MERCURY RELEASE INVENTORY, WASTE STORAGE AND DISPOSAL IN THE REPUBLIC OF SURINAME




DECEMBER 2016

NATIONAL INVENTORY OF MERCURY RELEASES IN THE REPUBLIC OF SURINAME

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This inventory was performed in accordance with UNEP's "Toolkit for identification and quantification of mercury releases", Inventory Level 1 (version 1.02, April 2013, or newer).

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LIST OF ABBREVIATIONS

ALCOA	Aluminum Company of America
AMAP	Arctic Monitoring and Assessment Programme
BCRC-Caribbean	Basel Convention Regional Centre for Training and Technology Transfer for the Caribbean
BOG	Public Health Office
CH_3Hg	Methylmercury
CCME	Canadian Council of Ministers of the Environment
ESMP	Environmental and Social Management Plan
GDP	Gross Domestic Product
GMD	Geological Mining Service
GOS	Government of Suriname
HARPRO	Regional Development and Physical Planning Department
HEAL	Health and Environment Alliance
HFO	Heavy Fuel Oil
Hg	Mercury
IEA	International Energy Agency
ISWA	International Solid Waste Association
km	kilometre
l	Litre
mg/kg	milligrams per kilogram
NIMOS	National Institute for Environment and Development in Suriname
N.V. EBS	N.V. Energy Company Suriname
ODA	Official Development Assistance
OGS	Commission Regulation Gold Sector
ppm	parts per million
PVC	Polyvinyl chloride
SEL	Specially Engineered Landfill
SPS	National Planning Office of Suriname
sq	squared
SURALCO	Suriname Aluminum Company
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNEP DTIE	United Nations Development Programme Division of Technology, Industry and Economics
USGS	United States Geological Service
VCM	Vinyl chloride monomer
WHO	World Health Organisation
yr	year

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EXECUTIVE SUMMARY

Mercury is a chemical of global concern and it occurs naturally in the earth's crust but due to human activities, the release of mercury in the environment is alarming. This is primarily because all forms of mercury have been established as toxic to both humans and animals; with no biological benefits and causing deleterious health impacts. It also results in serious contamination to the natural environment. The chemical is used in a range of areas including the industrial, commercial, health, domestic and waste sectors.

The Minamata Convention on Mercury was formally adopted on October 10th, 2013 as a global response to protect human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds. The Convention embodies both voluntary and compulsory measures that aim to reduce the impact of mercury on health and the environment, through various provisions related to extraction, usage, releases, trade, storage and waste management.

The Republic of Suriname is a sovereign state located on the north coast of South America. The country is rich in mineral resources such as gold, oil, and bauxite. The extraction and processing of these minerals accounted for 30% of the Gross Domestic product (GDP) and also 90% of exports. From the 1960s onwards, exports of bauxite, alumina, and aluminium have accounted for 70-80% of total export revenues, the bulk of government revenue. As of today, all bauxite mining activities have ceased, due to the closure of operations in-country by BHP Billiton and later by Aluminum Company of America (ALCOA), whose subsidiary in Suriname is known as Suriname Aluminum Company, L.L.C. (Suralco L.L.C.). Since the 1980s, there has been an increase in small scale gold mining in Suriname for which mercury is used in its process. The service industry, which accounts for nearly half of GDP, is dominated by trade and transport activities that are closely linked to the extractive industry. Agriculture is also important in the economy, accounting for just under 10% of GDP and 10% of exports.

In 2006, Suriname banned the import on mercury but the toxic substance is still excessively used in the small-scale gold mining field, as there does not exist a legal ban against the use of mercury. Particularly in eastern Suriname, recent studies indicated that high mercury levels exist in the atmosphere, fish, land and indigenous villagers. The Republic of Suriname is yet to sign the Minamata Convention.

The Basel Convention Regional Centre for Training and Technology Transfer for the Caribbean Region (BCRC-Caribbean), in collaboration with the UNEP "Chemicals and Waste Branch" of the United Nations Environment Programme Division of Technology, Industry and Economics (UNEP DTIE), received funding from the Norway Official Development Assistance (ODA) for execution of the "Mercury Storage and Disposal Project in the Caribbean: Jamaica, Trinidad and Tobago, Suriname." The Project aims to increase the capacities for environmentally sound stor-

age and disposal of mercury in the participating countries and thereby assist participating countries with acceding, ratifying and implementing the Minamata Convention.

One way to advance this process is to provide evidence of the potential sources of mercury and mercury pollution through the development of a national inventory of Mercury Releases in Suriname. As such, relevant stakeholders participated in the development of the inventory which was developed in 2016 based on data mainly from 2015. This inventory was designed using the United Nations Environment Programme's (UNEP) Toolkit for Identification and Quantification of Mercury Releases (Inventory Level 1). The Toolkit is based on mass balances for each mercury release source type group. The 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.

The inventory found that the major sources of mercury, in terms of estimated total releases, in the Republic of Suriname are:

- Primary metal production (excluding gold production by amalgamation)[1] * (**134,829 kg Hg/yr**)

- Gold extraction (**39,247 kg Hg/yr**)

- Use and disposal of other products (mercury-containing products, excluding dental amalgam **(552 kg Hg/yr)**

It should be noted that the toolkit Level 1 inventory was a desktop study that was completed using information gathered from questionnaires dispersed to relevant stakeholders, as well as from statistical websites. The questionnaires used are attached at Annex I. The data entered into the Toolkit was based on activity rates which generated the data values for each sector. For a more detailed estimation of mercury releases, it is recommended that a Level 2 inventory be completed.

The project also examined two additional components:

- Legislative and Policy Review and

[1] * **NOTE: In November 2015, the company responsible for alumina production from bauxite, Suralco L.L.C., discontinued its business in Suriname so the mercury releases contributing to primary metal production in terms of bauxite, would now be lower than estimated in this inventory.**

- Storage and Disposal Options

In Suriname, the legislative and policy review indicated current legislation regarding use, import, export and handling of mercury is non-existent and a comprehensive law needs to be developed to address this. Additionally, the Mining Decree, 1986 must be revised and updated with regulations put in place to reduce mercury releases and phase out mercury use in mining processes such as small-scale gold mining.

As it relates to storage and disposal, three (3) main options were detailed:

1) To develop a facility (or facilities) for interim storage of mercury waste, the location of which will need to be determined in further discussions with relevant stakeholders. A consolidation of mercury waste produced by individual companies would be done by the companies themselves who would have to develop infrastructure "in-house" to arrange for the environmentally sound collection and transport of the waste to the interim storage facility. The interim storage sites could be developed in collaboration with the main waste management companies as a sanitary engineered landfill under an integrated waste management approach, meaning that mercury waste as well as other hazardous waste will be handled at the facility.

2) To have stabilisation/ solidification processes done at the interim storage facilities for the mercury waste. The recommended process would be solidification via cementation where the mercury waste would be encased in a solid block.

3) To export the waste at a national level for environmentally sound disposal to a processing facility where environmentally sound mechanisms exist for the proper extraction and disposal of mercury, for example in countries like the United States of America, Canada, Spain and the Netherlands. The exportation of solidified waste may be expensive due to the potentially large mass of the solid blocks so considerations would need to be made as to how these costs could be off-set.

Based on the low response rate to questionnaires disseminated for data collection in this inventory, a follow-up survey with stakeholders is recommended.

It is recommended that the Government of the Republic of Suriname accede to the Minamata Convention on Mercury in order to better facilitate the implementation of environmentally sound management of mercury waste in the country. However, it should be noted that the time dedicated to obtaining the data for this project was approximately three (3) months resulting in an inventory that was incomplete. As a direct result, Suriname cannot commit to any policy directives at this time. Additionally, this high level of decision making must be approved under the auspices of Cabinet.

Suriname is developing its National Action Plan under the Minamata Convention and it is anticipated that this process will yield more information on the Gold Mining Sector which can lead to informed decision making.

1.0 INTRODUCTION

In order to address the issue of mercury in Suriname in both the short, medium and long term, Suriname needs to gain an understanding of the mercury waste streams. A better understanding of the mercury waste streams can lead to an informed decision as to whether or not to sign and ratify the Minamata Convention.

The "Mercury Storage and Disposal Project" aims to collect accurate data on the sources and quantities of mercury waste as well as on the amounts of mercury released to the environment.

1.1 BACKGROUND ON MERCURY

Mercury is a chemical of global concern and it occurs naturally in the earth's crust but due to human activities, the release of mercury in the environment is alarming (Health and Environment Alliance (HEAL), 2005). Environmental mercury levels have increased significantly since the commencement of the industrial age. The element mercury has broad uses in everyday objects and is released to the atmosphere, soil and water from a variety of sources (Minamata Convention on Mercury, 2016). Elemental mercury (Hg) and its compounds are highly toxic to human beings. These harmful effects manifest in the nervous, digestive and immune systems, lungs and kidneys. It can be fatal. The damage also extends to the environment where there has been evidence of bioaccumulation in fishes as well as severe neurological disorders in birds. The various sources of mercury and the transport and mobilization processes are complex and they come together to create a biogeochemical cycle appropriately titled the Global Mercury Cycle (UNEP, 2013). This is shown below in Figure 1.

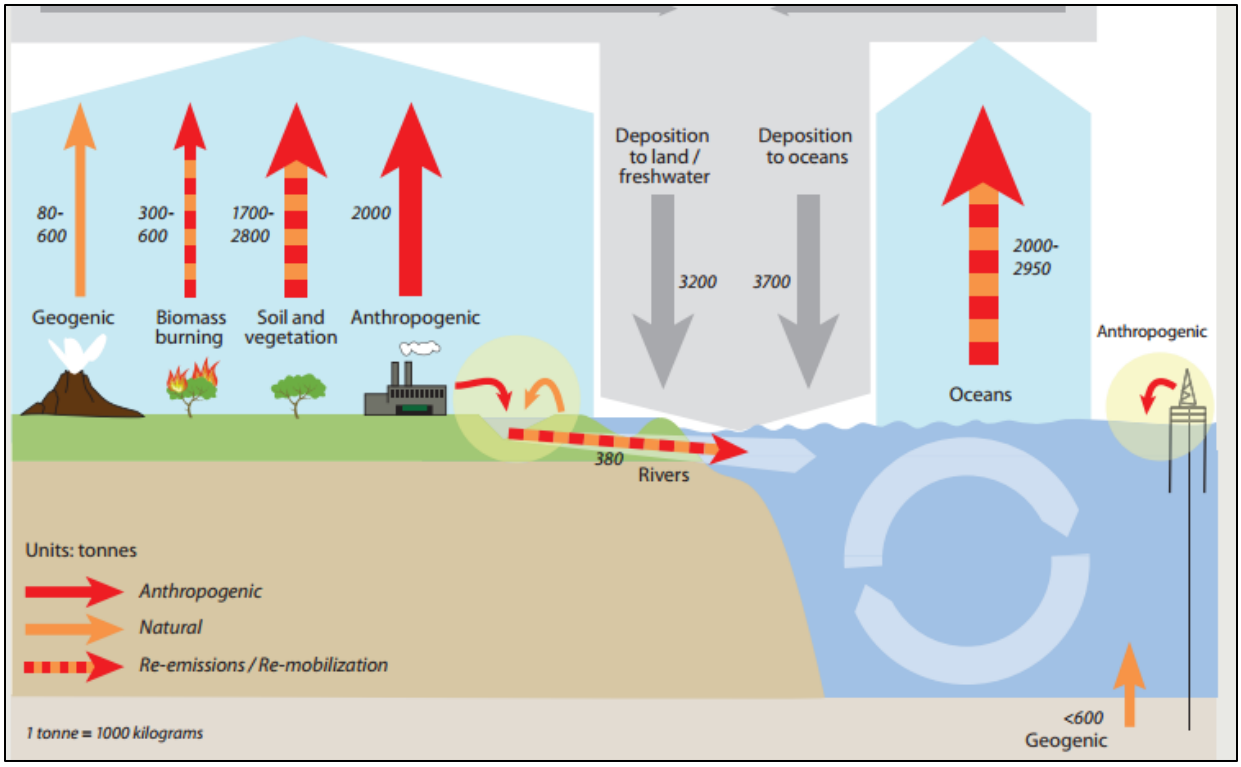

Figure 1: The Global Mercury Cycle (UNEP, 2013)

Anthropogenic sources account for 30% of the mercury emissions in the atmosphere (UNEP 2013). Even regions with no consequential mercury releases, such as the Arctic, are negatively affected on account of the transcontinental and global transport of mercury. Exposure to mercury, depending on the form, can have various deleterious effects on the human body. According to the Global Mercury Assessment (UNEP, 2013), the major sources of mercury worldwide are:

- Artisanal and small scale gold mining;
- Coal combustion;
- Non-ferrous metals;
- Cement production;
- Consumer products;
- Iron and Steel production;
- Chlor-alkali production;
- Oil refining

The Global Mercury Assessment 2013 found Asia to be the largest contributor of mercury into the environment, accounting for almost 50% of global emissions. The Latin America and Caribbean region accounted for 2.4% which was approximately 47.2 tonnes per year of mercury emissions and this was primarily due to chlor-alkali production (UNEP, 2013).

Figure 2 below provided in the Arctic Monitoring and Assessment Programme (AMAP)/ UNEP technical background report for the Global Mercury Assessment 2013, showed that artisanal and small scale gold mining produces the highest emissions.

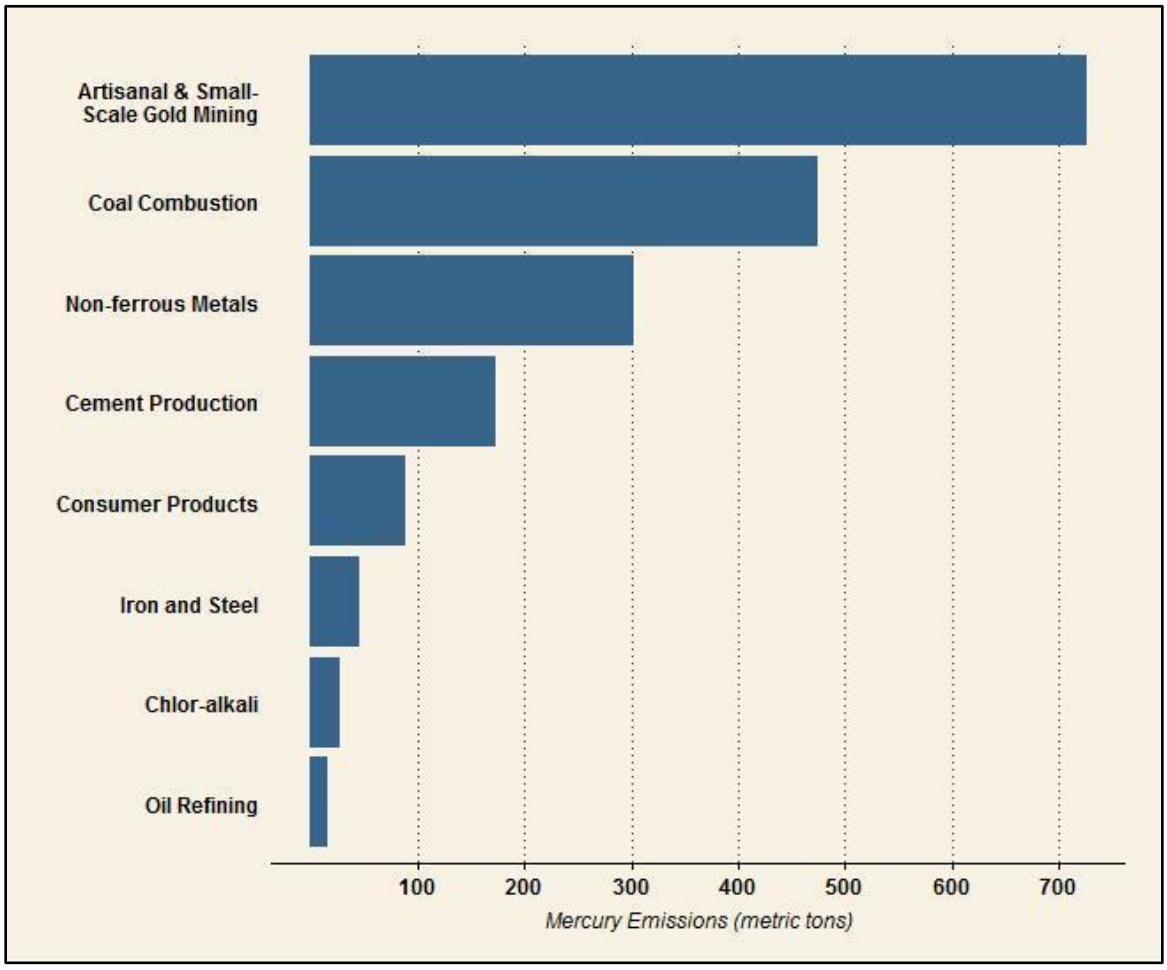

Figure 2: Major Sources of Mercury Emissions to the Environment (AMAP, 2013)

Mercury pollution is a worldwide issue that needs to be addressed through national, regional, and international actions (UNEP Chemicals, 2004). For that reason, the Minamata Convention was assembled. The Minamata Convention is a global treaty to protect human health and the environment from the harmful effects of mercury. Regulating the anthropogenic releases of mercury throughout its lifecycle has been a fundamental aspect in shaping the obligations under the Convention (Minamata Convention on Mercury, 2016).

1.2 COUNTRY INFORMATION

The Republic of Suriname is a sovereign state located on the north coast of South America. Clockwise, starting north, it borders to, the Atlantic Ocean, French-Guiana, Brazil and Guyana, respectively (Menke, 2016). It covers a total area of approximately 163.820 sq. km with a population of 541,638 (Over gov.sr). The capital of Suriname, Paramaribo, is home to the vast portion of the population; the remaining residents live spread out through the country, yet most of the land, up to 80%, remains pristine forest (Pan American Health Organization, 2012). Suriname is a multiethnic society, with the Amerindians as its original inhabitants, hereafter the Blacks, Maroons, Hindustani, Javanese, Chinese and Boeroes (whites) became part of the population (Over gov.sr)**.** The official language is Dutch, but due to the wide variety of cultures, there are many other languages and dialects spoken (Menke, 2016). The geographical location of Suriname (Figure 3) is between 2° and 6° north latitudes and between 54° and 58° west longitudes (Weblocher N.V, 2010).

Figure 3: Geographic setting of the Republic of Suriname (Ministry of Labour, Technological Development and Environment (ATM), 2013)

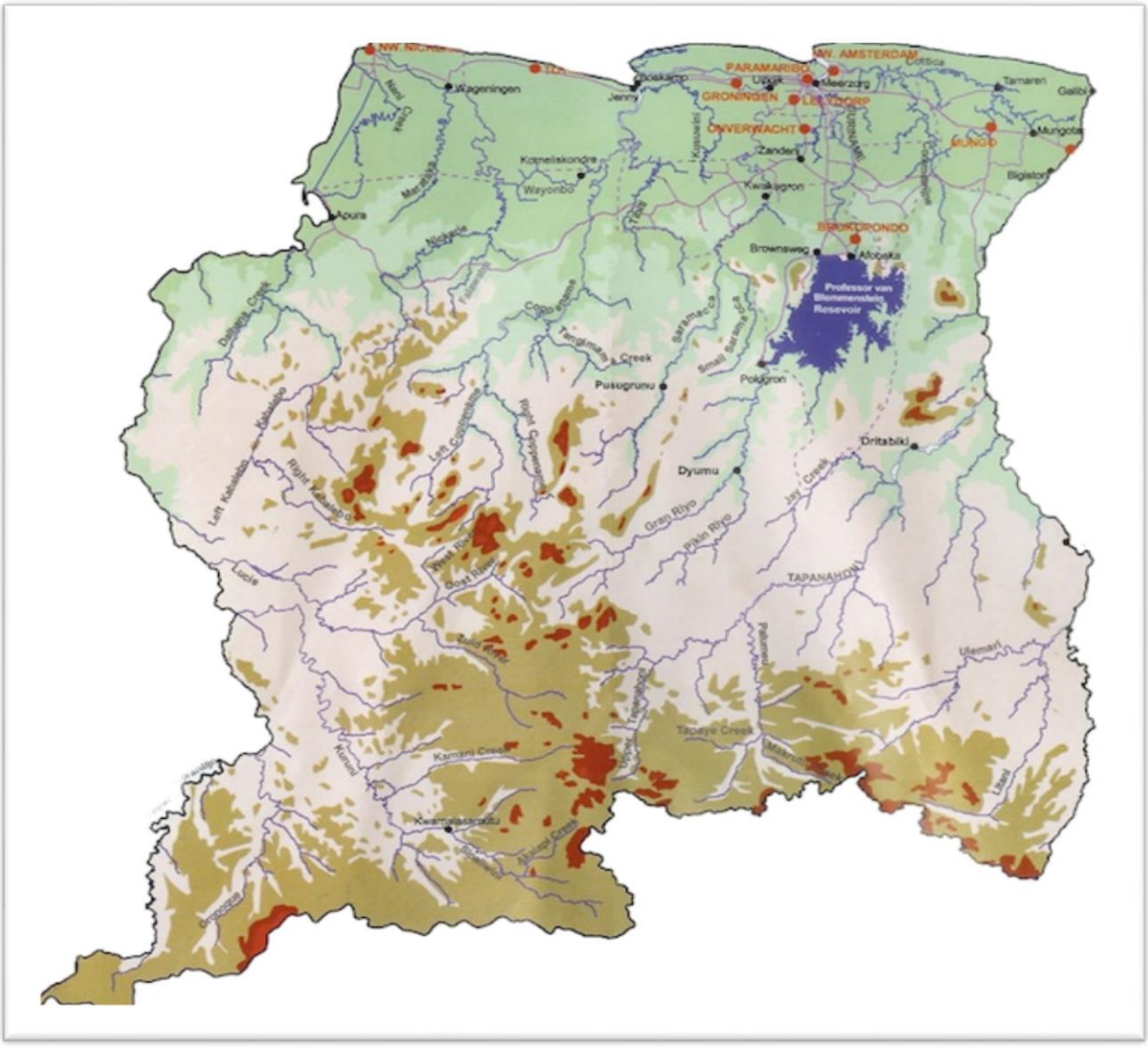

Figure 4: Map of Suriname (Republiek Suriname, n.d.).

The coast of Suriname consists of sandbanks and mudbanks deposited by the southern equatorial currents from the area surrounding the mouth of the Amazon River, located at the east of Suriname, in Brazil. The New Coastal Plain, begins at the south of the mudbanks and consists of swampland. The region is traversed by sandy ridges that run parallel to the coast. After the New Coastal Plain comes the Old Coastal Plain. This region consists largely of fine clays and sands and contains a variety of topographies, including old ridges, clay flats, and swamps. South of the Old Coastal Plain is the Zanderij formation. Most of the region is covered by tropical rainforest, but swamps and areas of savanna grassland are also found. Farther to the south, bordering Brazil, is an area consisting largely of a central mountain range, its various branches, and scattered hilly areas; a vast tropical rainforest covers these highlands. In the southwest near the Brazilian border

is the Sipaliwini Plain, another savanna area (Encyclopedia Britannica, 2016). The geology can be seen in Figure 5.

