Table 1-1 Summary of mercury inventory results

Source category	Estimated Hg input, Kg Hg/y	Estimated Hg releases, standard estimates, Kg Hg/y					
		Air	Water	Land	By-products and impurities	General waste	Sector specific waste treatment /disposal
Coal combustion and other coal use	7,169.6	6,452.6	0.0	0.0	0.0	717.0	0.0
Other fossil fuel and biomass combustion	403.9	403.9	0.0	0.0	0.0	0.0	0.0
Oil and gas production	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Primary metal production (excl. gold production by amalgamation)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gold extraction with mercury amalgamation	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other materials production	3,729.0	2,237.4	0.0	0.0	745.8	745.8	0.0
Chlor-alkali production with mercury-cells	-	-	-	-	-	-	-
Other production of chemicals and polymers	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Production of products with mercury content	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Use and disposal of	12,000.0	240.0	3,984.0	0.0	432.0	2,304.0	2,304.0

dental amalgam fillings							
Use and disposal of other products	15,200.0	3,360.0	1,320.0	4,480.0	0.0	4,680.0	1,360.0
Production of recycled metals	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Waste incineration and open waste burning*1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Waste deposition*1	-	-	-	-	-	-	-
Informal dumping of general waste *1*2	0.0	0.0	0.0	0.0	-	-	-
Waste water system/treatment *3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Crematoria and cemeteries	2,097.6	0.0	0.0	2,097.6	0.0	0.0	0.0
TOTALS	**40,600.0**	**12,690.0**	**5,300.0**	**6,580.0**	**1,180.0**	**8,450.0**	**3,660.0**

Notes:

*1: To avoid double counting of mercury inputs from waste and products in the input TOTAL, only 10% of the mercury input to waste incineration, waste deposition and informal dumping is included in the total for mercury inputs. These 10% represent approximately the mercury input to waste from materials which were not quantified individually in Inventory Level 1 of this Toolkit.

See Appendix 1 to the Inventory Level1 Guideline for more explanation.

*2: The estimated quantities include mercury in products which has also been accounted for under each product category.

To avoid double counting, the release to land from informal dumping of general waste has been subtracted automatically in the TOTALS.

*3: The estimated input and release to water include mercury amounts which have also been accounted for under each source category.

To avoid double counting, input to, and release to water from, waste water system/treatment have been subtracted automatically in the TOTALS.

As shown in table 1.1, the following sources contribute with the major mercury inputs:

- Other coal uses
- Combustion/use of petroleum coke and heavy oil
- Biomass fired power and heat production
- Charcoal combustion
- Cement production
- Dental amalgam fillings ("silver" fillings)*
- Electrical switches and relays with mercury*
- Cemeteries

* Note that the calculation of mercury inputs for these mercury release sources were based on default factors from the mercury Toolkit, which are derived from developed countries, and as such the inputs may be over-estimated.

The individual mercury release contributing with the highest mercury inputs were

- Energy consumption
- Other materials production
- Use and disposal of products with mercury content

The individual mercury release sub-categories contributing with the highest mercury releases to the atmosphere were:

- other coal uses
- Electrical switches and relays with mercury

Detailed presentation of mercury inputs and releases for all mercury release source types present in the country are shown in the following report sections.

Data gaps

Major data gaps were the following:

- Incineration of municipal/general waste
- Incineration of medical waste
- Open fire waste burning (on landfills and informally)
- Informal dumping of general waste *1
- Waste water system/treatment
- Use and disposal of products with mercury content

2 Mercury release source types present

Table 2-1 shows which mercury release sources were identified as present and absent, respectively, in the country. Only source types positively identified as present are included in the quantitative assessment.

It should be noted however, that the presumably minor mercury release source types shown in Table 2-2 were not included in the detailed source identification and quantification work.

Table 2-1 Identification of mercury release sources in the country; sources present (Y), absent (N), and possible but not positively identified (?).

Source category	Source present?
	Y/N/?
Energy consumption	
Coal combustion in large power plants	n
Other coal uses	y
Combustion/use of petroleum coke and heavy oil	y
Combustion/use of diesel, gasoil, petroleum, kerosene	y
Use of raw or pre-cleaned natural gas	n
Use of pipeline gas (consumer quality)	n
Biomass fired power and heat production	y
Charcoal combustion	y
Fuel production	

Oil extraction	n
Oil refining	n
Extraction and processing of natural gas	n
Primary metal production	
Mercury (primary) extraction and initial processing	n
Production of zinc from concentrates	n
Production of copper from concentrates	n
Production of lead from concentrates	n
Gold extraction by methods other than mercury amalgamation	y
Alumina production from bauxite (aluminium production)	n
Primary ferrous metal production (iron, steel production)	n
Gold extraction with mercury amalgamation - without use of retort	y
Gold extraction with mercury amalgamation - with use of retorts	y
Other materials production	
Cement production	y
Pulp and paper production	n
Production of chemicals	
Chlor-alkali production with mercury-cells	n
VCM production with mercury catalyst	n
Acetaldehyde production with mercury catalyst	n
Production of products with mercury content	
Hg thermometers (medical, air, lab, industrial etc.)	n
Electrical switches and relays with mercury	n
Light sources with mercury (fluorescent, compact, others: see guideline)	n
Batteries with mercury	n
Manometers and gauges with mercury	n
Biocides and pesticides with mercury	n
Paints with mercury	n

