

# MINAMATA INITIAL ASSESSMENT REPORT

South Africa

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Compiled by

ZABCOR Pty Ltd

Pretoria

Tel: +27 76 383 6466

Email: Info@zabcor.com



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# Glossary of Abbreviations

| | |
|---|---|
| ASGM | Artisanal gold mining |
| BAT/BEP | Best Available Technology/Best Environmental Practices |
| DEA | Department of Environmental Affairs |
| DFFE | Department of Forestry, Fisheries, and the Environment |
| Discovery | Discovery Health Medical Scheme |
| DMRSA | Department of Mineral Resources of South Africa |
| FCDA | Foodstuffs, Cosmetics and Disinfectants Act (Act No. 54 of 1972) |
| FGD | Flue-gas Desulfurization |
| GDP | Gross Domestic Product |
| GEMS | Government Employees Medical Scheme |
| GHG | Greenhouse Gas |
| HAS | Hazardous substances Act (Act No. 15 of 1973) |
| Hg | Mercury |
| IEA | International Energy Association |
| ITAA | International Trade Administration Act (Act No. 71 of 2002) |
| ITAC | International Trade Administration Commission |
| MC | Minamata Convention |
| MIA | Minamata Initial Assessment |
| MoA | Memorandum of Agreement |
| MoU | Memorandum of Understanding |
| NEM: WA | National Environmental Management: Water Act |
| NEM:AQA | National Environmental Management: Air Quality Act |
| NEMA | National Environmental Management Act (Act No. 107 of 1998) |
| NERSA | National Regulator for Compulsory Specification |
| NHA | National Health Act (Act No, 63 of 1977) |
| PGM | Platinum Group Metals |
| PPP | Purchasing Power Parity |
| RR | Rand Refinery |
| SA MIA | South African Minamata Initial Assessment |
| SAPS | South African Police Service |
| SARS | South African Revenue Services |
| SAWIC | South African Waste Information Centre |
| UNEP | United Nations Environmental Programme |
| USGS | United State Geological Survey |
| VCM | Vinyl Chloride Monomer |
| WHO | World Health Organization |

# Foreword

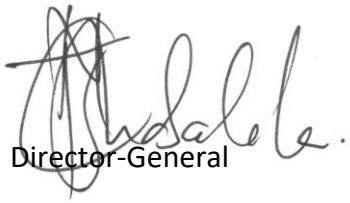
The adverse effects of Mercury on the environment and human health have been widely documented. These include, among others, its harmful effects on the nervous, digestive and immune systems. Mercury has drawn global attention due to its persistence, toxicity, long-range transport, and bioaccumulation in the environment. South Africa joined the global community in the efforts to address the scourge of mercury by playing a crucial role in several negotiations to develop a globally legally instrument on Mercury, which culminated with the adoption of the Minamata Convention on Mercury in 2013. The Convention later entered into force in 2016. South Africa signed the Convention in 2013 and ratified it in 2019.

South Africa's participation in global efforts to address the scourge of mercury is in line with the 1996 Constitution, which enshrines the right of everyone to a healthy and safe environment, and the pursuit of sustainable development. It further pursues the objectives of the Waste Act; the National Development Plan; and the pursuit of Sustainable Development Goals. Within the context of the Convention, these ideals will be achieved, amongst others, by ensuring that most sources, releases and emissions of mercury are managed in an environmentally sound manner.

The Department of Forestry, Fisheries and the Environment (DFFE) undertook the Minamata Initial Assessment (MIA) in 2016 and finalised it in 2021. The MIA unearthed the status quo of the sources and releases of mercury, including appropriate associated management tools in a country, and will form the basis for developing the National Implementation Plan (NIP) that will guide the country in terms of, among others, the phasing out of mercury-added products, the reduction of emissions and releases, the management of mercury containing wastes, undertaking awareness raising activities, etc.

The Government commits to implementing the Convention effectively, and in this regard earnest efforts will be undertaken to continue to put in place proper disposal facilities and systems to deal with mercury waste, coupled with endeavours to reduce anthropogenic emissions and releases. Mercury-added products will also be phased down as per the Convention's obligations. These will be supplemented by further actions aimed at education and awareness raising on the harmful effects of mercury, as well as the strengthening of capacity of relevant authorities in order to better monitor and manage the use of Mercury.

We would like to express our profound, heartfelt appreciation to various stakeholders who participated in the development of the MIA. Our appreciation also goes to the Global Environment Facility, for their generous financial support, the UN Environment and the Africa Institute, for their immense technical support.



Director-General

Department of Forestry, Fisheries, and the Environment

# EXECUTIVE SUMMARY

## Introduction

South Africa undertook the South African Minamata Initial Assessment (SA MIA) during the period 2017 to 2020. The project was undertaken in order to determine the national requirements and needs for the ratification of the Minamata Convention and establish a national foundation to undertake future work towards the implementation of the Convention. The SA MIA project enabled the country to:

- Develop Mercury inventories;
- Identify stock and stockpiles, as well as contaminates sites;
- Understand policy, regulatory and institutional arrangements; and
- Develop priorities for implementation.

This report provide details of the process followed and the key findings in respect to the above. A summary of such processes and findings is provided in the following subsections of this executive summary chapter.

## Approach/methodology

For the purpose of this report, the inventory of Mercury inputs to society (South Africa) was developed using the Level 2 "Toolkit for Identification and Quantification of Mercury Releases (version 2015)" made available by the Chemicals Branch of the United Nations Environment Programme (UNEP Chemicals). The Toolkit methodology is based on mass balances for each mercury release source sub-category. The base years for the inventory were 2016 to 2018; however, data from different periods (but as close as possible to the year 2016 publications and data) was used.

In addition to the inventory, Mercury stocks and stockpiles were identified. The identification of stocks and stockpiles was done through (i) interviews with mercury resellers and recyclers of fluorescent lamps, (ii) media reports on historical storage of Mercury stockpiles, and (iii) mathematical calculation/estimation of mercury from e-waste recycling activities. The aim was to identify individual stocks of mercury or mercury compounds exceeding 50 metric tons, as well as sources of mercury supplies generating stocks exceeding 10 metric tons per year in accordance with Article 3(5) of the Minamata Convention. As part of this exercise, potentially contaminated sites

were identified based on information from DEFF's Contaminated Land Register; as well as literature-reported analytical data from various environmental samples (soil, hair, sediments etc.). Finally, data on supply and trade of mercury was sought from international trade statistics.

Further to the above, the project undertook an assessment of existing national legislation and institutional capacities that is relevant for the implementation of the Articles of the Minamata Convention. The purpose of the review was to identify opportunities and challenges presented by various legislation and institutional capacities to the implementation of the convention in South Africa.

Lastly, the project identified national priorities in efforts to address the mercury issue in the country. Only an initial set of priority actions arising from the SA MIA assessments were developed, as the country is yet to develop a detailed implementation plan. The process of developing such a plan is underway.

## Results and discussion

### *Mercury Inventory*

An aggregated presentation of the results for main groups of mercury release sources is presented in Table E1 below.

*Table E-1 Summary of mercury inventory results*

| Category | Source category | Calculated. Hg input to society(Kg/y) | Percentages of Total |
|---|---|---|---|
| **5.1** | Extraction and use of fuels/energy sources | 38080 | 53.8 |
| **5.2** | Primary (virgin) metal production | 12894 | 18.2 |
| **5.3** | Production of other minerals and materials with mercury impurities | 803 | 1.1 |
| **5.4** | Intentional use of mercury in industrial processes | 0 | 0.0 |
| **5.5** | Consumer products with intentional use of mercury | 11726 | 16.6 |
| **5.6** | Other intentional product/process use | 4346 | 6.1 |
| **5.7** | Production of recycled metals ("secondary" metal production) | 1594 | 2.3 |
| **5.8** | Waste incineration*3 | 905 | 1.3 |
| **5.9** | Waste deposition/landfilling and wastewater treatment | 408 | 0.6 |
| **5.10** | Crematoria and cemeteries | 1250 | 1.8 |

The individual mercury releases sub-categories contributing with the highest mercury releases to the atmosphere were coal combustion in power plants[18096 Kg/year]; Gold (and silver) extraction with

mercury amalgamation processes[4991 kg/year ] and other non-ferrous metals - extraction and the individual mercury release sub-categories contributing with the highest mercury releases to the atmosphere were coal combustion in power plants, gold extraction and nonferrous metal extraction and processing. Their total contribution is 80% of all the mercury released to the atmosphere in South Africa and 57% is attributed to coal combustion in power plants.

The individual mercury release sub-categories contributing with the highest inputs of new mercury were coal combustion in power plants, gold extraction and electrical switches and relays with mercury.

The origin of mercury in waste and waste water produced in the country is mercury in products and materials. Waste fractions and waste water do therefore not represent original mercury inputs to society (except imported waste). Waste and waste water may however represent substantial flows of mercury through society. The following were found to be the major flows of mercury with waste and waste water: Electrical switches and relays with mercury, Light sources with mercury and Batteries with mercury.

### *Stocks and stockpiles*

The following information was obtained in relation to stocks and stockpiles of mercury and mercury compounds.

| | |
|---|---|
| **Mercury stocks for re-sale** | Personal communication with one of the re-sellers of Mercury suggests that there are approximately five resellers of Mercury in the country. The contacted person indicates that the five resellers in total may be re-selling approximately **5000 kg Hg/yr.** |
| **Mercury stocks from recycling activities** | Two main recyclers of fluorescent lamps in South Africa reported that there is approximately **1050 kg Hg/y** of Mercury (combined with phosphate powder in the lamps) that is recovered from the recycling process. |
| **Mercury stockpiles from e-waste recycling** | South Africa has over 100 recyclers of e-waste. These facilities process 45 000 tons (or 45 000 000 kg) of e-waste per year. Using this number and emission factor of 0,22 g/kg e-waste, it was estimated that the **990 kg Hg/y** could be released as stockpile from e-waste (assuming that Hg is extracted). |
| **Mercury stockpiles at historical chlor-** | South Africa has a history of chlor-alkali production. Thor Chemicals South Africa has historically produced chlor-alkali, using high volumes of Mercury in its production. Although the facility was closed in 1996-1998, it is speculated that **3000 tons** of Hg is still stocked at the facility |

| | |
|---|---|
| **alkali production plant** | |

*Figure E1: Summary of information on Mercury stocks and stockpiles*

Based on the above, it is clear that the only stockpile that requires attention in terms of Article 3 (5) of the convention is the 3 000-ton stockpile at the former Thor Chemicals plant. This site is also listed as a hotspot for mercury contamination.

### *Trade*

South Africa is a net importer of Mercury. A 10-year trade statistics suggest that between the period 2010 and 2018, the country imported between **7000 kg (2011 value) and 39 660 (2016) Kg Hg of elemental Mercury annum (ITAC trade statistic)**. During the same period, the country exported between 191 kg Hg (2018 value) and 17 643 Kg Hg (2017 value) (see Table 6 ). The amount of Mercury imported and exported fluctuates greatly in between the years. In addition to trade of elemental Mercury, trade statistics shows that the country imports approximately **40 000 kg of Mercury Sulphate and 40 000 kg of Mercury Dichloride (2017)**.

### *Contaminated sites*

A list of contaminated sites was compiled using the information from DEFF's Contaminate Land Register; as well as literature-reported analytical data of various environmental samples (soil, hair, sediments etc.). The sites are shown in figure E-1 below:

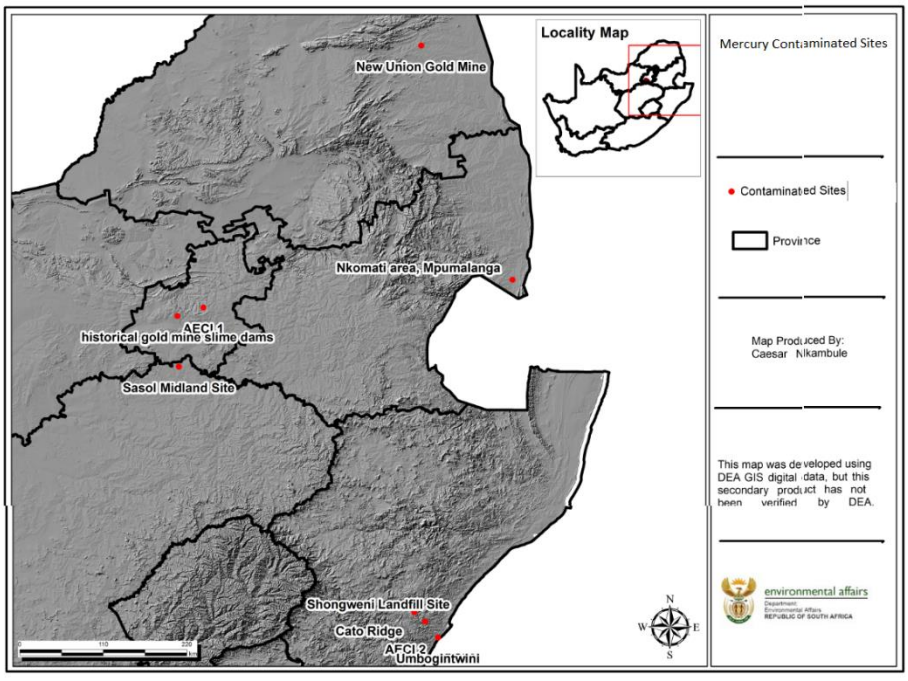


***Figure E1: Location of contaminated sites/hotspots***

Most contaminated sites are in the provinces of Gauteng and Kwazulu-Natal. It is important to note that in some cases the contamination is as a result of a combination of mercury and other chemicals.

## *Legislation*

Various legislative tools are available in South Africa to support the implementation of Minamata conventions. Table below provide a summary of such legislation, as well as empowering provisions that support the implementation of Minamata Convention.

***Table E1: Legislation and empowering provisions that supports the Minamata Convention***

| Legislation | Empowering provisions |
|---|---|
| *Hazardous substances Act (Act No. 15 of 1973) (HAS)* | HSA empowers the Minister of Health to provide for the prohibition and control of the importation, sale, use, application, modification, disposal or dumping of mercury and to provide for matters connected therewith.<br>The Minister of Health has already set regulations that prohibits Mercury trade and use in ASGM. The only challenge is compliance and enforcement of the prohibition as per regulations. |
| *Minerals Resources and Petroleum Development Act (Act No. 28 of 2002) (MPRDA)* | Empowers the minister responsible for Mining to deny any application for a permit or mining right for primary mercury mining. The law does not explicitly prohibit Hg mining.<br>MPRDA (Chapter 2 section 5 and 5A) The MPRDA prohibits any form of mining without a permit. This renders all ASGM activities in South Africa Illegal. |
| *International Trade Administration Act (Act No. 71 of 2002) (ITAA) (chapter4 part A, B, C, D and E)* | Import control of mercury stocks could be facilitated by means of the permit system through ITAC, NRCS, the ITAA and the SARS list of restricted / prohibited articles. |
| *Foodstuffs, Cosmetics and Disinfectants Act (Act No. 54 of 1972) (FCDA) (Chapter 2 section 1 and 2)* | According to regulations published by the Minister of Health under the FCDA, mercury and its compounds may not form part of the composition of cosmetic products. Meaning that cosmetics manufacturers in South Africa are not allowed to use mercury as input to their product during manufacturing. |
| *National Environmental Management Act (Act No. 107 of 1998) (NEMA)* | NEMA lists activities that activities may be restricted, or even prohibited, if the Minister (DEA) determines it is necessary to ensure the protection of the environment, the conservation of resources or sustainable development. As such, |

| Legislation | Empowering provisions |
|---|---|
| | NEMA provides a mechanism through which Mercury manufacturing activities can be listed and prohibited. |
| *NEM:Air Quality Act* | In terms of the NEM:AQA, listed activities require an Atmospheric Emissions License and they need to comply with emission limits. AQA provisions can be used to ensure that existing manufacturing activities in Annex B put measures in place to reduce Mercury emissions. |
| *NEM: Waste Act* | National norms and standards have been set for the storage, treatment and disposal of hazardous waste. These standards will ensure that the release of Mercury into the environment is minimized.<br>NEM:WA makes provisions for the Minister of Forestry Fisheries, and Environment to require any person to remediate land where contamination presents, or may present, a significant risk of harm to health or the environment.<br>National norms and standards for the remediation of contaminated land and soil quality have been promulgated in terms of the NEM:WA and include screening values for mercury |
| *National Health Act (Act No, 63 of 1977) (NHA)* | The National Health Council is empowered to provide advice to the Minister for Health on policy development, on the procurement and use of health technology including machinery and equipment (thermometers, dental amalgams and sphygmomanometers). |
| *Occupational health and Safety Act (Act No. 85 of 1993) (OHSA)* | Employers must provide such information, instructions, training and supervision as may be necessary to ensure, as far as is reasonably practicable, the health and safety at work of his employees.<br>The Hazardous Substances Regulations promulgated under the OHSA, provide occupational exposure limits - recommended limits for mercury alkyls (skin absorption) and for mercury & compounds. |

### *Institutional assessment*

Various institutions in South Africa are responsible for the management of mercury and other chemicals in different aspects of their lifecycle. Table E-2 below provides a summary of government institutions that should be involved in the implementation of Minamata Convention as well as their capacities.