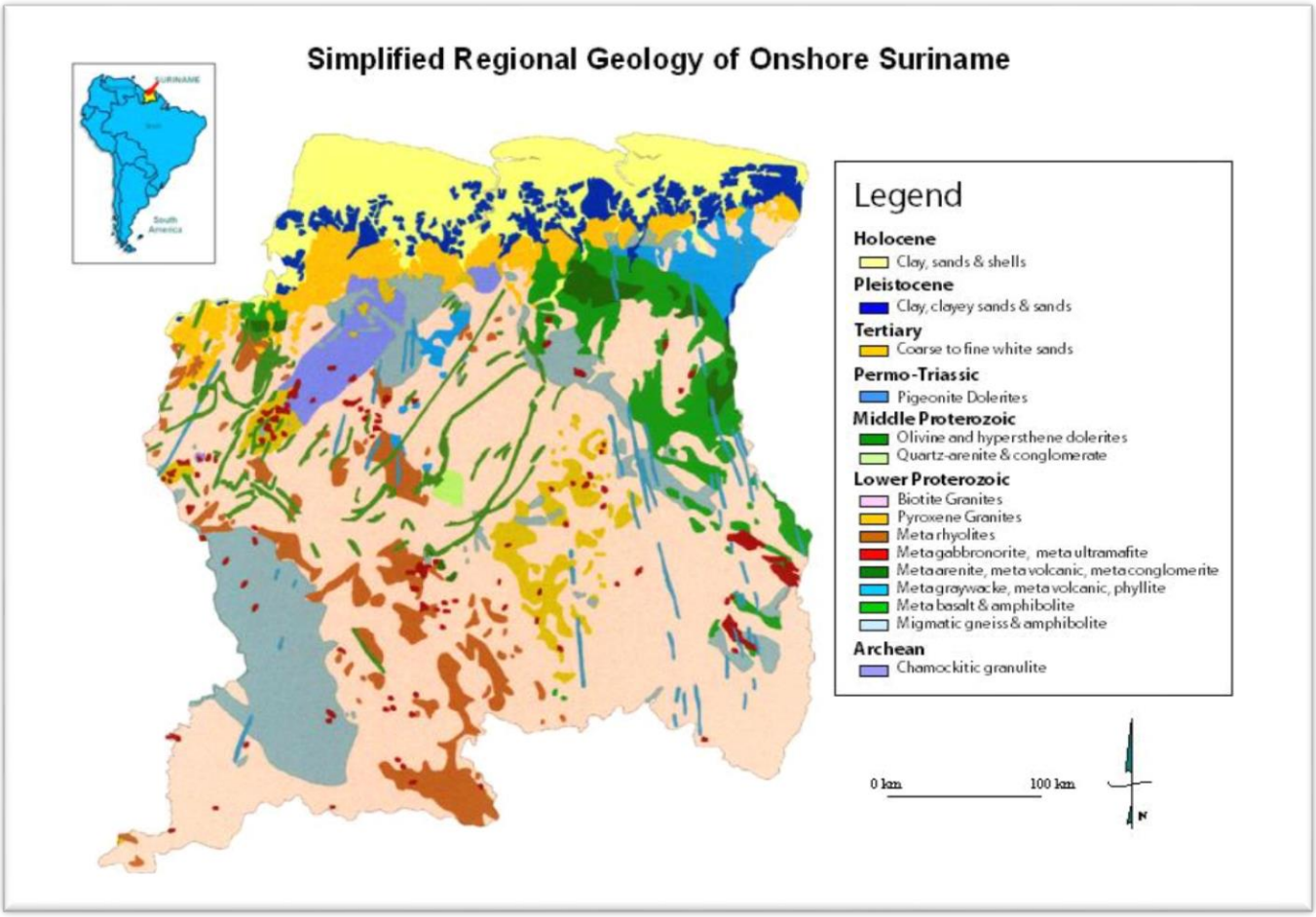

Figure 5: Simplified regional geology of onshore Suriname (Geology). (Republiek Suriname, n.d.).

Suriname is divided in 10 districts: Nickeri, Coronie, Saramacca, Wanica, Paramaribo, Commewijne, Marowijne, Para, Brokopondo, Sipaliwini (The National Planning Office of Suriname (SPS); Regional Development and Physical Planning Department (HARPRO), 1988).

Suriname is rich in mineral resources such as gold, oil, and bauxite. The extraction and processing of these minerals account for 30% of the Gross Domestic product (GDP) and also 90% of exports (Suriname Sector Competitiveness Analysis, 2016). Since World War II, the economy has been largely based on bauxite mining and processing activities, which were carried out by a joint venture of Aluminum Company of America (ALCOA) whose subsidiary in Suriname is known as Suriname Aluminum Company, L.L.C. (Suralco L.L.C.) and BHP Billiton. From the 1960s onwards, exports of bauxite, alumina, and aluminium have accounted for 70-80% of total

export revenues, the bulk of government revenue (Ministry of Labour, Technological Development and Environment (ATM), 2013).

As of today, all bauxite mining activities have ceased due to the closure of operations in-country by BHP Billiton and later by Aluminum Company of America (ALCOA), whose subsidiary in Suriname is known as Suriname Aluminum Company, L.L.C. (Suralco L.L.C.).

Since the 1980s, there has been an increase in small scale gold mining in Suriname and, for every 1 kg of gold that has been extracted, approximately 1 kg of mercury has been released in the environment, which suggests that an estimate of approximately 10,000 kg of mercury is discharged in the environment annually (Ouboter, Review of mercury pollution in Suriname, 2015). The service industry, which accounts for nearly half of GDP, is dominated by trade and transport activities that are closely linked to the extractive industry. Agriculture is also important in the economy, accounting for nearly 10% of GDP and 10% of exports. The shares of employment of services and agriculture are 57% and 14% respectively, greater than the sector shares in value added in production (Suriname Sector Competitiveness Analysis, 2016).

In 2006 Suriname, banned the import on mercury, nevertheless, the toxic substance is still excessively used in the field, as there does not exist a legal ban against the use of mercury. Particularly in eastern Suriname, recent measurements present that high mercury levels exist in the atmosphere, fish, land and indigenous villagers. This is linked to the fact that these villagers consume large amount of fish compared to average communities, they are more susceptible to the adverse effects of mercury (Daniel Peplow, 2014).

1.3 PROJECT BACKGROUND

The BCRC-Caribbean collaborated with the Chemicals and Waste Branch of UNEP DTIE and received funding from the Norway ODA for the "Mercury Storage and Disposal Project in the Caribbean: Jamaica, Trinidad and Tobago and Suriname." This project would assist these three (3) countries in their efforts to accede, ratify and implement the Minamata Convention on Mercury.

The main outputs of the Project include:

- Establishment of a decision making process at the national level;
- Gaining an understanding of the mercury waste streams and management options i.e. disposal and storage;

- Understanding the regulatory framework for the environmentally sound management of mercury;
- Enhancing countries' understanding of the mercury waste and commodity issues as it relates to surplus mercury;
- Development of a national storage and waste management action plan; and
- Increasing awareness and education on the issue.

A key component of the Project is the development of national inventories of mercury releases in each country, for use in quantifying the mercury status in the respective territories.

1.4 METHODOLOGY

A national project inception workshop was held to introduce key stakeholders from Suriname to the Minamata Convention and to the project activities. Following this, a National Working Group was formed comprising of representatives from the core group of stakeholders such as the ministerial bodies and associated agencies including:

- Office of the President of Suriname
- Head of Chemical Central Laboratory
- National Institute for Environment and Development in Suriname (NIMOS)
- School of Mining and Mineral Processing
- Grassalco (Mining Company)

Data collection was very important for the inventory in order to derive the necessary calculations for mercury releases. The National Working Group further identified stakeholders who may be major contributors to mercury emissions and coordinated their efforts to obtain data from these stakeholders. The group collaborated with the BCRC-Caribbean in the development of questionnaires for each of the following sectors:

- Oil and Gas
- Gold production

- Alumina production (from bauxite)
- Cement production
- Power Generation
- Mercury and Mercury Containing Devices
- Dental
- Waste
- Funeral Homes

The questionnaires were then distributed to the appropriate personnel within these sectors to gather relevant data for the inventory. All questionnaires developed are attached as Annex 1 to this report.

This inventory was conducted in 2016 using the UNEP's Toolkit for Identification and Quantification of Mercury Releases (Inventory Level 1). The Toolkit is based on mass balances for each mercury release source type. Inventory Level 1 works with pre-determined factors based largely on assumptions on 2015 population data. These assumptions are used to calculate 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 the relevant mercury source types from available literature and other relevant sources such as the International Energy Agency's website.

The Toolkit consisted of a Microsoft Excel spreadsheet with predetermined formulae in certain cells to automatically calculate mercury inputs and releases. Data was separated based on the following sectors or steps:

- Energy Consumption and Fuel Production
- Domestic Production of Metals and Raw Materials
- Domestic Production and Processing with Intentional Mercury Use
- Waste Treatment and Recycling
- General Consumption of Mercury in Products, as Metal Mercury and as Mercury Containing Substances

- Crematoria and Cemeteries
- Miscellaneous Mercury Sources

The completed inventory Toolkit is available as Annex 2.

NOTE: When available, data for the year 2015 has been used for this inventory. For some data sets however, data from that year may not have been available and as such, the corresponding year for all data retrieved has been indicated for that data group.

The National Working Group developed an Action Plan for achieving the objectives of the project which is available in Annex 3. Table 1 below provides the project timeline for the activities of the project.

TABLE 1: GENERAL PROJECT TIMELINE 2016

April May	June	July Aug	Sept	Oct	Nov	Dec
Preparation for Workshops	National Inception Workshop	Data Collection, Questionnaires, Draft Report			Results Workshops	Closure of Project

1.5 DATA GAPS

The biggest challenge in completing the inventory was acquiring the adequate data to complete the various sections that were applicable to the country, in a very short timeframe. In order to collect the information required, questionnaires based on various sectors that emit mercury were used (Annex 1) and distributed to the relevant personnel.

The most challenges were encountered by identifying and obtaining the data and information necessary to complete Step 5 Waste handling and recycling of the inventory. Specifically, in obtaining information on waste incinerated. There are a few companies with waste incinerators in Suriname but collecting due to lack of recording of data there were difficulties in obtaining information. In terms of medical waste, The Waspar facility incinerates mainly medical waste. Waspar was contacted but there was no information available on the amount of waste incinerated per year due to a hard drive malfunction. This company needs to be contacted for further follow-up.

Step 6 of the inventory which focuses on data collection and inventory of the consumption of mercury contained in products, as metal mercury and as mercury containing substances, also met a few problems. Most of the information obtained for this category were from the UN-Comtrade website (http://comtrade.un.org/).

In the sub-category “batteries with mercury” the data collected did not specify the types of batteries imported in Suriname, it only specified how many car batteries(accu) were in imported and the number of other batteries which can include a number of types such as AA, AAA, C, D alkaline, atomic, lithium-ion batteries, mercury-zinc cells, etc. The type of battery is of significant importance because not all batteries contain mercury.

The data for gold extraction was obtained from USGS (SURINAME: PRODUCTION OF MINERAL COMMODITIES) and the data for the year 2013 was fed into the toolkit

2.0 RESULTS AND DISCUSSION

An aggregated presentation of the results for main groups of mercury release sources is shown in Figure 6 – 12 and summarized in Table 2.

As shown in Table 2, the source groups that contribute to the input of mercury are:

- Primary metal production
- Gold extraction
- Use and disposal of other products (mercury-containing excluding dental amalgam)

TABLE 2: SUMMARY OF TOTAL MERCURY INVENTORY RESULTS FOR SURINAME 2016.

Source category	Estimated Hg input, Kg Hg/y	Estimated Hg releases, standard estimates, Kg Hg/y							Percent of total releases *3*4
		Air	Water	Land	By-products and impurities	General waste	Sector specific waste treatment /disposal	Total releases *3*4*5	
Coal combustion and other coal use	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0%
Other fossil fuel and biomass	6.9	6.9	0.0	0.0	0.0	0.0	0.0	7	0%
Oil and gas production	4.9	0.5	0.6	0.0	0.0	0.0	0.3	1	0%
Primary metal production (excl. gold production by amalgamation)	134,828.6	5,492.1	2,768.6	120,535.7	5,357.1	585.0	90.0	134,829	77%
Gold extraction with mercury amalgamation	39,247.3	15,740.9	12,496.8	11,009.7	0.0	0.0	0.0	39,247	22%
Other materials production	8.5	6.3	0.0	0.0	2.1	0.0	0.0	8	0%
Chlor-alkali production with mercury-cells	?	?	?	?	?	?	?	0	0%
Other production of chemicals and polymers	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0%
Production of products with mercury content*1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0%
Application, use and disposal of dental amalgam fillings	2.2	0.0	0.7	0.1	0.1	0.4	0.4	2	0%
Use and disposal of other products	551.9	136.0	8.2	142.3	0.0	257.8	7.6	552	0%
Production of recycled metals	11.8	3.9	0.0	4.0	0.0	3.9	0.0	12	0%
Waste incineration and open waste burning*2	50.9	50.8	0.0	0.0	0.0	0.0	0.1	51	0%

Waste deposition*2	386.2 (actual input 39)	3.9	0.0	0.0	-	-	-	4	0%
Informal dumping of general waste *2*3	11.9	1.2	1.2	9.5	-	-	-	2	0%
Waste water system/treatment *4	-	-	-	-	-	-	-	0	0%
Crematoria and cemeteries	8.9	2.6	0.0	6.3	0.0	0.0	0.0	9	0%
TOTALS (rounded) *1*2*3*4*5	**174,710**	**21,450**	**15,280**	**131,700**	**5,360**	**850**	**100**	**174,720**	**100%**

Notes to table and figures above:

*1 To avoid double counting of mercury in products produced domestically and sold on the domestic market (including oil and gas), only the part of mercury inputs released from production are included in the input TOTAL.

*2: 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 the Toolkit.

*3: 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.

*4: 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.

*5: Total inputs do not necessarily equal total outputs due to corrections for double counting (see notes*1-*3) and because some mercury follows products/metal mercury which are not sold in the same country or in the same year.

2.1 MERCURY RELEASE SOURCE TYPES PRESENT

Table 3 shows which mercury release sources were identified as present or absent in the country. Only source types positively identified as present are included in the quantitative assessment.

TABLE 3: 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	N
Combustion/use of petroleum coke and heavy oil	Y
Combustion/use of diesel, gasoil, petroleum, kerosene	Y
Biomass fired power and heat production	N
Charcoal combustion	N
FUEL PRODUCTION	
Oil extraction	Y
Oil refining	Y
Extraction and processing of natural gas	N
PRIMARY METAL PRODUCTION	
Mercury (primary) extraction and initial processing	N
Production of zinc from concentrates	?
Production of copper from concentrates	?
Production of lead from concentrates	N
Gold extraction by methods other than mercury amalgamation	Y
Alumina production from bauxite (production)	Y
Primary ferrous metal production (iron, steel production)	?
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 AND POLYMERS	
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.)	N

Electrical switches and relays with mercury	?
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	N
Paints with mercury preservatives	N
Skin lightening creams and soaps with mercury chemicals	?
Medical blood pressure gauges (mercury sphygmomanometers)	?
Other manometers and gauges with mercury	Y
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	N
Incineration of hazardous waste	Y
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	Y
Informal dumping of general waste *1	Y
Waste water system/treatment	N
CREMATORIA AND CEMETERIES	
Crematoria	Y
Cemeteries	Y

It should be noted that the presumably minor mercury release source types shown in Table 4 were not included in the detailed source identification and quantification work. These may however be present in some countries.

TABLE 4: MISCELLANEOUS POTENTIAL MERCURY SOURCES NOT INCLUDED IN THE QUANTITATIVE INVENTORY; WITH PRELIMINARY INDICATION OF POSSIBLE PRESENCE.

Source category	Source present?
	Y/N/?
Combustion of oil shale	?
Combustion of peat	Y
Geothermal power production	N
Production of other recycled metals	Y
Production of lime	N
Production of light weight aggregates (burnt clay nuts for building purposes)	Y
Chloride and potassium hydroxide produced from mercury-cell technology	?
Polyurethane production with mercury catalysts	?
Seed dressing with mercury chemicals	?
Infra-red detection semiconductors	?
Bougie tubes and Cantor tubes (medical)	?
Educational uses	Y
Gyroscopes with mercury	?
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	N
Tanning	?
Pigments	?
Products for browning and etching steel	Y
Certain colour photograph paper types	?
Recoil softeners in rifles	?
Explosives (mercury-fulminate a.o.)	?
Fireworks	Y
Executive toys	?

2.2 PRESENTATION OF FINDINGS

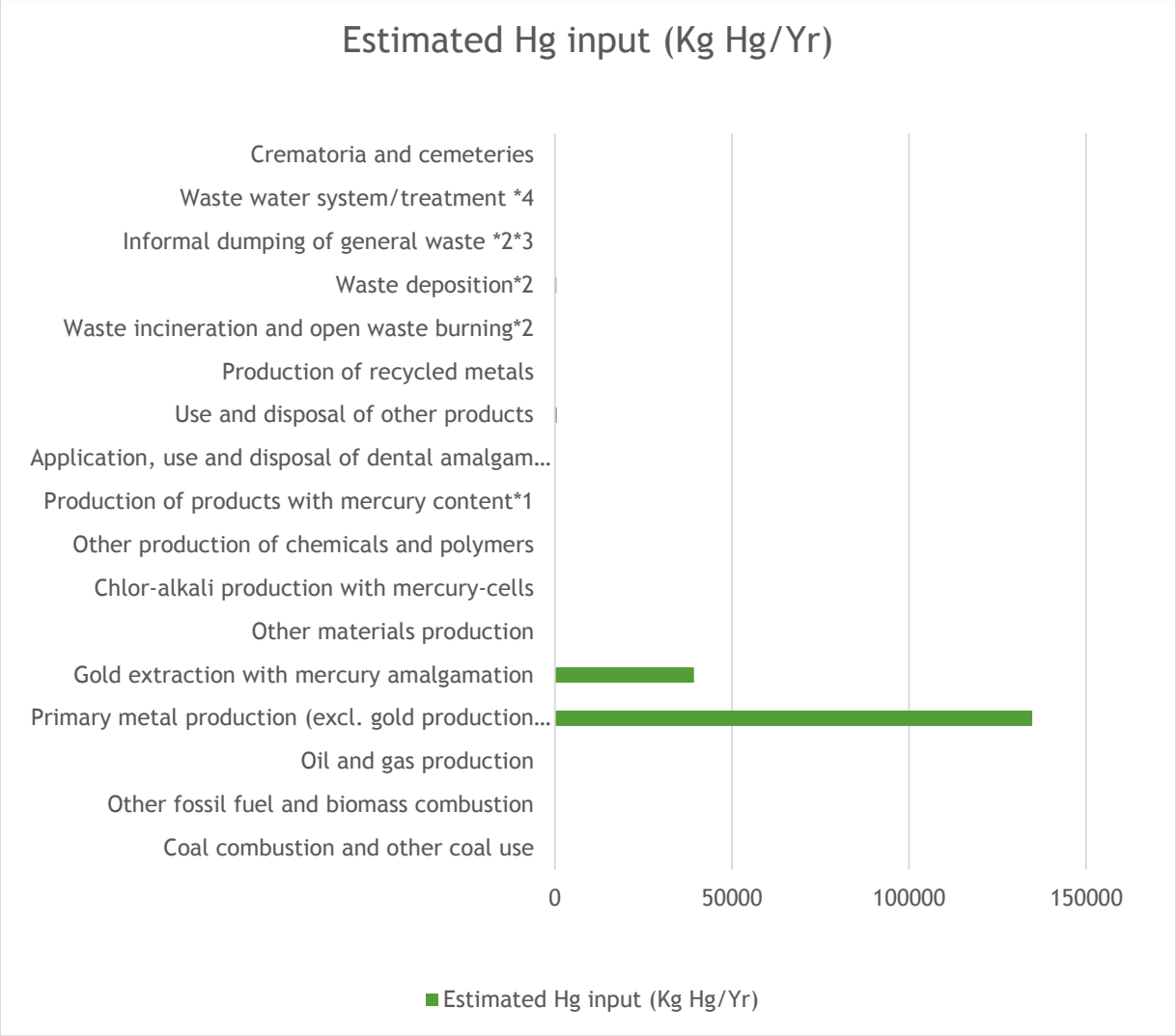

Figure 6: Estimated Hg inputs (Kg Hg/Yr)

As Figure 6 indicated, the largest inputs of mercury primary metal production which referred to gold extraction by methods other than mercury amalgamation and alumina production from bauxite. Gold extraction with the use of mercury amalgamation also contributed significantly to mercury inputs at over 39,000 kg Hg/yr.