Skin lightening creams and soaps with mercury chemicals	n
Use and disposal of products with mercury content	
Dental amalgam fillings ("silver" fillings)	y
Thermometers	Y
Electrical switches and relays with mercury	y
Light sources with mercury	Y
Batteries with mercury	Y
Polyurethane (PU, PUR) produced with mercury catalyst	?
Paints with mercury preservatives	?
Skin lightening creams and soaps with mercury chemicals	?
Medical blood pressure gauges (mercury sphygmomanometers)	?
Other manometers and gauges with mercury	?
Laboratory chemicals	y
Other laboratory and medical equipment with mercury	y
Production of recycled of metals	
Production of recycled mercury ("secondary production")	n
Production of recycled ferrous metals (iron and steel)	y
Waste incineration	
Incineration of municipal/general waste	y
Incineration of hazardous waste	n
Incineration of medical waste	y
Sewage sludge incineration	n
Open fire waste burning (on landfills and informally)	y
Waste deposition/landfilling and waste water treatment	
Controlled landfills/deposits	n
Informal dumping of general waste *1	y
Waste water system/treatment	y
Crematoria and cemeteries	
Crematoria	n
Cemeteries	y

Table 2-2 Miscellaneous potential mercury sources not included in the quantitative inventory; with preliminary indication of possible presence in the country.

Source category	Source present?
	Y/N/?
Combustion of oil shale	n
Combustion of peat	n
Geothermal power production	y
Production of other recycled metals	?
Production of lime	y
Production of light weight aggregates (burnt clay nuts for building purposes)	n
Chloride and sodium hydroxide produced from mercury-cell technology	n
Polyurethane production with mercury catalysts	n
Seed dressing with mercury chemicals	n
Infra red detection semiconductors	n
Bougie tubes and Cantor tubes (medical)	n
Educational uses	y
Gyroscopes with mercury	n
Vacuum pumps with mercury	?
Mercury used in religious rituals (amulets and other uses)	?
Mercury used in traditional medicines (ayurvedic and others) and homeopathic medicine	?
Use of mercury as a refrigerant in certain cooling systems	?
Light houses (levelling bearings in marine navigation lights)	n
Mercury in large bearings of rotating mechanic parts in for example older waste water treatment plants	?
Tanning	y
Pigments	?
Products for browning and etching steel	?
Certain colour photograph paper types	?
Recoil softeners in rifles	?
Explosives (mercury-fulminate a.o.)	?
Fireworks	?
Executive toys	?

3 Summary of mercury inputs to society

Mercury inputs to society should be understood here as the mercury amounts made available for potential releases through economic activity in the country. This includes mercury intentionally used in products such as thermometers, blood pressure gauges, fluorescent light bulbs, etc. It also includes mercury mobilised via extraction and use of raw materials which contains mercury in trace concentrations.

Table 3-1 Summary of mercury inputs to society

Source category	Source present?			Estimated Hg input, Kg Hg/y
	Y/N/?	Activity rate	Unit	Standard estimate
Energy consumption				
Coal combustion in large power plants	n	0	t coal combusted/y	-
Other coal uses	y	26,554,000	t coal used/y	7,170
Combustion/use of petroleum coke and heavy oil	y	123,621	t oil product combusted/y	7
Combustion/use of diesel, gasoil, petroleum, kerosene	y	1,936,313	t oil product combusted/y	11
Use of raw or pre-cleaned natural gas	n	0	Nm3 gas/y	-
Use of pipeline gas (consumer quality)	n	0	Nm3 gas/y	-
Biomass fired power and heat production	y	82,896	t biomass combusted/y (dry weight)	2
Charcoal combustion	y	3,200,000	t charcoal combusted/y	384
Fuel production				
Oil extraction	n	0	t crude oil produced/y	-
Oil refining	n	0	t oil refined/y	-
Extraction and processing of natural gas	n	0	Nm3 gas/y	-