***Table E-2: Legislation and empowering provisions that supports the Minamata Convention***

| Organisation | Roles & capacities | Relevant Articles |
|---|---|---|
| Department of Environment Forestry and Fisheries (DEFF) Formerly DEA | **Role:** Developing and implementing processes and system for efficient and effective administration of Minamata Convention; Creating or strengthening institutional enforcement arrangements; Facilitating inter-agency coordination structures; and Management of releases to air and waste<br>**Capacity:** DFFE is already a lead agent on matters related to the Minamata Convention | All |
| Department of Trade and Industry (DTI) | **Role:** DTI administers the International Trade Administration Act (ITAA) which makes provision for the establishment of the International Trade Administration Commission (ITAC) and for the control, through a permit system, of the import and export of goods specified by regulation<br>**Capacity:** ITAC host the permitting system for import and exports of regulated and /or controlled goods, including Mercury. | 3, 4, 11 |
| Department of Health (DoH) | **Role:** Make regulations controlling, restricting or prohibiting the manufacturing importation and transportation of Mercury. Issue and promote adherence to, norms and standards relating to environmental conditions that constitute a health hazard.<br>**Capacity:** The DoH has already developed and published regulations that control trade of Mercury. The regulations require that a person trading in Mercury to have a license. | 3,4, 5, 7, 9, 10, 11 |
| Department of Mineral Resources and Energy (DMRE) | **Role:** DMRE is responsible for, amongst others, developing mineral policies, norms and standards as well as drafting and amending mineral and related legislation.<br>**Capacity:** The DMRE has a dedicated Directorate that assists small-scale mining operators. DMRE can assist in the identification and management of contamination sites associated with historical gold mining and ASGM | 7,12 |
| Department of Water and Sanitation (DWS) | **Role:** DWS is responsible for the formulation and implementation of policy governing both water quality and quantity. DWS is responsible for controlling releases/discharge of contaminated water into natural water bodies<br>**Capacity:** DWS has the capacity to develop water quality objectives /discharge limits and monitor mercury releases to water. | 9 |

| | | |
|---|---|---|
| Department of Employment and Labour | Ensure that workers are protected from the harmful impacts of Mercury. | 16 |
| Department of Basic Education | Educate school children on the harmful effects of Mercury. Ensure that the health impacts of mercury are covered in curriculum of specific qualifications and or subjects | 16 |
| Research institutions and universities | Undertake Mercury related research including the impact of mercury and mercury compounds on human health and the environment | 16, 19 |
| Power generators | **Role:** The South African Mercury inventory shows that power generation is the largest source of Mercury emission. Hence the role of power utilities in reducing emissions is key.<br><br>**Capacity:** Various power utilities in South Africa has some capacity to undertake research on BAT for the control of emissions but may need financial support | 8 |

The following gaps were identified and needs to be addressed in order to strengthen institutional capacities:

- A national focal point for trade-related consent needs to be designated under Article 17.4 of the Convention.
- The current permitting system for the import of Mercury needs to be improved to ensure proper control of the movement of Mercury.
- Reporting mechanisms needs to be properly coordinated across various stakeholders and institutions.
- Tariff codes needs to be developed for the prohibited MAPS to be listed under International Trade Administration Act (ITAA) and for SARS list of prohibited items.
- Financial mechanisms to support research in various areas where gaps have been identified, such as health impacts, gender dimensions, identification of vulnerable groups, testing of suspected contaminated sites etc.

## Implementation plan

South Africa is yet to develop a National Implementation Plan (NIP) for the implementation of the Convention. Currently, only priority actions were identified and presented in chapter VI of this report. The first priority will be actions, largely within government, to establish a sound regulatory

and/or administrative framework for the implementation of the Convention. The priorities listed are:

**Priority 1:** Ratification and domestication of the Minamata Convention on Mercury.

**Priority 2:** Phasing down/out of the Dental Amalgam use in the health sector.

**Priority 3:** Development of the ASGM National Action Plan.

**Priority 4**: Reducing emissions from coal-fired power plants and industrial boilers.

**Priority 5**: Effective management of mercury containing waste.

**Priority 6:** Strengthening and upgrading of relevant laboratories for detection of mercury.

**Priority 7:** Awareness and Training.

Details on how these priorities could be accounted for in the implementation plan are provided in Table .

# INTRODUCTION

Mercury (Hg) is a Mercury (Hg) is a naturally occurring element that is found in the air, water and soil. However, over the last century, there has been an increase in Hg emissions into the environment, which has largely been attributed to anthropogenic sources (Streets et al., 2005; Zhang et al., 2008). This is concerning given its toxicity, persistence and ability to bio accumulate in the environment Once in the environment, Mercury can enter bodies of living organisms through food consumption. Not only does it enter the bodies but it bio accumulates along food chains; meaning, its concentrations get higher for organisms that are higher in the food chain. When mercury eventually reaches the body of humans through food chains, it causes adverse health impacts to the brain, heart, kidneys, lungs, and immune system. It has been demonstrated that high levels of methylmercury for example in the bloodstream of unborn babies and young children may harm the developing nervous system, making the child less able to think and learn. Mercury also causes increased cancer risk of the liver and of the oesophagus. Respiratory toxicity may also cause pulmonary oedema, congestion, coughing, interstitial pneumonitis and respiratory failure. Mercury may also affect reproduction by causing increased spontaneous abortions, congenital anomalies, and reduced fertility among women.

The Minamata Convention on Mercury, hereafter referred to as the Minamata Convention or the Convention, was adopted by the Conference of Parties at the Diplomatic Conference for the Minamata Convention on Mercury, in October 2013 in Japan. The Convention came into force in August 2016. South Africa ratified the Convention in April 2019, making it party to the Convention.

The objective of the Convention is to protect human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds into the environment. In order to achieve this objective, the convention requires parties to set and implement a number of regulatory and policy measures to control the supply and trade of mercury and/or its compounds, including certain specific sources of mercury such as primary mining, mercury-added products such as dental amalgams, various measurement equipment, fluorescent bulbs, etc. and, manufacturing processes in which mercury or mercury compounds are used, as well as artisanal and small scale gold mining. In addition, the

Convention requires parties to control air emissions as well as water and land releases of mercury and/or its compounds. This is achieved by setting limit values for mercury emissions in industries such as coal-fired power plants; coal-fired industrial boilers; smelting and roasting processes used in the production of non-ferrous metals; waste incineration facilities; cement clinker production facilities, based on BAT and implementing emission/ releases control measures for existing facilities. It also contains provisions on the environmentally sound interim storage of mercury and on mercury wastes, contaminated sites, public health and information dissemination aspects.

Minamata Initial Assessment (MIA) stems from the Minamata Convention's Article 30 (paragraph 4), which states that "*Each State or regional economic integration organization is encouraged to transmit to the Secretariat at the time of its ratification, acceptance, approval or accession of the Convention information on its measures to implement the Convention*". A MIA provides an opportunity for a country to undertake a mercury inventory, determine and agree upon the measures it will take to implement the Convention, estimate associated costs and communicate this information in a concise and clear manner.

The government of South Africa undertook the MIA project from 2017 to 2019. The South African Minamata Initial Assessment (SA MIA) was undertaken in order to determine the national requirements and needs for the ratification of the Minamata Convention and establish a national foundation to undertake future work towards the implementation of the Convention. The project generated the following outputs/reports:

- Mercury Inventory Level 2 Report;
- Augmentation of the Gaps Identified in the Mercury Inventory Level 2 Study;
- An Assessment of the National Infrastructure, Including Legislation, of Ratifying and Implementing the Minamata Convention in South Africa; and
- Identification of Challenges, Needs and Opportunities to Implement the Minamata Convention on Mercury in South Africa.
- Awareness raising report.

This report provides a consolidation of the outputs above. The report provides a summary of the country's mercury emission and its capacity to implement the Minamata Convention precepts.

# CHAPTER I: COUNTRY PROFILE – SOUTH AFRICA

## 1.1. Geography and population of South Africa

South Africa is a medium-sized country, with a total land area of slightly more than 1.2 million square kilometres. It measures about 1600km from north to south, and roughly the same from east to west. The country has 9 provinces, which vary considerably in size (Figure 1). The smallest yet most populated province is Gauteng. This province is the economic hub of the country. In terms of size, the largest province is Northern Cape, which takes up almost a third of South Africa but least populated.

South Africa's long coastline stretches from the northwest desert border with Namibia on the Atlantic coast, southwards around the tip of Africa, then northeast to the border with subtropical Mozambique on the Indian Ocean. The low-lying coastal zone is narrow, soon giving way to a mountainous escarpment that separates it from the high inland plateau. In some places, notably the province of KwaZulu-Natal in the east, a greater distance separates the coast from the escarpment (OECD Data , 2017).




**Figure 1: Map of the Republic of South Africa**

According to the most recent census, Census 2011, South Africa's population stands at 51,770,560 people. The 2017 mid-year population estimate puts it at 56.5 million (Forbes, 2017).

**Table 2: Census 2011- South Africa**

| Population group | Number | % of Total |
|---|---|---|
| African | 41 000 938 | 79.2% |
| Coloured | 4 615 401 | 8.9% |
| White | 4 586 838 | 8.9% |
| Indian/Asian | 1 286 930 | 2.5% |
| TOTAL | 51 770 560 | 100% |

*Source: Statistics South Africa*

## 1.2. Political and socio-economic profile of South Africa

South Africa's peaceful and stable transition to democracy in 1994, is universally recognised as one of the major achievements of the 20th Century. Now on its second decade of a constitutional democracy, South Africa has endorsed the principles of private enterprise within a free-market system, offering equal opportunities for its entire population.

South Africa is a middle-income emerging market with an abundant supply of natural resources; well-developed financial, legal, communications, energy, and transport sectors; and a stock exchange that is Africa's largest and among the top 20 in the world. Due to consistent and sound budgetary policies, South Africa has been able to tap into international bond markets with reasonable sovereign risk spreads. The 2012 Open Budget Index prepared by the International Budget Partnership ranked South Africa second among 94 countries surveyed. In 2014 and 2015 however, South Africa's ratings have been downgraded by most rating agencies citing poor growth prospects and rising government debt as well as high deficits on the current account (Forbes, 2017).

The country's economic outlook is affected both by national concerns, such as unrest in and pressure on the mining industry, as well as international sluggishness, with Europe as one of South Africa's chief export destinations. However, trade and industrial policies encourage local firms to explore new areas of growth based on improved competitiveness. Infrastructure, mining, finance and retail developments across Africa are helping to fuel a growth trajectory in which South Africa can participate (Brand South Africa, 2015).

South Africa has made considerable strides toward improving the wellbeing of its citizens since its transition to democracy in the mid-1990s. Based on a poverty line of $1.90 per day at Purchasing Power Parity (PPP), poverty fell from 33.8% in 1996 to 16.9% by 2008. Factors driving these included social safety nets, real income growth, as well as decelerating inflationary pressure on households, the expansion of credit, and growth in formal housing. Yet, progress has slowed in recent years due to structural challenges and weak global growth since the global financial crisis of 2008. Poverty was 16.6% in 2011, but the World Bank estimates suggest poverty barely changed in 2016, dropping just marginally to an estimated 15.9%. Economic growth has decelerated in recent years, slowing to an estimated 0.3% in 2016. Unemployment, poverty, and inequality (which are among the highest in the world) remain a challenge. South Africa's unemployment rate hit a 12-year high in 2016, at 27.3% in the third quarter (29% in third quater2019). The unemployment rate is even higher among youths (55% in third quarter 2019) (Stats SA, 2019).

## 1.3. Key economic sectors

Although South Africa constitutes only 4% of Africa's area, it produces about 25% of the continent's goods and services. South Africa has a diverse economy, with key sectors contributing to GDP as follows:

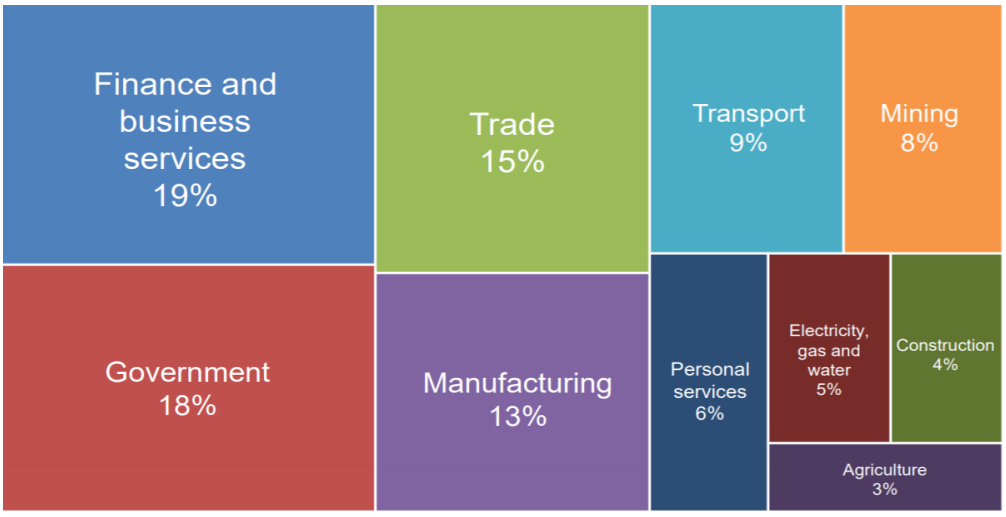



**Figure 2: South Africa's sectoral contributions to the GDP (Stats SA Quarter 2;2019)**

Of the above, there are three key economic sectors that contribute to Mercury emissions. These are mining and mineral production, agriculture and energy/electricity production. The contribution of these sectors to the economy are explained here after.

### a) Mining and mineral production

Mining in South Africa was once the main driving force behind the history and development of Africa's most advanced and richest economy. Large-scale and profitable mining started with the discovery of a diamond on the banks of the Orange River in 1867 and the subsequent discovery and exploitation of the Kimberley pipes a few years later. Gold rushes to Pilgrim's Rest and Barberton were precursors to the biggest discovery of all i.e. the Main Reef in 1886 and the Witwatersrand Gold Rush (The Economist, 2017). About 40% of all the gold that has ever been mined in the world comes from the northern region of South Africa. Diamonds, coal and copper are other valuable raw materials produced in South Africa.

Diamond and gold production are now well down from their peaks, though South Africa is still the world's number 2 in gold production. In spite of this, South Africa remains a cornucopia of mineral riches. It is the world's largest producer of chrome, manganese, platinum, vanadium and vermiculite. It is the second largest producer of ilmenite, palladium, rutile and zirconium. It is also the world's third largest coal exporter. South Africa is also a big producer of iron ore; overtaking India to become the world's third-biggest iron ore supplier to China, who the world's largest consumers of iron ore (International Mining Weekly, 2013).

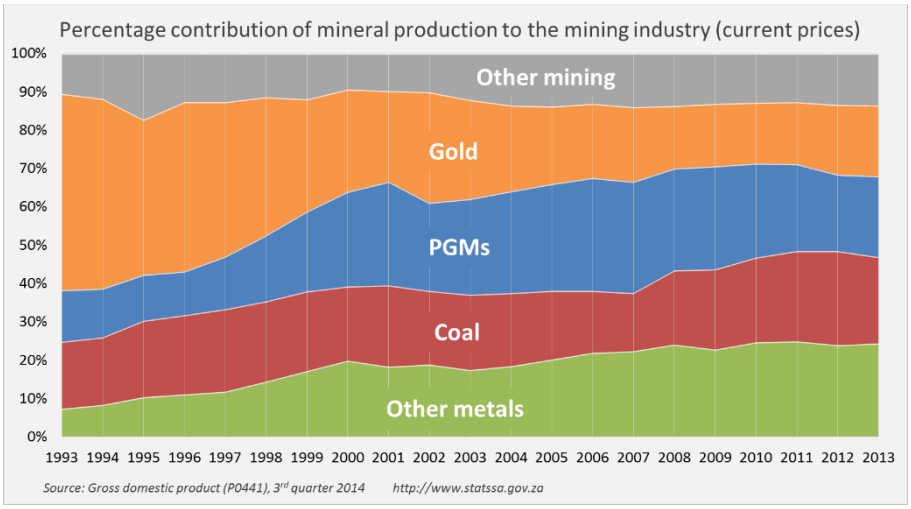



**Figure 3: Contribution of mineral production to the mining industry in SA (2014)**

### b) Agriculture sector

Although South Africa does not have vast adequate farming land, it still exports products including corn, wheat, sugar cane, citrus fruits etc. Great wines are produced in the southern

regions which have a Mediterranean climate. Farmers raise sheep, cattle and pigs for meat and other products (The Economist, 2017).

Modern agriculture relying on the use of pesticides and synthetic fertilisers is contributing to the destruction of the environment, human health and economic stability of small-scale farmers. The agro-industrial sector in South Africa contributes approximately 12% to the GDP and employs 8% of the formal workforce. However, when nonregistered farmworkers and subsistence farmers in rural areas were included, estimates of the workforce were as high as 30%. To maintain high agricultural yields, the use of pesticides and herbicides is a common agricultural practice in the country (The Economist, 2017).

**c) Energy sector**

According to NERSA (2005), approximately 93% of South Africa's electricity is produced from coal. This is of concern since coal contains 3-5 mg of Hg which is released during combustion. South Africa also processes crude oil in three of its refineries, to meet 70% of the country's liquid fuel needs. Therefore, Hg emissions may also come from this source. In 2015, it was estimated that 19 757 kilo tons of crude oil was imported into and processed in South Africa (IEA, 2015) for refining. The amount of mercury released during crude oil refining depends on the origin of oil.

South Africa also uses a significant amount of coal as a feedstock to produce viable alternative fuels and chemicals. A large facility located near Secunda in the Mpumalanga Province produces about 30% of South Africa's liquid fuels requirements and amounts to 180 000 barrels of fuels and chemicals per day. In 2004, the total coal consumption to produce alternative fuels and chemicals in South Africa amounted to about 41 Tg (DME, 2008).

## 1.4. Environmental overview

As with other countries, South Africa is facing a myriad of environmental issues. Details on these are detailed in the State of Environment Outlook report (DEA, 2018). As an overview, the key environmental issues faced by South Africa involves biodiversity, resource exploitation, water pollution, pollution of oceans and coasts, solid waste and emission of pollution into the atmosphere,

**Biodiversity:** South Africa is facing biodiversity pressures such as irreversible loss of natural habitat, ecosystem and land degradation, the spread of invasive alien species, over-abstraction and harvesting (over-exploitation of biodiversity resources and ecosystem services), pollution, and effects of climate change. Most of these are as a result of land-based activities that include inter alia poor land management practices, overgrazing, eutrophication, pesticides, micro-pollutants, over-abstraction of water and changes in flow, destruction of riverbanks (DEA, 2018).

**Resource over extraction:** The mining industry remains an important player in the South African economy, but it is also a key sector that puts pressures on environmental resources. Acid mine drainage (AMD) and other sources of mining related pollution place pressure on land available for other sectors such as agriculture. Pollution of the environment by mines that dump wastes onto land or within drainage lines have dire effects on the environment and agricultural production in affected areas (DEA, 2018). Of specific importance for Mercury is the dumps from historical gold mining activities that used Mercury amalgam as well as the re-mining of these dumps by artisanal gold miners.

**Water pollution:** The impacts and deterioration of water quality is a factor of growing concern and is attributed to effluent discharges and run-off from urban and industrial areas, seepage and discharges from areas that support mining, and pollution from intensive agriculture. According to the Department of Water and Sanitation (DWS, 2017), key sources of water pollutants include:

- Sewage from urban areas which is often not treated properly prior to discharge;
- Industrial and mining effluent containing hazardous and toxic chemicals, including Mercury;
- leachate from waste disposed to landfills and seepage from mineral by-products stored in tailings dams or slag heaps. Such leachate and seepages may in some instances contain Mercury; and
- Agricultural practices (pesticides and fertilisers) which may also cause Mercury contamination.