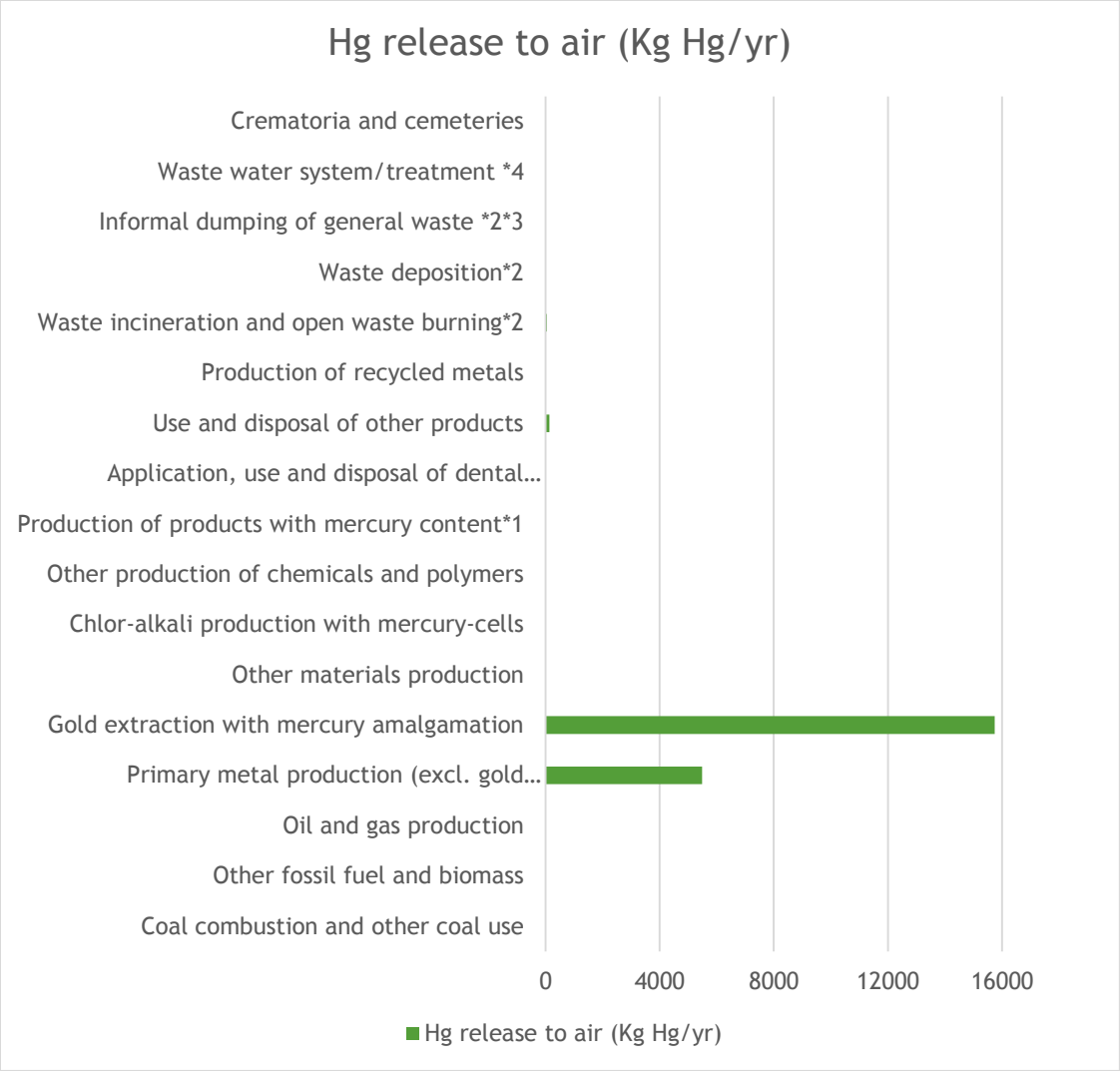

Figure 7: Estimated Hg releases to air (Kg Hg/Yr)

Figure 7 shows that gold extraction with mercury amalgamation contributed the highest mercury releases to air at approximately 15,700 Kg Hg/yr being released which was almost two times higher than air releases of mercury due to primary metal production activities. Use and disposal of other products contributed to 136 kg Hg being released to air per annum, the third largest contributor. Mercury can be released to air due to combustion of mercury containing components or due to diffusion of mercury vapour.

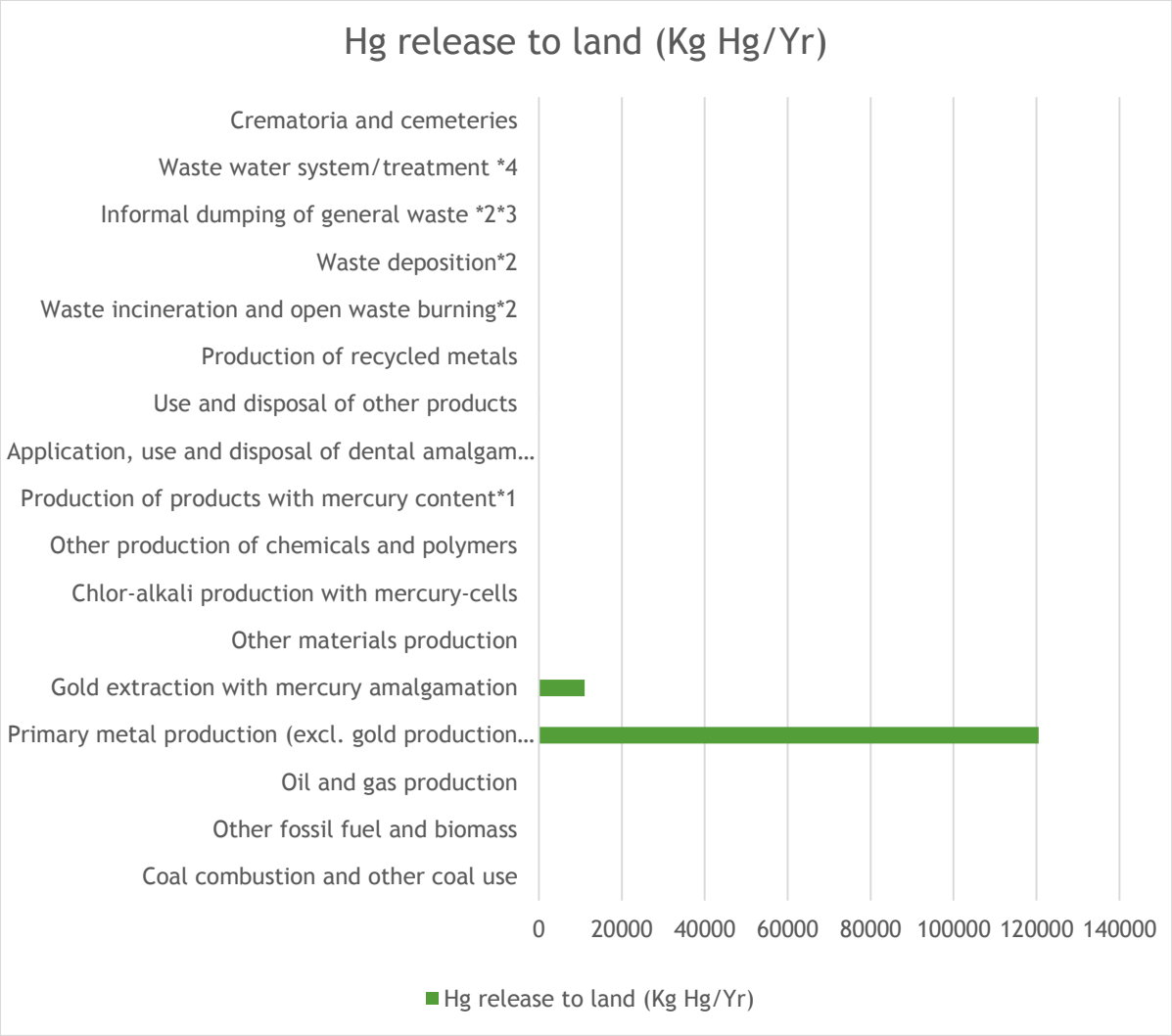

Figure 8: Estimated Hg releases to land (Kg Hg/Yr)

Mercury releases to land include among others, solid residues from activities that involved the presence of mercury and uncollected waste dumped or buried. According to Figure 8, approximately 120,000 kg Hg/yr were released to land due to the primary metal production sector. The second largest contributing sector was gold extraction with mercury amalgamation at an estimated 11,000 kg Hg/yr.

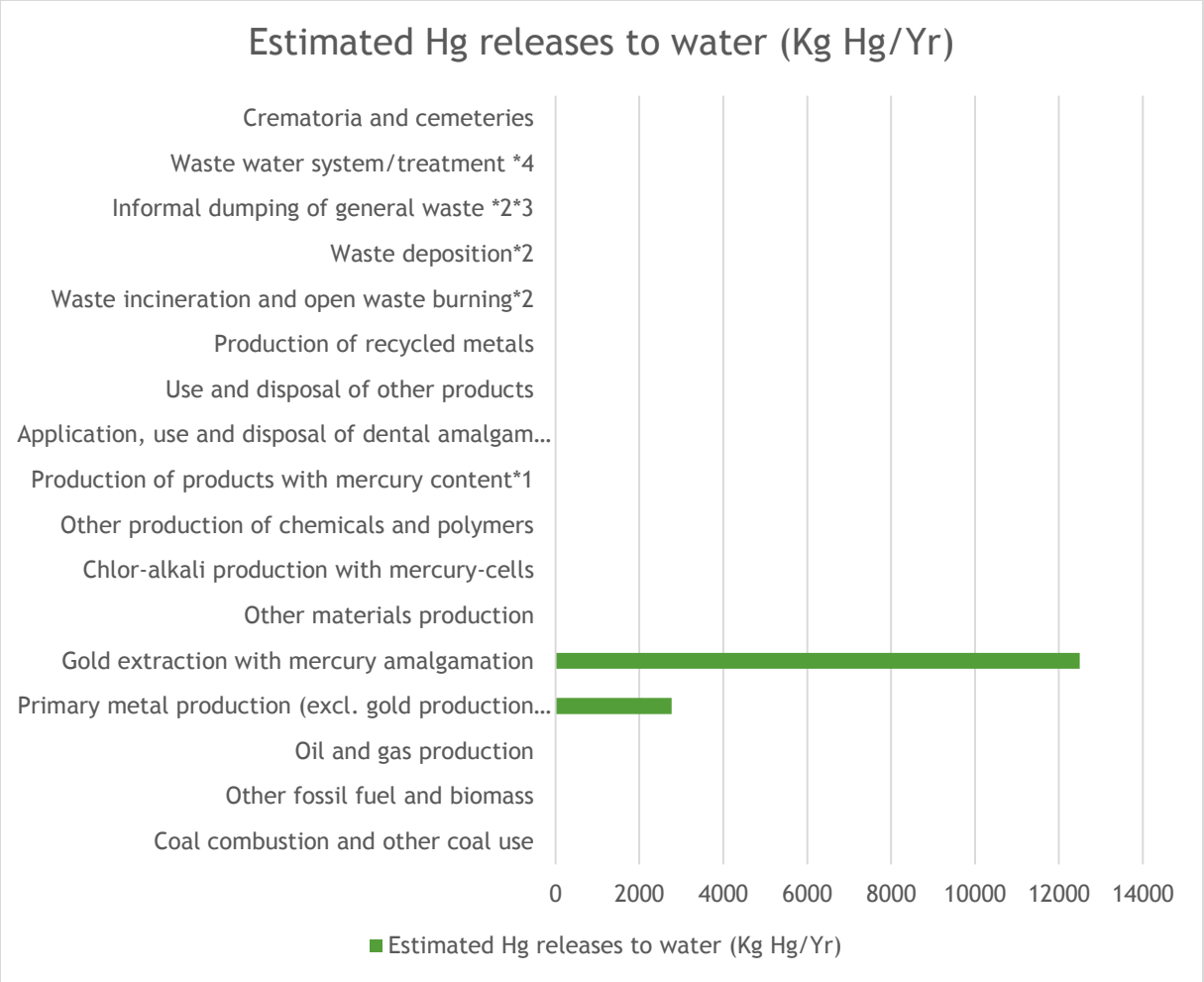

Figure 9: Estimated Hg releases to water (Kg Hg/Yr).

Figure 9 indicates that the two main sectors responsible for releases of mercury to water are gold extraction with mercury amalgamation (12,500 kg Hg/yr approximately), followed by primary metal production at less than 3000 kg Hg/yr.

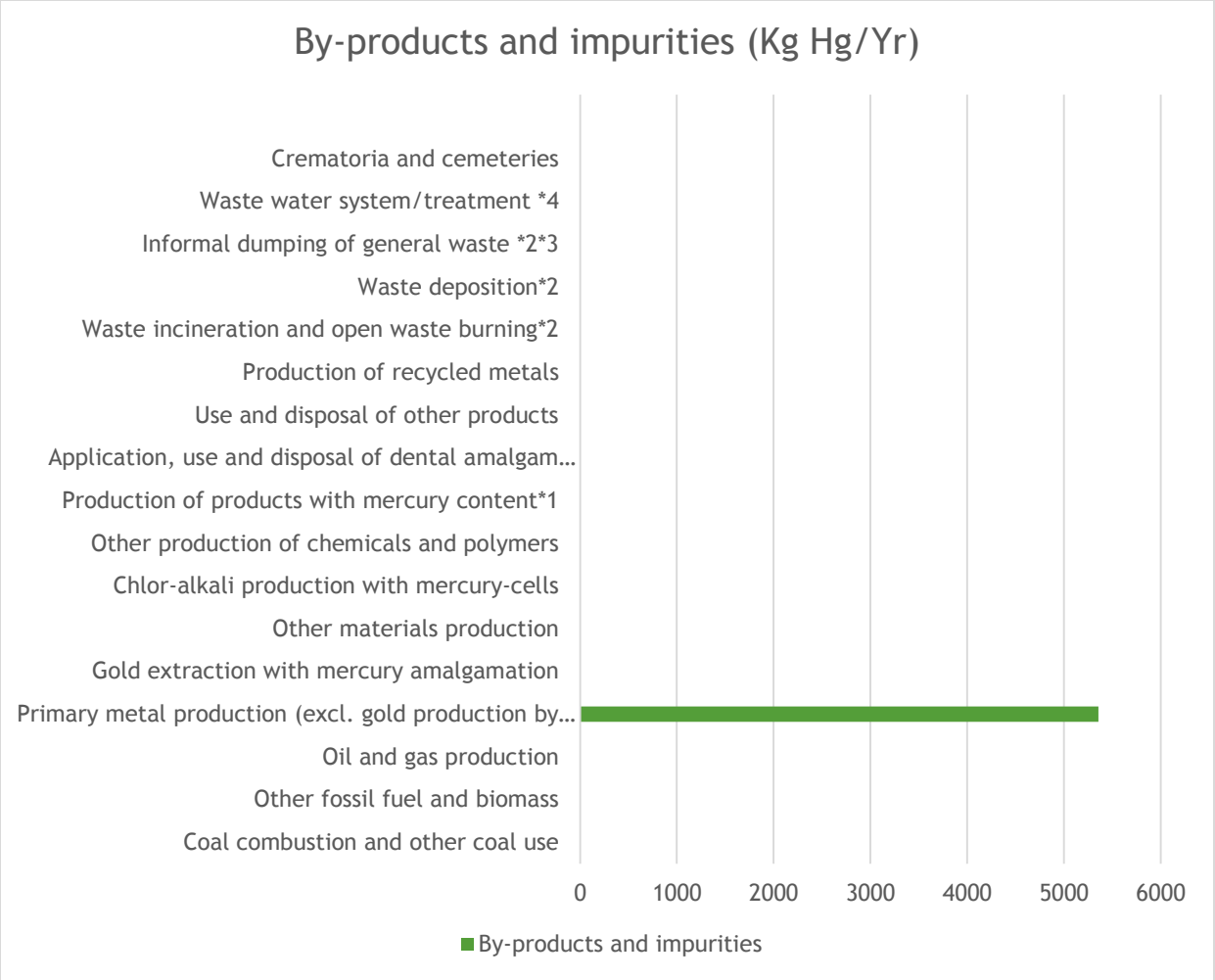

Figure 10: Estimated Hg releases from by-products & impurities.

The only significant sector that causes a release of mercury from by-products and impurities is primary metal production (excluding gold production by amalgamation) as seen in Figure 10. The activities: gold extraction by methods other than mercury amalgamation and alumina production from bauxite, cause the production and release of impurities containing mercury. Liquid metal mercury may be released as a by-product due to non-ferrous metal mining activities.

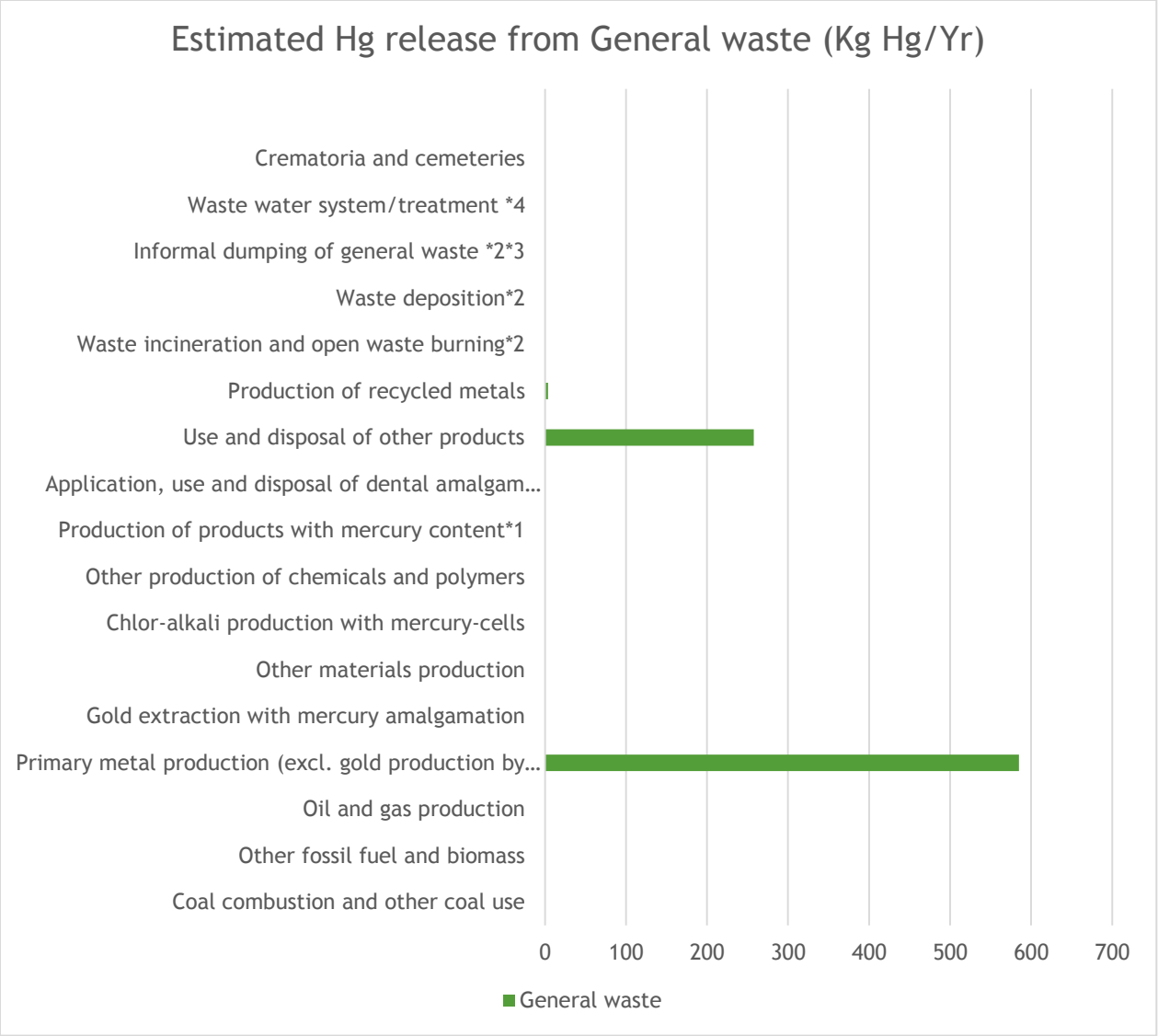

Figure 11: Estimated Hg release from General Waste (Kg Hg/Yr).

General waste refers to household and institution waste where the waste undergoes a general treatment, whether incineration, landfilling or informal dumping. Figure 11 shows that production of recycled metals (namely recycled steel) had a minor impact on mercury releases to this waste stream. Use and disposal of other products contributed the second highest releases to general waste followed by primary metal production at 585 kg Hg/yr.

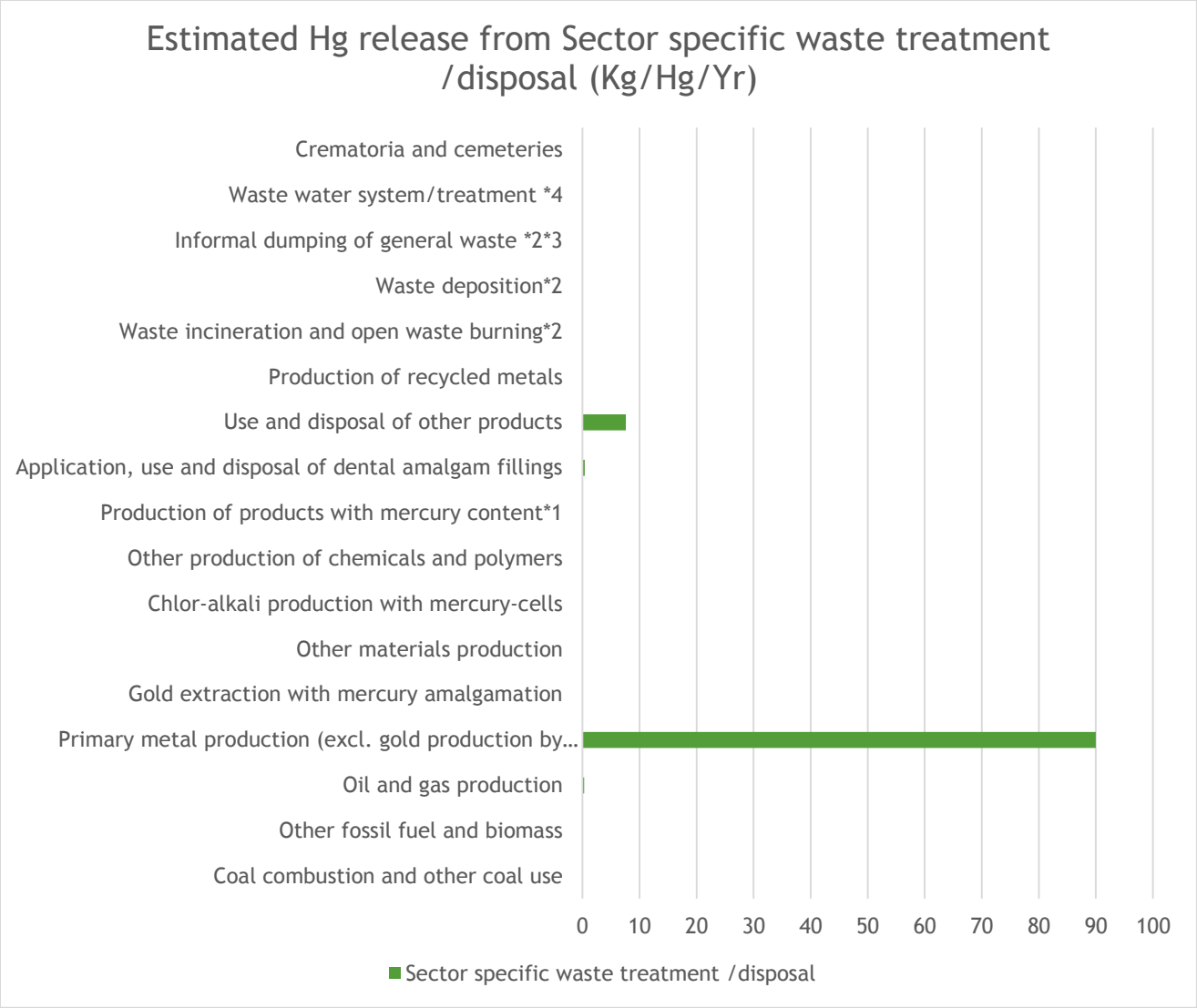

Figure 12: Estimated Hg release from Sector specific waste treatment /disposal (Kg Hg/Yr).