Primary metal production				
Mercury (primary) extraction and initial processing	n	0	t mercury produced/y	-
Production of zinc from concentrates	n	0	t concentrate used/y	-
Production of copper from concentrates	n	0	t concentrate used/y	-
Production of lead from concentrates	n	0	t concentrate used/y	-
Gold extraction by methods other than mercury amalgamation	y	0	t gold ore used/y	0
Alumina production from bauxite (aluminium production)	n	0	t bauxit processed/y	-
Primary ferrous metal production (iron, steel production)	n	0	t pig iron produced/y	-
Gold extraction with mercury amalgamation - without use of retort	y	0	kg gold produced/y	0
Gold extraction with mercury amalgamation - with use of retorts	y	48	kg gold produced/y	0
Other materials production				
Cement production	y	13,560,000	t cement produced/y	3,729
Pulp and paper production	n	0	t biomass used in production/y	-
Production of chemicals				
Chlor-alkali production with mercury-cells	n	0	t Cl2 produced/y	-
VCM production with mercury catalyst	n	0	t VCM produced/y	-
Acetaldehyde production with mercury catalyst	n	0	t acetaldehyde produced/y	-
Production of products with mercury content				
Hg thermometers (medical, air, lab, industrial etc.)	n	0	kg mercury used for production/y	-
Electrical switches and relays with mercury	n	0	kg mercury used for production/y	-
Light sources with mercury (fluorescent, compact, others: see guideline)	n	0	kg mercury used for production/y	-
Batteries with mercury	n	0	kg mercury used for production/y	-
Manometers and gauges with mercury	n	0	kg mercury used for production/y	-
Biocides and pesticides with mercury	n	0	kg mercury used for production/y	-
Paints with mercury	n	0	kg mercury used for production/y	-
Skin lightening creams and soaps with mercury chemicals	n	0	kg mercury used for production/y	-
Use and disposal of products with mercury content				

Dental amalgam fillings ("silver" fillings)	y	80,000,000	number of inhabitants	12,000
Thermometers	Y	0	items sold/y	0
Electrical switches and relays with mercury	y	80,000,000	number of inhabitants	11,200
Light sources with mercury	Y	0	items sold/y	0
Batteries with mercury	Y	0	t batteries sold/y	0
Polyurethane (PU, PUR) produced with mercury catalyst	?	80,000,000	number of inhabitants	?
Paints with mercury preservatives	?	0	t paint sold/y	?
Skin lightening creams and soaps with mercury chemicals	?	0	t cream or soap sold/y	?
Medical blood pressure gauges (mercury sphygmomanometers)	?	0	items sold/y	?
Other manometers and gauges with mercury	?	80,000,000	number of inhabitants	?
Laboratory chemicals	y	80,000,000	number of inhabitants	800
Other laboratory and medical equipment with mercury	y	80,000,000	number of inhabitants	3,200
Production of recycled of metals				
Production of recycled mercury ("secondary production")	n	0	kg mercury produced/y	-
Production of recycled ferrous metals (iron and steel)	y	0	number of vehicles recycled/y	0
Waste incineration				
Incineration of municipal/general waste*1	y	0	t waste incinerated/y	0
Incineration of hazardous waste*1	n	0	t waste incinerated/y	-
Incineration of medical waste*1	y	0	t waste incinerated/y	0
Sewage sludge incineration*1	n	0	t waste incinerated/y	-
Open fire waste burning (on landfills and informally)*1	y	0	t waste burned/y	0
Waste deposition/landfilling and waste water treatment				
Controlled landfils/deposits *1	n	0	t waste landfilled/y	-
Informal dumping of general waste *1*2	y	0	t waste dumped/y	0
Waste water system/treatment *3	y	0	m3 waste water/y	0
Crematoria and cemeteries				
Crematoria	n	0	corpses cremated/y	-
Cemeteries	y	839,038	corpses buried/y	2,098
TOTAL of quantified inputs				**40,600**

Notes to table:

*1: To avoid double counting of mercury inputs from waste and products in the input TOTAL, only 10% of the mercury input to waste incineration sources, waste deposition and informal dumping is included
in the total for mercury inputs. These 10% represent approximately the mercury input to waste from materials which were not quantified individually in Inventory Level 1 of this Toolkit.

See Appendix 1 to the Inventory Level1 Guideline for more explanation.

*2: The estimated quantities include mercury in products which has also been accounted for under each product category.
To avoid double counting, the release to land from informal dumping of general waste has been subtracted automatically in the TOTALS.

*3: The estimated input and release to water include mercury amounts which have also been accounted for under each source category.
To avoid double counting, input to, and release to water from, waste water system/treatment have been subtracted automatically in the TOTALS.

Note that the following source sub-categories made the largest contributions to mercury inputs to society:

- Dental amalgam fillings ("silver" fillings)*
- Other coal uses
- Combustion/use of diesel, gasoil, petroleum, kerosene
- Charcoal combustion
- Cement production
- Electrical switches and relays with mercury*
- Cemeteries

* Note that the calculation of mercury inputs for these mercury release sources were based on default factors from the mercury Toolkit, which are derived from developed countries, and as such the inputs may be over-estimated.

In the Table 3-2 below, a summary of mercury releases from all source categories present is given. The key mercury releases here are releases to air (the atmosphere), to water (marine and freshwater bodies, including via waste water systems), to land, to general waste, and to sectors specific waste. An additional output pathway is "by-products and impurities" which designate mercury flows back into the market with by-products and products where mercury does not play an intentional role. See Table 4-2 below for a more detailed description and definition of the output pathways.