**Pollution of the oceans and coasts:** The effects of contamination and pollution impacts from effluent point source and diffuse discharge are not limited to inland water sources only, but

oceans as well. Wastewater discharge as a point source into the ocean are made up of storm-water runoff, municipal sewage and industrial wastewater and can contain various contaminants.

**Waste generation:** According to the World Bank 65% of South African population lives in urban areas and this is estimated to increase to 71.3% by 2030. The rate of urbanization puts significant pressure on waste management services and infrastructure. The Municipal Waste Sector Plan (RSA, 2012a) reports that municipal waste generation per capita differs noticeably across South African income groups, with low, middle and high-income groups generating 0.41, 0.74 and 1.29 kg/capita/day respectively. This translates into the middle class, generating in the order of 2.7Mt/annum of domestic waste (DEAT, 2006; as in RSA, 2012a) which is comparable to that produced daily in developed countries such as the United Kingdom (Austin et al., 2006, as in RSA, 2012a). It is, therefore, imperative for urban centres to have adequate waste management practices in place to manage drastic increases in waste volumes, and to shift to a circular economy, to address the mounting pressure of increasing waste volumes.

**Atmospheric emissions:** Extractive and consumptive activities result in increased atmospheric pollutants and greenhouse gases (GHGs) emitted to the atmosphere. Activities such as electricity generated from fossil fuels, mining activities, transportation, domestic fuel burning, and incineration of waste all results in increased air pollution and put pressures on the climatic change. The country's reliance on fossil fuels for electricity generation (over 90%) has serious implications for Mercury emission as well as climate change mitigation. South Africa's National GHG Inventory shows that nett GHG emissions have increased 16.2% over the period 2000-2012; rising from 434,304 $GgCO_{2eq}$ in 2000 to 518,297 $GgCO_{2eq}$ in 2012 (DEA, 2018). Energy sector, in particular power generation remain the highest contributor to GHG emissions. Power generation is also the largest source of atmospheric Mercury emissions in the country.

# CHAPTER II: MERCURY INVENTORY AND IDENTIFICATION OF EMISSIONS AND RESOURCES

The South African Mercury emissions inventory was undertaken by DEFF during the years 2016 to 2019. The inventory used data from different periods but as close as possible to the year 2016 publications and data. In the said inventory, three data collection tools were applied. Firstly, readily available online resources on source categories/economic activities and their characteristic were searched through the internet. Secondly, request letters were sent to the relevant institutions aiming at identification of emission and release sources of mercury. Thirdly, interviews were conducted with main stakeholders, including representatives of relevant agencies, potential recipients and users of mercury containing items such are medical tools/instruments and lab devises (Thermometers, manometers etc.).

## 2.1. Summary of mercury releases, stockpiles, and supply and trade

### 2.1.1. Mercury release source types present

The initial step for the South African Initial Mercury Assessment was the identification of major mercury release sources present in South Africa. Table 3 below shows which mercury release sources are present or absent in South Africa. Only source types positively identified as present were included in the quantitative assessment.

**Table 3: Sources of Mercury present/ not present in South Africa**

| Category Number | Sub-Category Number | Source category | Exists? (y/n/?) |
|---|---|---|---|
| **5.1** | | **Source category: Extraction and use of fuels/energy sources** | |
| | 5.1.1 | Coal combustion in power plants | y |
| | 5.1.2 | Other coal use | y |
| | 5.1.3 | Mineral oils - extraction, refining and use | y |
| | 5.1.4 | Natural gas - extraction, refining and use | y |
| | 5.1.5 | Other fossil fuels - extraction and use | y |
| | 5.1.6 | Biomass fired power and heat production | y |
| | 5.1.7 | Geothermal power production | n |
| **5.2** | | **Source category: Primary (virgin) metal production** | |
| | 5.2.1 | Mercury (primary) extraction and initial processing (a | n |

| Category Number | Sub-Category Number | Source category | Exists? (y/n/?) |
|---|---|---|---|
| | 5.2.2 | Gold (and silver) extraction with mercury amalgamation processes | y |
| | 5.2.3 | Zinc extraction and initial processing | y |
| | 5.2.4 | Copper extraction and initial processing | y |
| | 5.2.5 | Lead extraction and initial processing | y |
| | 5.2.6 | Gold extraction and initial processing by methods other than mercury amalgamation | y |
| | 5.2.7 | Aluminium extraction and initial processing | y |
| | 5.2.8 | Other non-ferrous metals - extraction and processing | y |
| | 5.2.9 | Primary ferrous metal production | y |
| **5.3** | | **Source category: Production of other minerals and materials with mercury impurities** | |
| | 5.3.1 | Cement production | y |
| | 5.3.2 | Pulp and paper production | y |
| | 5.3.3 | Production of lime and light weight aggregates | y |
| **5.4** | | **Source category: Intentional use of mercury in industrial processes** | |
| | 5.4.1 | Chlor-alkali production with mercury-technology | n |
| | 5.4.2 | VCM production with mercury catalyst | n |
| | 5.4.3 | Acetaldehyde production with mercury catalyst | n |
| | 5.4.4 | Other production of chemicals and polymers with mercury | y |
| **5.5** | | **Source category: Consumer products with intentional use of mercury** | |
| | 5.5.1 | Thermometers with mercury | y |
| | 5.5.2 | Electrical switches and relays with mercury | y |
| | 5.5.3 | Light sources with mercury | y |
| | 5.5.4 | Batteries with mercury | y |
| | 5.5.6 | Biocides and pesticides with mercury | y |
| | 5.5.7 | Paints with mercury | y |
| | 5.5.8 | Cosmetics and related products with mercury | y |
| **5.6** | | **Source category: Other intentional product/process use** | |
| | 5.6.1 | Dental mercury-amalgam fillings (b | y |
| | 5.6.2 | Manometers and gauges with mercury | y |
| | 5.6.3 | Laboratory chemicals and equipment with mercury | y |
| | 5.6.4 | Mercury metal use in religious rituals and folklore medicine | y |
| | 5.6.5 | Miscellaneous product uses, mercury metal uses, and other sources | y |
| **5.7** | | **Source category: Production of recycled metals ("secondary" metal production)** | |
| | 5.7.1 | Production of recycled mercury ("secondary production") | n |
| | 5.7.2 | Production of recycled ferrous metals (iron and steel) | y |
| | 5.7.3 | Production of other recycled metals | y |
| **5.8** | | **Source category: Waste incineration*3** | |
| | 5.8.1 | Incineration of municipal/general waste | y |
| | 5.8.2 | Incineration of hazardous waste | y |
| | 5.8.3 | Incineration of medical waste | y |
| | 5.8.4 | Sewage sludge incineration | y |
| | 5.8.5 | Informal waste burning | y |
| **5.9** | | **Source category: Waste deposition/landfilling and wastewater treatment** | |

| Category Number | Sub-Category Number | Source category | Exists? (y/n/?) |
|---|---|---|---|
| | 5.9.1 | Controlled landfills/deposits | y |
| | 5.9.2 | Diffuse disposal under some control | - |
| | 5.9.3 | Informal local disposal of industrial production waste | y |
| | 5.9.4 | Informal dumping of general waste | y |
| | 5.9.5 | Wastewater system/treatment | y |
| **5.10** | | **Source category: Crematoria and cemeteries** | |
| | 5.10.1 | Crematoria/cremation | y |
| | 5.10.2 | Cemeteries | y |
| | | | |

### 2.1.2. Summary of mercury inputs to society

The inventory of Mercury inputs to society (South Africa) was developed using the "Toolkit for Identification and Quantification of Mercury Releases (version 2015)" made available by the Chemicals Branch of the United Nations Environment Programme (UNEP Chemicals). More specifically, the team applied Toolkit's Inventory Level 2. The toolkit method is based on mass balances for each mercury release source type. The UNEP Toolkit level II requires two principal parameters in the calculation of Mercury inputs to society. These are **(i) activity rates and (ii) input factors**.

**Activity rates:** Activity rates were obtained from various reports, databases and websites, including the South African Waste Information Centre (SAWIC), Statistic SA, Department of Mineral Resources of South Africa (DMRSA), South African Revenue Services (SARS), UN Comtrade, United State Geological Survey (USGS) report, International Energy Association (IEA) and others.

**Input factors:** With respect to input factors, previously determined factors found in various reports were used. In some cases, the input factors were determined in samples using recognized analytical methods. In cases where information was not available and laboratory analysis were not undertaken, default values provided in the UNEP toolkit were used.

Using activity rates and input factors, Mercury inputs to society from various sources were determined. A summary of Mercury inputs to South African society is provided in Table 4. These Mercury inputs to society should be understood as the mercury amounts made available for potential releases through economic activity in the country.

**Table 4: Summary of Mercury inputs to society**

| Category | Sub-Category | Source category | Calculated. Hg input to society | Percentage of Total |
|---|---|---|---|---|
| **5.1** | | **Source category: Extraction and use of fuels/energy sources** | **38080** | **48.2** |
| | 5.1.1 | Coal combustion in power plants | 36563 | 46.3 |
| | 5.1.2 | Other coal use | 469 | 0.6 |
| | 5.1.3 | Mineral oils - extraction, refining and use | 48 | 0.1 |
| | 5.1.4 | Natural gas - extraction, refining and use | 650 | 0.8 |
| | 5.1.5 | Other fossil fuels - extraction and use | 0 | 0.0 |
| | 5.1.6 | Biomass fired power and heat production | 350 | 0.4 |
| | 5.1.7 | Geothermal power production | 0 | 0.0 |
| **5.2** | | **Source category: Primary (virgin) metal production** | **12894** | **16.3** |
| | 5.2.1 | Mercury (primary) extraction and initial processing (a | 0 | 0.0 |
| | 5.2.2 | Gold (and silver) extraction with mercury amalgamation processes | 6654 | 8.4 |
| | 5.2.3 | Zinc extraction and initial processing | 340 | 0.4 |
| | 5.2.4 | Copper extraction and initial processing | 93 | 0.1 |
| | 5.2.5 | Lead extraction and initial processing | 479 | 0.6 |
| | 5.2.6 | Gold extraction and initial processing by methods other than mercury amalgamation | 1 390 | 1.8 |
| | 5.2.7 | Aluminium extraction and initial processing | 1518 | 1.9 |
| | 5.2.8 | Other non-ferrous metals - extraction and processing | 2350 | 3.0 |
| | 5.2.9 | Primary ferrous metal production | 70 | 0.1 |
| **5.3** | | **Source category: Production of other minerals and materials with mercury impurities** | **803** | **1.0** |
| | 5.3.1 | Cement production | 650 | 0.8 |
| | 5.3.2 | Pulp and paper production | 153 | 0.2 |
| | 5.3.3 | Production of lime and light weight aggregates | 0 | 0.0 |
| **5.4** | | **Source category: Intentional use of mercury in industrial processes** | **0** | 0.0 |
| | 5.4.1 | Chlor-alkali production with mercury-technology | 0 | 0.0 |
| | 5.4.2 | VCM production with mercury catalyst | 0 | 0.0 |
| | 5.4.3 | Acetaldehyde production with mercury catalyst | 0 | 0.0 |
| | 5.4.4 | Other production of chemicals and polymers with mercury | 0 | 0.0 |
| **5.5** | | **Source category: Consumer products with intentional use of mercury** | **11575** | **14.6** |
| | 5.5.1 | Thermometers with mercury | 100 | 0.1 |
| | 5.5.2 | Electrical switches and relays with mercury | 6731 | 8.5 |
| | 5.5.3 | Light sources with mercury | 1097 | 1.4 |
| | 5.5.4 | Batteries with mercury | 3647 | 4.6 |

| Category | Sub-Category | Source category | Calculated. Hg input to society | Percentage of Total |
|---|---|---|---|---|
| | 5.5.6 | Biocides and pesticides with mercury | 0 | 0.0 |
| | 5.5.7 | Paints with mercury | 0 | 0.0 |
| | 5.5.8 | Cosmetics and related products with mercury | 0 | 0.0 |
| **5.6** | | **Source category: Other intentional product/process use** | **4346** | **5.5** |
| | 5.6.1 | Dental mercury-amalgam fillings (b | 1702 | 2.2 |
| | 5.6.2 | Manometers and gauges with mercury | 240 | 0.3 |
| | 5.6.3 | Laboratory chemicals and equipment with mercury | 2404 | 3.0 |
| | 5.6.4 | Mercury metal use in religious rituals and folklore medicine | 0 | 0.0 |
| | 5.6.5 | Miscellaneous product uses, mercury metal uses, and other sources | 0 | 0.0 |
| **5.7** | | **Source category: Production of recycled metals ("secondary" metal production)** | **1594** | **2.0** |
| | 5.7.1 | Production of recycled mercury ("secondary production") | 0 | 0.0 |
| | 5.7.2 | Production of recycled ferrous metals (iron and steel) | 1 345 | 1.7 |
| | 5.7.3 | Production of other recycled metals | 249 | 0.3 |
| **5.8** | | **Source category: Waste incineration*3** | **905** | **1.1** |
| | 5.8.1 | Incineration of municipal/general waste | 0 | 0.0 |
| | 5.8.2 | Incineration of hazardous waste | 689 | 0.9 |
| | 5.8.3 | Incineration of medical waste | 71 | 0.1 |
| | 5.8.4 | Sewage sludge incineration | 103 | 0.1 |
| | 5.8.5 | Informal waste burning | 42 | 0.1 |
| **5.9** | | **Source category: Waste deposition/landfilling and wastewater treatment** | **408** | **0.5** |
| | 5.9.1 | Controlled landfills/deposits*3 | 408 | 0.5 |
| | 5.9.2 | Diffuse disposal under some control | 0 | 0.0 |
| | 5.9.3 | Informal local disposal of industrial production waste | 0 | 0.0 |
| | 5.9.4 | Informal dumping of general waste*1*3 | 0 | 0.0 |
| | 5.9.5 | Wastewater system/treatment*2 | 0 | 0.0 |
| **5.1** | | **Source category: Crematoria and cemeteries** | **1250** | **1.6** |
| | 5.10.1 | Crematoria/cremation | 125 | 0.2 |
| | 5.10.2 | Cemeteries | 1 125 | 1.4 |
| **SUM OF QUANTIFIED RELEASES** | | | **77908** | **100.0** |
| **SUM OF QUANTIFEIED INPUT TO SOCIETY** | | | **70825** | **90.9** |

**Notes:**

1. The estimated quantities include mercury in products which has also been accounted for under each product category. To avoid double counting, the release to land from informal dumping of general waste has been subtracted automatically in the TOTALS.
2. To avoid double counting of mercury inputs from waste and products in the input TOTAL, only 10% of the mercury input to waste incineration sources, waste deposition and informal dumping is included in

the total for mercury inputs. These 10% represent approximately the mercury input to waste from materials which were not quantified individually in Inventory Level 1 of this Toolkit.

3. 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.

The table 4 above shows that the total Hg released from the various categories is **77 908 kg per annum**. Extraction and use of fuel (energy sources) and primary (virgin) metal production are the top contributors to environmental releases of Mercury. Specifically, the results indicated that **48.9 %** of Mercury came from extraction and use of fuel/energy resources; **16.6 %** from primary metal production (mainly through ASGM which is an illegal activity); **5.6 %** from other intentional product/process uses; **15.1 %** from consumer products and **< 5%** for each of the remaining sectors.

The total Mercury inputs to society was estimated at **70 825 kg Hg/yr**. The difference between total Mercury releases and Mercury input to society is that while the latter considered all releases, the former assumes that some of the mercury released does not enter the environment and therefore only what enters the environment is considered as an input to society.

There were challenges in obtaining certain type of information required for the inventory. This included information on informal open dumping of waste (general and industrial) and releases from wastewater treatment activities. Nonetheless, in a separate research (Augmentation report), informal open burning of waste that is not collected by municipalities was taken into consideration. It was assumed that all waste that is not collected by municipality is burnt, as an attempt by residents to avoid odours and accumulation.

There were also challenges in obtaining information from industries regarding the use of mercury in paints and production of lime and light weight aggregates. The challenge also lied in the misconception held by industries that causes them to believe that by providing information to government, they are encouraging the development of legislation. Lastly, there were challenges in obtaining information on religious rituals and folklore medicine due to the informal nature of the sector. These remain challenges that South Africa needs to resolve through awareness raising going forward.

***It is important to note that this was an initial assessment of Mercury in South Africa; hence there are some limitations in terms of the data collected. In particular, the following should be noted with the South African Mercury inventory***:

*Mercury in cosmetics:* In South Africa, the Food, Drugs and Cosmetics Act prohibits the use of Mercury in cosmetics. The possibilities are that cosmetic products that contain mercury enters the country though illegal means and through online trading platforms. Although samples collected from some cosmetics indicated the presence of Mercury, it is not clear where such cosmetics are manufactured nor their true origin. Preliminary assessment based on the product labels suggests that these cosmetics are originating in South Africa, India, England, Pakistan, Italy, Nigeria, China, Congo etc. There is a high possibility that these are illicit cosmetics.

*Coal fired power plants:* It is not clear the mass balance of mercury. Local power utilities need to undertake mass balance and speciation assessments based on plant-specific data. This is because, during the coal combustion process, the Mercury (Hg) speciation changes from pure mercury ($Hg^0$) vapour in the boiler furnace zone. As it exits the furnace, halogens such as Chlorides (Cl) and Bromides (Br) which are also present in the flue gas stream interact with the unburnt carbon to create the site for the oxidation of the $Hg^0$. Additionally, sulphur contributes to the oxidation of mercury. The degree that mercury can be oxidised (or subsequent speciation) has a direct effect on the degree of mercury capture co-benefit. The formation of particle-bound mercury $Hg^p$ with fly ash and unburned carbon can occur before the conversion of elemental mercury to $HgCl_2$, $HgBr_2$, $HgSO_4$ etc, further downstream, as the flue gas stream leaves the air preheater. The $Hg^P$ can be is collected in the fly ash at the particulate abatement control plant. If there is an FGD after the particulate abatement control plant, part of the Hg0 converts to Mercurous Ion ($Hg^{2+)}$ which is retained in the FGD-scrubber solution/solids. The remaining Hg0 is emitted through the stack. Similarly, the boiler bottom ash has a mixture $Hg^0$, Hg-P and $Hg^{2+.}$ As such the rate on conversion across the flow path described above varies from plant to plant.