Sector specific waste treatment and disposal refers to waste from industry and consumers which is collected and treated in separate systems. Figure 12 indicates that the most significant sector to contribute to this waste stream was primary metal production.

2.3 SUMMARY OF MERCURY INPUTS TO SOCIETY

Mercury inputs to society (shown in Table 5) 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 mobilized via extraction and use of raw materials which contain mercury in trace concentrations.

TABLE 5: SUMMARY OF MERCURY INPUTS TO SOCIETY FOR SURINAME 2016

Source category	Source present?			Estimated Hg input, Kg Hg/y
	Y/N/?	Activity rate	Unit	Standard estimate
Energy consumption				
Combustion/use of petroleum coke and heavy oil	Y	121,836	Oil product combusted, t/y	7
Combustion/use of diesel, gasoil, petroleum, kerosene, LPG and other light to medium distillates	Y	44,053	Oil product combusted, t/y	0
Fuel production				
Oil extraction	Y	830,000	Crude oil produced, t/y	3
Oil refining	Y	606,466	Crude oil refined, t/y	2
Primary metal production				
Production of zinc from concentrates	?	0	Concentrate used, t/y	?
Production of copper from concentrates	?	0	Concentrate used, t/y	?
Gold extraction by methods other than mercury amalgamation	Y	8,928,571	Gold ore used, t/y	133,929
Alumina production from bauxite (aluminium production)	Y	1,800,000	Bauxite processed, t/y	900
Primary ferrous metal production (pig iron production)	?	0	Pig iron produced, t/y	?
Gold extraction with mercury amalgamation - without use of retort	Y	18,246	Gold produced, kg/y	39,229
Gold extraction with mercury amalgamation - with use of retorts	Y	184	Gold produced, kg/y	18
Other materials production				
Cement production	Y	65,000	Cement produced, t/y	8

Production of chemicals				
Chlor-alkali production with mercury-cells	?	0	Cl2 produced, t/y	?
VCM production with mercury catalyst	?	0	VCM produced, t/y	?
Acetaldehyde production with mercury catalyst	?	0	Acetaldehyde produced, t/y	?
Production of products with mercury content				
Electrical switches and relays with mercury	?	0	Mercury used for production, kg/y	?
Use and disposal of products with mercury content				
Dental amalgam fillings ("silver" fillings)	Y	531,170	Number of inhabitants	2
Thermometers	Y	38	Items sold/y	0
Electrical switches and relays with mercury	Y	531,170	Number of inhabitants	62
Light sources with mercury	Y	585,017	Items sold/y	13
Batteries with mercury	Y	4	t batteries sold/y	452
Skin lightening creams and soaps with mercury chemicals	?	0	Cream or soap sold, t/y	?
Medical blood pressure gauges (mercury sphygmomanometers)	?	0	Items sold/y	?
Other manometers and gauges with mercury	Y	531,170	Number of inhabitants	2
Laboratory chemicals	Y	531,170	Number of inhabitants	4
Other laboratory and medical equipment with mercury	Y	531,170	Number of inhabitants	18
Production of recycled of metals				
Production of recycled ferrous metals (iron and steel)	Y	10,711	Number of vehicles recycled/y	12
Waste incineration				
Incineration of hazardous waste	Y	16	Waste incinerated, t/y	0
Incineration and open burning of medical waste	Y	30	Waste incinerated, t/y	1
Open fire waste burning (on landfills and informally)	Y	9,965	Waste burned, t/y	50
Waste deposition/landfilling and waste water treatment				
Controlled landfills/deposits	Y	77,242	Waste landfilled, t/y	386
Informal dumping of general waste *1	Y	2,373	Waste dumped, t/y	12

Crematoria and cemeteries				
Crematoria	Y	1,042	Corpses cremated/y	3
Cemeteries	Y	2,515	Corpses buried/y	6
TOTAL of quantified inputs*1*2*3				**174,710**

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

- Gold extraction by methods other than mercury amalgamation
- Gold extraction with mercury amalgamation - without use of retort
- Alumina production from bauxite and,
- Batteries with mercury

2.4 SUMMARY OF MERCURY RELEASES

In the Table 6 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 treatment. 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 7 below for a more detailed description and definition of the output pathways.

TABLE 6: SUMMARY OF MERCURY RELEASES FOR SURINAME 2016

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						
Combustion/use of petroleum coke and heavy oil	6.7	0.0	0.0	0.0	0.0	0.0
Combustion/use of diesel, gasoil, petroleum, kerosene, LPG and other light to medium distillates	0.2	0.0	0.0	0.0	0.0	0.0
Fuel production						
Oil extraction	0.0	0.6	0.0	0.0	0.0	0.0
Oil refining	0.5	0.0	0.0	0.0	0.0	0.3
Primary metal production						
Production of zinc from concentrates	?	?	?	?	?	?
Production of copper from concentrates	?	?	?	?	?	?
Gold extraction by methods other than mercury amalgamation	5,357.1	2,678.6	120,535.7	5,357.1	0.0	0.0
Alumina production from bauxite	135.0	90.0	0.0	0.0	585.0	90.0
Primary ferrous metal production (pig iron production)	?	?	?	?	?	?
Gold extraction with mercury amalgamation - without use of retort	15,737.2	12,489.4	11,002.3	0.0	0.0	0.0

Gold extraction with mercury amalgamation - with use of re-torts	3.7	7.4	7.4	0.0	0.0	0.0
Other materials production						
Cement production	6.3	0.0	0.0	2.1	0.0	0.0
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						
Electrical switches and relays with mercury	?	?	?	?	?	?
Use and disposal of products with mercury content						
Dental amalgam fillings ("silver" fillings)	0.0	0.7	0.1	0.1	0.4	0.4
Thermometers	0.1	0.1	0.1	0.0	0.1	0.0
Electrical switches and relays with mercury	18.7	0.0	25.0	0.0	18.7	0.0
Light sources with mercury	3.8	0.0	3.8	0.0	5.1	0.0
Batteries with mercury	112.9	0.0	112.9	0.0	225.8	0.0
Skin lightening creams and soaps with mercury chemicals	?	?	?	?	?	?
Medical blood pressure gauges (mercury sphygmomanometers)	?	?	?	?	?	?
Other manometers and gauges with mercury	0.4	0.7	0.4	0.0	0.7	0.0
Laboratory chemicals	0.0	1.5	0.0	0.0	1.5	1.5
Other laboratory and medical equipment with mercury	0.0	5.9	0.0	0.0	5.9	6.1
Production of recycled of metals						
Production of recycled ferrous metals (iron and steel)	3.9	0.0	4.0	0.0	3.9	0.0
Waste incineration						
Incineration of hazardous waste	0.3	0.0	0.0	0.0	0.0	0.0
Incineration and open burning of medical waste	0.6	0.0	0.0	0.0	0.0	0.1
Open fire waste burning (on landfills and informally)	49.8	0.0	0.0	0.0	0.0	0.0

Waste deposition/landfilling and waste water treatment						
Controlled landfills/deposits	3.9	0.0	0.0	-	-	-
Informal dumping of general waste *1	1.2	1.2	9.5	-	-	-
Crematoria and cemeteries						
Crematoria	2.6	0.0	0.0	-	0.0	0.0
Cemeteries	0.0	0.0	6.3	-	0.0	0.0
TOTAL of quantified releases*1*2	**21,450.0**	**15,280.0**	**131,700.0**	**5,360.0**	**850.0**	**100.0**

Notes to table above:

*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 includes 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: Gold extraction with mercury amalgamation - without use of retort, Alumina production from bauxite (aluminum production) and Open fire waste burning (on landfills and informally).

Table 7 below provides general descriptions and definitions of the output pathways.

TABLE 7: 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 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 such as small-scale gold mining, informal burning of 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 gas cleaning systems on 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 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

3.0 DATA AND INVENTORY ON ENERGY CONSUMPTION AND FUEL PRODUCTION

3.1 ENERGY CONSUMPTION

The following categories of energy consumption do not apply for Suriname:

- Coal Combustion in Large Power Plant
- other coal uses
- Combustion/Use of Petroleum Coke, Petroleum and Kerosene
- Use of Raw or Pre-Cleaned Natural Gas and
- Charcoal Combustion.

The power sector in Suriname consists mainly of two types of power systems; individual thermal power plants (Heavy fuel oil, HFO and diesel) and a hydro power plant. Electricity is thus produced by the hydropower plant (the Afobaka Hydropower Plant) and parastatal/public thermal generators (Jharap, 2014).

The following charts and table show the growth in energy consumption of the Republic of Suriname over the years since 1990 until 2010 and are taken from the website: http://www.reegle.info/countries/suriname-energy-profile/SR

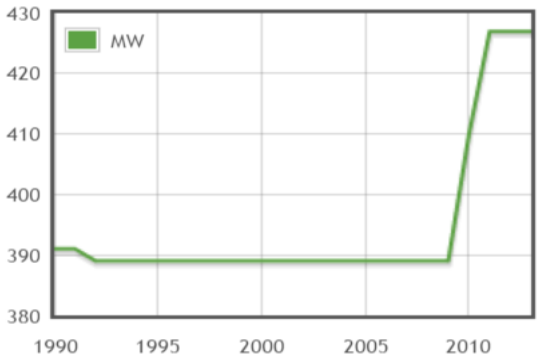

Figure 13: Electricity - total net installed capacity of electric power plants, main activity & auto producer (reegle, n.d.).

Figure 13 and Table 8 indicate the growth of electricity consumption through the years.

TABLE 8: ELECTRICITY-TOTAL NET INSTALLED CAPACITY OF ELECTRIC POWER PLANTS, MAIN ACTIVITY & AUTO PRODUCER (REEGLE).

Year	Quantity	unit
2010	410	MW
2011	427	MW
2012	427	MW
2013	427	MW

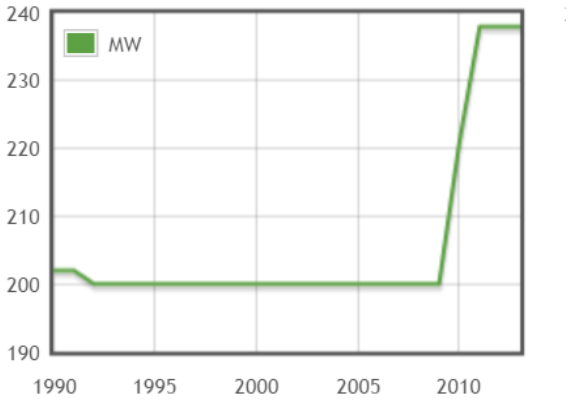

Figure 14: Total net installed capacity of electric power plants, combustible fuels (reegle).

Figure 14 indicates the growth of the use of combustible fuels through the years.

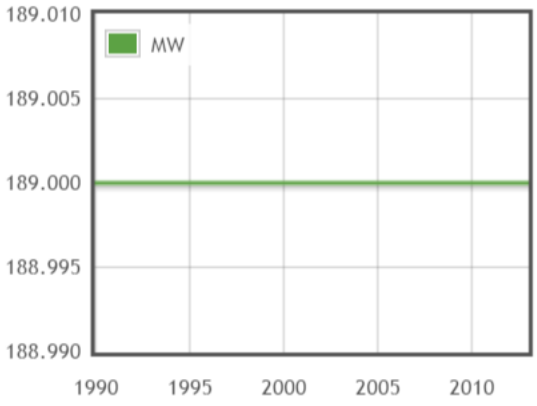

Figure 15: Electricity - total net installed capacity of electric power plants, hydro (reegle).

The graph above (Figure 15) indicates the capacity of hydro-energy in Suriname.

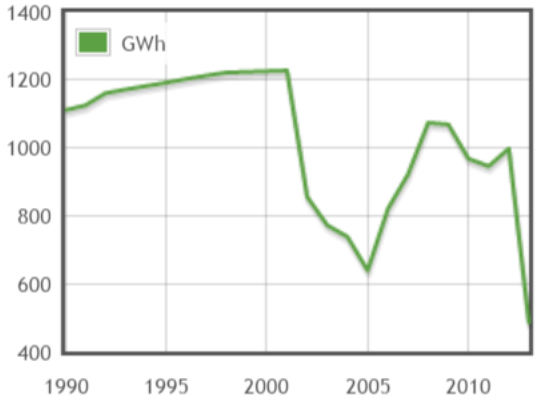

Figure 16: Electricity - total hydro production (reegle, n.d.).

The graph above indicates the total hydro production through the years.

3.2 COMBUSTION/USE OF HEAVY OIL

The N.V. Energy Company Suriname (N.V.EBS) is the national power company that supplies electricity with a substantial part of the generators being fueled with Heavy Fuel Oil (HFO).

A questionnaire was disseminated to the N.V. EBS with the results shown in Table 9.

TABLE 9: HFO USE FROM 2011-2015.

HFO in liters	Year	HFO in tonnes
131,025,658	2015	121,835.86
128,345,519	2014	119,361.33
72,556,528	2013	67,477.57
70,565,229	2012	65,625.66
47,740,279	2011	44,398.46

The figures in this table are in liters, they were converted into tonnes with the use of the density (= 930 kg/m^3) of HFO and the figure of reference year 2015 was fed into the Toolkit.

3.3 COMBUSTION/USE OF DIESEL, GASOIL, PETROLEUM, KEROSENE, LPG AND OTHER LIGHT TO MEDIUM DISTILLATES

According to the statistics, 85% of Suriname's population has access to energy. The energy demand of Suriname's population is between 150MW and 265MW and is met through diesel generator sets (51.6MW), hydropower (115MW), and small diesel generators with capacity in the range of 10-60kW servicing rural villages. The projected energy demand by 2022 is estimated to be 500MW (UNFCCC, 2015).

A questionnaire was disseminated to the N.V. EBS and indicates the following as seen in Table 10 and 11:

TABLE 10: LVGO CONSUMPTION 2011-2015.

LVGO (Light Vacuum Gas Oil) in liters	Year	LVGO in tonnes
30,688,477	2015	28,178.16
31,288,694	2014	28,729.28
51,411,042	2013	47,205.62
42,364,300	2012	38,898.90
21,214,703	2011	19,479.34

Density LVGO= 918.2 kg/m^3

TABLE 11: DIESEL CONSUMPTION 2011-2015.

Diesel in liters	Year	Diesel in tonnes
666,570	2015	589.91
609,030	2014	538.99
538,306	2013	476.40
448,373	2012	396.81
431,980	2011	382.30

Density diesel= 885 kg/m^3

The figures in the tables are in liters, they were converted into tonnes with the use of their density. The figures of reference year 2015 of both tables were added and fed into the Toolkit.

3.4 USE OF PIPELINE GAS (CONSUMER QUALITY)

Thermal energy for households is mainly in the form of imported LPG gas (cooking gas). LPG gas is shipped to Suriname from Trinidad and Tobago. In Suriname, the gas is distributed in cylinders of various sizes (Jharap, 2014).

The use of cooking gas (distribution seen in Table 12) is by far the most important fuel used for cooking by households in Suriname. 87% of the households in the capital (Paramaribo) and adjacent district Wanica (where approximately 66% of the total population of Suriname lives) use LPG gas for cooking. The demand over the whole country can be illustrated by the following percentages: 70% are the domestic users, 17.6 % are the commercial users (bakeries, restaurants, hotels) and 3.4% accounts for the industrial users (heating & welding purposes) (Jharap, 2014).

TABLE 12: TOTAL COOKING GAS DISTRIBUTION (KG), 2011-2015

District	2011	2012	2013	2014	2015
	kg				
Paramaribo	14,789,287	15,184,503	15,746,760	15,932,400	19,350,500
Nickerie	850,532	953,983	922,101	**938,300**	**957,100**
Totaal/Total	**15,639,819**	**16,138,486**	**16,668,861**	**16,871,700**	**20,307,600**

Source: Suriname Energy Company, department Ogane

The data of reference year 2011 was added with the data of diesel and LVGO with reference year 2015 and fed into the toolkit (28,178.16 + 589.91 + 15,285.14= 44,053.21 tonnes).

3.5 BIOMASS FIRED POWER AND HEAT PRODUCTION

There is no structured use of biomass in Suriname. The only form of biomass which can be considered to be used on broader scale, is wood fire in the rural areas, used for cooking.

Heating facilities in households are inapplicable in Suriname due to the tropical temperatures (Jharap, 2014).

3.6 FUEL PRODUCTION (OIL EXTRACTION, OIL REFINING, EXTRACTION AND PROCESSING OF NATURAL GAS)

Suriname's State Oil Company, Staatsolie Maatschappij Suriname N.V., is engaged in the exploration, production, refining and trading of crude oil and derivatives, including fuel oils, gasoline (95 RON) and automotive diesel. Furthermore, the SOM provides bunkering and transportation services by tanker trucks and barges to local ports.

There is no significant natural gas production in Suriname. Minor quantities of natural gas, which are extracted during the crude oil refining process are used within the SOM plant for heating purposes.

SOM is Suriname's only fuel production company. A questionnaire was disseminated and they provided the information needed which was fed into the toolkit.

4.0 DATA AND INVENTORY ON DOMESTIC PRODUCTION OF METALS AND RAW MATERIALS

4.1 PRIMARY METAL PRODUCTION

The following subcategories do not apply for Suriname: Mercury (primary) extraction and initial processing; Production of zinc from concentrates; Production of copper from concentrates; Production of lead from concentrates; Primary ferrous metal production (pig iron production); Pulp and paper production.

Until recently Suriname was ranked among the world's top 10 leaders in the production of bauxite. At its peak, bauxite mining and alumina production were the largest industries. The bauxite industry accounted for more than 70% of export earnings and 15% of the GDP (Bermúdez-Lugo, 2002). As of today, all bauxite mining activities are terminated, due to the departure of BHP Billiton and ALCOA (Suralco) from Suriname.

Other minerals produced in the country are cement, clay, gold, fossil fuels, sand and gravel, and broken and crushed stone. Gold production in Suriname is mainly from small-scale localized alluvial deposits. The Sara Kreek gold area is the country's largest gold-producing area (Bermúdez-Lugo, 2002). In addition, there are two industrialized mining companies namely the multinational IAMGOLD, which operates at the concession of Rosebel Gold Mines N.V., and Newmont, the majority shareholder of Newmont Suriname.

Gold production in Suriname reached its lowest point in the middle of the 20th century and a new stage of growth driven by the rising gold price beginning in the 1970s was disrupted by the Interior War (1986–1992). Since the end of the war, jointly with the rise of the price of gold, the now safer gold fields attract immigrants, foreign prospecting companies and urban Surinamese to the interior of the country. The trend of gold mining activity (Figure 17) shows a relatively constant progression of land deforested between 2001 and 2014, however, the level of deforestation was higher during the last period 2008-2014 (around 26,000 ha) compared to 2001-2008 (approximately 19,000 ha). This seems to follow the annual gold production, which was relatively stable between 2004 and 2013 with a slight increase since 2008 (Rahm, et al., 2014).

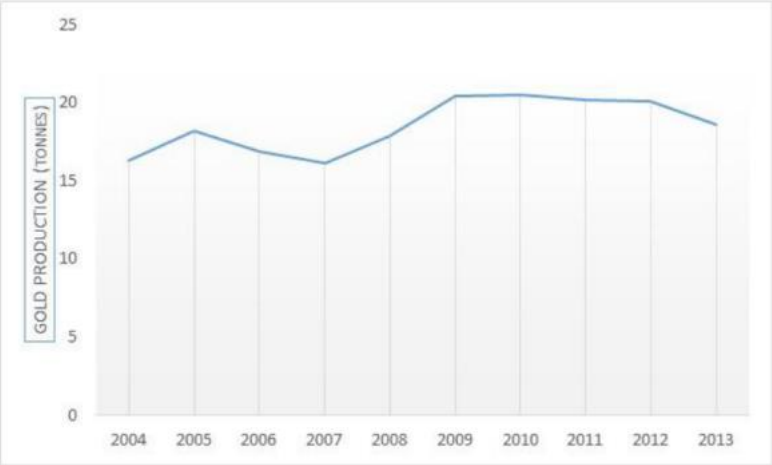

Figure 17: Annual Gold Production in Suriname (Rahm, et al., 2014).

According to a report published by the Central Bank of Suriname (CBvS, 2014), the year 2003 represents a turning point in global gold production. The high increase in gold production that year was not only linked to the international gold prices, but also to the liberalization of the gold market, as well as the establishment of the Rosebel Goldmine in Suriname which started its commercial production in 2004. Large scale gold mining contributed to about 40% of the gold production at that time.

4.2 GOLD EXTRACTION BY METHODS OTHER THAN MERCURY AMALGAMATION

Gold extraction by methods other than mercury is usually done at the large-scale goldmining operations. Large-scale goldmining is done by the Rosebel Mine N.V. (IAMGOLD Corp) and recently, by the Suriname Gold Company, LLC (Surgold) which was renamed Newmont Suriname as of October 1st 2016.

The Rosebel gold mine is located in the Brokopondo district in north eastern Suriname. The mining concession covers 170 square kilometers. The Rosebel gold mine began commercial production in 2004 and has produced just over 3 million ounces of gold in the mine's first 11 years of production. Ownership is 95% IAMGOLD and 5% Government of Suriname.

Newmont Suriname, owned by Newmont Mining Corporation, owns and operates the Merian Project. The Merian Project is a gold deposit located approximately 66 km south of the town of Moengo and 30 km north of the Nassau Mountains in Suriname. In July 2014, Newmont an-

nounced it would invest in the development of the Project which was then commissioned in October 2016.

The methods used by these companies to extract gold are further explained in the additional info.

Gold extraction by methods other than mercury amalgamation: 8 928 571.38 tonnes of ore processed annually.

Since the unit required in the category “Gold extraction by methods other than mercury amalgamation” (large-scale gold mining) is tons of gold ore used, gold production (12.500kg) was converted into processed gold ore using the estimated grade (1.4g/t Au) reported by IAMGOLD. It was assumed that in order to gain 12 500kg of gold, 8 928 571.38 tonnes of gold ore would be processed annually.

4.2.1 ADDITIONAL INFORMATION ON: MINING AND PROCESSING AT ROSEBEL GOLDMINES N.V.

Mining progresses according to a planning schedule based on a three- month forecast. The mining sequence includes drilling, blasting and hauling for both ore and waste rock.

Mining at Rosebel (Figure 18) has been carried out at eight open pits to date: Royal Hill, Pay Caro, East Pay Caro, Koolhaven, Rosebel, Roma, J-Zone and Mayo. Mining is done by using conventional open pit methods, with excavators and trucks. Material is designated as soft rock, transition or hard rock with the latter two types requiring blasting (IAMGold corportion, 2016).

Figure 18: Open Pit at Rosebel Gold Mines (IAMGold corportion, 2016).