Table 3-2 Summary of mercury releases

Source category	Estimated Hg releases, standard estimates, Kg Hg/y					
	Air	Water	Land	By-products and impurities	General waste	Sector specific waste treatment /disposal
Energy consumption						
Coal combustion in large power plants	-	-	-	-	-	-
Other coal uses	6,452.6	0.0	0.0	0.0	717.0	0.0
Combustion/use of petroleum coke and heavy oil	6.8	0.0	0.0	0.0	0.0	0.0
Combustion/use of diesel, gasoil, petroleum, kerosene	10.6	0.0	0.0	0.0	0.0	0.0
Use of raw or pre-cleaned natural gas	-	-	-	-	-	-
Use of pipeline gas (consumer quality)	-	-	-	-	-	-
Biomass fired power and heat production	2.5	0.0	0.0	0.0	0.0	0.0
Charcoal combustion	384.0	0.0	0.0	0.0	0.0	0.0
Fuel production						
Oil extraction	-	-	-	-	-	-
Oil refining	-	-	-	-	-	-
Extraction and processing of natural gas	-	-	-	-	-	-
Primary metal production						
Mercury (primary) extraction and initial processing	-	-	-	-	-	-
Production of zinc from concentrates	-	-	-	-	-	-
Production of copper from concentrates	-	-	-	-	-	-
Production of lead from concentrates	-	-	-	-	-	-

Gold extraction by methods other than mercury amalgamation	0.0	0.0	0.0	0.0	0.0	0.0
Alumina production from bauxite (aluminium production)	-	-	-	-	-	-
Primary ferrous metal production (iron, steel production)	-	-	-	-	-	-
Gold extraction with mercury amalgamation - without use of retort	0.0	0.0	0.0	0.0	0.0	0.0
Gold extraction with mercury amalgamation - with use of retorts	0.0	0.0	0.0	0.0	0.0	0.0
Other materials production						
Cement production	2,237.4	0.0	0.0	745.8	745.8	0.0
Pulp and paper production	-	-	-	-	-	-
Production of chemicals						
Chlor-alkali production with mercury-cells	-	-	-	-	-	-
VCM production with mercury catalyst	-	-	-	-	-	-
Acetaldehyde production with mercury catalyst	-	-	-	-	-	-
Production of products with mercury content						
Hg thermometers (medical, air, lab, industrial etc.)	-	-	-	-	-	-
Electrical switches and relays with mercury	-	-	-	-	-	-
Light sources with mercury (fluorescent, compact, others: see guideline)	-	-	-	-	-	-
Batteries with mercury	-	-	-	-	-	-
Manometers and gauges with mercury	-	-	-	-	-	-
Biocides and pesticides with mercury	-	-	-	-	-	-
Paints with mercury	-	-	-	-	-	-
Skin lightening creams and soaps with mercury chemicals	-	-	-	-	-	-
Use and disposal of products with mercury content						
Dental amalgam fillings ("silver" fillings)	240.0	3,984.0	0.0	432.0	2,304.0	2,304.0

Thermometers	0.0	0.0	0.0	0.0	0.0	0.0
Electrical switches and relays with mercury	3,360.0	0.0	4,480.0	0.0	3,360.0	0.0
Light sources with mercury	0.0	0.0	0.0	0.0	0.0	0.0
Batteries with mercury	0.0	0.0	0.0	0.0	0.0	0.0
Polyurethane (PU, PUR) produced with mercury catalyst	?	?	?	?	?	?
Paints with mercury preservatives	?	?	?	?	?	?
Skin lightening creams and soaps with mercury chemicals	?	?	?	?	?	?
Medical blood pressure gauges (mercury sphygmomanometers)	?	?	?	?	?	?
Other manometers and gauges with mercury	?	?	?	?	?	?
Laboratory chemicals	0.0	264.0	0.0	0.0	264.0	272.0
Other laboratory and medical equipment with mercury	0.0	1,056.0	0.0	0.0	1,056.0	1,088.0
Production of recycled of metals						
Production of recycled mercury ("secondary production")	-	-	-	-	-	-
Production of recycled ferrous metals (iron and steel)	0.0	0.0	0.0	0.0	0.0	0.0
Waste incineration						
Incineration of municipal/general waste	0.0	0.0	0.0	0.0	0.0	0.0
Incineration of hazardous waste	-	-	-	-	-	-
Incineration of medical waste	0.0	0.0	0.0	0.0	0.0	0.0
Sewage sludge incineration	-	-	-	-	-	-
Open fire waste burning (on landfills and informally)	0.0	0.0	0.0	0.0	0.0	0.0
Waste deposition/landfilling and waste water treatment						
Controlled landfills/deposits	-	-	-	-	-	-
Informal dumping of general waste *1	0.0	0.0	0.0	-	-	-

Waste water system/treatment *2	0.0	0.0	0.0	0.0	0.0	0.0
Crematoria and cemeteries						
Crematoria	-	-	-	-	-	-
Cemeteries	0.0	0.0	2,097.6	-	0.0	0.0
TOTAL of quantified releases	**12,690.0**	**5,300.0**	**6,580.0**	**1,180.0**	**8,450.0**	**3,660.0**

Notes:
*1: The estimated quantities include mercury in products which has also been accounted for under each product category.
To avoid double counting, the release to land from informal dumping of general waste has been subtracted automatically in the TOTALS.
*2: The estimated release to water include mercury amounts which have also been accounted for under each source category.
To avoid double counting, input to, and release to water from, waste water system/treatment have been subtracted automatically in the TOTALS.