### 2.1.3. Summary of mercury releases

From Mercury inputs to society above, Mercury releases to each environmental media were calculated. According to the UNEP Mercury Inventory toolkit, mercury releases are defined as

emissions to air (the atmosphere), water (marine and freshwater bodies, including via wastewater systems), land, general waste and, sector-specific wastes (e.g. waste treatment). An additional output pathway is “by-products and impurities” which implies Mercury flow back into the market with by-products and products where Mercury does not play an intentional role. Table 5 below shows the Toolkit results of Mercury releases to different pathways or environmental media for each of the Mercury sources accounted for in this inventory.

**Table 5: Mercury releases to different pathways/environmental media**

| C | Sub-C | Source category | Calculated. Hg input to society | Calculated Hg output, Per Medium Kg/y | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Air | Water | Land | By-pro-ducts and impurities | General waste | Sector specific treatment /disposal |
| **5.1** | | **Source category: Extraction and use of fuels/energy sources** | | | | | | | |
| | 5.1.1 | Coal combustion in power plants | **36563** | 18096 | 180 | 0 | 0 | 0.0 | 18288 |
| | 5.1.2 | Other coal use | 469 | 468 | 0 | 0 | 0 | 0 | 1 |
| | 5.1.3 | Mineral oils - extraction, refining and use | 48 | 36 | 5 | 0 | 0 | 0 | 7 |
| | 5.1.4 | Natural gas - extraction, refining and use | 650 | 130 | 130 | 0 | 325 | 0 | 65 |
| | 5.1.5 | Other fossil fuels - extraction and use | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 5.1.6 | Biomass fired power and heat production | 350 | 350 | 0 | 0 | 0 | 0 | 0 |
| | 5.1.7 | Geothermal power production | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **5.2** | | **Source category: Primary (virgin) metal production** | | | | | | | |
| | 5.2.1 | Mercury (primary) extraction and initial processing (a | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 5.2.2 | Gold (and silver) extraction with mercury amalgamation processes | **6654** | 4991 | 865 | 799 | 0 | 0 | 0 |
| | 5.2.3 | Zinc extraction and initial processing | 340 | 68 | 136 | 136 | 0 | 0 | 0 |
| | 5.2.4 | Copper extraction and initial processing | 93 | 84 | 0 | 0 | 0 | 0 | 9 |
| | 5.2.5 | Lead extraction and initial processing | 479 | 431 | 0 | 0 | 0 | 0 | 48 |
| | 5.2.6a | Gold extraction and initial processing by methods other than mercury amalgamation | 1390 | 56 | 28 | 1251 | 56 | 0 | 0 |
| | 5.2.7 | Aluminium extraction and initial processing | 1518 | 228 | 152 | 0 | 0 | 987 | 152 |
| | 5.2.8 | Other non-ferrous metals - extraction and processing | **2350** | 2350 | 0 | 0 | 0 | 0 | 0 |
| | 5.2.9 | Primary ferrous metal production | 70 | 67 | 0 | 0 | 0 | 0 | 4 |
| **5.3** | | **Source category: Production of other minerals and materials with mercury impurities** | | | | | | | |
| | 5.3.1 | Cement production | **650** | 390 | 0 | 0 | 130 | 0 | 130 |
| | 5.3.2 | Pulp and paper production | 153 | 138 | 0 | 0 | 0 | 15 | 0 |
| | 5.3.3 | Production of lime and light weight aggregates | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **5.4** | | **Source category: Intentional use of mercury in industrial processes** | | | | | | | |
| | 5.4.1 | Chlor-alkali production with mercury-technology | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 5.4.2 | VCM production with mercury catalyst | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 5.4.3 | Acetaldehyde production with mercury catalyst | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 5.4.4 | Other production of chemicals and polymers with mercury | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **5.5** | | **Source category: Consumer products with intentional use of mercury** | | | | | | | |
| | 5.5.1 | Thermometers with mercury | **100** | 10 | 30 | 0 | - | 30 | 30 |
| | 5.5.2 | Electrical switches and relays with mercury | **6731** | 673 | 0 | 673 | - | 5385 | 0 |
| | 5.5.3 | Light sources with mercury | **1097** | 55 | 0 | 0 | - | 1042 | 0 |
| | 5.5.4 | Batteries with mercury | **3647** | 912 | 0 | 912 | - | 1823 | 0 |
| | 5.5.6 | Biocides and pesticides with mercury | 0 | 0 | 0 | 0 | - | 0 | 0 |
| | 5.5.7 | Paints with mercury | 0 | 0 | 0 | 0 | - | 0 | 0 |
| | 5.5.8 | Cosmetics and related products with mercury | 151 | 7 | 3 | 67 | - | 67 | 7 |
| **5.6** | | **Source category: Other intentional product/process use** | | | | | | | |
| | 5.6.1 | Dental mercury-amalgam fillings (b | **1702** | 33 | 768 | 134 | 100 | 334 | 334 |
| | 5.6.2 | Manometers and gauges with mercury | **240** | 24 | 72 | 0 | 0 | 144 | 0 |
| | 5.6.3 | Laboratory chemicals and equipment with mercury | **2404** | 0 | 793 | 0 | 0 | 793 | 817 |

| C | Sub-C | Source category | Calculated. Hg input to society | Calculated Hg output, Per Medium Kg/y | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 5.6.4 | Mercury metal use in religious rituals and folklore medicine | **0** | 0 | 0 | 0 | 0 | 0 | 0 |
| | 5.6.5 | Miscellaneous product uses, mercury metal uses, and other sources | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **5.7** | | **Source category: Production of recycled metals ("secondary" metal production)** | | | | | | | |
| | 5.7.1 | Production of recycled mercury ("secondary production") | 0 | 0 | 0 | 0 | - | 0 | 0 |
| | 5.7.2 | Production of recycled ferrous metals (iron and steel) | **1345** | 444 | 0 | 457 | 0 | 444 | 0 |
| | 5.7.3 | Production of other recycled metals | **249** | 75 | 25 | 0 | 0 | 75 | 75 |
| **5.8** | | **Source category: Waste incineration*3** | | | | | | | |
| | 5.8.1 | Incineration of municipal/general waste | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 5.8.2 | Incineration of hazardous waste | 689 | 689 | 0 | 0 | 0 | 0 | 0 |
| | 5.8.3 | Incineration of medical waste | 71 | 64 | 0 | 0 | 0 | 0 | 7 |
| | 5.8.4 | Sewage sludge incineration | 103 | 93 | 0 | 0 | 0 | 0 | 10 |
| | 5.8.5 | Informal waste burning | **42** | 42 | 0 | 0 | 0 | 0 | 0 |
| **5.9** | | **Source category: Waste deposition/landfilling and waste water treatment** | | | | | | | |
| | 5.9.1 | Controlled landfills/deposits*3 | 408 | 404 | 4 | 0 | 0 | 0 | 0 |
| | 5.9.2 | Diffuse disposal under some control | 0 | - | - | - | - | - | - |
| | 5.9.3 | Informal local disposal of industrial production waste | 0 | 0 | 0 | 0 | - | - | - |
| | 5.9.4 | Informal dumping of general waste*1*3 | **0** | 0 | 0 | 0 | - | - | - |
| | 5.9.5 | Waste water system/treatment*2 | **0** | 0 | 0 | 0 | 0 | 0 | 0 |
| **5.10** | | **Source category: Crematoria and cemeteries** | | | | | | | |
| | 5.10.1 | Crematoria/cremation | 125 | 125 | 0 | 0 | - | 0 | 0 |
| | 5.10.2 | Cemeteries | 1125 | 0 | 0 | 1125 | - | 0 | 0 |
| **SUM OF QUANTIFIED INPUTS AND RELEASES *1*2*3*4** | | | **70825** | **31530** | **3191** | **5553** | **610.7** | **11139.5** | **19983** |

The amount of mercury released through the major output pathways is summarized in  to Figure 9. The figures show the highest contributing sources to air, water, land, by-product/waste and sector specific releases.