Mill processing unit operations (Figure 19) include a gyratory crusher and coarse ore stockpile with feeders, a grinding circuit, a gravity recovery circuit, a leaching circuit, a carbon-in-leach (CIL) circuit, a carbon stripping circuit and a refinery as shown in the mill flow sheet (IAMGold corportion, 2016)

Hard and transition rock is reduced in size through a primary crusher then stacked over two apron feeders for delivery to the mill grinding. Soft rock is fed by excavators through two apron feeders in parallel to the primary crusher, reporting to the grinding circuit on the same conveyor as the hard and transition rock. Ore is ground to 80% -75 microns to liberate the gold for leaching (pulp). Within the grinding circuit, a portion of the cyclone underflow reports to the gravity circuit where screens, cones and a Knelson concentrator are used to separate gravity recoverable gold (GRG). Gravity gold is then further concentrated on a Deister table, dried and refined in the induction furnace at 1,250°C (IAMGold corportion, 2016).

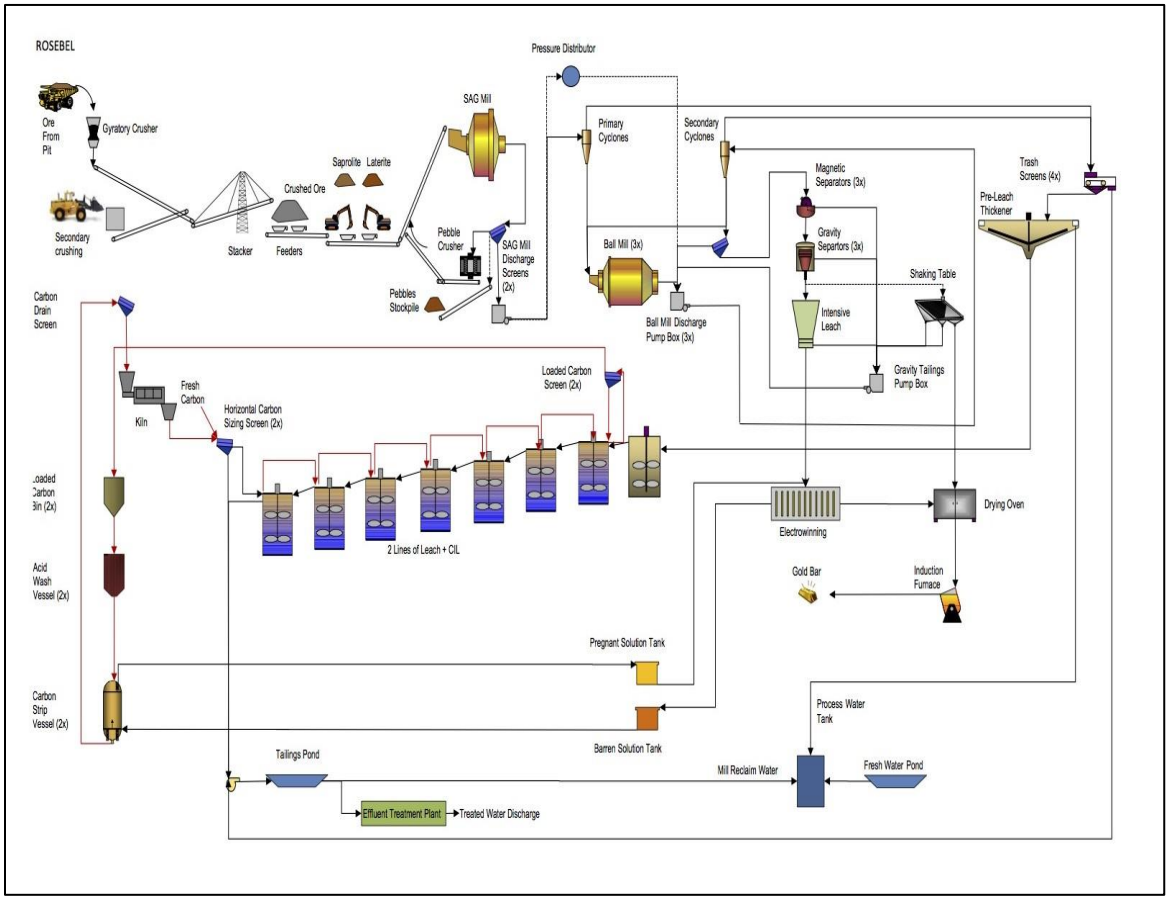

Figure 19: Mill Flow Sheet at Rosebel Gold Mines (IAMGold corportion, 2016).

The pulp from the cyclone overflow is thickened and then fed to leach tanks where 70% of the feed gold is leached to be recovered by activated carbon in the CIL process. Pulp leaving the CIL circuit enters the tailing pond with trace levels of gold. The loaded carbon from the CIL process is recovered by screening and sent to the stripping circuit where gold is stripped from carbon and put into solution. The solution reports to an electro-winning process where the gold is plated onto cathodes by electrolysis, the gold sludge is washed from the cathodes, dried and finally refined in the induction furnace. The pulp from the cyclone overflow is thickened and then fed to leach

tanks where 70% of the feed gold is leached to be recovered by activated carbon in the CIL process. The loaded carbon from the CIL process is recovered by screening and sent to the stripping circuit where gold is stripped from carbon and put into solution. The solution reports to an electro-winning process where the gold is plated onto cathodes by electrolysis, the gold sludge is washed from the cathodes, dried and finally refined in the induction furnace (IAMGold corportion, 2016).

Depending on the gold mineralogy, the rock type, the ore grade, and the processing rate, recovery at Rosebel is typically in the low to mid 90% range (IAMGold corportion, 2016).

4.3 ALUMINA PRODUCTION FROM BAUXITE (ALUMINIUM PRODUCTION)

ALCOA's presence in Suriname extends back to 1916. Suralco, a subsidiary of ALCOA, originally focused on mining bauxite, an ore from which alumina is extracted and used to make aluminum. In 1958, Suralco signed an agreement with the Suriname government to develop the country's hydropower and bring the aluminum industry to the country. Suralco produced approximately 3,150 metric tons of alumina each day at its Paranam location (alcoa, 2016). On November 30th 2015, Suralco discontinued its business in Suriname (Eersteling, 2015).

A questionnaire was disseminated to the Bauxite Institute of Suriname and the data in Table 13 with reference year 2015 was fed into the Toolkit.

TABLE 13: BAUXITE PROCESSED 2010-2015.

Year	Bauxite processed (Mt)
2010	3.1
2011	3.2
2012	2.8
2013	2.6
2014	2.7
2015	1.8

4.4 GOLD EXTRACTION WITH MERCURY AMALGAMATION - WITHOUT USE OF RETORT

In Suriname, the greatest mercury discharge is in the artisanal and small-scale goldmining (ASGM) sector, where mercury is used for the gold extraction process. For every kg gold extracted 1 kg mercury is released in its surroundings. In other words, approximately 10, 000 kg of mercury is released in the interior annually (Ouboter, Review of mercury pollution in Suriname, 2015).

The most recent results on gold export from ASGM in Suriname are from 2011 and indicate that 19 tonnes of gold were exported of which 97% of the miners used mercury (Legg, et al.,2015). This equals to 18,430 kg of gold exported with the use of mercury. This amount was extracted by a sum of 10% (for the use with a retort), so that 18,246 kg was the value used in the Toolkit.

4.4.1 ADDITIONAL INFORMATION ON: ARTISANAL AND SMALL-SCALE GOLDMINING (ASGM) IN SURINAME

According to Heemskerk (2009), artisanal and small-scale gold mining refers to mining activities that use rudimentary methods to extract and process gold on a small scale. The artisanal gold miners in Suriname primarily use mercury for the amalgamation process to recover gold from other soil particles. The gold is recovered by heating the amalgam, while the mercury evaporates and the gold remains, this is usually done without adequate personal protection or concern for release of this toxic substance into the atmosphere, land or waterways. Gold miners favor this method because it is effective, simple, and inexpensive (Heemskerk, 2009) (Kooreman, 2009).

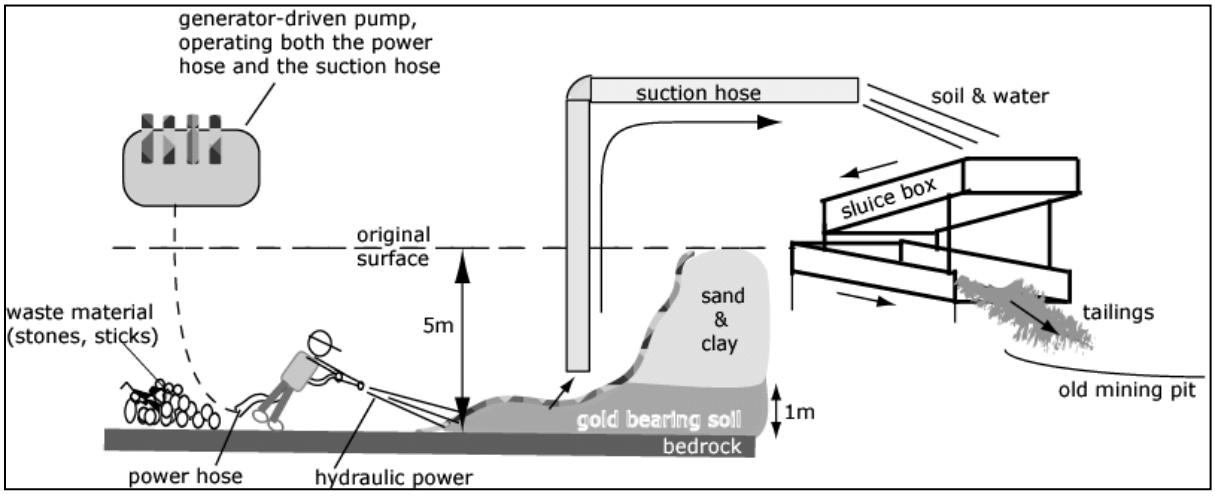

Figure 20: Hydraulic mining method

The hydraulic method as shown in Figure 20 is mainly used in ASGM and takes place in successive stages. It is a form of mining that uses high pressurized water via hoses to dislodge rock material or break up and erode the soil. The resulting slurry (water-sediment) is channeled to sluice boxes with the use of pumps (Henry, 2013).

4.4.2 ADDITIONAL DATA ON: GOLD MINING IMPACT ON THE FOREST TERRITORY

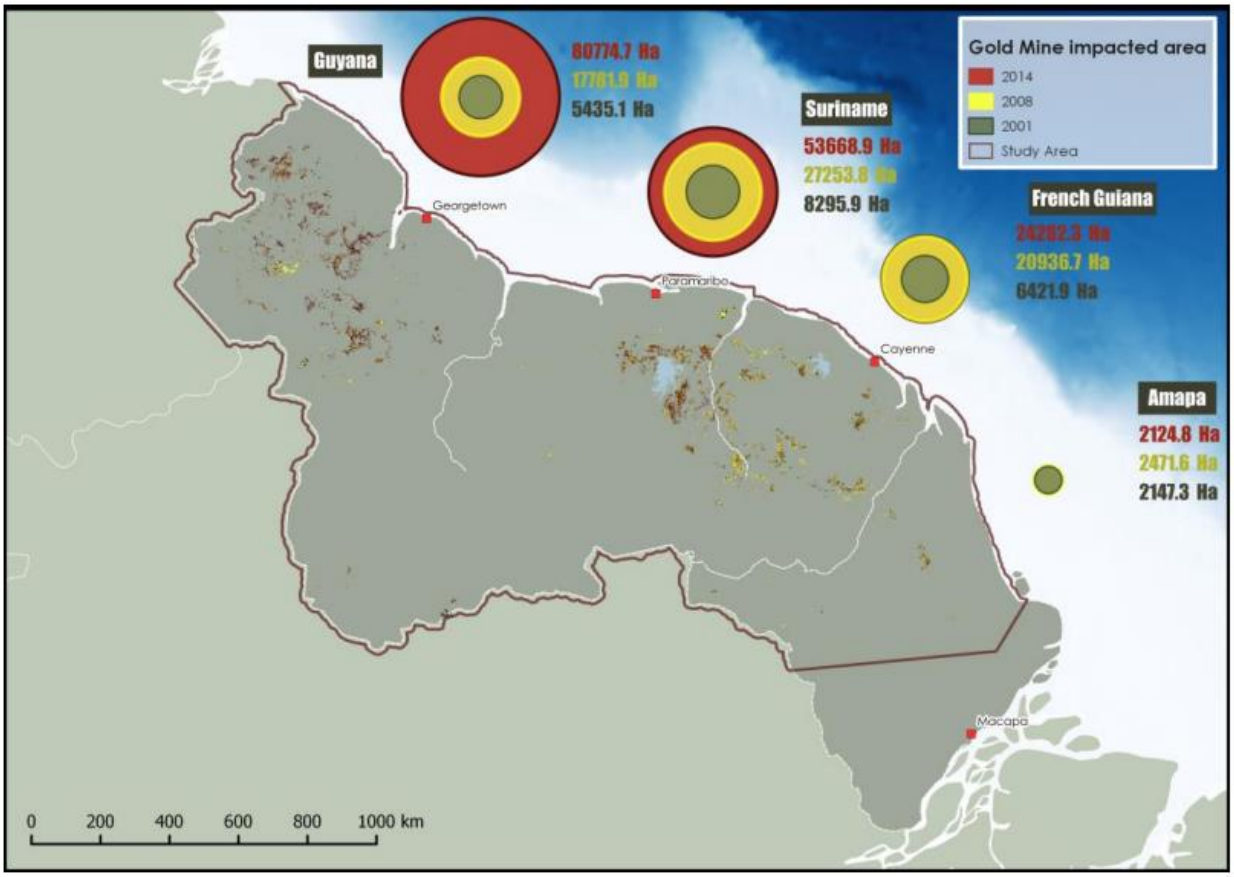

Figure 21: Evolution of gold mining impact on the forest cover by territory (Rahm, et al., 2014).

The figure above illustrates the evolution of the impact goldmining has on the forest cover. The figure indicates a significant increase in area impacted by goldmining activities in Suriname from over 13 years from 8295.9 Ha in 2001 to 53668.9 Ha in 2014.

4.5 GOLD EXTRACTION WITH MERCURY AMALGAMATION - WITH USE OF RETORTS

Few goldminers consistently use a retort, even though they have the knowledge of the existence of this device. A study was performed in the goldmining area, where 178 goldminers were surveyed and only 8.8 percent claim to "always" use the retort for amalgam burning (Duijves & Heemskerk, 2014).

It is unclear how much of the gold amalgam is burnt with a retort, therefore an estimate of 10% from the 18,430 kg produced by ASGM was taken, so that a value of 1,843 kg was used in the toolkit.

4.5.1 ADDITIONAL INFORMATION: KALOTI SURINAME MINT HOUSE

Dubai headquarters Kaloti Precious Metals (Kaloti), one of the world's largest gold and precious metals refiners and trading houses, opened the Kaloti Suriname Mint House (Kaloti, 2016). The refinery is part of a joint venture with the Suriname government and local gold traders and is expected to eventually produce as much as 60 tonnes of refined gold when it is fully functioning in 2016 (Conervation international).

It is important to note that Kaloti Mint House has compiled an Environmental and Social Management Plan (ESMP) for its company to set out the management and monitoring measures required to minimize the potential negative environmental and social impacts, to enhance the positive impacts during the operation of the company and to ensure that responsibilities and appropriate resources are efficiently allocated to these activities (P-all Projects Supply Suriname N.V., 2015).

It may be useful to explore the best practices at Kaloti as Suriname begins to regulate the gold mining industry.

4.6 CEMENT PRODUCTION

In Suriname, there is one cement producing company named Argos, also known as Vensur. Vensur was established in 1965 as a joint venture between Kersten and Venezolana de Cementos. Besides producing cement, cement is also imported from the neighboring countries. In 2012, Vensur supplied more than 50% of the cement requirement in Suriname. Vensur N.V. (Surcol Houdstermaatschappij N.V., 82.24%) is a clinker grinding facility near Livorno, about 5 kilometers south of Paramaribo. Cement producing annual capacity is 60,000 tonnes.

5.0 DATA AND INVENTORY ON DOMESTIC PRODUCTION AND PROCESSING WITH INTENTIONAL MERCURY USE

There is no domestic production of chemicals, which involves the use of a Mercury catalyst or mercury cells.

In Suriname, it is very unlikely that production of products with Mercury content (such as thermometers with Mercury, light sources with Mercury, Manometers/gauges with Mercury, biocides & pesticides with Mercury, batteries with Mercury, paints with Mercury or skin lightening creams and soaps with Mercury) is taking place.

6.0 DATA AND INVENTORY ON WASTE HANDLING AND RECYCLING

Waste management in Suriname is in a developmental stage, and currently, existing systems can hardly cope with the waste generated. There is little or no regulation for the operations of the country's dumps (Ministry of Foreign Affairs, 2013).

For Suriname, a distinction should be made between the services in Greater Paramaribo and those in the remaining districts. In Greater Paramaribo, the collection and disposal of solid waste are the responsibility of the Ministry of Public Works. The Solid Waste Collection and Disposal Division (VOV) of the Sub-directorate of Services of this ministry is responsible for the operational execution of this task. In the districts, the Districts Commissioner (DC) coordinates the solid waste management tasks (Pan American Health Organization, 2003).

The Solid Waste Collection and Disposal Division (VOV) which is in charge of waste disposal in Greater Paramaribo is only able to collect about 70% of solid waste generated within the city. This institute charged with responsibility of providing municipal solid waste management services has found it increasingly difficult to play this role. The difficulty has been aggravated by lack of effective legislation, inadequate funds and services, and inability of this institute to provide the services cost-efficiently (Zuilen, 2006).

There is little or no waste recycled or processed to produce new products. Five years ago, few companies and foundations started recycling. The waste problem can be slightly resolved if waste was recycled on a higher scale (ABS, 2014).

It is estimated that household waste generated ranges from 0.3 kg per capita per day in the rural areas to 0.5 kilograms per capita per day for Paramaribo (Ministry of Foreign Affairs, 2013).

6.1 PRODUCTION OF RECYCLED MERCURY ("SECONDARY PRODUCTION")

As mentioned before, a lot of mercury is used in the goldmining sector, but mercury is not recycled in Suriname. Consequently, there was no data entered into the Toolkit.

6.2 PRODUCTION OF RECYCLED OF METALS

There is no data available regarding this sub-category. Therefore, no data was entered into the Toolkit and no outcome could be calculated.

6.3 PRODUCTION OF RECYCLED FERROUS METALS (IRON AND STEEL)

Table 14 shows the amount of recycled steel from Rosebel Gold mines N.V. in the period 2008-2013 with an increase of 241.9% (ABS, 2014).

TABLE 14: AMOUNT OF STEEL RECYCLED FROM ROSEBEL GOLDMINESS N.V.

Type of waste	Unit	2008	2009	2010	2011	2012	2013
Recycled steel	Tonnes	541.4	958.5	971.0	2,096.3	1,366.2	1,851.1

The figure of 2013 was used in the Toolkit; the unit is in number of vehicles recycled per year. The average weight of a car is 4079 pounds or 2.04 tonnes, which converts into approximately 907.4 cars.

Besides Rosebel Gold mines N.V. there is also a scrap-iron recycling company, Para Schroot, where old cars are collected, crushed and exported. The company collects approximately 8,000 tonnes per year. This figure converts into approximately 3,921.6 cars per year.

Another iron recycling company is COBO where they process approximately 12,000 tonnes per year of recycled iron. The scrap-metal is put in an oven and melted, molded into blocks and after sold as reinforcing bars. This figure was converted the same way as above, which converts into approximately 5,882.35 cars per year.

The numbers were added and the result was fed into the Toolkit.

6.4 INCINERATION OF MUNICIPAL/GENERAL WASTE

Suriname has six waste incinerators in total of which one is no longer active. Four of the incinerators are located in the district Paramaribo; there is one in Brokopondo and the other in Nickerie. The waste incinerators are mainly used for the incineration of medical waste.

6.5 INCINERATION OF HAZARDOUS WASTE

At present, Suriname does not have a dedicated facility to store or dispose of hazardous waste. The problem is often exacerbated because of the small quantities of many types of hazardous waste.

However, the company COBO does incinerate 3,000 liters of waste oil per day (864,000 liter per year) from Staatsolie, N.V. EBS and SOL. The data has to be converted into tonnes, required in the Toolkit. Recomsur also processed about 15,000 kg of hazardous waste which was also entered into the Toolkit.

6.6 INCINERATION AND OPEN BURNING OF MEDICAL WASTE

Currently, medical waste is incinerated at 3 locations in Paramaribo, namely RecomSur, Waspar and the Academisch Hospital, but the waste incinerator of the academisch hospital is currently out of order so their waste is sent to district Nickerie at the only hospital in Nickerie. The other two facilities are fully operational. Furthermore, the Ministry of Health is working on a Central Medical Waste Processing Plant to accommodate all the healthcare facilities in and around Paramaribo. This plant will be situated away from populated areas to reduce healthcare risk which can be caused by waste incineration. District Brokopondo also has its own medical waste incinerator.

For Waspar an estimated amount of 1500kg per year was taken.

TABLE 15: VARIOUS WASTE INCINERATION FACILITIES.

Facility	Waste incinerated per year in kg
Recomsur	20,000
Waspar	N/A
Academisch ziekenhuis	1,000 (sent to Nickerie)
Streek ziekenhuis (Nickerie)	8,709
Brokopondo	No information

6.7 SEWAGE SLUDGE INCINERATION

Sewage sludge incineration is not practiced in Suriname.

6.8 OPEN FIRE WASTE BURNING (ON LANDFILLS AND INFORMALLY)

Waste of most households is collected twice a week, but there are also areas where collection does not occur regularly or at all. Inadequate collection of waste often leads to informal dumping, open fire burning or burying of waste, usually in the interior (ABS, 2014).

The number of households in 2012 registered for Suriname was 140,367. The households that burn their waste in 2012 was 10.2%, equivalent to a number of 14,386 households. A simple calculation was made with the given numbers and the open fire waste burning in tonnes was received and used in the Toolkit.

6.9 CONTROLLED LANDFILLS/DEPOSITS

Suriname does not have a controlled landfill and most garbage is dumped. A large part of the waste from the districts of Paramaribo, Wanica and Commewijne is deposited in the open dump Ornamibo, about 15 km south of Paramaribo (ABS, 2014). The open dump operates at low level of efficiency and poses health and environmental risks to persons entering and operating within the facility and neighboring community. Illegal dumping and littering along roadsides and in open waters continues to be a problem (Ministry of Foreign Affairs, 2013). In the other districts, there are also small landfills, both legal and illegal. Not a lot of waste is recycled (ABS, 2014).