Note that the following source sub-categories made the largest contributions to mercury releases to the atmosphere:

- Energy consumption
- Other materials production
- Electrical switches and relays with mercury

Table 3-3: Description of the types of results.

Calculation result type	Description
Estimated Hg input, Kg Hg/y	The standard estimate of the amount of mercury entering this source category with input materials, for example calculated mercury amount in the amount of coal used annually in the country for combustion in large power plants.
Air	Mercury emissions to the atmosphere from point sources and diffuse sources from which mercury may be spread locally or over long distances with air masses; for example from: • Point sources such as coal fired power plants, metal smelter, waste incineration; • Diffuse sources as small scale gold mining, informally burned waste with fluorescent lamps, batteries, thermometers..
Water	Mercury releases to aquatic environments and to waste water systems: Point sources and diffuse sources from which mercury will be spread to marine environments (oceans), and freshwaters (rivers, lakes, etc.). for example releases from: • Wet flue cleaning systems from coal fired power plants; • Industry, households, etc. to aquatic environments; • Surface run-off and leachate from mercury contaminated soil and waste dumps
Land	Mercury releases to soil, the terrestrial environment: General soil and ground water. For example releases from: • Solid residues from flue gas cleaning on coal fired power plants used for gravel road construction;. • Uncollected waste products dumped or buried informally • Local un-confined releases from industry such as on site hazardous waste storage/burial • Spreading of sewage sludge with mercury content on agricultural land (sludge used as fertilizer) • Application on land, seeds or seedlings of pesticides with mercury compounds
By-products and impurities	By-products that contain mercury, which are sent back into the market and cannot be directly allocated to environmental releases, for example: • Gypsum wallboard produced from solid residues from flue gas cleaning on coal fired power plants. • Sulphuric acid produced from desulphurization of flue gas (flue gas cleaning) in non-ferrous metal plants with mercury trace concentrations • Chlorine and sodium hydroxide produced with mercury-based chlor-alkali technology; with mercury trace concentrations • Metal mercury or calomel as by-product from non-ferrous metal mining (high mercury concentrations)
General waste	General waste: Also called municipal waste in some countries. Typically household and institution waste where the waste undergoes a general treatment, such as incineration, landfilling or informal dumping. The mercury sources to waste are consumer products with intentional mercury content (batteries, thermometers, fluorescent tubes, etc.) as well as high volume waste like printed paper, plastic, etc., with small trace concentrations of mercury.
Sector specific waste treatment /disposal	Waste from industry and consumers which is collected and treated in separate systems, and in some cases recycled; for example. • Confined deposition of solid residues from flue gas cleaning on coal fired power plants on dedicated sites. • Hazardous industrial waste with high mercury content which is deposited in dedicated, safe sites • Hazardous consumer waste with mercury content, mainly separately collected and safely treated batteries, thermometers, mercury switches, lost teeth with amalgam fillings etc. • Confined deposition of tailings and high volume rock/waste from extraction of non-ferrous metals

4 Data and inventory on energy consumption and fuel production

4.1 Data description

ENERGY CONSUMPTION AND FUEL PRODUCTION

Source category	Source present?	Activity rate		Estimated Hg input, Kg Hg/y	Estimated Hg releases, standard estimates, Kg Hg/y							
Energy consumption	**Y/N/?**	Annual consumption/production	Unit	Standard estimate	Air	Water	Land	By-products and impurities	General waste	Sector specific waste treatment /disposal	Cat. no.	Notes:
Coal combustion in large power plants	n		t coal combusted/y	-	-	-	-	-	-	-	5.1.1	
Other coal uses	y	26,554,000	t coal used/y	7,170	6,452.6	0.0	0.0	0.0	717.0	0.0	5.1.2	Ministry of Water and Energy 2011
Combustion/use of petroleum coke and heavy oil	y	123,621	t oil product combusted/y	7	6.8	0.0	0.0	0.0	0.0	0.0	5.1.3	Ministry of Water and Energy 2011