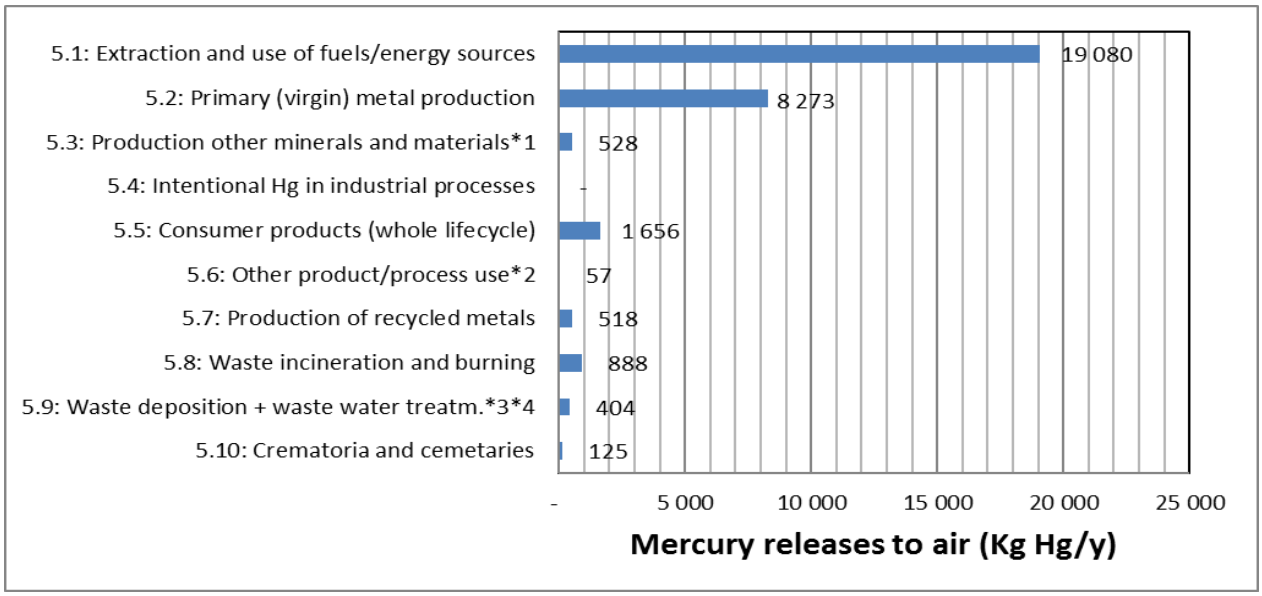



***Figure 4: Summary of estimated mercury releases to air***

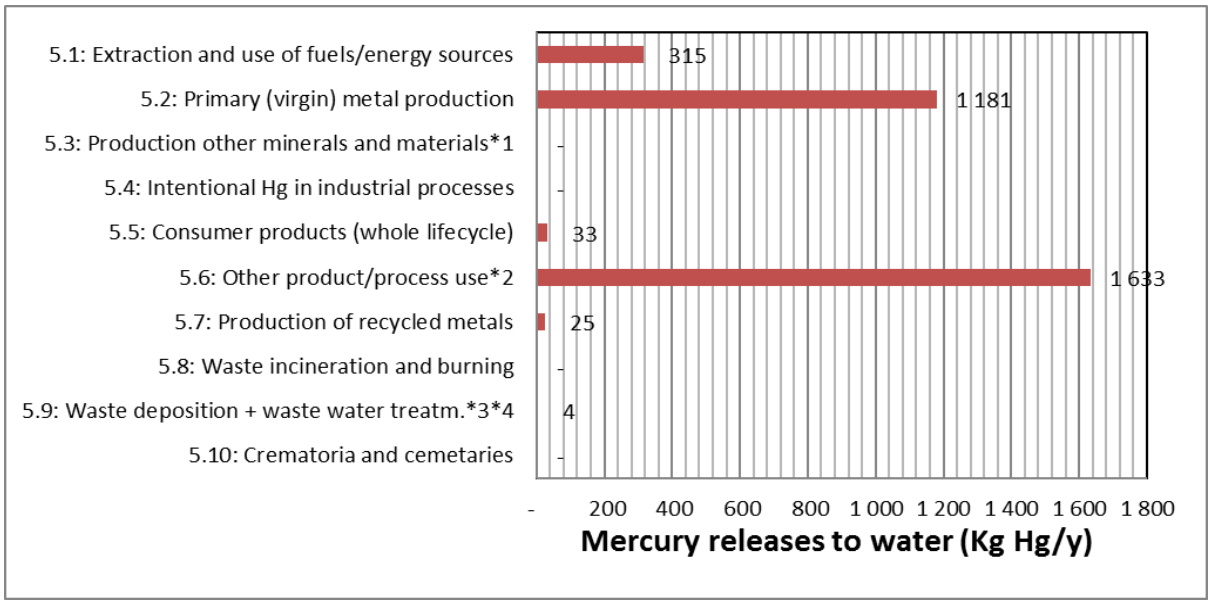



***Figure 5: Summary of estimated mercury releases to water***

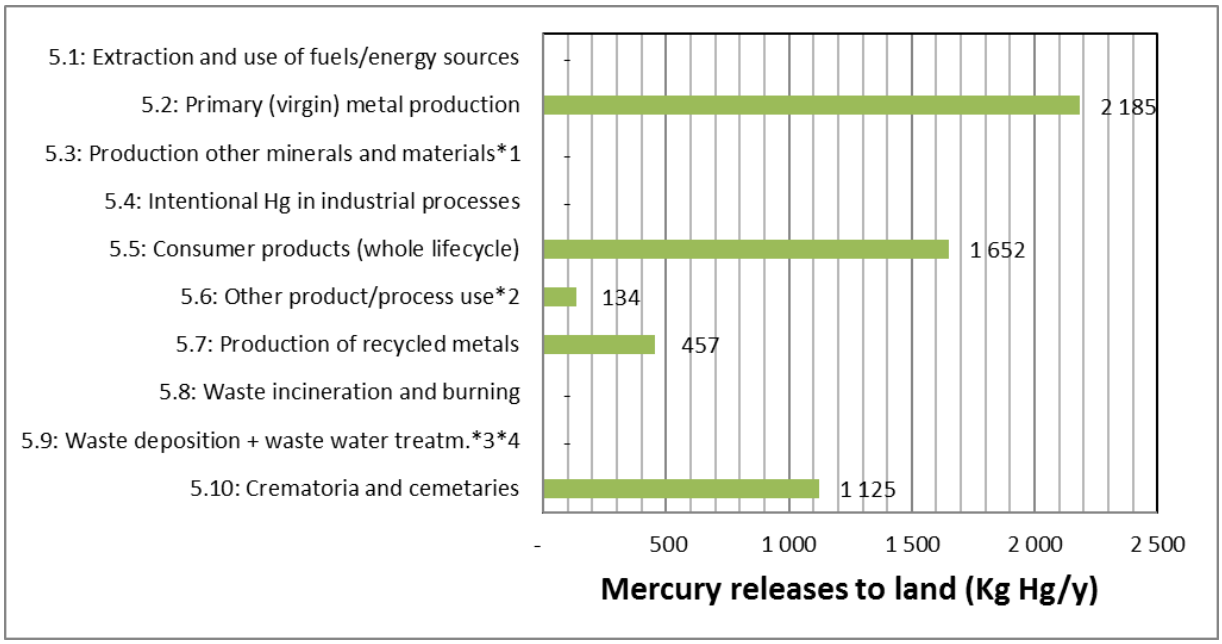



**Figure 6: Summary of estimated mercury releases to land**

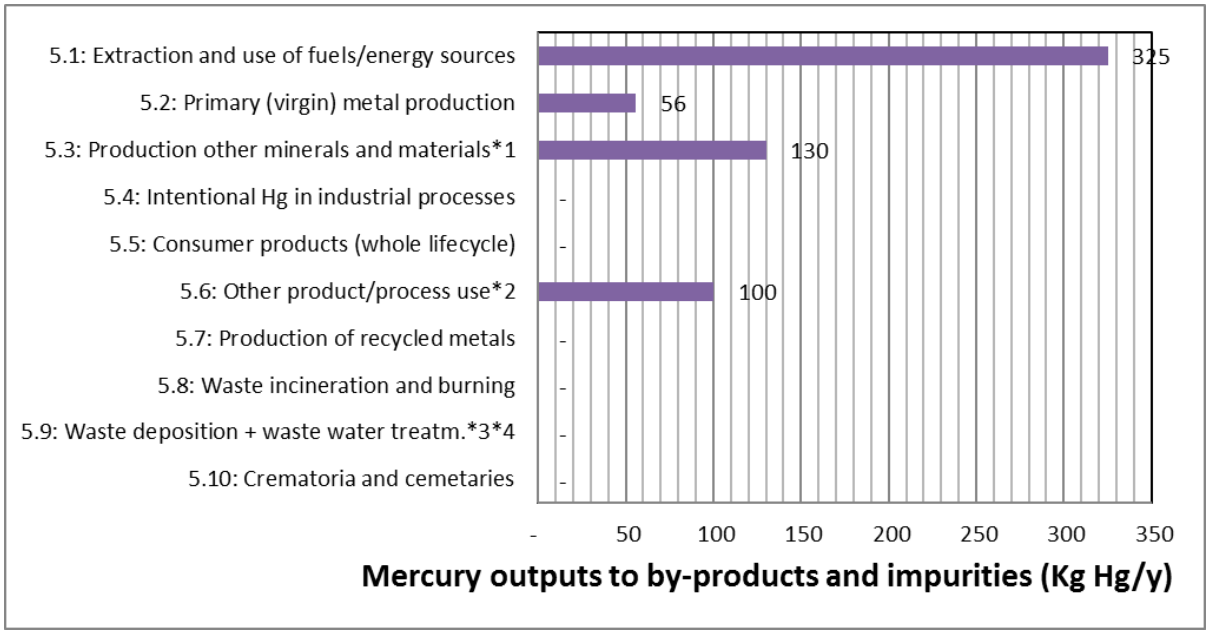



**Figure 7: Summary of estimated mercury releases to by-product and impurities**

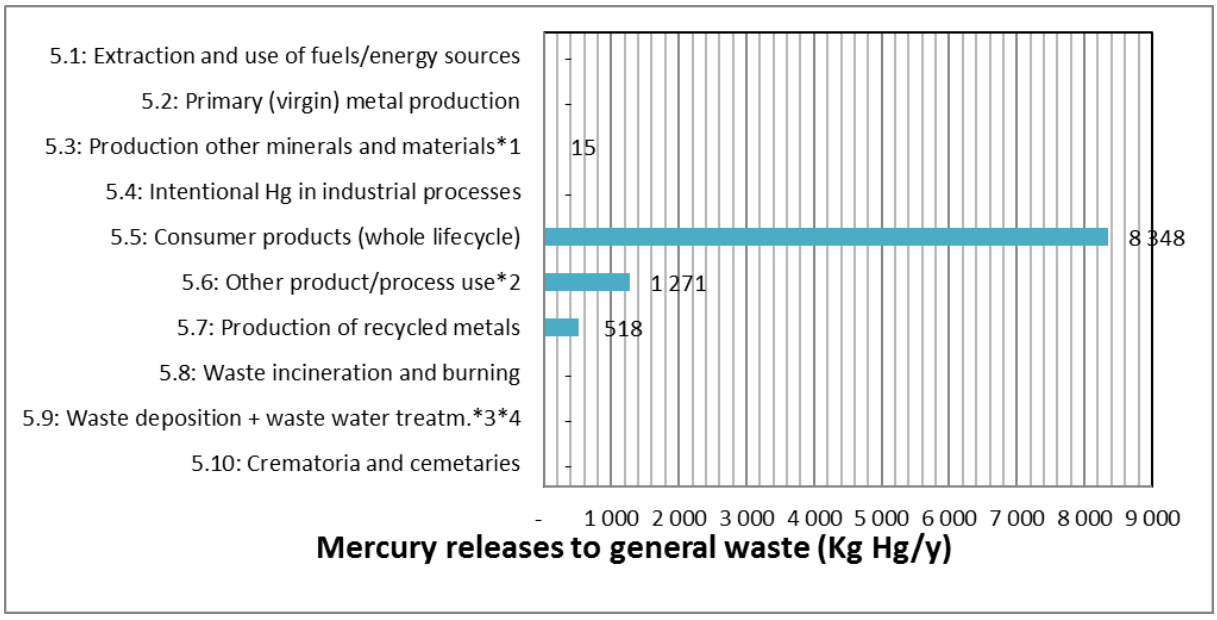



**Figure 8: Executive summary of estimated mercury releases to general waste**

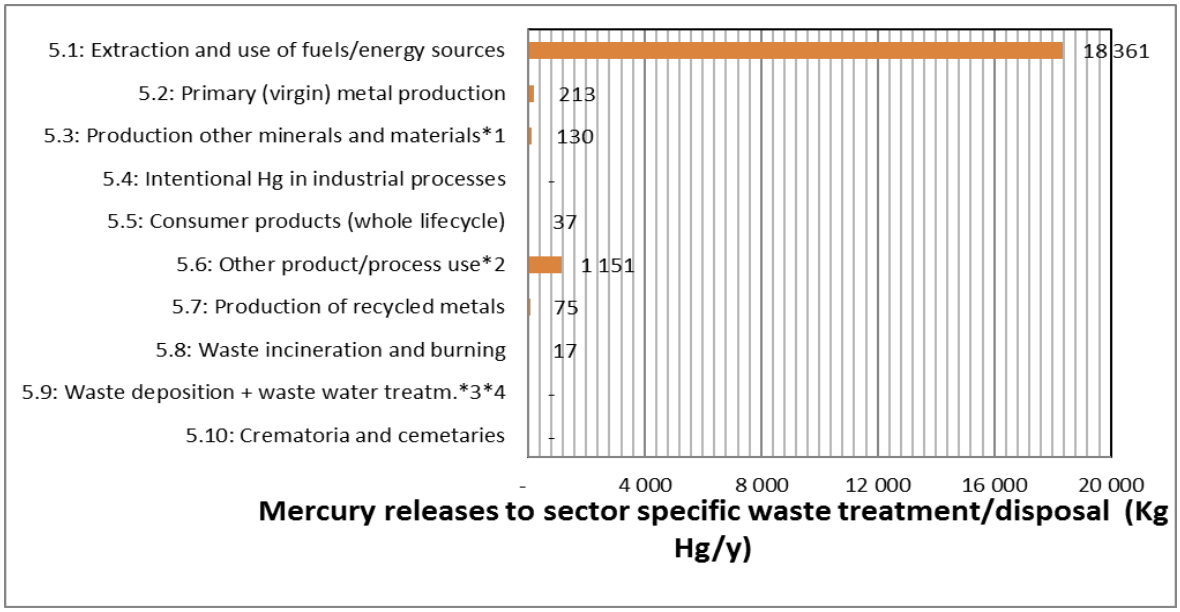



**Figure 9: Executive summary of estimated mercury releases to sector specific waste treatment/disposal**

### 2.1.4. Summary of mercury stockpiles, supply and trade

#### a) Stocks and stockpiles

The MIA for South Africa identified some of the companies that holds stocks of Mercury for re-sale, as by-product of their process or for use in product manufacturing. Information on the type (and in some cases amount) of mercury stocks held is summarized in paragraphs below.

**Mercury stocks for re-sale:** Personal communication with one of the re-sellers of Mercury suggests that there are approximately five resellers of Mercury in the country. These resellers sell Mercury to South Africa's neighboring countries. The contacted person indicates that the five resellers in total may be re-selling approximately 5000 kg Hg/yr.

**Mercury stocks from recycling activities:** there are two main recyclers of fluorescent lamps in South Africa. Representatives of these recyclers reported that there is approximately 1050 kg/y of Mercury (combined with phosphate powder in the lamps) that is recovered from the recycling process.

**Mercury stockpiles from e-waste recycling:** South Africa has over 100 recyclers of e-waste (used computers, cellphones, etc.). These facilities process 45 000 tons (or 45 000 000 kg) of e-waste per year. Using this number and emission factor of 0,22 g/kg e-waste[1], it was estimated that the 990 kgHg/y could be released as stockpile from e-waste (assuming that Hg is extracted).

**Mercury stockpiles at historical chlor-alkali production plant:** South Africa has a history of chlor-alkali production. Thor Chemicals South Africa has historically produced chlor-alkali, using high volumes of Mercury in its production. Although the facility was closed in 1996-1998, it is speculated that 3000 tons of Hg is still stocked at the facility.

Stocks of Mercury for use in industrial processes: According to ITC Trade MAP website, there are South African companies that are importing Mercury and their names are listed in the website. Although the extent to which the list of companies is up to date cannot be ascertained, it is clear that most of these companies are the chemicals manufacturing sector.

[1] According to Ari (2016), and LED computer (a typical component of electronic waste) contain 0.693g per computer which weighs 31kg

Efforts to contact these companies for information on the quantities and use of Mercury has not been fruitful.

Further efforts need to be taken to understand the use of Mercury by companies that import Mercury for use in manufacturing processes (i.e. for manufacturing of mercury-added products and use in industrial processes). This is important because this companies will, at any given time, keep stocks of mercury that is not properly managed can cause contamination.

### a) Supply and trade

South Africa does not undertake any primary mining of Mercury. Therefore, in the supply chain, Mercury enters the country through trade of elemental mercury, mercury compounds (Mercury Sulphate and Mercury Dichloride) and as a component of Mercury-added products. The amount of elemental Mercury and Mercury compounds imported in and exported out of the country was obtained from the South African Revenue Services (SARS) trade statistics and from UN Comtrade. The results are shown in the Table 6 and

**Table 7** below.

| | 2016 | | 2017 | | 2018 | |
|---|---|---|---|---|---|---|
| **Product** | **Imports (kg)** | **Exports (Kg)** | **Imports (kg)** | **Exports (Kg)** | **Imports (kg)** | **Exports (Kg)** |
| Mercury-sulphate – (2852) | Not reported | Not reported | **48 504** | **383 947** | 48 493 | 173 611 |
| Mercury-dichloride (inorganic mercury) (285290) | Not reported | Not reported | **48 046** | **199 334** | 47 682 | 6 279 |

**Table 6: Mercury imports and exports for South Africa (SARS trade statistics)**

| Year | Mercury Imports (kg) | Mercury Exports (Kg) |
|---|---|---|
| 2010 | 5 582 | 178 |
| 2011 | 7 976 | 744 |
| 2012 | 39 534 | 2 213 |
| 2013 | 32 283 | 2 318 |
| 2014 | 28 089 | 1 445 |
| 2015 | 29 660 | 212 |
| 2016 | 36 202 | 341 |
| 2017 | 13 111 | 17 643 |
| **2018** | **23701** | **191** |

**Table 7: Annual imports and exports of Mercury compounds in South Africa (UN Comtrade)**

| | 2016 | | 2017 | | 2018 | |
|---|---|---|---|---|---|---|
| **Product** | **Imports (kg)** | **Exports (Kg)** | **Imports (kg)** | **Exports (Kg)** | **Imports (kg)** | **Exports (Kg)** |
| Mercury-sulphate – (2852) | Not reported | Not reported | **48 504** | **383 947** | 48 493 | 173 611 |
| Mercury-dichloride (inorganic mercury) (285290) | Not reported | Not reported | **48 046** | **199 334** | 47 682 | 6 279 |

The above data shows that the quantities of elemental Mercury imported into the country fluctuates on year to year. As such, one cannot deduce either an increase or decrease in Mercury imports and exports. There is also a consistent supply of Mercury compounds in the form of Mercury Sulphate and Mercury Dichloride. The companies involved in the exports and imports of these products were not found and as such remain unknown.

## 2.2. Identified hot-spots of mercury contamination

Article 12 of the Minamata Convention on Mercury encourages parties to develop appropriate strategies for identifying and assessing sites contaminated by Mercury or Mercury compounds. Parties are also encouraged to take actions to reduce environmental and human health risks posed by such sites; and cooperate in developing strategies and implementing activities for identifying, assessing, prioritizing, managing and, as appropriate, remediating contaminated sites.

At the time of compiling this report, the parties to the Convention had not yet finalised the guidance for contaminated sites. However, South Africa has identified potential contaminated sites using the guidance provided in IPEN (2016). IPEN (2016) proposes that suspected contaminated sites may be identified without specialised technical equipment by the following means:

a) Visual observation of the site conditions or attendant contaminant sources;
b) Visual observation of manufacturing or other operations known to have used or emitted Mercury;
c) Observed adverse effects in humans, flora, or fauna presumably caused by the proximity to the site;
d) Physical (e.g. pH) or analytical results showing contaminant levels; and

e) Reports from the community to the authorities of suspected releases.

For the purpose of this MIA, information on contaminated sites was obtained from the National Contaminated Land Register by the DEA. This is a register maintained by the DEA of all areas that are known to contaminated by either Mercury alone or Mercury in conjunction with other chemicals.

In addition to the data provided in the DEA contaminated land register, other facilities that may have contamination were identified based on analytical results of samples collected from environmental media and biota. The investigation enabled the compilation of the list of Mercury contaminated sites as shown in Table 8 to Table 9 below. See figure E-2 (executive summary for locations of the sites). It is important to note that in some cases the contamination is as a result of a combination of mercury and other chemicals.

**Table 8: List of potentially contaminated sites (hotspots) as per National Contaminated Land Register**

| Site location | Nature and origin of contamination |
|---|---|
| Umbogintwini Industrial Complex, Wharhirst Road, Athlone Park, Amanzimtoti, KwaZulu Natal | Soil contamination Mercury and other contaminants due to historical spillages. |
| AECI and/or subsidiaries and or state and other third parties, AECI Place | PCE, TCE, phthalates, hexachlorobutadiene, VC, mercury, arsenic |
| AECI and/or subsidiaries and or state AECI PLACE | Lime based sludge and waste material (approx. 5 million te). Main COC's are chlorinated ethenes (tetrachloroethene (PCE), trichloroethene (TCE) and daughter products 1,2-dichloroethene (DCE) and vinyl chloride (VC), aluminium, mercury, lead, manganese, atrazine, diazinon and hexachlorobutadiene. Co-disposed with lime waste. |
| AECI and/or subsidiaries and or state AECI PLACE | Mercury and lime-based sludge and waste (approximately 2500m3) |
| Cato Ridge, Durban | Mercury contamination from historical Chlor Alkali Production |
| Shongweni Landfill Site | Possible contamination due to disposal of Mercury waste. |
| Sasol Midland Site (Recent reports suggest that the site has been remediated) | VCM production |

**Table 9: List of potentially contaminated sites (hotspots) associated with historical gold mining**

| Location/site | Nature of contamination | Source |
|---|---|---|
| New Union Gold Mine | Samples collected from tailings A & B and nearby streams showed concentrations between 161.8 to 1999.1 µg/g dry weights.<br>These are above the Soil Screening Values for Mercury set in the South African Norms and Standards for Contaminated Land and Soil Quality. | Nembilwi et al, 2016 |
| Other historical gold mine slime dams in the Witwatersrand region | Dust samples collected from areas near Mine dumps (e.g. Soweto) had high levels of Mercury ranging from 0.500 to 1.349 µg/g, with a mean of 0.687 µg/g. | Cukrowska et al., 2017 |

**Table 10: List of potentially contaminated sites (hotspots) associated with ASGM**

| Location/site | Nature of contamination | Source/Notes |
|---|---|---|
| Nkomati area, Mpumalanga | Various reports (Walters, 2011; Oostheizen, 2010) have shown elevated levels of Mercury in sediments and human samples (see section 2.1). They attributed this to ASGM. Hence, there is a reason to believe there is contamination since these activities are informal, with no control or measures to safeguard the spillage of mercury. | Walters, 2011; Oostheizen, 2010 |
| Goldreefs, Johannesburg | According to the Mercury inventory Level 2 study, artisanal gold mining activities are existing in the Gold reefs. Hence, there is a reason to believe there is contamination since these activities are informal, with no control or measures to safeguard the spillage of mercury. | DEA, 2018 |

As indicated, the lists above present *potentially* contaminated sites. Further assessments still need to be done in order to confirm the contamination and the concentrations thereof. Direct screening sampling (soil, water and air) at these suspected contaminated sites can be done at these sites. Following such sampling, laboratory analysis of Mercury content can be done in comparison with the set standard(s) to confirm contamination. It is only after the degree of contamination is confirmed that the remedial action plans can commence.

## 2.3. Data and inventory on extraction and use of fuels/energy sources

The major sources of Mercury in South Africa in the extraction and use of fuel category include coal mining and processing, use of coal in power stations, ferrochrome smelters, synthetic fuel production by Fischer Tropsch, use of gas turbine in power generation and other uses such as small boiler heating in industrial operations, hospitals and prisons. In these processes, coal is used as a source of fuel causing Mercury releases. South Africa uses mainly two types of coals namely bituminous and anthracite coals. The power stations and the synthetic fuel sectors use mainly bituminous coal of varying grades, while the iron and steel sector use anthracite coal. Coal combustion is regarded as one of the most important Hg sources South Africa.

### 2.3.1. Subcategory: coal combustion in power plants

**Activity rate:** Activity data for coal combustion in power plants was obtained from Eskom (primary power utility in South Africa), other power stations and Sasol reports. From this data it was estimated that approximately 77 Million Tonnes/year of washed and unwashed coal is used/consumed in South Africa for power generation.

**Input factor:** Because of the diversity of coal quality used by the power stations which come from coal fields from different geological formations in South Africa, different input factors were used. For coal used by Eskom power stations, the input factors, 0.13-0.24 g Hg/ton (bitmous) were used to calculate the mercury input from each power station. Input factors of (0.15 g Hg/ton of coal (washed anthracite - mainly exported and used in steel industry) was used. Specific input factor of 0.045 g Hg/ton of coal was used for coal washing (contributing only to leachate during washing) was used. Specific input factor of 0.105 g Hg/ton (washed coal used in South Africa) was used.

The above values were applied to the UNEP toolkit and the estimated Mercury input from coal combustion was **36 563 kg/yr**.

### 2.3.2. Subcategory: Other coal use (Coke production/combustion/sub-bitomous coal)

**Activity rate**: According to IEA energy report, South Africa produces on average 3 Mt/yr of coke. Of this, 80 000 ton/yr is used in the country. The 80 000 ton/yr was used as activity rate for coke combustion.

**Input factor:** The average input factors of 0.15 g Hg/yr for the anthracite combusted in South Africa and 0.232 g Hg/ton for sub-bitomous coal were used.

The above values were applied to the UNEP toolkit and the estimated Mercury input this subcategory amounted to **469 kg Hg/yr**. This is distributed as follows: 468 kg Hg/yr (air) and 1 kg Hg/yr (sector specific).

### 2.3.3. Subcategory: Mineral oils (Extraction, refining and use)

South Africa does not have any crude oil extraction activities. Instead, the country imports all its crude oil requirements and process it 4 refineries across the country to meet 80% of the

country's petroleum requirements (the rest coming from coal gasification process). It is the processing/refining of crude oil at the refineries that contribute to Mercury emission.

**Activity rate**: It was estimated that the country refines 14, 158, 760 ton/yr of crude oil (IEA energy report) and this was used as an activity rate.

**Input factor:** A default input factor of 3.4 mg Hg/ton derived from the Toolkit Level II was used.

The above values were applied to the UNEP toolkit and the estimated Mercury input this subcategory amounted to **48 kgHg/yr.** Distribution into different environmental compartments is as follows: 36.1 kg Hg/yr (air), 4.81 kg Hg/yr (water) and 7.22 kg Hg/yr (sector specific).

### 2.3.4. Subcategory: Natural gas (extraction, refining and use)

**Activity rate**: Raw/pre-cleaned gas activity rate of 6.5 billion $Nm^3$/yr was used as the activity rate. This was derived from converting 5,000 kt of gas (IEA) into $Nm^3$.

**Input factor:** The average default value of 100 ug Hg/$Nm^3$ of gas from the Toolkit was employed.

The above values were applied to the UNEP toolkit and the estimated Mercury input this subcategory amounted to **650 kg/yr**. Distribution into various environmental compartments is as follows: 130 kg Hg/yr (air); 130 kg Hg/yr (water); 325 kg Hg/yr (by-products); and 65 kg Hg/yr (sector specific).

### 2.3.5. Subcategory: Biomass fired power and heat production

**Activity rate:** Activity rates of 6, 454,044 ton/dry weight/yr for biomass fired power station and 661,188 ton/dry weight/yr for charcoal produced were used.

**Input factor:** Default values of 0.0385 g Hg/ton dry weight for biomass fired power generation and 0.154 g Hg/ton dry weight charcoal produced were used.

The above values were applied to the UNEP toolkit and the estimated Mercury input this subcategory amounted to **350 kg Hg/yr.** This is emitted into air only.