TABLE 16: OVERVIEW OF DISPOSAL SITES IN SURINAME (PAN AMERICAN HEALTH ORGANIZATION, 2003)

Disposal site	Receiving waste from:	Type:	Management
Ornamibo	Greater Paramaribo, Lelydorp, Domburg	Open dump	Government
Zoelen	Alkmaar, Meerzorg, Nieuw Amsterdam, Tamanredjo	Open dump	Government
Moengo, along the road to Patamacca	Part (35%) of Moengo	Open dump	Government
Albina, along east-west connection	Albina	Open dump	Government
Damboetong	Groningen	Open dump	Government
Totness, near the mouth of the fresh-water canal	Totness	Open dump	Government
Rijsdijk	Nieuw Nickerie	Open dump	Government
Curmotibo	Part of Moengo (65%) and non-	Sanitary	Suralco L.L.C.

	hazardous household and office waste Suralco L.L.C. - Curmotibo operations	landfill, compacted clay bottom	
Stowell	Household waste from Onverwacht en Onverdacht (Para), and non-hazardous household and office waste BHP Billiton and its contractors	Controlled landfill	Suralco L.L.C. (formerly managed by BHP Billiton Group)
Paranam	Paranam and non-hazardous household and office waste Suralco L.L.C. - Paranam operations	Sanitary landfill, compacted clay bottom	Suralco L.L.C.

The dumpsite of Totness is very close to a drainage canal and some of the waste may also end up in the water. In Nieuw, Nickerie the dumpsite is close to the Corantijn River and it has been reported that some waste occasionally ends up in the river (Pan American Health Organization, 2003).

The waste dumped at all the open dumpsites may contain hazardous waste, as waste of small industries, shops and workshops is dumped here, and household waste may contain hazardous waste since there is no separation (Pan American Health Organization, 2012).

Bulky waste, like car wrecks, freezers and washing machines are not accepted at most dumpsites. This type of waste is occasionally dumped along rivers or in the sea to serve as a fill and to protect the land against tidal erosion. Rubble and demolition debris is often used as a fill of low-lying open lots (Pan American Health Organization, 2003).

The Suralco L.L.C. has taken the responsibility for the solid waste management in part of Mungo and in Paranam. The BHP Billiton Group did the same in Onverdacht, which then went under the management of ALCOA (Pan American Health Organization, 2003).

The total amount of waste disposed in Suriname over a 5 year period is shown in Figure 22.

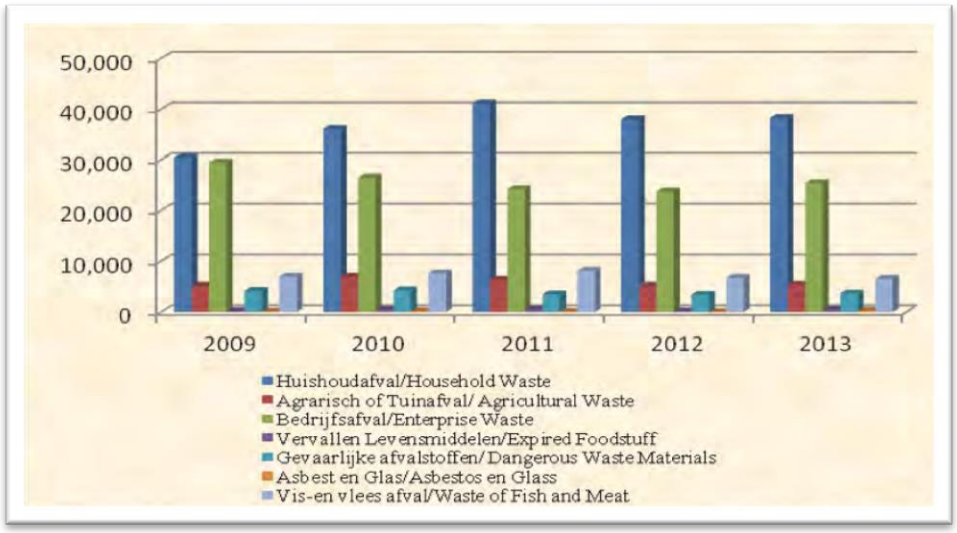

Figure 22: Amount of waste disposed in m^3, 2009-2013

TABLE 17: WASTE COLLECTED AND BROUGHT TO ORNAMIBO

Year	2010	2011	2012	2013
Waste in tonnes	75,062.03	78,420.10	68,404.16	77,241.65

This information was initially provided in m^3 and converted into tonnes.

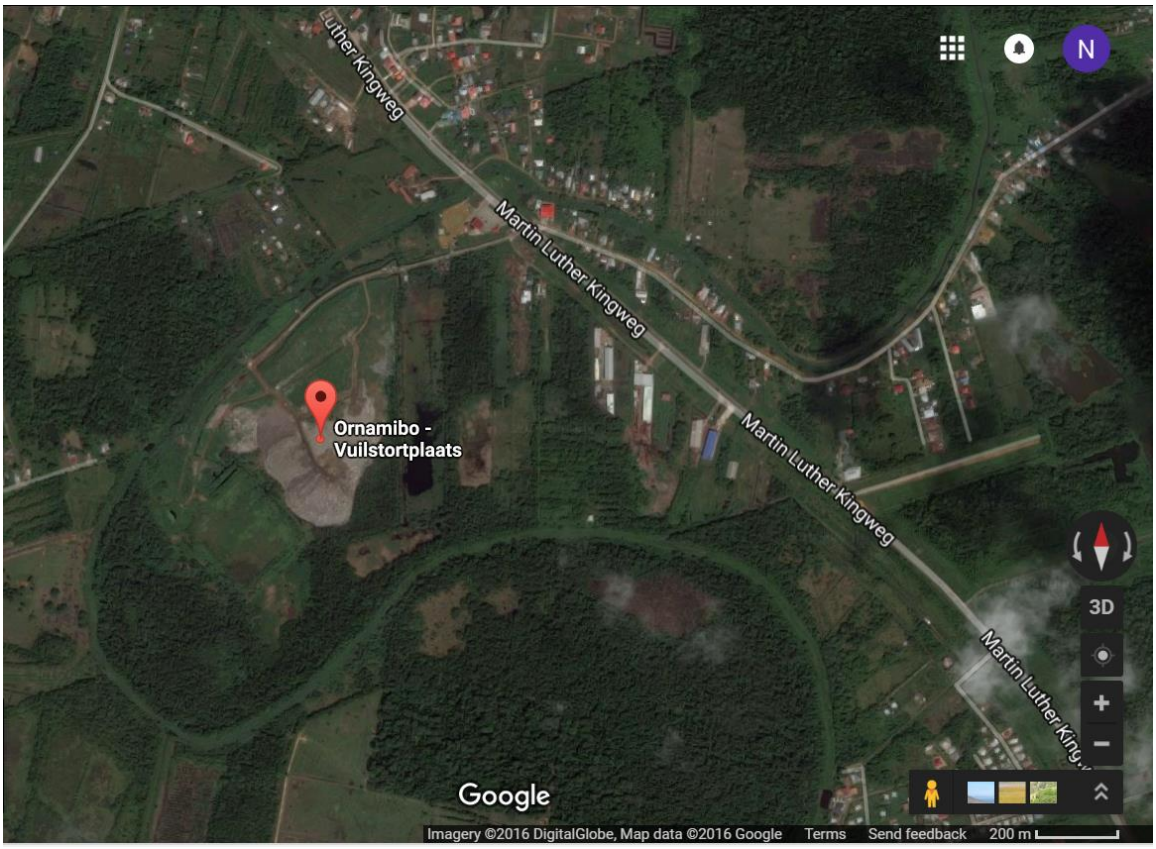

Figure 23: Aerial view of open dump Ornamibo (google maps).

The aerial view of the dumpsite Ornamibo, (Figure 23), reveals that people live nearby and that can have serious health effects on them.

6.10 INFORMAL DUMPING OF GENERAL WASTE

As mentioned in Section 6.9, inadequate waste collection can lead to informal dumping of waste by households. The households that informally dumped their waste in 2012 amounted to 2.4% of total households (total number of households is 140,367) equivalent to a number of 3,411 households. A simple calculation was made with the given numbers and the open fire waste burning in tonnes was received and entered into the Toolkit.

6.11 WASTE WATER SYSTEM/TREATMENT

At present in Paramaribo, 80% to 85% of the population uses septic tanks while the rest of the urban population use pit latrines, typically in areas with low water supply. The design and maintenance of the septic tanks is often inadequate which in many cases results in overflow of raw sewage into the surface water drains or leakages of seepage into the underlying aquifer. When the rainwater enters the combined drainage system the foul gases are first released. Continued rains can cause flooding when the carrying capacity of the combined system is exceeded. In rural areas, the majority of the population has no access to sanitary facilities (The Government of Suriname (GOS), 2010).

At the home owner's expense both septic tanks and pit latrines are emptied periodically by privately owned Septic Waste Companies. In Paramaribo, the content of the suction tanks of these companies are emptied at a location into the Suriname River. The location of the discharge into the river is close to the city's public slaughter house and next to the flour mill; this practice can create health hazards. There was no data available on the quantity of wastewater that is being discharged daily or on its composition (Caribbean Regioal Fund for Wastewater Management, 2010).

Treatment of wastewater is not practiced.

6.12 ADDITIONAL INFORMATION/DATA ON: WATERWAYS POTENTIALLY IMPACTED BY GOLDMINING

Figures 24-26, referenced from Legg et al. (2015), illustrate data regarding the potential mercury polluted waterways in Suriname, the mean mercury levels found in the sediment of said waterways and the mean concentration of mercury levels found in piscivorous fish.

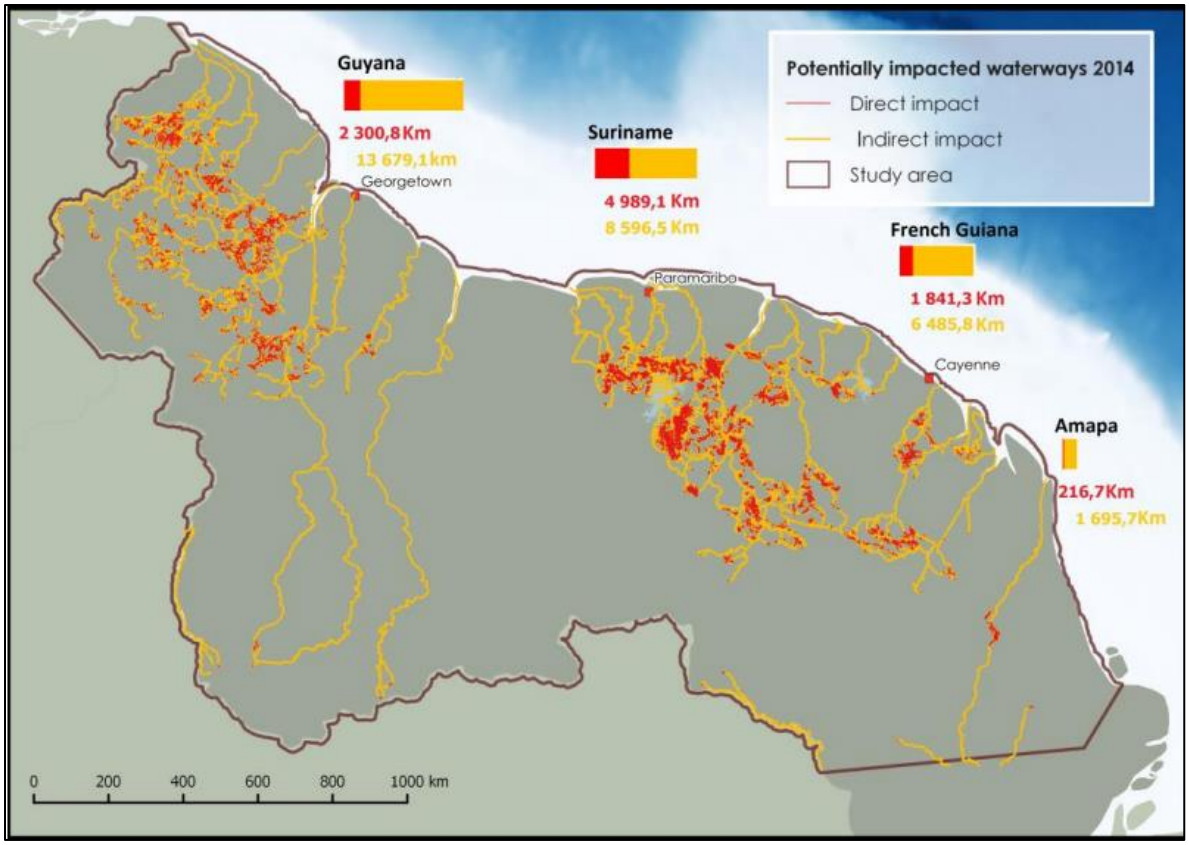

Figure 24: Waterways of the Guiana shield potentially impacted by goldmining for the reference year 2014 (Rahm, et al., 2014)

The figure above indicated that in 2014, approximately 5,000 km were directly impacted and in-directly approximately 8,000 km of waterways were impacted by goldmining activities practiced in Suriname.

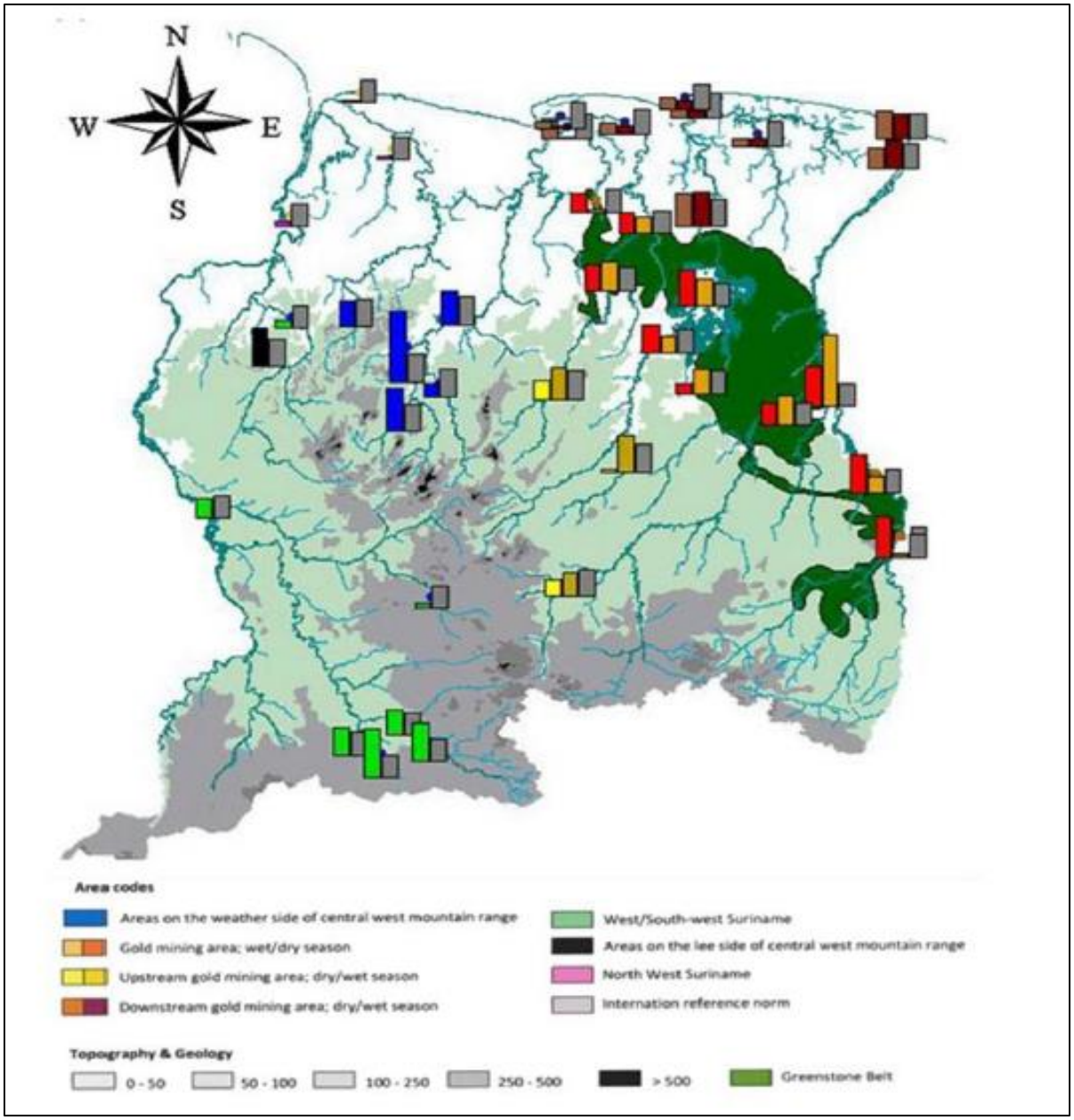

Figure 25: Mean mercury levels found in sediments in different river systems in Suriname 2002–2010. Grey bars represent the CCME Guideline for Protection of Aquatic Life of 0.17 µg/L (Legg, et al.,2015).

Figure 25 indicated the mean mercury levels found in the sediment of various rivers in Suriname. Elevated to high mercury levels in bottom sediments were found in most gold mining localities, as well as upstream. The highest levels were recorded for the Brokopondo Reservoir. Mercury levels in the downstream sections of the rivers were generally lower, although high mercury levels were found in the bottom sediments of Galibi (mouth Marowijne River).

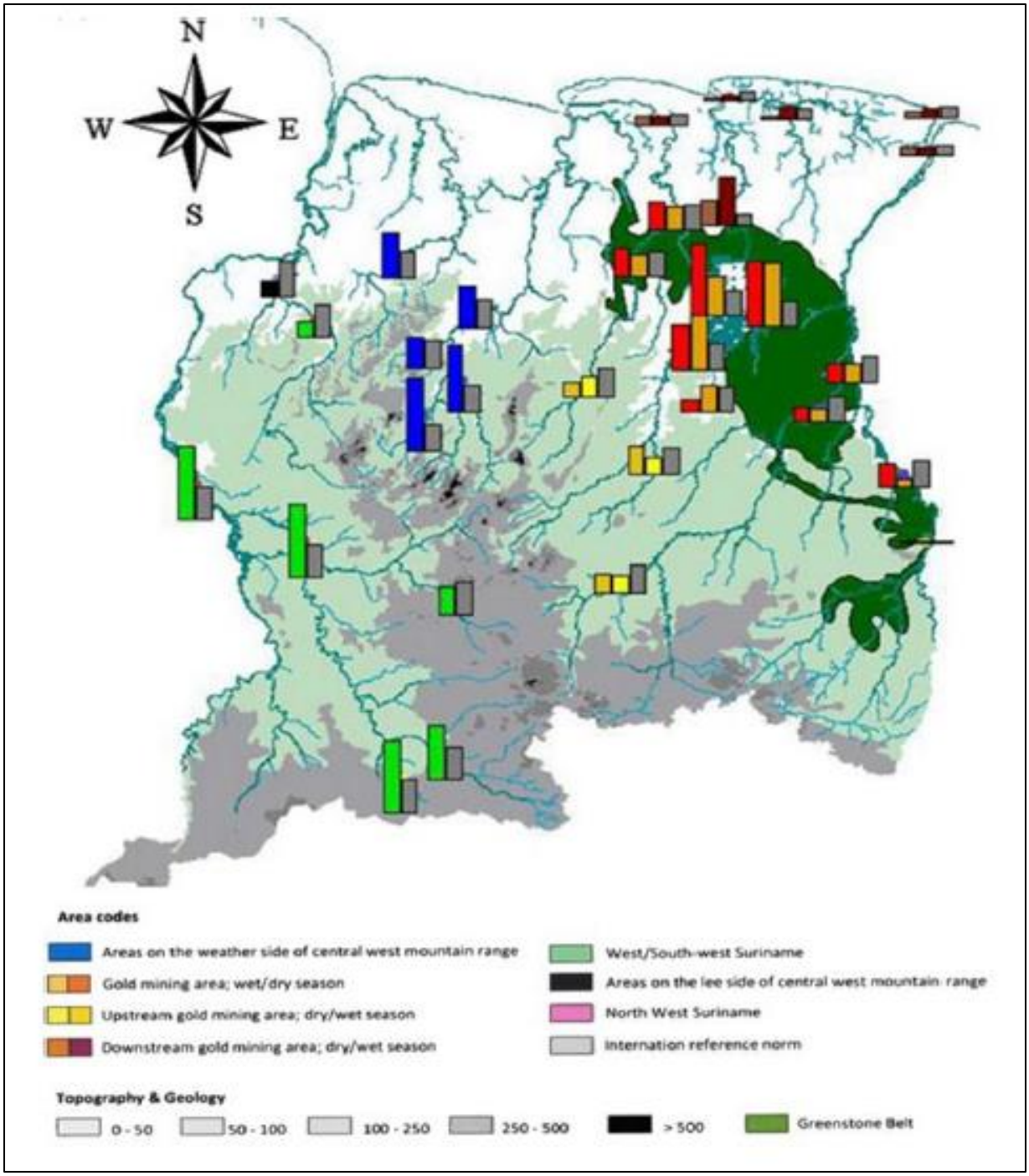

Figure 26: Mean mercury concentration in piscivorous fishes in Suriname. Grey bars represent the WHO standard for human consumption of 0.5 µg/g (Legg, et al.,2015).

The figure above indicated the mean mercury concentration in piscivorous fish in different areas or rivers in Suriname. Elevated to high mercury levels were also found in the tissues of predatory fish in most gold mining localities and also upstream.

7.0 DATA AND INVENTORY ON GENERAL CONSUMPTION OF MERCURY IN PRODUCTS, AS METAL MERCURY AND AS MERCURY CONTAINING SUBSTANCES

7.1 GENERAL BACKGROUND DATA

Background calculations for the product groups listed below were based on the data on population, electrification rate and dental personnel density shown in Table 18.

TABLE 18: SUB-CATEGORIES WITH THEIR DATA TYPES.

Sub-category	Data types used as activity rates
Dental amalgam fillings ("silver" fillings)	Population, density of dental personnel
Electrical switches and relays with mercury	Population, electrification rate (percent of population with access to electricity)
Polyurethane (PU, PUR) produced with mercury catalyst	Population, electrification rate (percent of population with access to electricity)
Other manometers and gauges with mercury	Population, electrification rate (percent of population with access to electricity)
Laboratory chemicals	Population, electrification rate (percent of population with access to electricity)
Other laboratory equipment with mercury	Population, electrification rate (percent of population with access to electricity)

TABLE 19: BACKGROUND DATA FOR DEFAULT CALCULATIONS FOR DENTAL AMALGAM AND CERTAIN OTHER PRODUCT TYPES.

BACKGROUND DATA FOR DEFAULT CALCULATIONS AND RANGE TEST			
Country	Population in 2010 (or as recent as available data allow; UNSD, 2012)	Dental personnel per 1000 inhabitants	Electrification rate, % of population with access to electricity
	531,170	0.017	84

The data in Table 19 are provided as part of the Toolkit. For most countries they are based on authoritative international data sources (population data: UNSD; Dental data: WHO; Electrification data: IEA). For a few countries, data from these sources have not been available and other sources were used as described in the Toolkit Reference Report's Annex 8.4.