Combustion/use of diesel, gasoil, petroleum, kerosene	y	1,936,313	t oil product combusted/y	11	10.6	0.0	0.0	0.0	0.0	0.0	5.1.3	Ministry of Water and Energy 2011
Use of raw or pre-cleaned natural gas	n		Nm3 gas/y	-	-	-	-	-	-	-	5.1.4	
Use of pipeline gas (consumer quality)	n		Nm3 gas/y	-	-	-	-	-	-	-	5.1.4	
Biomass fired power and heat production	y	82,896	t biomass combusted/y (dry weight)	2	2.5	0.0	0.0	0.0	0.0	0.0	5.1.6	Ministry of Water and Energy 2011
Charcoal combustion	y	3,200,000	t charcoal combusted/y	384	384.0	0.0	0.0	0.0	0.0	0.0	5.1.6	Ministry of Water and Energy 2011
Fuel production												
Oil extraction	n		t crude oil produced/y	-	-	-	-	-	-	-	5.1.3	
Oil refining	n		t oil refined/y	-	-	-	-	-	-	-	5.1.3	
Extraction and processing of natural gas	n		Nm3 gas/y	-	-	-	-	-	-	-	5.1.4	

4.2 Background calculations and approximations

Questionnaire was prepared and sent out to collect data from the Ministry of Water and Energy in relation to biomass fired power and heat production. However, it is not possible to get quantified data about it. This is due luck of systematic data handling system

4.3 Data gaps and priorities for potential follow up

- Biomass fired power and heat production

5 Data and inventory on domestic production of metals and raw materials

5.1 Data description

DOMESTIC PRODUCTION OF METALS AND RAW MATERIALS

Source category	Source present?	Activity rate		Estimated Hg input, Kg Hg/y	Estimated Hg releases, standard estimates, Kg Hg/y						
	Y/N/?	Annual consumption/production	Unit	Standard estimate	Air	Water	Land	By-products and impurities	General waste	Sector specific waste treatment /disposal	Cat. no.
Primary metal production											
Mercury (primary) extraction and initial processing	n		t mercury produced/y	-	-	-	-	-	-	-	5.2.1

Production of zinc from concentrates	n		t concentrate used/y	-	-	-	-	-	-	-	5.2.3
Production of copper from concentrates	n		t concentrate used/y	-	-	-	-	-	-	-	5.2.4
Production of lead from concentrates	n		t concentrate used/y	-	-	-	-	-	-	-	5.2.5
Gold extraction by methods other than mercury amalgamation	y		t gold ore used/y	0	0.0	0.0	0.0	0.0	0.0	0.0	5.2.6
Alumina production from bauxite (aluminium production)	n		t bauxit processed/y	-	-	-	-	-	-	-	5.2.7
Primary ferrous metal production (iron, steel production)	n		t pig iron produced/y	-	-	-	-	-	-	-	5.2.9
Gold extraction with mercury amalgamation - without use of retort	y		kg gold produced/y	0	0.0	0.0	0.0	0.0	0.0	0.0	5.2.2
Gold extraction with mercury amalgamation - with use of	y	48	kg gold produced/y	0	0.0	0.0	0.0	0.0	0.0	0.0	5.2.2

retorts												
Other materials production												
Cement production	y	13,560,000	t cement produced/y	3,729	2,237.4	0.0	0.0	745.8	745.8	0.0	5.3.1	Ministry of Industry 2011
Pulp and paper production	n		t biomass used in production/y	-	-	-	-	-	-	-	5.3.2	

5.2 Background calculations and approximations

Questionnaire was prepared and sent out to collect data from the Ministry of Industry and Ministry of Mines in relation to source category indicated in the above table. However, it is not possible to get quantified data about it except Gold extraction with mercury amalgamation - with use of retorts and Cement production. This is due luck of systematic data handling system

5.3 Data gaps and priorities for potential follow up

- Gold extraction by methods other than mercury amalgamation
- Gold extraction with mercury amalgamation - without use of retort

6 Data and inventory on domestic production and processing with intentional mercury use

6.1 Data description

DOMESTIC PRODUCTION AND PROCESSING WITH INTENTIONAL MERCURY USE

Source category	Source pre-sent?	Activi-ty rate		Estimated Hg input, Kg Hg/y	timated Hg releases, standard estimates, Kg Hg/y						
Produc-tion of chemi-cals	**Y/N/?**	Annual con-sump-tion/pr oduc-tion	Unit	Standard estimate	Air	Water	Land	By-products and impurities	General waste	Sector specific waste treatment /disposal	Cat. no.
Chlor-alkali produc-tion with mercury-cells	n		t Cl2 pro-duced/y	-	-	-	-	-	-	-	5.4.1

VCM production with mercury catalyst	n		t VCM produced/y	-	-	-	-	-	-	-		5.4.2
Acetaldehyde production with mercury catalyst	n		t acetaldehyde produced/y	-	-	-	-	-	-	-		5.4.3
Production of products with mercury content												
Hg thermometers (medical, air, lab, industrial etc.)	n		kg mercury used for production/y	-	-	-	-	-	-	-		5.5.1
Electrical switches and relays with mercury	n		kg mercury used for production/y	-	-	-	-	-	-	-		5.5.2