### 2.3.6. Summary

The total input from different fuels are as follows: 36,563 kgHg/yr (coal); 469 kgHg/yr (coke), 48 kgHg/yr (oil); 650 kgHg/yr (gas); 248 kgHg/yr (biomass); and 102 kgHg/yr (charcoal). In terms of distribution of Hg into various environmental compartments from coal, the releases of Hg are as follows: 16, 37 kgHg/yr (air); 271.2 kgHg/yr (water); and 19 449.7 kgHg/yr sector specific treatment/disposal). For coke, the distribution is only into the air (696 kgHg/yr). For biomass, the distribution is only into the air (248 kgHg/yr). For charcoal, the distribution is only into the air (102 kg/yr). The distribution into different environmental compartment from oil are a 12 kgHg/yr (air); 0.5 kgHg/yr (water); and 7 kgHg/yr (sector specific). Gas distribution of Hg into various environmental compartments are as follows: 130 kgHg/yr (air); 130 kgHg/yr (water); 325 kgHg/yr (by-products); and 65 kgHg/yr (sector specific). The total Hg releases from this category amounted to 34% of the national releases.

## 2.4. Data and inventory on primary (virgin) metal production

Mercury is an element that is naturally present in metal ores in varying amounts. Mercury that naturally occurs in some gold ore is primarily released into the air during the ore-heating stage of gold extraction. Mining and refinement of metals is the third largest man-made source of mercury emissions.

South Africa is one of the leading world producers of gold. In 2014, gold was recovered from 52 operations, with the industry employing approximately 131 591 people. The metal was recovered mainly from mines exploiting reefs in the Witwatersrand Basin, secondary production (scrap) and from Platinum Group Metals (PGM) and uranium base metal mines as a by-product. Scrap-recovery operations, such as Goldplats reclaim gold from mine waste and play an integral part in the gold value chain. After smelting, which takes place on the larger individual mines, bullion bars containing about 85% gold, 9% silver and 4-5% base metals, are taken to the Rand Refinery (RR) near Johannesburg and processed to either 99.5% or 99.9 % to meet specialized demands from certain industries.

Mercury was once used throughout the world in gold processing. It was employed to assist with the extraction of gold and silver from ore. This process has since been replaced by more efficient and less environmentally damaging techniques such as cyanide leaching in large-

scale and industrial mining. However, since mercury occurs in ores, it is most often released into the environment during crushing and as waste from ore processing. Therefore, the mining of ores is still seen as one of the major sources of emitting mercury into the environment despite the improvements in the abatement techniques and cyanide leaching in the case of gold.

### 2.4.1. Subcategory: Gold extraction (without mercury amalgam)

**Activity rate:** The activity rate used was 27,990, 000 tons of gold ore extracted per year. The activity was back calculated based on the gold production of 152 ton/yr in 2016. The activity rate of 27,990,000 was also used for gold production. An activity rate of 24,960, 000 ton of tailings/yr was used with the input factor, 1.5 g Hg/ton.

**Input factor:** The input factors used for the gold sub-groups were obtained from the gold sector studies. For gold ore extraction, the input factor was 0.05 g Hg/ton of ore extracted. For gold production, the input factor of 0.15 g Hg/ton of ore was used (default). The third input factor used was based on gold extraction by reprocessing of old tailings (1.5 g Hg/ton tailings). The 1.5 g Hg/ton tailings were calculated from the data provided by one of the mines and later applied to calculate the national average.

Using the above figures, the toolkit calculated mercury release from the formal gold sector are: **1,390 kg Hg/yr** (0.05 g Hg/ton of ore input factor); and **4, 169 g Hg/yr** (0.15 g Hg/ton default input factor). The use of default input factor increased the calculated mercury input threefold. The extraction of gold per reprocessing of old tailings produced per calculated mercury input of **37, 008 kg/yr**. The re-mining appears to be a major contributor to mercury releases into the environment.

### 2.4.2. Subcategory: Gold extraction with Mercury amalgam (ASGM)

Artisanal gold mining (ASGM) is one of the major concerns in South Africa and it is a priority for the National Action Plan (NAP) due to the resulting socio-economic and environmental effects caused by the activity. There are many reasons why artisanal and small-scale miners continue to operate within the informal sector. They may lack knowledge of legal requirements and this may be compounded by demanding bureaucratic procedures often required to become and remain a formal operation. Where communities have traditionally

operated outside of the formal sector, they may also be reluctant to be legalised, particularly where there are no obvious incentives to do so and where legalisation involves paying taxes that they would otherwise not pay. A lack of capacity on the part of governments to enforce penalties and to provide the benefits, which should be associated with legalisation, acts as a further disincentive to miners to be legalised.

The common artisanal gold mining (ASGM) in South Africa is in the form of illegal mining of mine pillar and other gold reefs in closed, abandoned and ownerless mines. The participants in ASGM are called “Zama Zamas” which literally means risk/chance takers. The Zama Zamas members are territorial and very media averse. Hence, in this study, some members of the community assisted in information gathering from the Zama Zamas. The information on mercury utilisation and the procedures of ore mining were given orally and, therefore, may not be as reliable. The information collected from the Zama Zamas was used to calculate the approximate amount of mercury released into the air during amalgam burning.

**Activity rate:** According to the Human Rights Commission SA (2014), there are about 39,000 active unregistered artisanal gold miners in South Africa. Activity rate used was based on approximate gold produced by Artisanal Gold Miners (ASGM) sector which was 5 118.8-ton gold/year. (Human Rights Commission on the population of ASGM in South Africa).

**Input factor:** During the course of this study, the investigators managed to get some quantitative data, in terms of gold ore extracted per day per group, the size of groups, the equipment used to process the ore. Ore is collected underground from closed shafts especially on pillars showing rich gold lines. About 9 kg gas cylinders loaded with about 4 kg of ore and still ball (mimicking ball mill in conventional gold processing) are used to crush the ore. The dosage of mercury into the “mini ball mill” made from gas cylinders is between 1 and 2 kg Hg per 4 kg gold ore depending on perceived quality. The mercury used is recycled to reduce input cost. Hence an input factor of 1.6 kg Hg/kg gold produced was estimated from the data which was collected through oral interviews with the miners. From the information gathered, the total amount of gold produced per annum and the amount of mercury released into the atmosphere during the burning of the Au-Hg amalgam was calculated.

Using the above figures and considering the assumption made which is based on the information provided by the Zama Zamas, mercury releases from ASGM were estimated and

ranged from **5,460 to 16,380 kg Hg/yr.** This is a released into air, land and water according to output distribution factors.

### 2.4.3. Subcategory: Zinc extraction and initial processing

**Activity rate:** According to the DMR Economic report (2016), South Africa produces 33,987.5 ton/yr of Zinc. Meanwhile, according to the USGS data for 2014, South African produces 64,574 ton/yr of Zinc concentrate. These values were used as activity rate input to the toolkit i.e. 33,987.5 ton/yr for zinc production and 64,574 ton/yr for zinc concentrate production respectively.

**Input factor:** The input factors used were 10 g Hg/ton of zinc produced (sector report) and 65 g Hg/ton of zinc concentrate produced (reviewer recommended default input factor).

Using the above, the calculated mercury inputs amounted to **340 kg Hg/yr (10 g Hg/ton of Zn produced) and 4, 197 kg Hg/yr (65 g Hg/ton of Zn concentrate)**. The distribution of mercury releases is into air, water, land and sector specific.

### 2.4.4. Subcategory: Copper extraction and initial processing

**Activity rate**: Activity rates of 92,540 ton/yr Cu produced (DMR Mineral Economic Report 2016); and 331,293 ton/yr of Cu concentrate (USGS 2014) were used. It is important to note that Mercury is released as ore is converted to concentrates and as concentrate is converted to pure copper. Hence the use of two activity rates and two input factors.

**Input factor:** Input factors of 1.0 g Hg/ton of Cu produced (Leaner et al 2008) and a default input factor of 30 g Hg/ton of Cu concentrate produced (reviewer recommended default input factor) were employed in the calculation.

Mercury input calculated amounted to **93 kg Hg/yr** using the input factor of 1.0 g Hg/ton obtained from the sector report studies. However, mercury input using the default factor of 30 g Hg/ton of Cu concentrate amounted to **9, 939 kg Hg/yr**. With respect to distribution into different environmental compartments, the releases are into air, water and sector specific.

### 2.4.5. Subcategory: Lead extraction and initial processing

**Activity rate**: Activity rates of 47,893 ton/yr of Pb produced (DMR Mineral Economics Report 2016) and 119,733 ton/yr Pb concentrate (USGS 2014) for the default value of 30 g Hg/ton were used in the calculation.

**Input factor:** Input factors of 10 g Hg/ton of lead produced (Leaner et al 2008) and a default input factor of 30 g Hg/ton of Pb concentrate were used in the toolkit calculation.

Based on the above, the total Mercury releases were estimated at **479 kg Hg/yr** using the sector input factor of 10 g Hg/ton and at 3, 592 kg Hg/yr when using the default input factor of 30 g Hg/ton. The default value gave mercury input eight times higher than the sector input factor of 10 g Hg/ton. The mercury input is distributed into air and sector specific.

### 2.4.6. Subcategory: Other non-ferrous, extraction and processing (Cr, Ni, PGMs etc.)

**Activity rate**: The activity rate of 4,700,000 ton/yr of other non-ferrous extraction and processed metals was used (DMR Mineral Economic Report 2016).

**Input factor**: A factor of 0.5 g Hg/ton (sector report) of non-ferrous, extraction and processing metals was used.

The calculated mercury input amounted to **2,350 kg Hg/yr** using the input factor of 0.5 g Hg/ton. Distribution is into air only.

### 2.4.7. Subcategory: Primary ferrous metals production

**Activity rate**: Activity rate of 1,391,782 ton/yr (DMR Mineral Economic Report 2016) was used.

**Input factor**: An input factor of 0.05 g Hg/ton of pig iron produced was used based on the sector report.

Mercury input of **70 kg Hg/yr** was obtained based on sector input of 0.05 g Hg/ton. However, mercury input of 235 kg Hg/yr was obtained using the USGS 2014 Report of activity rate of 4, 700 ton of pig iron/yr. Mercury releases is into air and sector specific.

### 2.4.8. Subcategory: Aluminium production from bauxite

**Activity rate:** According to the USGS Report (2014) the amount of bauxite used in South Africa was 3, 036,119 ton/yr. This was used as an activity rate in the toolkit calculations.

**Input factor:** An input 0.5 g Hg/ton of bauxite (default factor) was used.

Using the above, Mercury input from Aluminium production amounted to **1,518 kg Hg/yr.** The distribution to environmental compartments was estimated as follows: 228 kg Hg/yr (air); 152 kg Hg/yr (water); 987 kg Hg/yr (general waste); 152 kg Hg/yr (sector specific treatment).

### 2.4.9. Summary

*Gold:* The calculated mercury inputs from the formal gold sector are: 1,390 kg Hg/yr (0.05 g Hg/ton of ore input factor); 4,169 g Hg/yr (0.15 g Hg/ton default input factor). The extraction of gold per reprocessing of old tailings produced per calculated mercury input of 37, 008 kg/yr.

*Zinc:* The calculated mercury inputs from Zinc production amounted to 340 kg Hg/yr (10 g Hg/ton of Zn produced) and 4, 197 kg Hg/yr (65 g Hg/ton of Zn concentrate). The mercury input obtained using the default factor is more than ten times higher than the input obtained using the input factor of 10 g Hg/ton. The distribution of mercury releases was into air, water, land and sector specific.

*Copper:* For copper production, the Mercury input calculated amounted to 93 kg Hg/yr using the input factor of 1.0 g Hg/ton obtained from the sector report studies. However, Mercury input using the default factor of 30 g Hg/ton of Cu concentrate amounted to 9, 939 kg Hg/yr. The latter value is more than hundred times higher than the value obtained using the input factor from the sector studies. With respect to distribution into different environmental compartments, the releases are into air, water and sector specific.

*Lead:* With respect to lead, 479 kg Hg/r was calculated using the sector input factor of 10 g Hg/ton and 3, 592 was obtained using the default input factor of 30 g Hg/ton. The default value gave mercury input eight times higher than the sector input factor of 10 g Hg/ton. The mercury input is distributed into air sector specific.

*Other:* For other non-ferrous, extraction and processing (chrome, nickel PGMs and others), the calculated mercury input amounted to 2, 350 kg Hg/yr using the input factor of 0.5 g Hg/ton. Distribution is into air only; while for primary ferrous metals production, mercury input of 70 kg Hg/yr was obtained based on sector input of 0.05 g Hg/ton. However, mercury input of 235 kg Hg/yr was obtained using the USGS 2014 Report of activity rate of 4, 700 ton for pig iron/yr. Mercury releases is into air and sector specific.

*Aluminium:* With regard to Aluminium production from bauxite, the mercury input amounted to 1,518 kg Hg/yr. The distribution to environmental compartments are as follows: 228 kg Hg/yr (air); 152 kg Hg/yr (water); 987 kg Hg/yr (general waste); 152 kg Hg/yr (sector specific treatment).

Overall, the current data indicate the following trend in the releases of mercury: Non-Ferrous (2,350 kgHg/yr)>Aluminium (1,518 kg Hg/yr)>Au (1,390 kgHg/yr)>Pb (479 kgHg/yr)>Zn (340 kgHg/yr)>Cu (93 kgHg/yr)>Ferrous (70 kgHg/yr).

## 2.5. Data and inventory on intentional use of mercury in industrial processes

Mercury releases can result from intentional use of Mercury in industrial processes such as the production of Chlor-alkali chemicals. Chlor-alkali chemicals are widely utilized as ingredients in consumer products such as polyurethane flooring, polyvinyl chloride (PVC), and food additives such as monosodium glutamate (MSG), sodium benzoate, and potassium benzoate. Chlor-alkali chemicals are also used to process the raw ingredients and to adjust pH levels in many chemical processes, including the corn wet-milling process that produces High-Fructose Corn Syrup (HFCS), dextrose, corn starch, and other corn sweeteners for human consumption. Chlor-alkali chemicals are also used to produce products such as pharmaceuticals, bleach, and toothpaste, and are important for water purification.

South Africa has a history of chlor-alkali production. In 1941, the South African Department of Defence leased an area near Modderfontein, on the Klipfontein farm, and built a Chlor-alkali plant to manufacture phosgene and mustard gas. After 1945, Klipfontein Organic Products was transferred to the Department of Commerce and Industries and the plant converted to make DDT and other pesticides. After the war, it was taken over by the

Department of Commerce and Industries and production was focused on DDT, insecticides, caustic soda, hydrogen, hydrochloric acid and other chlorine by-products.

Another historical chlor-alkali production facility in South Africa was Thor Chemicals in Carto ridge of KwaZulu Natal Province. Although the facility was closed in 1996-1998, it is suspected that there is still an approximated 3000 tons of Mercury or Mercury wastes stored at the facility from historical times.

Available information indicates that currently, chlor-alkali industry in South Africa is no longer in existence today. However, the historical chlor-alkali sites are recognised as hotspot for mercury contamination Table 8. No information is available on whether there has been any form of rehabilitation on any of the sites.

## 2.6. Data and inventory on production of other minerals and materials with mercury impurities

### 2.6.1. Cement production

Mercury enters in the cement manufacturing process as a trace element with the raw materials and through the use of fuels. The mercury content of natural raw materials varies between individual raw material deposits and even within the same deposit. In fuels, the amount of mercury can vary in an analogous way, depending on the fuel type and the fuel source. Depending on their origin, alternative raw materials and fuels may have a higher or a lower mercury content than the ordinary materials they replace.

There are mechanisms and operating conditions that allow cement kilns to capture mercury. There is very low (if any) retention of mercury in the clinker. Mercury and its compounds form an external cycle when the dust, together with the condensed volatile compounds, precipitate on the feedstock in cool areas of the kiln system or when it is separated in dedusting devices and returned to the raw meal and subsequently to the kiln.

**Activity rate:** 10, 000, 000 ton/y
**Input factor:** 0.065 g Hg/ton of cement produced

The method used to generate the input factor is based on coal used for firing cement kilns and producing clinker which is the major source of Hg in cement production. For the activity rate, the annual cement production data, the annual coal consumption are used to estimate

the mercury releases from cement production since data on mercury levels in the cement industrial could not be supplied. For example, if approximately 15 Mg of coal is burned to produce 100 Mg of cement clinker in South Africa, using appropriate emission reduction factors, approximately 3.77 Mg of Hg will be released into the South African environment. Cement production is most likely to increase in future as new infrastructure is required to support the growing South African economy. Thus, Hg emissions for South Africa and the continent will increase. For cement, pulp and paper, the input factors 0.03 g Hg/ton dry weight of pulp and paper) and activity rates: 5,100, 000 pulp and paper (UN Energy Statistics for Biomass).

Using the above, the amount of mercury released was **650 kg Hg/yr.** This is distributed as follows: 390 kg Hg/yr (air), 130 kg Hg/yr (by- products) and 130 (sector specific).

### 2.6.2. Pulp and paper

Mercury is potentially used or released at paper mills in four different areas namely:

- ✓ A component in equipment (e.g. switches, gauges, thermometers);
- ✓ An ingredient in chemicals or laboratory chemicals (e.g. thimerosal);
- ✓ A contaminant in raw materials (e.g. caustic soda) and
- ✓ An incidental release due to a production process (e.g. coal combustion).

**Activity rate:** Activity rate of 5,100, 000 biomass used for pulp and paper production was used (UN Energy Statistics for Biomass).
**Input factor:** An input factor of 0.03 g Hg/ton of biomass used dry weight of pulp and paper was used.

Using the above as toolkit inputs, an estimated **153 kg Hg/yr** was released and distributed as follows: 138 kg Hg/yr (air) and 15 kg Hg/yr (general waste).

## 2.7. Data and inventory on consumer products with intentional use of mercury

Mercury is intentionally used in the production of wide variety of devices and products namely, **thermometers** - Mercury is used in thermometers because it expands and contracts evenly with temperature changes; **switches** - mercury switch conducts electricity and is used

in many applications including light switches (silent type), top-loading freezers and washing machines; **thermostats** - mercury in these devices act as switches to energize heating and cooling systems; **luminaries (lights)** - Fluorescent, HID (High intensity discharge) lamps such as mercury vapour, High Pressure Sodium and Metal Halide, and Neon all contain mercury in a metallic as well as vapour form; **batteries** – A number of batteries used in homes contained mercury. Current mercury containing batteries are "button" shaped and are used in hearing aids, watches and other items requiring a small battery; **Paints** - Latex paint produced before 1992 had large amounts of mercury to prevent fungus growth; **Pesticides** - Fungicides and biocides produced before 1994 used mercury to kill fungus, weeds and other pests (Most new pesticides are mercury-free); **Medical products** - **Sphygmomanometers (blood pressure gauge)** - contain almost 1.5 pounds of mercury; **Esophageal dilators -**The space between the outer and inner tubes houses the medium, typically mercury; **Pharmaceuticals** - Thimerosal (about 48% mercury) has been used in antiseptic creams and as preservatives in pharmaceutical solutions including contact lens solutions; **Instruments** - **Barometers** are instruments used to measure pressure in the atmosphere; most of the older devices contain liquid mercury; and **Instruments** - **Hygrometers** measure the moisture content in air. Hygrometers/psychrometers are found in workplaces where ambient moisture measurements are used for predicting weather and atmospheric conditions.