Dental restoration is a standard technique to treat cavities. If left untreated, cavities often lead to severe pain or discomfort, sooner or later requiring the removal of affected teeth. Dental amalgam is a broadly used restorative material that contains roughly 50% mercury (UNEP, 2016). The Global Mercury Assessment of 2013 revealed that mercury in dental use accounted worldwide for 270-341 tonnes of mercury releases in 2010, 10% of the mercury consumption overall. One of the requirements of the Minamata Convention is for countries to diminish their use of dental amalgam (UNEP, 2016).

Other materials can also be used to fill cavities caused by dental decay. The primary alternatives to dental amalgam are as follows (FDA, 2015):

- Composite Resin Fillings: the most common alternative to dental amalgam. They are made of a type of plastic (an acrylic resin) reinforced with powdered glass filler. The color (shade) of composite resins can be customized to closely match surrounding teeth. Composite resin fillings are often light cured by a "blue-light" in layers to build up the final restoration. Some advantages of these fillings are that they blend with surrounding teeth; they are very strong and; require minimal removal of healthy tooth structure for placement. The disadvantages are that they are less durable than dental amalgam, more difficult to place and are higher in cost.

- Glass Ionomer Cement Fillings: contain organic acids, such as eugenol, and bases, such as zinc oxide, and may include acrylic resins. Like some composite resins, glass ionomer cements include a component of glass filler that releases fluoride over time. Also like composite fillings, glass ionomer cements are tooth-colored. The composition and properties of glass ionomer cements are best suited for very small restorations. Unlike composite resin fillings, glass ionomer cements are self-curing and usually do not need a "blue light" to harden. The advantages of glass ionomer cements are ease of use and appearance. Their chief disadvantage is that they are limited to use in small restorations.

7.2 MEDICAL MERCURY THERMOMETERS

It is well-known that some medical thermometers contain mercury, but there was no information/data available in Suriname regarding this sub-category.

7.3 OTHER GLASS HG THERMOMETERS (AIR, LABORATORY, DAIRY, ETC.)

A questionnaire was disseminated to the laboratories in Suriname and it has shown that the central laboratory of the Public Health Office (BOG) has 32 thermometers and 6 barometers containing mercury. This information was fed into the Toolkit.

7.4 ENGINE CONTROL HG THERMOMETERS AND OTHER LARGE INDUSTRIAL/SPECIALITY HG THERMOMETERS

There was no information/data available regarding this sub-category. For that reason, there was no data entered into the Toolkit and no outcome was calculated.

7.5 ELECTRICAL SWITCHES AND RELAYS WITH MERCURY

The data regarding electrical switches and relays used with mercury could not be traced. Therefore, no data was fed into the Toolkit, consequently no outcome could be calculated.

7.6 FLUORESCENT TUBES (DOUBLE END)

Some recycling companies collect fluorescent tubes.

Information regarding this sub-category was taken from the UN-Comtrade website, using HS Codes shown in Table 20.

TABLE 20: IMPORT OF HS CODE:7011 (UNITED NATIONS, 2010).

Year	Code	Trade value	Net Weight in kg	Quantity unit (weight in kg)	Trade quantity
2010	7011	$1,093	318	8	318
2011	7011	$6,393	17,429	8	17,429
2013	7011	$5,304	306	8	306
2014	7011	$113,475	45,992	8	45,992

Code description 7011: Glass envelopes (including bulbs and tubes), open, and glass parts thereof, without fittings, for electric lamps, cathode-ray tubes or the like.

The 2014 data was used in the Toolkit. Using the unit conversion sheet, kg was converted to items sold per year before being copied and used in the sub-category.

7.6.1 ADDITIONAL INFORMATION

RECOMSUR is a recycling company and they also recycle bulbs and fluorescent lamps. However, the bulbs and fluorescent tubes are processed for their clients and not stored. Storage of the lamps is left in the responsibility of the customers and once a sufficient number of bulbs and fluorescent tubes is met, it is collected and processed by Recomsur. It is evident that consumers in Suriname are buying more fluorescent tubes than the incandescent light bulb which may present a problem in the future in terms of disposal.

7.7 COMPACT FLUORESCENT LAMP (CFL SINGLE END)

Information regarding this sub-category was taken from the UN-comtrade website shown in Table 21.

TABLE 21: IMPORT OF HS CODE: 853931 (UNITED NATIONS, 2010)

Year	Code	Trade value	Net Weight in kg	Quantity unit (number of items)	Trade quantity
2010	853931	$234,065	80,399	5	152,144
2011	853931	$144,988	43,482	5	98,864
2012	853931	$117,283	33,920	5	78,123
2013	853931	$146,694	48,582	5	83,889
2014	853931	$188,872	60,798	5	120,697

Code description 8539311: Discharge lamps, other than ultra-violet lamps: Fluorescent, hot cathode.

The data from reference year 2014 was entered directly into the Toolkit.

7.8 OTHER HG CONTAINING LIGHT SOURCES

Information regarding this sub-category was taken from the UN-comtrade website and shown in Table 22.

TABLE 22: IMPORT OF HS CODE:85392 (UNITED NATIONS, 2010).

Year	Code	Trade value	Net Weight in kg	Quantity unit (number of items)	Trade quantity
2010	853932	$9,342	159	5	730
2011	853932	$19,033	1,024	5	1,478
2013	853932	$8,729	298	5	698
2014	853932	$51,950	1,084	5	4,400

Code description 853932: Discharge lamps, other than ultra-violet lamps: Mercury or sodium vapor lamps; metal halide lamps.

The data from reference year 2014 entered directly into the Toolkit.

7.9 BATTERIES WITH MERCURY

There are different types of batteries with mercury in them such as:

- Mercury oxide (button cells and other sizes); also called mercury-zinc cells, button cell batteries and miniature batteries. They are used in small portable electronic devices such as watches, cameras, digital thermometers, calculators and toys. Zinc air, alkaline, and silver oxide button cell batteries contain small amounts of mercury. These batteries do not pose a health risk when in use since the chances of the mercury leaking out are minmal (EPA, 2016).
- Other button cells (zinc-air, alkaline button cells, silver-oxide)
- Other batteries with mercury (plain cylindrical alkaline, permanganate, etc., see guideline)

An accu (from accumulator) is a rechargeable galvanic cell, which are often used in vehicles (not in the electronics). They are widely used because of their simple design and can deliver a high current. However, these batteries do not contain mercury.

Information regarding batteries in general and accus imported in Suriname is shown in Table 23.

TABLE 23: IMPORT OF BATTERIES 2009-2013

Year	Batteries	Accu's
2009	278,833	100,691
2010	259,549	62,559
2011	385,829	58,380
2012	138,476	56,366
2013*	107,351	56,164

*= provisional figure

It was assumed that 1% of the total imports for batteries in 2013 represented each of the following respectively, mercury oxide batteries (button cells and other sizes), other button cells (zinc-air, alkaline button cells, silver-oxide) and batteries with mercury (plain cylindrical alkaline, permanganate, etc). Therefore, 3% of the total batteries value was entered into the Toolkit.

7.10 POLYURETHANE (PU, PUR) PRODUCED WITH MERCURY CATALYST

There was no information/data regarding this sub-category. Accordingly, no data was entered into the Toolkit and the outcome was not calculated.

7.11 PAINTS WITH MERCURY PRESERVATIVES

There are only two paint producers in Suriname namely Esuverfa and Varrosieau. Both companies were contacted and they both indicated that no mercury was present in their paint. Other paint companies such as John Ziel and Benjamin Moore import their paint from Trinidad and Tobago and the U.S. A. and do not contain mercury or lead.

7.12 SKIN LIGHTENING CREAMS AND SOAPS WITH MERCURY CHEMICALS

Cosmetic skin lightening is practiced globally and mercury is a registered melanotoxin added to some of these products. The amount of mercury in cosmetics permitted by The Food and Drug Administration (FDA) is a trace amount of 1 ppm, but studies reveal that this amount is still ex-

ceeded in many products which could be dangerous especially for the fetus of pregnant women (Hamann, et al., 2014). There is no legislation against mercury containing products in Suriname.

There was no information/data regarding this sub-category.

7.13 MEDICAL BLOOD PRESSURE GAUGES (MERCURY SPHYGMOMANOMETERS)

There was no information/data regarding this sub-category. Hence, no data was entered into the Toolkit and the outcome could not be calculated.

7.14 OTHER MANOMETERS AND GAUGES WITH MERCURY

A questionnaire was disseminated to the laboratories in Suriname and it has shown that the central lab of BOG has 6 pieces of vacuum gauges containing mercury. This information was entered into the Toolkit.

7.15 LABORATORY CHEMICALS

A questionnaire was disseminated to the laboratories in Suriname and data regarding this subcategory was entered into the Toolkit.

7.16 OTHER LABORATORY AND MEDICAL EQUIPMENT WITH MERCURY

A questionnaire was disseminated to the laboratories in Suriname and it has shown that the central lab of BOG has 3 spectral tubes and a filter of Mercury Analyzer containing mercury. This information was entered into the Toolkit.

8.0 DATA AND INVENTORY ON CREMATORIA AND CEMETERIES

The number of deaths registered in 2013 was 3,557.

Questionnaires were disseminated to government authorities (Academisch ziekenhuis and the Central Registration Office) but neither had the data needed for this category.

8.1 CREMATORIA

The total population in Suriname is 541,638. In Suriname, mostly the Hindustanis practice cremation because of religious reasons. An estimate of 90% of the Hindustani population was entered into the toolkits as well as an estimate of 10% of the remaining population who were assumed to prefer cremation instead of burial. The total number of Hindustanis in Suriname is 148,443, which is approximately 27% of the population.

8.2 CEMETERIES

The remaining number of deaths of 2,515 was entered into the Toolkit to represent the number of burials assumed to have taken place.

9.0 REVIEW OF POLICY AND REGULATORY FRAMEWORK

Currently the national law which is in place to regulate the mining sector is the Mining Decree 1986. In terms of protection of the environment, the Mining Decree is outdated with little reference to the environment.

Article 43 states that with the granting of rights for construction materials, the Minister can set out conditions regarding the safety, interest of third parties and protection of the environment.

The decree has no clear standards to prevent, reduce and mitigate damage to the environment.

In order to comply with national and international legislation related to the environment (e.g. the Minamata Convention) the Ministry of Natural Resources of the Republic of Suriname is currently in the process of developing a new Mining Law with clear standards regarding safety, health, environment and the use of mercury. The Government of Suriname has also the intention of implementing an Extractive Industries Transparency Initiative (EITI) in Suriname. The preparations for implementation of EITI in Suriname are already in progress.

Environmental standards and the restrictive use of mercury will also be embedded in permits issued for the extraction of minerals (Small – scale gold mining sector). In short, the new Mining Law will specifically focus on the sustainable development of the mining sector with minimal impacts on the environment (information provided by The Ministry of Natural Resources of the Republic of Suriname).

In order to regulate the gold mining sector, a commission was established in 2011, directly under the Cabinet of the President. The main objective of this "Commission Regulation Gold Sector (OGS)" is the maximization of the national incomes from gold mining while minimizing the environmental and social impact. They are complementary to the Geological Mining Service (GMD), who act as a technical work arm of the Ministry for Natural Resources, responsible for issuance of mining concessions and geological mapping (Rahm, et al., 2014).

In Suriname, the legal regulations regarding mercury are very limited. There are no legal regulations regarding the use of mercury, it has been placed on a negative list of substances which means that all imports and exports require licensing and dispensation from the Ministry of Trade and Industry. However, while there has been no official import of mercury under this system despite 19 tonnes of gold export from ASGM in 2011 alone, there are indications that the vast majority (97%) of miners involved in ASGM use mercury. Mercury is portable and easy to move across borders making it likely that the mercury used in the ASGM industry is smuggled into Suriname without the required documentation (Legg, et al.,2015).

The National Institute for Environment and Development in Suriname (NIMOS) has composed a policy document and roadmap concerning the Minamata Convention for the government to help revise the mining law and policies regarding phasing out mercury.

NIMOS states that the analysis of statutory regulations shows that the current legislation is regulated by sector and that a comprehensive law to regulate the use, import, export and handling of mercury is missing (NIMOS, Advies Document Betreffende het Minamata Verdrag, 2014).

Shortcomings of the regulatory institutions include (NIMOS, Advies Document Betreffende het Minamata Verdrag, 2014):

- No controls on environmental requirements in permits for gold buyers and exporters;
- No statutory mandate for the protection of the environment at district level. The protection of the environment is not sufficiently provided by the current nuisance law;
- Little or no co-operation between institutions responsible for the regulation of the use, the import, transport or handling of mercury. A coordinating body is not present;
- Limited capacity for the measurement of mercury in its various chemical forms. Validation of data is not present.
- Limited human capacity that is expressed in the multiple functions of stakeholder such as scientists and regulators.

The Minamata Convention is a global treaty that aims to control anthropogenic releases of mercury to protect the environment and most importantly human health from the adverse effects of mercury (Minamata Convention on Mercury, 2015). Countries that sign this treaty, commit to eliminating the use of mercury. The Convention was drafted on the 19th January 2013 and it contains guidelines and measures that must be adhered to by the participating countries. The treaty can be placed under the category of treaties which deals with chemicals and waste issues and is the first treaty that specifically regulates mercury as a heavy metal (NIMOS, Het minamata verdrag- Korte Nederlandse toelichting op het verdrag, 2015). In Japan, 147 countries signed the treaty on the 10th of October 2013. Suriname was present and agreed to its text, but has yet to sign the treaty as the GOS must first assess whether the rules of the treaty can be efficiently implemented.

Suriname, as a developing country, is facing many challenges to phase out the use of mercury. The main problem is the lack of visibility on the gold mining sector and in particular, the illegal activity in small-scale gold mining. This is due to several reasons including a lack of human and financial resources to regulate the use of mercury. Suriname's neighboring countries have signed and ratified the Convention which increases the internal pressures and challenges. There is a tendency to assume that the illegal activities in the ASGM will shift from the neighboring countries into Surinamese territory (NIMOS, Advies Document Betreffende het Minamata Verdrag, 2014).

In summary, the mining law should be revised and updated quickly and better reporting of the mercury trade is clearly necessary on both a national and international scale. This would significantly improve knowledge regarding flows of mercury within and between the Guianas and around the world (Legg, et al.,2015). The steps to phase out mercury in the goldmining sector should also be taken and consequently the Minamata Convention should be ratified by the Republic of Suriname.

9.1 ADDITIONAL INFORMATION ON ILLEGAL MERCURY

As of 2016, the police in the district Nickerie had 128 kg of mercury in custody. The mercury was confiscated because it was illegally imported from Guyana, and the Public Prosecutor is exploring disposal options. Mercury is most commonly entered into Suriname through illegal importations from neighbouring countries. Formally, mercury cannot be imported without a permit. In Figure 27, the mercury in custody is displayed and evidently not properly stored.

Figure 27: Photos of containers of mercury confiscated by police in Suriname

10.0 STORAGE AND DISPOSAL OPTIONS FOR MERCURY WASTE

In order to ensure environmentally sound storage and disposal of mercury wastes, it is useful to understand the types of mercury wastes that exist at national level as well as the sources generating them.

The Basel Convention Technical Guidelines as well as the Minamata Convention on Mercury identify three categories of mercury wastes:

- wastes consisting of mercury or mercury compounds
- wastes containing mercury or mercury compounds
- wastes contaminated with mercury or mercury compounds

Suriname signed the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal on December 19, 2011. The Basel Convention deals with the transboundary shipment and disposal of hazardous waste between countries. The objectives concerning this Convention are (GOV.SR , 2012):

- to restrict the exports and imports of hazardous waste between countries to a minimum;
- to reduce the content of hazardous substances in waste;
- to process hazardous waste near the source as much as possible;
- to assist developing countries to handle hazardous waste in the most environmentally sound way possible.

The Minamata Convention has not been signed nor ratified, but Suriname is seeking to develop this inventory in order to make an informed decision to do so. The Convention draws attention to a global and ubiquitous metal that, while naturally occurring, has broad uses in everyday objects and is released to the atmosphere, soil and water from a variety of sources. Controlling the anthropogenic releases of mercury throughout its lifecycle has been a key factor in shaping the obligations under the Convention (Minamata Convention on Mercury, 2016).

Mercury wastes often need to be stored somewhere where it can be easily moved or retrieved before being sent for recovery or disposal operations. Such storage is currently limited in Suriname, as allowed by national standards. It needs to be undertaken in an environmentally sound manner to avoid contamination of the environment. Storage should be done in compliance with the requirements stipulated by relevant national and international law, including the Minamata Convention, where applicable.

Useful criteria for siting and design of storage facilities include the following:

- not built in sensitive locations (floodplains, earthquake zones etc.), unless technical and legal conditions are sufficient to ensure the Environmentally Sound Management (ESM) of facilities in the area in question
- floors covered with mercury-resistant material
- constant low temperature
- storage area clearly marked with warning signs

General criteria for operation and safety includes:

- Mercury wastes stored separately from other wastes
- Full inventory; regular monitoring, audits and inspections
- Keep facility locked and secure from theft; restricted access
- Trained personnel; fire alarm and suppression system; emergency plan; vapour detection instruments etc.

Storage of mercury wastes may fulfil different functions and be undertaken in varying locations. This may include the following:

1. on-site at industrial facilities pending collection, recovery operations or disposal operations
2. on-site in public institutions pending collection, recovery operations or disposal operations
3. off-site in suitable centralized hazardous waste management facilities pending recovery operations or disposal
4. off-site in dedicated facilities specially equipped for storage of mercury for a long period of time pending disposal

Storage may occupy a central position for countries wishing to export mercury wastes for disposal should they currently lack the necessary infrastructure to ensure environmentally sound recovery/recycling, physicochemical treatment, and/or disposal in SELs or permanent storage in underground facilities.

In Suriname, the laboratories, which are suggested as storage options, are not properly equipped and need to be developed if it is decided to store mercury at said laboratories. Another option is the old SURALCO plant which can be equipped to handle interim storage. The Kaloti Suriname Mint House can in principle, be considered for the development of a storage and disposal processing chain for the whole mining sector in Suriname as the facility has been designed to handle contamination from mercury waste. Stored waste can then be exported to facilities where environmentally sound mechanisms exist for the proper extraction and disposal of mercury, for example in countries like the United States of America, Canada, Spain and the Netherlands.

10.1.1 ADDITIONAL INFORMATION ON GUIDELINES FOR GOLD AND SILVERSMITHS

Use and storage of chemicals

1. No gold-mercury amalgams may be used as raw material for jewelry.
2. Chemicals must be handled and stored according to the guidelines set in the EHS Guidelines Gold and Silversmiths.
3. Potassium cyanide is a highly toxic substance. When working with this substance under all circumstances it must be applied under a strict personal safety, namely to protect hands using gloves (neoprene, PVC), wearing a face shield, appropriate clothing (long-sleeved) and the prevention of leakages and spills of this material in the workplace.
4. All substances should be stored in a separate and well insulated space with an extraction system.

Environmental management and waste management

1. The work areas must be well ventilated during production hours by means of an exhaust system.
2. Waste material with both components of potassium cyanide and acids must be stored separately from battery acid. Their storage must be airtight and if large quantities of waste occur, contact should be made with NIMOS for further assistance.
3. The waste water of potassium cyanide should not be discharged into the environment, but must be stored in glass containers with glass lids. The covers ensure that no air enters the container and/or vapors escaping from the container.
4. Further, the containers should be stored with clearly visible labeling as being environmentally hazardous.
5. The substances are toxic to the aquatic environment and the vapors are very reactive with acids and oxidants, such as oxygen and chlorine. Storage should be airtight and well insulated.
6. The applicant may ask experts for assistance namely the chemical laboratory of the Anton de Kom University of Suriname.

Safety

1. Working with chemicals in a fume hood is the first form of protection against exposure to hazardous vapors or particles.
2. The work in a fume cupboard also prevents that third parties are exposed to the chemicals in the workplace.

Accessibility for inspection bodies

1. The license applicant must meet the guidelines set out by the Fire Department of Suriname and the Labor Inspectorate of the Ministry of Labor, Technological Development and Environment.
2. The location should be more accessible for inspection and monitoring activities of government agencies such as the Fire Department, District Commissioner, Ministry of Labor and NIMOS.

11.0 CONCLUSION

The Minamata Convention has not yet been ratified but steps are being taken by the Republic of Suriname to determine the merits of accession. The country's mercury releases have not been monitored in some cases but from the preliminary findings of this inventory, it is evident that mercury emissions from the relevant sectors in Suriname can have a substantial impact on worldwide emissions.

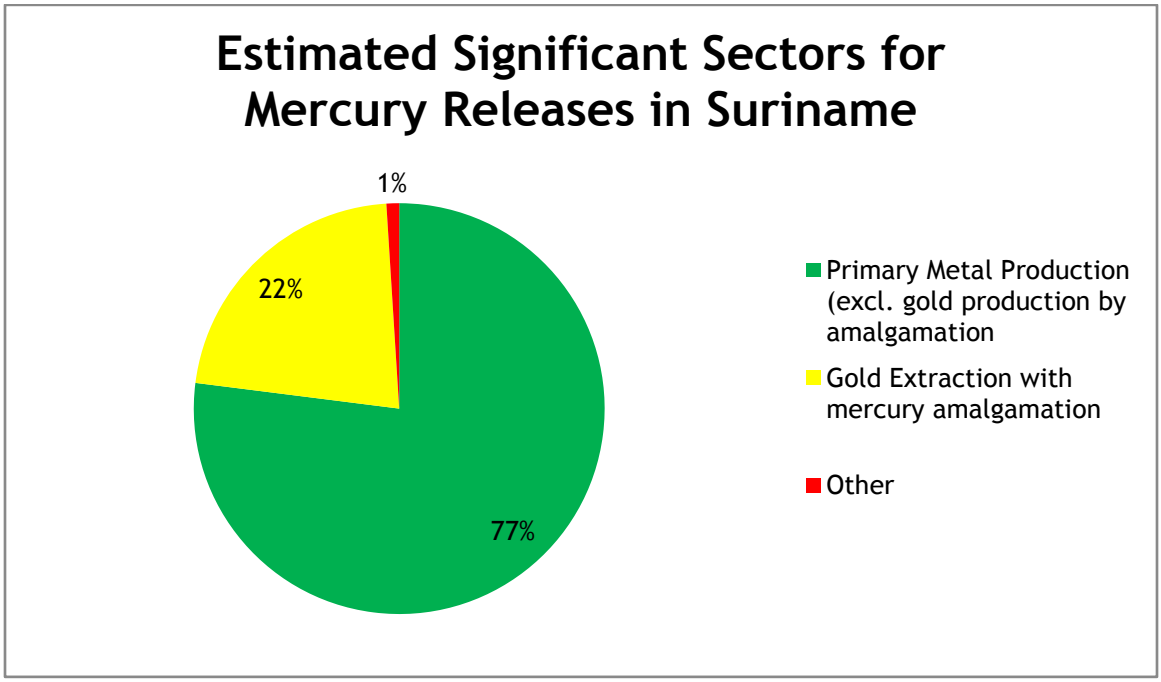

Figure 28: Estimated Significant Sectors for Mercury Releases in Suriname.