Light sources with mercury (fluores-cent, compact, others: see guide-line)	n		kg mercury used for pro-duction/y	-	-	-	-	-	-	-		5.5.3
Batteries with mercury	n		kg mercury used for pro-duction/y	-	-	-	-	-	-	-		5.5.4
Ma-nometers and gauges with mercury	n		kg mercury used for pro-duction/y	-	-	-	-	-	-	-		5.6.2
Biocides and pes-ticides with mercury	n		kg mercury used for pro-duction/y	-	-	-	-	-	-	-		5.5.5
Paints with mercury	n		kg mercury used for pro-duction/y	-	-	-	-	-	-	-		5.5.6
Skin lighten-ing	n		kg mercury used for pro-duction/y	-	-	-	-	-	-	-		5.5.7

creams and soaps with mercury chemi-cals											

6.2 Background calculations and approximations

Questionnaire was prepared and sent out to collect data from the Ministry of Industry **in** relation to source category indicated in the above table. However, it is not possible to get quantified data about it. This is due luck of systematic data handling system

6.3 Data gaps and priorities for potential follow up

- Electrical switches and relays with mercury
- Paints with mercury
- Skin lightening creams and soaps with mercury chemicals

7 Data and inventory on waste handling and recycling

7.1 Data description

Source category	Source present?	Activity rate		Estimated Hg input, Kg Hg/y	Estimated Hg releases, standard estimates, Kg Hg/y						
Production of recycled of metals	**Y/N/?**	Annual production /waste disposal	Unit	Standard estimate	Air	Water	Land	By-products and impurities	General waste	Sector specific waste treatment /disposal	Cat. no.
Production of recycled mercury ("secondary production")	n		kg mercury produced/y	-	-	-	-	-	-	-	5.7.1
Production of recycled ferrous metals (iron and steel)	y		number of vehicles recycled/y	0	0.0	0.0	0.0	0.0	0.0	0.0	5.7.2

Waste incineration											
Incineration of municipal/general waste	y		t waste incinerated/y	0	0.0	0.0	0.0	0.0	0.0	0.0	5.8.1
Incineration of hazardous waste	n		t waste incinerated/y	-	-	-	-	-	-	-	5.8.2
Incineration of medical waste	y		t waste incinerated/y	0	0.0	0.0	0.0	0.0	0.0	0.0	5.8.3
Sewage sludge incineration	n		t waste incinerated/y	-	-	-	-	-	-	-	5.8.4
Open fire waste burning (on landfills and informally)	y		t waste burned/y	0	0.0	0.0	0.0	0.0	0.0	0.0	5.8.5
Waste deposition/landfilling and waste water treatment											
Controlled	n		t waste landfilled/y	-	-	-	-	-	-	-	5.9.1

landfills/ deposits											
Informal dumping of general waste *1	y		t waste dumped/y	0	0.0	0.0	0.0	-	-	-	5.9.4
Waste water system/treatment	y		m3 waste water/y	0	0.0	0.0	0.0	0.0	0.0	0.0	5.9.5

7.2 Background calculations and approximations

Questionnaire was prepared and sent out to collect data from the relevant intuition like the Ministry of Health related to Incineration of medical waste. Similarly data related to incineration of municipal waste and waste water treatment sent to the Ministry of Construction and Urban Development. In addition to this Questionnaire also sent to the Ministry of Industry in relation to Production of recycled of metals. However, none of them provided quantified data about it.

7.3 Data gaps and priorities for potential follow up

- Production of recycled ferrous metals (iron and steel)
- Incineration of municipal/general waste
- Incineration of medical waste
- Open fire waste burning (on landfills and informally)
- Informal dumping of general waste *1
- Waste water system/treatment

8 Data and inventory on general consumption of mercury in products, as metal mercury and as mercury containing substances

8.1 Data description

GENERAL CONSUMPTION OF MERCURY IN PRODUCTS, AS METAL MERCURY AND AS MERCURY CONTAINING SUBSTANCES											
Source category	Source present?	Activity rate		Estimated Hg input, Kg Hg/y	Estimated Hg releases, standard estimates, Kg Hg/y						
	Y/N/?	Annual consumption/population	Unit	Standard estimate	Air	Water	Land	By-products and impurities	General waste	Sector specific waste treatment /disposal	Cat. no.
			NOTE: Selection regarding waste management:		Less than 2/3 of the waste is collected and treated under public control						
Use and disposal of products with mercury content											