Mercury is also a common ingredient found in skin lightening soaps and creams. It is also found in other cosmetics, such as eye makeup cleansing products and mascara (USFDA 2000 & 2011, Glahder & Appel, 1999; Ladizinski et al, 2011). Inorganic mercury such as ammoniated mercury is used in skin lightening soaps and creams while organic mercury compounds (thiomersal-ethyl mercury and phenyl mercuric salts) are used as cosmetic preservatives in eye makeup cleansing products and mascara (USFDA 2000; Glahder & Appel, 1999; Ladizinski et al, 2011; USFDA, 2011). In South Africa however, the Food, Cosmetics and Disinfectants Act prohibits the use of Mercury in cosmetic products and the sale of Mercury containing cosmetics. The draft regulations under the same Act and best practice and guidelines in Cosmetic Toiletry and Fragrance Association (CTFA) compendium (Annex V), allows for only 0,007% use of Phenyl mercuric salts Hg in final cosmetic products. In such instances, the label must include a warning statement: “Contains Phenylmercuric compounds”.

### 2.7.1. Subcategory: Cosmetic products

**Activity rate:** The activity rate of 4,000,000 people per year was arrived at after estimating the quantity of cosmetics used by most women in South Africa. The Activity rate was determined by making the following estimations:

- Average quantity of, say, cream used by most women/month
- Population of females in South Africa;
- Percentage of women using skin lightening cosmetics derived from the population of women in South Africa;
- Population of age range of women using skin lightening cosmetics

**Input factor:** There is currently paucity of literature on Mercury content in cosmetic products in South Africa. Hence in order to establish this factor, Mercury content in various cosmetic products was determined using the procedure by Peregrino et al. (2011).

A total of 28 different brand products were purchased from local markets were used for experiments, wherein 22 products were skin lightning creams, 4 were skin lightning soaps and 2 were skin lightning body lotions. Approximately 0.5 g of each product was weighted and placed in a microwave digestion tubes. Thereafter, 10 ml of $HNO_3$ followed by $H_2O_2$ was added to the aliquot and closed tightly with a microwave digestion tube lid and placed inside the oven. The mixture was subjected to microwave digestion in two cycles within 30 minutes; the microwave was programmed to gradually increase its temperature from 0 $^0$C to 190 $^0$C for the first 15 minutes, and then maintain 190 $^0$C. To ensure complete digestion the cycles were repeated twice for each bunch loaded. The microwave energy was 75 %. After cooling at room temperature, the aliquot was decanted into 250 ml Teflon bottle (Scotch, Durban). For each sample, 200 ml of ultrapure water was used to thoroughly rinse the microwave digestion tubes and their lids, the same water used to rinse was decanted into the same aliquot for dilution. After, a prepared $SnCl_2$ was added to reduce and vaporize mercury; the absorbance of mercury in the samples was determined by CV-AAS. The concentrations are shown below.

**Table 11: Concentrations of Mercury in cosmetic samples from local markets**

| SAMPLE ID | COUNTRY OF ORIGIN | CONCENTRATION RANGE (ng/g) |
|---|---|---|
| Cream (n=22) | South Africa (n=8)<br>India (n=5)<br>England (n=2)<br>Pakistan (n=2)<br>France (n=1)<br>Italy (n=3)<br>Nigeria (n=1) | ND-168 |
| Soap (n=4) | Congo (n=1)<br>Cote d'ivore (n=2) | 0.2-9.5 |
| Lotion (n=2) | China (n=1)<br>Cote d'ivore (n=1) | 1-4.6 |

From the data above, the input factor was determined by taking the ND-168 ng/g since the other values fall within this range. Consequently, the average Mercury input factor of 0.000168 kg Hg/ton was used in the toolkit to estimate Mercury input to society. It is noted that more scientifically robust methodologies are required to validate these measurements. A scientifically validated test method to determine mercury level in cosmetics is currently being determined by International Standards Organisation (ISO).

Using the above, Mercury releases from cosmetics were estimated at **151 kg Hg/yr.** This is distributed as follows: 7 kg Hg/yr (air); 3 kg Hg/yr (water), 67 kg Hg/yr (land), 67 kg Hg/yr (by-product); and 7 kg Hg/yr (sector specific).

### 2.7.2. Subcategory- Thermometers with mercury, electrical switches and relays with mercury, light sources with mercury, batteries with mercury, biocides and pesticides with mercury.

**Activity rates and Input factors**

Activity rates for this category were based on the quantities of imported and exported devices and products were obtained from SARS and STATS SA. UN electrification factors and used to calculate the mercury releases from electrical switches and relays. Input factors were obtained from published reports on the quantities and levels of mercury in these consumer products. The activity rates and input factors used are stated in the next paragraphs.

- Medical thermometers with mercury (input factor of 1.0 g Hg/item and activity rate of 100,000 items/yr);
- Electrical switches and relays with mercury (input factor of 0.14 g Hg/item linked to 86% of penetration of electricity/population and activity rate of 55,908,900 inhabitants);
- Fluorescent tubes (double end) (input factor of 25 mg Hg/item and activity rate of 37,420,856 items/yr);
- Compact fluorescent lamps (input factor of 10 mg Hg/item and activity rate of 507,127 items/yr (UN Comtrade);
- High pressure sodium lamps (input factor of 20 mg Hg/item and activity rate of 3,500,000 items/yr);
- UV light for tanning (input factor of 15 mg Hg/item and activity rate of 79,596 items/yr);
- Metal halite lamps (input factor of 25 mg Hg/item and activity rate of 3,403,522 items/yr);
- Mercury oxides batteries (input factor 320 kg Hg/ton of battery and activity rate of 8,792 batteries ton/yr)
- Zinc button cell batteries (input factor 12 kg Hg/ton of batteries and activity rate of 8.79 ton/yr);
- Alkaline button cells batteries (input factor of 5 kg Hg/ton and activity rate of 141.7 ton/yr);
- Silver oxide button cell batteries (input factor of 4 kg Hg/ton of batteries and activity rate of 2.96 ton/yr);
- Alkaline and other button cell shape (input factor of 0.25 kg Hg/ton of batteries and activity rate of 30.7 ton/yr of batteries);
- Polyurethane with mercury catalyst, production, use and disposal: An input factor of 0.03 g Hg/inhibited/yr linked to 86% of penetration of electricity/population; and activity rate of 55,908,900 inhabitants.

Using the above the toolkit-calculated Mercury releases were as follows: **thermometers, 100 kg Hg/yr** (10 kg Hg/yr –air; 30 kg Hg/yr –water; 30 kg Hg/yr –general waste and 30 kg Hg/yr – sector specific), **electrical switches and relays, 6731 kg Hg/yr** (673 kg Hg/yr –air; 673 kg Hg/yr

–land; 5385 kg Hg/yr –general waste), **light sources, 1097 kg Hg/yr** (55 kg Hg/yr –air; 1042 kg Hg/yr – general waste); **batteries, 3647 kg Hg/yr** (912 kg Hg/yr –air; 912 kg Hg/yr –land; 1823 kg Hg/yr –general waste) **and cosmetics, 151 kg Hg/yr** (7 kg Hg/yr –air; 3 kg Hg/yr –water, 67 kg Hg/yr –land, 67 kg Hg/yr –general waste, 7 kg Hg/yr –sector specific).

## 2.8. Data and inventory on other intentional product/process uses

This category concerns mercury releases from dental amalgam fillings; laboratory chemicals and equipment; ethnic/cultural/ritualistic uses; vacuum pumps with mercury, marine navigation lights; infra-red detection semiconductors. However, this inventory considered only dental amalgam and laboratory uses, because information on others (i.e. ritualistic, cultural, marine navigation and/or detection semiconductors) was not available.

### 2.8.1. Subcategory: Dental amalgam

Mercury can be emitted and released during production and preparation of fillings and from the disposal or removed fillings. In addition, Mercury can be released into solid waste and wastewater from removed fillings. For this inventory, the estimations of Mercury level from this source was limited to only dental restorations. The consumption of Mercury for dental amalgam was determined based on the number of restorations carried out and the type and size of each restoration.

**Input factor:** Input factors of 0.125 g Hg/yr*inhabitants (Calculation mid-point from the given range) and 0.198 (dentist density per 1000 inhabitants) were used.

To derive input factors, restoration statistics were obtained from two medical schemes i.e. Discovery Health Medical Scheme (Discovery) and Government Employees Medical Scheme (GEMS). According to data from Discovery, amalgam comes in 1, 2 and 3 spill containers with total weight of 400mg, 600mg and 800mg respectively. Given that mercury accounts for approximately 50% of the material it was safe to assume that mercury content is 200mg, 300mg and 400mg respectively.

According to Discovery, there are 261 080 dental fillings per year, of which 22% used 200mg; 41% used 300mg, 37% used 400mg. With these figures, the total amount of mercury estimated per year amounted to 82.36 kg. **82.36 kgHg/261080 filings =315 mg.** Similar

information was obtained from GEMS and suggested the amount of **296 mg** of Hg used per filling on average. An average (315 + 295 mgHg/filling) = 305 mgHg/filling =**3.05x $10^{-6}$ kg Hg** of mercury per filling calculated from the two major medical health schemes in South Africa. This was used as the input factor in the toolkit.

**Activity rate:** For the activity rate, population of 56 million (2016) was used. Adjustment for dentistry personnel was 0.198 dentists per 1000 inhabitants.

For dental mercury-amalgam fillings, the amount of mercury released was estimated at **2670 kg Hg/yr**. This is distributed as follows: 53.4 kg Hg/yr (air); 1228.23 kg Hg/yr (water); 213.6 kg Hg/yr (land); 160.2 kg Hg/yr (general waste); and 534 kg Hg/yr (sector specific).

### 2.8.2. Subcategory: Laboratory chemicals

**Input factors:** An input factor of 0.01 g Hg/yr/inhabitants was used.

**Activity rate:** Activity rate was 55,908,900 inhabitants.

Using the above, the amount of mercury released was estimated at **559.1 kg Hg/yr**. This is distributed 184.5 kg Hg/yr (water), 184.5 kg Hg/yr (general waste), and 190.1 kg Hg/yr (sector specific disposal site).

### 2.8.3. Subcategory: Laboratory equipment

**Input factors:** For thermostats, input factor of 4 g Hg/item was used. For thermometers, manometers and other measuring equipment, input factor of 0.4 g Hg/item was used. For manometers and gauges with mercury, input factor of 0.005 g Hg/yr/inhabitants linked to penetration of electricity of 86% was used. For other laboratory equipment, input factor of 0.04 g Hg/yr/inhabitants was used.

**Activity rates:** For thermostats, activity rate of 7,069,971 items/yr was used. For thermometers, manometers and other measuring equipment activity rate of 218,000 item/yr was used. For manometers and gauges, activity rate of 55,908,900 inhabitants was used. For other laboratory equipment, activity rate of 55,908,900 inhabitants was used.

Using the above, the amount of mercury released was estimated **2236.4 kg Hg/yr.** This is distributed 738 kg (general waste) and 760.4 kg Hg/yr (sector specific).

## 2.9. Data and inventory on production of recycled metals

This category pertains to mercury releases from production of recycled mercury (metal production), including the collection and processing involved in recycling of mercury; production of recycled ferrous metals; scrap yard handling, scrap auto smelting, shredder and re-melting furnace. Generally, the amount of mercury released in the recycling of scrap metals, for example in secondary steel and non- ferrous metal production, is generally lower than that released during primary metal production. Much of the scrap steel in some countries comes from automobiles that may still have devices that contain mercury, and which may not be removed prior to recycling of the steel. These devices are largely being phased out so mercury emissions from scrap steel may be expected to decrease. However, significant differences exist between countries in the way they treat their mercury-containing wastes, including scrap metals that are recycled in secondary metal production.

**Activity rate:** For recycling of scrap metal, an activity rate of 1,222,568 was used. This was based on the 1,222,568 number of vehicles scraped/yr (SAWIC). For the production of other recycled metals, activity rate of 414,433 ton/yr was used.

**Input factor:** For recycling of ferrous metals (iron and steel), the input factor of 1.1 g Hg/vehicle and input factor of 0.6 g Hg/ton for production of other recycled metals were used.

Given the above, the release of mercury from the production of recycled ferrous metals was estimated at **1334.8 kg Hg/yr** distributed as follows: 443.8 kg Hg/yr (air), 457.2 kg Hg/yr (land) and 443.8 kg Hg/yr (general waste) (Figure 13.1). To produce other recycled metals, the total mercury releases amounted to **248.7 kg Hg/yr**. This is distributed as follows 64.6 kg Hg/yr (air), 24.9 kg Hg/yr (water), 74.6 kg Hg/yr (general waste) and 74.6 kg Hg/yr (sector specific).

## 2.10. Data and inventory on waste incineration and burning

This category pertains to incineration of municipal/general waste; incineration of hazardous waste; incineration of medical waste; sewage sludge incineration and informal combustion of waste. Activity rates for these activities were obtained from SAWIS. The following input factors and activity rates were used for different subcategories.

### 2.10.1. Subcategory: Incineration of hazardous waste

**Activity rate:** 4,274,098 ton/yr

**Input factor:** 10 g Hg/ton

Using the activity rate and input factor above, the estimated Mercury release was **42,741 kg Hg/yr** for hazardous waste. This is released into air only.

### 2.10.2. Subcategory: Medical waste incineration

**Activity rate:** 27,723 ton/yr

**Input factor:** 24 g Hg/ton

Mercury releases via incineration of medical waste amounted to a total of **665 kg Hg/yr.** This is distributed as follows: 599 kg Hg/yr (air); 66 kg Hg/yr (sector specific).

### 2.10.3. Subcategory: sewage sludge incineration

**Activity rate:** 51,746 ton/yr

**Input factor:** 2 g Hg/ton

Using the above, the total mercury releases due to incineration of sludge is **103 kg Hg/yr**. This is distributed as follows: 93 kg Hg/yr(air) and 10 kg Hg/yr (sector specific).

### 2.10.4. Subcategory: Informal burning (open burning and landfills)

**Activity rate:** 8,311 ton/yr

**Input factor:** 5 g Hg/ton

Using the above, the total mercury releases due to informal open burning of waste was **42 kg Hg/yr**. This is released into the air only.

### 2.10.5. Summary

A total of **42,741 kg Hg/yr** for hazardous waste is released into air only. Mercury releases via incineration of medical waste amounted to a total of **665 kg Hg/yr** distributed as follows: 599 kg Hg/yr (air); 66 kg Hg/yr (sector specific). The total input mercury for sludge is **103 kg Hg/yr**,

distributed into air (93 kg Hg/yr) and sector specific (10 kg Hg/yr). For open fire burning, a total of **42 kg Hg/yr** is released into the air only.

## 2.11. Data and inventory on waste disposal, deposition/landfilling

In many countries, the urban wastes are usually discharged into landfills where they produce toxic leachate and toxic gases. Leachate is any liquid material that drains from land or stockpiled material and contains significantly elevated concentrations of undesirable material derived from the material that it has pass through (Henry and Heinke, 1996). Most of the materials that are no longer useful are dumped in landfills as part of urban waste, e.g., dry cell batteries, fluorescent light bulbs and thermometers that contain mercury. When it rains, rainwater tends to percolate through the residues and its inherent aqueous fraction comprises leachate which is characterised by high concentration of organic matter, salts, suspended particles and toxic elements (Christense *et al*, 2001 and Kjeldsen *et al*, 2002). Mercury is one of the elements often present in landfill leachates and it may become an environmental hazard (Slack *et al*, 2005).

**Input factor:** In order to determine the input factors for Mercury released from landfills, leachate and sediment samples were collected from five landfill sites in Gauteng province (Pretoria and Johannesburg) and one landfill site in Limpopo (Thohoyandou). The selected landfill sites represent highly urbanized and rural settings. From the laboratory analysis of samples, the input factor was determined at 1.0 gHg/ton waste deposited.

**Activity rate:** The activity rate 40,398,081-ton waste/year was used as input to the toolkit based on the quantity of waste deposited in landfills in 2016 - obtained from South Africa Waste Information Centre (SAWIC) database.

Given the above, the mercury input from waste was an estimated **40 398 kg Hg/yr**. Of this, 403.98 kg Hg/yr is released into the atmosphere and 4.04Kg Hg/yr into water. There is no value for land since this is a controlled site and is assumed to be lined.

## 2.12. Data and inventory on crematoria and cemeteries

Mercury may be released during cremation of corpses and after burial of corpses. Most of the mercury released is due to the presence of dental amalgam fillings that contain mercury.

Data on the amount of Mercury released by corpses was obtained from monitoring data submitted to DEA by crematoria. All crematoria in South Africa are required (in terms of their Atmospheric Emission License issued in terms of the Air Quality Act) to monitor the release of toxic substances using isokinetic techniques at least 3 times per year. The results of isokinetic monitoring were used to determine Mercury input factors as shown in the next paragraph. Due to the complexity of the equipment used in isokinetic monitoring, small crematoria operated by rural local municipalities find it difficult to undertake such monitoring as required. Thus, only limited data from urban crematoria was used.

**Input factor**: Isokinetic monitoring data for Hg was obtained from 18 crematoria registered in the DEA's NAEIS database of facilities with Atmospheric Emission Licenses. The data showed that the amount of Mercury released into the air varies significantly across facilities. However, an average of 2.5 Hg/corpse was derived from the dataset. Thus, an input factor of 2.5 g Hg/corpses was used in the toolkit.

**Activity rates:** Activity rates of 50, 000 corpses/yr and 450, 000 corpses/yr for cremation and cemetery respectively were used (derived from Statistic SA).

Using the above, the calculated mercury input from crematoria and cemeteries was **1250 kg Hg/yr** distributed as 125 kg Hg/yr (air) associated with crematoria; and 1125 kg Hg/yr (land) associated with cemeteries. The Mercury releases from this sector are expected to decrease due to the increased substitution of amalgam restorations with restorations that do not use mercury.