As seen in Figure 28 the largest contributions to mercury releases (134,829 kg Hg/yr) were due to primary metal production which referred to activities:

- Gold extraction by methods other than mercury amalgamation and;
- Alumina production from bauxite

Of these two sectors, the highest releases to air, land, water and by-products and impurities came from gold extraction by methods other than mercury amalgamation. 22% of the country's mercury releases were derived from gold extraction with mercury amalgamation, mainly due to extraction activities without the use of a retort. It is clear that the gold mining industry must be regulated and the use of mercury in their activities be phased out.

Mercury releases from all other potential source categories were estimated to account for 1% of the remaining releases of mercury in Suriname, the most significant category being the use and disposal of mercury containing products excluding dental amalgam. Although in relation to the other major sectors identified in Figure 28, use and disposal releases are small, the sector is still responsible for an estimated release of 552 kg Hg/yr which must be managed.

In order to accede to the Convention, reviewing of the regulatory framework relating to mercury and mercury containing compounds is necessary. The Mining Decree 1986 should be revised and updated quickly and better reporting of the mercury trade is clearly necessary on both a national and international scale. This would significantly improve knowledge regarding flows of mercury within and between the Guianas and around the world (Legg, et al.,2015). Regulations must also be developed to manage the import, export, handling and storage for disposal of mercury containing products.

Only after such amendments have taken place can the Government of the Republic of Suriname successfully implement and comply with the provisions of the Minamata Convention as they will be consistent with local legislation. However, it should be noted that the time dedicated to obtaining the data for this project was approximately three (3) months resulting in an inventory that was incomplete. As a direct result, Suriname cannot commit to any policy directives at this time. Additionally, this high level of decision making must be approved under the auspices of Cabinet.

Suriname is developing its National Action Plan under the Minamata Convention and it is anticipated that this process will yield more information on the Gold Mining Sector which can lead to informed decision making.

12.0 RECOMMENDATIONS

The phasing out of the use of mercury in mining activities, especially small-scale gold mining, must be implemented. Although the importation of mercury in Suriname was banned since 2006, it is still excessively used in the small-scale gold mining field, as there does not exist a legal ban against the use of mercury. Legislation must be developed to ban the use of mercury in these practices and the ban on imports must be efficiently enforced. All initiatives being made by the Government of Suriname to develop and implement EITIs and a new Mining Law with clear standards regarding safety, health, environment and the use of mercury are further encouraged.

Legislation regarding the proper storage and disposal of mercury and other waste streams must be developed and enforced. Collaboration amongst the main environmental agencies (including NIMOS), waste management organisations and education institutions to set up public awareness campaigns and collection centres or collection/exchange drives for personal mercury containing products such as thermometers and fluorescent bulbs can be effective measures to removing these products from homes and ensuring that they are managed in an environmentally sound manner as authorities can then accumulate mercury with the intent to conduct either recycling, reclamation or recovery. The possibility of using centralized box crushers for fluorescent bulb disposal as an intermediate means of reducing mercury releases to landfill from this commodity and concentrating any Hg liquids should be explored. With respect to the importation and use of fluorescent bulbs, the option of setting a reduced tariff level on bulbs containing low or no mercury in them is recommended.

In addition, in some cases substitute products could be used as opposed to those that contain mercury. These would include mercury-free digital thermometers, LED (light emitting diode) lights and dental amalgam substitutes like ceramic, porcelain, gallium, cold silver and glass isomers. However, it is important to note that many of these mercury products are used due to their low cost in comparison to their mercury-free counterparts. Considerations should be given to reducing the duties placed on these mercury-free alternatives to make them more economically feasible options. Collaboration with the Ministry of Health can ensure that the public are made aware of the direct health implications caused by mercury containing products such as skin lightening creams.

In Suriname, the best options for storage and disposal are:

1) To develop a facility (or facilities) for interim storage of mercury waste, the location of which will need to be determined in further discussions with relevant stakeholders. A consolidation of mercury waste produced by individual companies would be done by the companies themselves who would have to develop infrastructure “in-house” to arrange for the environmentally sound collection and transport of the waste to the interim storage facility. The interim storage sites would be developed in collaboration with the main

waste management companies as a sanitary engineered landfill under an integrated waste management approach, meaning that the facility would be equipped to handle mercury wastes as well as other hazardous wastes.

2) To have stabilisation/ solidification processes done at the interim storage facilities for the mercury waste. The recommended process would be solidification via cementation where the mercury waste would be encased in a solid block.
3) To export the waste at a national level for environmentally sound disposal to a processing facility where environmentally sound mechanisms exist for the proper extraction and disposal of mercury, for example in countries like the United States of America, Canada, Spain and the Netherlands. The exportation of solidified waste may be expensive due to the potentially large mass of the solid blocks so considerations would need to be made as to how these costs could be off-set.

An opportunity for accessing funds to offset the financial requirements of the storage and disposal options suggested for Suriname would be the upcoming seventh replenishment of the Global Environment Facility Trust Fund (GEF-7) for the period 2018-2022. It is therefore recommended that the Government of the Republic of Suriname ratify the Minamata Convention on Mercury before this period in order to better make use of this potential opportunity.

It was also noted that based on the low response rate to questionnaires disseminated for data collection in this inventory, a follow-up survey with stakeholders is recommended.

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ANNEX 1

Questionnaire Templates

ANNEX I

QUESTIONNAIRE FOR POWER GENERATION SECTOR

MERCURY STORAGE AND DISPOSAL PROJECT

COMPANY NAME			
MAILING ADDRESS (NUMBER, STREET, VILLAGE/CITY)/P.O. Box No.			
CEO/VICE PRESIDENT/DIRECTOR			
COMPANY CONTACT	Name (first,last):		
	Official Position:		
	Mailing Address (number, street, village/city)/ P.O. Box No.:		
	Telephone No.: Fax No.: Mobile No.: Email:		
SIGNATURE			
DATE (DD/MM/YYYY)			

1. For the past five (5) years, kindly indicate the following information where applicable:

	Processing of Natural Gas
Years	**(Nm^3/y)**
2011	
2012	
2013	
2014	
2015	

2. What is the MW rating for the plant?
3. How much electricity (MW) do you produce annually? At Peak?
4. Is the purchased natural gas treated to remove mercury? If yes what is the purchase specification for mercury content in purchased natural gas?
5. Is there any mercury air emission monitoring systems operating at your plant? If so describe their operation and results.
6. Mercury Management Programme:

   Describe the company's mercury management program to reduce mercury waste generation, manage the disposal of mercury wastes and actions to prevent Mercury from entering into the atmospheres, land, and water.

Please submit this data within three (3) weeks of receipt of this correspondence.

Thank you for taking the time to complete this survey

ANNEX II

QUESTIONNAIRE FOR OIL AND GAS SECTOR

MERCURY STORAGE AND DISPOSAL PROJECT

COMPANY NAME			
MAILING ADDRESS (NUMBER, STREET, VILLAGE/CITY)/P.O. Box No.			
CEO/VICE PRESIDENT/DIRECTOR			
COMPANY CONTACT	Name (first,last):		
	Official Position:		
	Mailing Address (number, street, village/city)/ P.O. Box No.:		
	Telephone No.: Fax No.: Mobile No.: Email:		
SIGNATURE			
DATE (DD/MM/YYYY)			

7. Facility Category

   ☐ Petroleum
   ☐ Natural Gas Production, Compression, Blending or Liquifaction Facility
   ☐ Other (*please specify*)

8. Provide a brief description of the facility's operations and activities that generate or are expected to generate Mercury, Mercury containing or Mercury Contaminated Waste.

Process	Raw Materi-als	Products & By-products	Wastes and Emissions	Frequency of Produc-tion

9. For the past five (5) years, kindly indicate the following information where applicable:

FUEL PRODUCTION			
	Oil Extraction	**Oil Refining**	**Extraction and Processing of Natural Gas**
Years	**Crude Oil produced (t/y)**	**Oil refined (t/y)**	**Produced gas (Nm^3/y)**
2011			
2012			

2013			
2014			
2015			

10. Please provide any information on mercury, mercury containing or mercury contaminated waste/effluent/wastewater/liquids/materials generated through your process/es and company facilities.

	Industry Segment	**Category**	**Amount Discharged (including what is stored and what is disposed of)** **(Please state appropriate units)**
Water	Natural Gas Production, Compression,blending or liquifaction facility	Produced Water	
	Oil Refining	Refinery WasteWater	
	Oil Transport	Tanker Ballast Wastewater	
Solid Waste	Oil and Gas Exploration	Drilling Waste	
	Oil Refining	Refinery Waste	
	Natural Gas Production, Compression, blending or liquifaction facility	Spent catalyst, carbon beds, Absorbent material, other	

Air	Oil and Gas Production, Compression, Compression, blending or liquifaction facility	Flared Gas/Stack Emissions	
	Oil Production	Fugitive Emissions	
	Natural Gas Production, Compression,blending or liquifaction facility and Transmission	Fugitive Emissions	
	Oil Production	Fuel Combustion	
	Natural Gas Production, Compression, ,blending or liquifaction facility	Fuel Combustion	
OTHER Examples: Mercury Containing or Contaminated Material, Condensate, bulbs and light fixtures, etc.			
CATALYST (if used in your process please identify the type of catalyst material)			

11. Mercury Management Programme

Is there any mercury management program or are there any measured in place currently to reduce, manage or prevent the use of Mercury and/or to prevent Mercury from entering into the atmospheres, land, water or disposal of Mercury, Mercury containing and Mercury contaminated waste?

12. Confidentiality Claim

If any information provided is considered to be a trade secret, confidential business information and/or if disclosed, would be contrary to the public interest; please indicate below:

Yes ☐

No ☐

Please explain:

Please submit this data within three (3) weeks of receipt of this correspondence.

Thank you for taking the time to complete this survey

ANNEX III

Your mining operation has been identified as a potential source for releases of mercury from primary metal production. Please see the attached cover letter providing more information about the project.

In order to more accurately compile our national inventory please provide us with and enter your data as requested in the table below. PLEASE FILL IN ALL THE BLANK BOXES IN THE TABLE BELOW. Kindly provide data from *[the year ……..]*, or the last year with available data.

Does your mining operation cover any of the following activities?	**Yes or No**	**Requested data covering your company's activity in this country**	**Annual consumption of relevant concentrate/ore****	**Year for data provided**
Production of zinc from concentrates*		Metric Tonnes concentrate used per year		
Production of copper from concentrates*		Metric Tonnes concentrate used per year		
Production of lead from concentrates*		Metric Tonnes concentrate used per year		
Alumina production from bauxite (aluminium production)		Metric Tonnes bauxite processed per year		
Large scale gold extraction by methods other than mercury amalgamation		Metric Tonnes gold ore used per year		

Notes: *In cases of co-production of several metals from the same concentrate, please report the amount of concentrate for the metal produced in the highest amount. If different concentrates are used for the different metals, please report the annual data for each concentrate type. **as specified in column 3.

Does your mining operation cover any of the following activities?	**Yes or No**	**Requested data covering your company's activity in this country**	**Annual production**	**Year for data provided**
Primary ferrous metal production (raw iron production)		Metric Tonnes pig iron produced per year		
Extraction and processing of other non-ferrous metals (nickel)		Metric Tonnes produced per year		
Gold extraction with mercury amalgamation with use of retorts		Kg gold produced per year		

We anticipate that you have the types of data requested above, should you however only have other data types for the same operations, please provide us with these data with clear indication of the units used.

Please also forward us, as feasible, any additional documentation for the numbers provided and other information you may have at hand (e.g. direct measurements or information about emission controls in place).

Name and location of mine:

_____

Name and contact data for your contact person in case of questions:

_____

Kindly return you reply to this questionnaire to NO LATER THAN [*insert date, approx. 2 weeks only*] to:

[*insert name, e-mail and postal address to recipient in research team*]

Thank you for your cooperation in this regard!

Sincerely

[*Name of research team member, and signature if sent by paper mail*]

ANNEX IV

QUESTIONNAIRE FOR MERCURY AND MERCURY CONTAINING DEVICES

MERCURY STORAGE AND DISPOSAL PROJECT

NAME			
COMPANY NAME (IF APPLICABLE)			
ADDRESS			
CONTACT INFORMATION	PHONE	MOBILE	EMAIL

Please submit this data within two (2) weeks of receipt of this correspondence.

Thank you for taking the time to complete this survey

	Do You Import These Items?	Yes/No	Quantity /Year	Purchasing Institution (i.e. who purchases this from you)	Comments (Is it still imported, replacement devices on market?)
1	Mercury Lab Thermometer				
2	Mercury Fever Thermometer				
3	Mercury Cooking Thermometer				
4	Mercury Sphygmomanometer				
5	Mercury Barometer				
6	Mercury Hygrometer				
7	Mercury Hydrometer				
8	Mercury Vacuum Gauge				
9	Mercury Spectral Tube				
10	Mercury Sling Psychrometer				
11	Mercury Gas Law Apparatus				
12	Mercury Anemometer				
13	Other metallic mercury containing instruments (Please list as needed)				

ANNEX V

QUESTIONNAIRE FOR BAUXITE AND CEMENT SECTOR

MERCURY STORAGE AND DISPOSAL PROJECT

NAME			
COMPANY NAME			
ADDRESS			
CONTACT INFORMATION	PHONE	MOBILE	EMAIL

1. For the past five (5) years, kindly indicate the following information where applicable:

	Primary Metal Production	**Other Materials production**
Years	**Alumina Production from bauxite [aluminium production]** **(Bauxite processed, t/y)**	**Cement Production** **(tonnes of cement produced, t/y)**
2011		
2012		
2013		
2014		
2015		

2. What type of fuel do you use at your facility for processing cement?

3. Do your scrubbers contain mercury?

4. If 'YES' to #3 above, please describe the disposal process.

Please submit this data within two (2) weeks of receipt of this correspondence.

Thank you for taking the time to complete this survey

ANNEX VI

QUESTIONNAIRE FOR DENTAL SECTOR

MERCURY STORAGE AND DISPOSAL PROJECT

NAME			
COMPANY NAME (IF APPLICABLE)			
ADDRESS			
CONTACT INFORMATION	PHONE	MOBILE	EMAIL

1. Which do you use in your dental practice?

- ☐ Elemental mercury (from a dispenser)
- ☐ Pre-capsulated mercury
- ☐ None

2. Can you indicate the dental amalgam supplier to your dental practice?

_____

3. For the past year (1), kindly indicate the following information where applicable:

Years	**Old Amalgams Removed**	**New Amalgams Placed**
2015		

4. What type of chair side trap filter do you use?

Reusable

Disposable

5. How do you manage your waste from chair side traps? (please tick all that are applicable)

- ☐ Recycle
- ☐ General garbage
- ☐ Biohazard Waste
- ☐ Wash down sink
- ☐ Don't know
- ☐ Other (please explain)

_____

_____

Please submit this data within two (2) weeks of receipt of this correspondence.

Thank you for taking the time to complete this survey

ANNEX VII

QUESTIONNAIRE FOR WASTE

MERCURY STORAGE AND DISPOSAL PROJECT

NAME			
COMPANY NAME			
ADDRESS			
CONTACT INFORMATION	PHONE	MOBILE	EMAIL

WASTE INCINERATION					
Years	**Incineration of Municipal/ General Waste** **Waste incinerated (t/y)**	**Incineration of hazardous waste** **Waste incinerated (t/y)**	**Incineration of medical waste** **Waste incinerated (t/y)**	**Sewage Sludge Incineration** **Waste incinerated (t/y)**	**Open fire waste burning (on landfills and informally)** **Waste burned (t/y)**
2011					
2012					
2013					
2014					
2015					

ANNEX I

QUESTIONNAIRE funeral homes

MERCURY STORAGE AND DISPOSAL PROJECT

NAME			
COMPANY NAME			
ADDRESS			
CONTACT INFORMATION	PHONE	MOBILE	EMAIL

1. For the past five (5) years, kindly indicate the following information:

Years	Number of Burials/Year	Number of Cremations/Year
2011		
2012		
2013		
2014		
2015		

Please submit this data within one (1) week of receipt of this correspondence.

Thank you for taking the time to complete this survey

ANNEX 2

Completed National Mercury Inventory Level 1 UNEP Toolkit for Identification and Quantification of Mercury Releases

Suriname Mercury Releases Inventory Level 1 UNEP Toolkit for Identification and Quantification of Mercury Releases

(Microsoft Excel Spreadsheet)

Available at:

https://www.dropbox.com/s/pdracexw9vozwgs/Suriname%20Mercury%20Inventory_Level_1_electronic_spreadsheet.xlsx?dl=0

ANNEX 3

National Work Plan

WORKPLAN FOR THE IMPLEMENTATION OF THE MERCURY STORAGE AND DISPOSAL PROJECT IN SURINAME

Specific Objective 1: strategies and programs available for identification and assessment of polluted areas					
Output/Activities	**Tasks**	*** Responsible**	*** Partners**	**Timeframe**	**Resources**
1.1 development guidelines for identification and assessment of polluted areas	POLICY LEVEL: Kab Pres/ NCM STEERING COM LEVEL: - NCM - BIS - Grassalco - NIMOS - BOG - OGS - Min. Labour EXECUTING LEVEL: (to be determined)	Government of Suriname /Kab Pres/ NCM	PRIVATE SECTOR NGO's: – ProBioS – WWF – CI – GHFS PUBLIC SECTOR: Min NH / GMD AdeK/ MW Staatsolie NV EBS	SHORT TERM (1 – 2 yr.)	GOV. BUDGET (In- kind) GEF PRIVATE FUNDING: SEMIF Alcoa Foundation Kaloti (funding)
1.2 adoption of ILO OSH in mining for occupational and environmental health risks and related issues	SENSIBILIZATION AND DISSEMINATION ILO-OSH, NEMS, DWCP	Min Arbeid Min Health AdeK	Min NH SSB Min Arbeid BOG Min of NH/GMD MZ AdeK	SHORT TERM (to be determined)	GOV BUDGET (in kind) ILO FUNDING

			SORTS		
Specific Objective 2: standards for treatment and waste management is in place					
2.1 Development guidelines for waste management	REGULAR MEETINGS: SC CONSULTING: UNEP guidelines Basel Convention	Kab Pres/NCM+BNV Min OW Min RO NIMOS	-Min Arbeid -Min OW -Min VG -Min RO - ADEK/ MW - Private Sector: Suresur Suwama BMB Group	SHORT TERM	GOV BUDGET (in kind)
2.2 Development of guidelines for temporarily storage facility	IDENTIFICATION OF POTENTIAL SITES	- Kab Pres/ NCM+BNV - Min RGB - Min NH - Min RO - NCCR - NIMOS	PUBLIC SECTOR - Min Arbeid - Min OW - Min RO - AdeK/ MW PRIVATE SECTOR - BMB Group - Sugrema (M. Tirtotaroeno)	SHORT TERM	GOV BUDGET (in kind) PRIVATE FUNDING: SEMIF Alcoa foundation WWF GEF World bank (grant) IDB (grant)
2.3 standards in Mineral decree is reviewed and updated in accordance with Basel	INVITATION EXPERTS: AdeK Min NH/GMD BIS REGULAR MEETINGS:	Kab Pres/NCM Min NH OGS GMD BIS	Private sector: MULTINATIONALS - Surgold - Iam gold NATIONALS:	SHORT TERM	GOV BUDGET (in kind) PRIVATE FUNDING: SEMIF ALCOA Foundation WWF

	SC		- Stg. Mijnbouwrechthouders -(Staatsolie)		GEF
Specific Objective 3: management of contaminated sites					
3.1 Preliminary assessment in the workplace and in ASGM sites	EXECUTING STAFF COORDINATING MECHANISM	- Kab Pres/NCM - Min Arbeid -OGS - GMD	Min VG Min NH Min RO PRIVATE SECTOR Local Mining Organizations (via OGS)	SHORT TERM	GOV BUDGET (in kind) PRIVATE FUNDING: SEMIF Alcoa Foundation Kaloti (funding)
3.2 Site investigation in the oil, bauxite gold and refineries (mining industries)	EXECUTING UNITS: SC WEEKLY MEETINGS: Coordination team	- Kab Pres/NCM + BNV - OGS - Min RO - Min NH/GMD - Min RGB -Min Arbeid -AdeK	WWF BIS I am gold Surgold Staatsolie Grassalco Kaloti	SHORT TERM	GOV BUDGET (in kind) PRIVATE FUNDING: Surgold I am Gold Alcoa Foundation Kaloti (funding) Staatsolie Grassalco
3.3 contamination of aquifiers (site)??	SC	- Min OW/WLA - AdeK			GOV BUDGET (in kind) Alcoa Foundation SMIF

Table 1: Work Plan Suriname

* Note: “Responsible’ and ‘Partners’ must not overlap

Abbreviations:

SC = Steering Committee

Kab Pres = the Cabinet of the President of the Republic of Suriname

NCM = Environmental Coordination at the Cabinet of the President

BIS = Bauxite Institute Suriname

BOG = Bureau of Public Health Care

NIMOS = National Institute for Environmental Research in Suriname

Min Arbeid = Ministry of Labour

Min NH = Ministry of Natural Resources

Min VG = Ministry of Health

Min OW = Ministry of Public Works

Min RO = Ministry of Regional Development

Min RGB = Ministry of Spatial Planning, Land and Forrest Management

OGS = Presidential Commission for the Structuring of the Gold Sector

GMD = Geological Mining Service

MZ = Medical Mission

AdeK = Anton de Kom University of Suriname

MW = Environmental Sciences Division on the AdeK University

Staatsolie NV = States Oil Company

EBS = Energy Company Suriname

ProBioS = Protect our Biodiversity in Suriname

GHFS = Green Heritage Fund Suriname

ABS = General Bureau of Statistics Suriname

SSB = Surinamese Standards Bureau

SORTS = Foundation for Development through Radio and Television in Suriname

BNV = Bureau for National Security

Suresur = Support Recycling Suriname Foundation

Suwama = Suriname Waste Management

BMB Group = Business Match Business Group NV

NCCR = National Coordination Commission for Disaster Management

Stg. Mijnbouwrechthouders = Foundation for Mining Extenders

Sugrema = Suriname Green Management

SEMIF = Suriname Environmental and Mining Foundation

SurGold = Surinamese limited liability company fully owned by Newmont

I am Gold = Mining and exploration company engaged in exploring and mining precious metals, primarily gold, under exploration portfolios, also in Suriname

Kaloti = Kaloti Suriname Mint House