Dental amalgam fillings ("silver" fillings)	**y**			**12,000**	**240.0**	**3,984.0**	**0.0**	**432.0**	**2,304.0**	**2,304.0**	5.6.1
Preparations of fillings at dentist clinics		80,000,000	number of inhabitants		240.0	1,680.0	0.0	0.0	1,440.0	1,440.0	
Use - from fillings already in the mouth		80,000,000	number of inhabitants		0.0	144.0	0.0	0.0	0.0	0.0	
Disposal (lost and extracted teeth)		80,000,000	number of inhabitants		0.0	2,160.0	0.0	432.0	864.0	864.0	
Thermometers	**Y**	**0**		**0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	5.5.1
Medical Hg thermometers	y		items sold/y	0							
Other glass Hg thermometers (air, laboratory, dairy, etc.)	y		items sold/y	0							
Engine control Hg thermometers and other large industrial/speciality Hg thermometers	y		items sold/y	0							5.5.1
Electrical switches and relays with mercury	y	80,000,000	number of inhabitants	11,200	3,360.0	0.0	4,480.0	0.0	3,360.0	0.0	5.5.2
Light sources with mercury	**Y**	0	items sold/y	**0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	5.5.3
Fluorescent tubes (double end)	y		items sold/y	0							
Compact fluorescent lamp (CFL single end)	y		items sold/y	0							
Other Hg containing light sources (see guideline)	?		items sold/y	?							
Batteries with mercury	**Y**	**0**	**t batteries sold/y**	**0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	5.5.4
Mercury oxide (button cells and other sizes); also called mercury-zinc cells	y		t batteries sold/y	0							
Other button cells (zinc-air, alkaline button cells, silver-oxide)	?		t batteries sold/y	?							
Other batteries with mercury (plain cylindrical alkaline,	?		t batteries sold/y	?							

permanganate, etc., see guideline)											
Polyurethane (PU, PUR) produced with mercury catalyst	?	80,000,000	number of inhabitants	?	?	?	?	?	?	?	5.5.5.
Paints with mercury preservatives	?		t paint sold/y	?	?	?	?	?	?	?	5.5.7
Skin lightening creams and soaps with mercury chemicals	?		t cream or soap sold/y	?	?	?	?	?	?	?	5.5.8
Medical blood pressure gauges (mercury sphygmomanometers)	?		items sold/y	?	?	?	?	?	?	?	5.6.2
Other manometers and gauges with mercury	?	80,000,000	number of inhabitants	?	?	?	?	?	?	?	5.6.2
Laboratory chemicals	y	80,000,000	number of inhabitants	800	0.0	264.0	0.0	0.0	264.0	272.0	5.6.3
Other laboratory and medical equipment with mercury	y	80,000,000	number of inhabitants	3,200	0.0	1,056.0	0.0	0.0	1,056.0	1,088.0	5.6.3, 5.6.5

8.2 Background calculations and approximations

Questionnaire was prepared and sent out to collect data from the relevant intuition like the Ministry of Health, the Ministry of Construction and Urban Development and the Ministry of Industry as deemed as necessary to the source category indicated in the above table. However, none of them provided quantified data about it.

8.3 Data gaps and priorities for potential follow up

- Dental amalgam fillings ("silver" fillings)
- Medical Hg thermometers
- Electrical switches and relays with mercury
- Light sources with mercury
- Compact fluorescent lamp (CFL single end)
- Batteries with mercury
- Other laboratory and medical equipment with mercury

9 Data and inventory on crematoria and cemeteries

9.1 Data description

Source category	Source present ?	Activity rate		Estimated Hg input, Kg Hg/y	Estimated Hg releases, standard estimates, Kg Hg/y							Notes :
Crematoria and cemeteries	**Y/N/?**	Annual numbers dead	Unit	Standard estimate	Air	Water	Land	By-products and impurities	General waste	Sector specific waste treatment /disposal	Cat. no.	
Crematoria	n		corpses cremated/y	-	-	-	-	-	-	-	5.10.1	
Cemeteries	y	839,038	corpses buried/y	2,098	0.0	0.0	2,097.6	-	0.0	0.0	5.10.2	based on death rate assumption 1999

9.2 Background calculations and approximations

Based on 1999 death rate assumption 10.8

9.3 Data gaps and priorities for potential follow up

None

10 List of major data gaps

Questionnaire was prepared and sent out to collect data from the relevant intuition like the Ministry of Health related to Incineration of medical waste and Use and disposal of products with mercury content. Similarly incineration of municipal waste, Open fire waste burning (on landfills and informally), Informal dumping of general waste and Waste water system/treatment to the Ministry of Construction and Urban Development. In addition to this Questionnaire also sent to the Ministry of Industry and the Ministry of Mines as deemed as necessary. However, none of them provided quantified data about the sources category listed below as data gaps

List of data gaps across all source categories

- Incineration of municipal/general waste
- Incineration of medical waste
- Open fire waste burning (on landfills and informally)
- Informal dumping of general waste *1
- Waste water system/treatment
- Use and disposal of products with mercury content
- Biomass fired power and heat production
- Gold extraction by methods other than mercury amalgamation
- Gold extraction with mercury amalgamation - without use of retort
- Electrical switches and relays with mercury

- Paints with mercury
- Skin lightening creams and soaps with mercury chemicals
- Production of recycled ferrous metals (iron and steel)
- Dental amalgam fillings ("silver" fillings)
- Medical Hg thermometers
- Light sources with mercury
- Compact fluorescent lamp (CFL single end)
- Batteries with mercury
- Other laboratory and medical equipment with mercury

References

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Appendix 1 - Inventory Level 1 calculation spreadsheets

[Append all spreadsheet pages in PDF or MS Word format]