## 2.13. Stocks of mercury and/or mercury compounds, and storage conditions

### 2.13.1. Overview of stocks of mercury and/or mercury compounds

Various types of organizations or companies that hold stocks of Mercury in South Africa were identified. This included stocks held by traders for re-sale, stocks held by recycling facilities and stocks from historical chlor-alkali plant. For stocks held by manufacturing facilities, information was not available, though the facilities were identified. Of all stocks and potential stocks identified, it is only the stock that is held at Thro Chemicals that exceed the 50 tons threshold stipulated in the Minamata Convention.

**a) Stock of raw mercury for re- sale**

South Africa has small-scale merchants of Mercury resellers. This is evident when one searches Mercury product on the web and classifieds. Personal communication with one of the re-sellers of Mercury suggests that there are approximately 5 known resellers of Mercury in the country. These resellers sell Mercury to South Africa's neighbouring countries. The contacted person indicates that the 5 resellers in total may be re-selling approximately 5000kg Hg/yr. In additions to there, it is possible that there may be illegal resellers.

**b) Stocks of raw mercury for manufacturing purposes**

The ITC Trade Map tracks global patterns of trade. According to their website there 9 South African companies that import Mercury. These companies were identified using the code "28054000"- Mercury in the search.

**c) Stocks from recycling facilities**

Recycling facilities are often able to recover mercury and/or mercury compounds from recycled products such as computer screens and fluorescent lamps. When these products are recycled, Mercury that is in the product is recovered and stocked for disposal or future use. As a result, these facilities may also have stocks on hand. The amount of stock held will depend on the demand of the recovered Mercury and pending decisions regarding the disposal thereof.

In South Africa, there is a number of recyclers of Mercury-containing products, in particular fluorescent lamps, and e-waste. A desktop study (online search) was undertaken to identify various recyclers of mercury containing waste (i.e. e-waste recycling and fluorescent lamps recycling). The list of such recyclers is provided in Appendix 2.

In order to estimate Mercury stocks from recyclers, a distinction was made between recyclers of e-waste and recyclers of fluorescent lamps. This is because according to ERA (2018), a definition of e-waste excludes fluorescent lamps, since this is considered a specialized waste stream. As such, in this study, Mercury releases from e-waste and fluorescent lamps were estimated separately in the following sections.

i. Estimating releases from e-waste recycling

In order to estimate Mercury releases from e-waste recycling, data on the total amount of e-waste that is recycled in the country was obtained from E-waste Recyclers Authority (ERA, 2018). According to their report, the amount of e-waste generated in SA varies across various reports, but the number that was agreed on by the steering committee appointed by DEA was 360 000 tons. It was further agreed that only 12 % of this is recycled. That is 45 000 tons (or 45 000 000 kg) of e-waste is being recycled in South Africa.

Using the latter figure (45 000 000 kg), it became possible to estimate the amount of Mercury that is potentially stored after being recovered from e-waste recycling activities. We used the following equation for our estimates:

Equation 1a: $S = P \times C$

Where:

| Term | Description | Input values to the equation |
|---|---|---|
| S | Mercury stock (kg); recovered from waste | |
| P | Mass of e-waste recycled in South Africa | 45 000 000 Kg (ERA, 2018) |
| C | Mass Mercury content in e-waste (gHg/ton waste). | 0.022gHg/kg e-waste (Ari, 2016)<br><br>According to Ari (2016), and LED computer (a typical component of electronic waste) contain 0.693g per computer which weighs 31kg. That translate to 0.022g per kg of computer waste. In the absence of data on Hg content in e-waste, this number was used to represent Mercury content in e-waste.<br><br>Assumption: We assumed that the amount of Hg released by all types of e-waste is the same. This is not entirely true, but due to unavailability of data on Hg content for all types of e-wastes, this was the most reasonable assumption. |

Using the above equation and values, the total potential Hg stockpiles from e-waste recycling facilities was estimated at 990 kg (0.9 tons). E-waste comprises a variety of waste streams including medical devices, monitoring & control instruments, computers, household appliances etc. It is important to note that the definition of e-waste according to ERA (2018) excludes fluorescent lamps, since this is considered a specialised waste stream whose Mercury stocks were estimated separately in the next paragraph.

ii. Estimated emissions from fluorescent lamps recycling

As indicated, fluorescent lamps are considered a specialised waste stream. Information on potential stocks of Mercury in fluorescent lamps recycling industry was obtained directly from two market leaders in the industry (if not the only fluorescent lamps recyclers). Representatives of these recyclers reported telephonically that there is approximately 50 kg /yr (recovered Mercury) and 1000 kg /yr (recovered Mercury combined with phosphate powder) from the recycling process.

The difference between the two facilities is that facility one facility produces Mercury by-product in the form of combined Mercury + Phosphate powder; while the other facility takes the process further to extract Mercury out of the Phosphate. Hence, the latter facility will have less Mercury waste in terms of quantity. Meanwhile, the fraction of Mercury to Phosphate in the former is unknown.

**d) Stocks of mercury from chlor-alkali inventory**

In South Africa, there is currently no active chlor-alkali or VC production. However, South Africa has a history of chlor-alkali production –Thor Chemicals South Africa has historically produced chlor-alkali, using high volumes of Mercury in its production. Although the facility was closed in 1996-1998, it is expected that there may still be some Hg stored in that facility. Thor Chemicals, Inc. of Great Britain (Thor) received shipments of mercury wastes from the United States and other countries as part of the company's mercury recycling programme.

Previous reports (News 24 Archives, 2003) have reported Mercury stocks of up to 8 000 tons at Thor Chemicals. However, more recent reports speculate that there is approximately 3 000 tons of Mercury stored at this old Thor Chemicals factory in KZN (IoL, 2012; The Citizen, 2019).

It is important to also note that in early September 2019, Thor chemicals was set on fire. The cause of fire is unknown and most importantly, the amount of Mercury that was destroyed by the fire is unknown. Investigations of the Mercury remains at this facility are ongoing.

**e) Stocks of mercury for manufacturing of mercury-added products**

Production facilities for mercury-added products or facilities that use processes that use mercury or mercury compounds such as fluorescent lamps and thermometers may also keep stocks of mercury depending on the supply chain demand. In essence, these facilities need to always have stocks of Mercury in place for future use.

A number of Manufactures of products that are known to potentially contain Mercury in South Africa were identified using an online search. These included:

- 6 Manufacturers of batteries
- 3 Manufacturers of thermometers

An email was sent to them requesting information as follows: but unfortunately, none of these companies responded to the email. A list of companies that were contacted and the email contact used is available on request.

**f) Stocks of mercury for use in industrial processes**

As indicated earlier, Mercury can also be imported for intentional use in industrial processes. Mainly, Mercury is used in the formulation of catalysts for example:

- Vinyl-chloride-monomer production where mercury-dichloride (HgCl2) is used as a catalyst;
- Acetaldehyde production with mercury-sulphate (HgSO4) as catalyst; and
- Other production of chemicals and polymers.

In order to characterise Mercury stocked by traders for use in industrial processes, the manufactures of ***Acetaldehyde, Vinyl-chloride-monomer production*** and ***sodium & potassium methylate production*** in South Africa were identified using an online search. An email was sent to them requesting information as follows: but unfortunately, none of these companies responded to the email.

### 2.13.2. Assessment of current storage conditions

Article 10 of MC requires each party to take measures to ensure that the interim storage of Mercury and mercury compounds intended for a use allowed to a Party under this Convention is undertaken in an environmentally sound manner. Mercury and Mercury compounds in this

respect excludes mercury wastes for disposal as set out in Article 11. None of the assessments done as part of the initial assessments identified Mercury storages. However, as indicated in section 2.13.1, the country has companies that import and store Mercury for use in industrial processes and for re-sale. The total Mercury imported into the country, possibly by the companies listed in that section, ranges from 5 582 kg/y to 36 202 kg/y (year 2010 to 2018) (Table 6). The actual quantities stored by each facility and storage conditions could not be ascertained due to poor response by industry concerned.

### 2.13.3. Evaluation of potential future storage needs

As indicated earlier, there are no known storage of large quantities of Mercury for future use in the country. The only known large stocks or Mercury in the country (3000 tons) is at Thor Chemicals where mercury was stored from the 1980s to the late 1990s for use in historical chlor alkali production during the same time. After several health concerns were raised by the public, Thor Chemicals closed down, leaving thousands of tons of Mercury stock. There is no intention from anyone in the country to put that stock to use. Hence, it is regarded as waste that needs to be disposed of in an environmentally sound manner. The challenge is that currently, there are no facilities in the country to dispose the said Mercury in an environmentally friendly manner. The South African Government South Africa is yet to develop and implement a plan that will see the health risks posed by Mercury at Thor Chemicals plant addressed.

## 2.14. Supply and trade of mercury and mercury containing compounds, including sources, recycling activities and quantities

South Africa imports between 20 000kg and 40 000 kg of raw Mercury per annum and export between 100kg and 2500kg per annum. Companies that are known, through ITC trade map to trade in Mercury are mainly in chemicals manufacturing and pharmaceuticals sectors **Error! Reference source not found.**.

In addition to the trade of raw mercury, South Africa imports an array of Mercury-added products such as thermometers, fluorescent lamps, batteries, LCD computers, vacuum gauges

etc., as well as mercury compounds such as Mercury-sulphate (approx. 48 000kg in 2018) and Mercury-dichloride (approx. 47 000kg in 2018).

### 2.14.1. Mercury trade process in South Africa

According to International Trade Administration Commission (ITAC), any person seeking to import certain listed chemicals into South Africa must seek permission from the. ITAC will then decide if it is in the best interests of the public to import the chemicals. Mercury is a listed chemical and therefore require authorisation.

Chemicals are controlled by ITAC for two reasons. Firstly, to comply with the 1988 United Nations Convention against Illicit Traffic in Narcotic Drugs and Psychotropic Substances. Secondly, to comply with the provisions of the Montreal Protocol. These are international efforts to fight international drug dealing and protect the ozone layer respectively.

The import control process as listed requires three activities as follows:

a) Completion of *Application for Permit to Import Chemicals*, form IE464
b) Completion of *Application for Permit to Import Chemicals Annexure*
*c)* In addition to the completion of these forms, the government requires that *"When you apply for a permit to import these chemicals, you must get a recommendation letter from the South African Police Service (SAPS) or from the Department of Environmental Affairs".*

The challenge is that the process does not make specific requirements in terms of which chemicals requires authorisation by DEA versus those that requires authorisation by SAPS. This means that authorisation could be obtained from SAPS, yet SAPS may not have the necessary capacity to advice on chemicals such as Mercury.

**Table 12: Process followed in the control of mercury importation**

| Process | Remarks |
|---|---|
| 1. Complete form IE464 | This form does not require the use or application of the chemicals. Also, it does not require information on whether the chemical is imported for sale or as a raw material. |
| 2. Complete Annexure IE464 | |
| 3. Recommendation letter from SAPS or DEA | Refer to number 5 and 6 |
| 4. VAT certificate or Certified ID copy | |

| | |
|---|---|
| 5. Rrecommendation from SAPS in the event of chemicals listed in the 1988 Convention Against Illicit Traffic in Narcotic Drugs and Psychotropic substances being imported | According to ITAC, control is exercised to assist the **SAPS** in ensuring that importers/exporters of listed chemicals are recorded, and the movements of these chemicals are adequately monitored as required by the Convention. |
| 6. Rrecommendation from the DFFE if the chemicals are listed in the Montreal Protocol. | According to ITAC, used electronic equipment is controlled to assist the **DFFE** to address the problem of dumping electronic waste. |
| The SAPS has been entrusted with the responsibility of make recommendations for chemicals listed in terms of the 1988 convention, this is to allow them to have a record and track movement. | |

In general, the current application process is not adequate to support to objectives of Minamata Convention.

### 2.14.2. Recommendations on trade related aspects

In order for South African government to properly control Mercury imports and exports, the DEA must have contractual and institutional arrangements with ITAC. The agreement can be in the form of Memorandum of Understanding (MoU) or Memorandum of Agreement (MoA). Firstly, ITAC must be mandated to administer trade issues related to the Minamata Convention the same way they currently administer trade issues related to the Montreal Protocol. ITAC should then be provided with a list of material that requires authorisation by DEA. This must then be shared with SARS customs and SAPS. SAPS is important in this agreement because they are currently responsible for providing recommendations on chemicals trade. Their involvement will ensure that they are able to distinguish chemicals that are controlled under the Minamata Convention and therefore defer applicants to DEA.

## 2.15. Impacts of mercury on human health and the environment

Mercury is a harmful pollutant given its persistence, mobility (in the atmosphere it can be transported over long distances), its ability to form organic compounds, to bio-accumulate in living organisms, and to be bio-magnified (its ability to increase its concentration as it goes up in the food chain). It has negative impacts in the environment and human health.

Atmospheric deposition is one of the most important pathways of introduction of mercury in aquatic and terrestrial environments. In terrestrial systems, Mercury deposited in the soil may be partially carried to the local water system through superficial runoff systems. However, a considerable part is retained by plants and soil. Once in the environment, Mercury can enter

bodies of plants and animals through root absorption and food consumption. Not only does it bioaccumulate in the body but it biomagnfies along food chains; meaning, its concentrations get higher for organisms that are higher in the food chain. A certain percentage of the mercury released into the aquatic environment is converted by microorganisms to methyl mercury (MeHg), which is more toxic and more easily bioavailable than elemental mercury (Hg), staying in the environment, where it accumulates and biomagnifies in aquatic and terrestrial food chain.

When mercury eventually reaches the body of humans through food chains, it causes adverse health impacts to the brain, heart, kidneys, lungs, and immune system. It has been demonstrated that high levels of methylmercury for example in the bloodstream of unborn babies and young children may harm the developing nervous system, making the child less able to think and learn. Mercury also causes increased cancer risk of the liver and of the oesophagus. Respiratory toxicity may also cause pulmonary oedema, congestion, coughing, interstitial pneumonitis and respiratory failure. Mercury may also affect reproduction by causing increased spontaneous abortions, congenital anomalies, and reduced fertility among women.

Methylmercury due to its methyl organic moiety is easily absorbed into the bloodstream and can readily diffuse through the placental barrier and the blood-brain barrier. Foetus and young children are the most vulnerable to methylmercury exposure due to the sensitivity of their nervous system development. Hence, pregnant women should avoid or minimize fish in their diet, particularly if they are not sure of the quality of the fish in terms of possible mercury contamination. Fish eating birds are equally vulnerable to mercury exposure, hence, the impact of mercury in the environment have a far-reaching impact to human health and the environment (USNRC, 2000).

There are a number of studies on the impacts of methyl mercury toxicity to the neurological, cardiovascular, and immune systems within humans. For example, the neurological impacts are often measured through lowered IQ levels that can also be economized (Spadaro and Rabl 2008) and through various neuropsychological tests (Grandjean et al. 1998). Cardiovascular and immunological impacts are often related to chronic exposure to Mercury (Sweet and Zelikoff 2010; Downer et al. 2017). However, the relative impacts from methyl mercury's toxic

effects can vary across human population, whereas some may be sensitive others may have more of an ability to not be as impacted.

Few studies have been done on the exposure of South Africans to Mercury. Oostheizen et al. (2010) assessed whether communities near small-scale gold mining activities were exposed to mercury. They sampled blood from adults living near ASGM activities in Inkomati area. From the results, three (15%) of the blood samples exceeded the guideline (<10 µg/l) for individuals who are not occupationally exposed, while 14 (50%) of the urine samples exceeded the guideline for Mercury in urine (<5.0 µg/g creatinine) for those not occupationally exposed. Although the authors could not confirm the cause of these elevated levels, they suspect that exposure could be associated with consumption of fish from rivers that are contaminated due to artisanal gold mining. The authors were able to rule out occupational exposure and coal use (only 20% of respondents indicated that they used coal as an energy carrier). Instead, their theory is supported by the fact that nineteen (63%) respondents consumed locally caught fish.

Another study by Papu-Zamxaka et al. (2009) assessed Mercury in fish and hair samples collected from villagers near former Thor Chemicals plant (a historical chlor-alkali plant). The levels of Mercury in hair samples were up to 51ug/g hair from samples collected from residents of three villages along the banks of the Inanda Dam near Thor facility. 50% of fish samples and 17% of hair samples collected from villagers had mercury concentrations that exceeded guideline levels of the World Health Organization.

## 2.16. References

African Rainbow Minerals Limited DRD Gold Limited 2009 Operating gold mines and recovery plants in the Republic of South Africa 2010; DIRECTORATE: Mineral Economics

AMAP. (2005) AMAP Assessment 2002: Heavy Metals in the Arctic. Arctic Monitoring and Assessment Programme (AMAP), Oslo, Norway.

AMAP/UNEP. (2008). Technical Background Report to the Global Atmospheric Mercury assessment. Arctic monitoring and assessment programme/UNEP Chemicals Branch.

AMAP/UNEP. (2015). Global Mercury Modelling: Update of Modelling Results in the Global Mercury Assessment 2013. Arctic Monitoring and Assessment Programme, Oslo, Norway/UNEP Chemicals Branch, Geneva, Switzerland. iv + 32 pp.

Barr RD, Rees PH, Cordy PE, Kungu A, Woodger BA, Cameron HM 1972. Nephrotic syndrome in adult Africans in Nairobi. British Medical Journal, 2(5806):131–134.

Basu, N. Clarke., 2015. Integrated assessment of artisanal and small-scale gold mining in Ghana. Part 1. Human Health Review. Int J. Env Res Public Health. 12. 5143-5176.

Christense, T.H., Kjeldsen, P., Bjerg, P.L., Jensen, D.L., et al., (2001). Biogeochemistry of landfill leachate plumes. Applied Geochemistry, 16, 659-781.

Compeau, C.G, and Bartha, R. (1984). Methylation and demethylation of mercury under controlled redox, pH and salinity conditions. Applied Environmental Microbiology 48, (6), 1203-1207.

COWI, (2012). Cost effectiveness of options for a global legally binding instrument on mercury. European Commission - Directorate-General Environment Contract No 07.0307/2011/605841/Ser/C3 - Support to the Commission for the International Negotiations on a Global Legally Binding Instrument on Mercury.

Cremation Assocation of North America (2010), “Statistics about Cremation Trends.", Accessed on May 17, 2010 at http://www.cremationassociation.org/Media/CremationStatistics/tabid/95/Default.aspx

Cremation Society of Great Britain, "International Cremation Statistics 2010", 2 pages. Accessed at
DEA, (2011). Reducing mercury emissions from coal combustion in the energy sector in South Africa, final project report.

DEA, 2017, South African Waste Information System, www.sawic.gov.za

DEA, 2018, 3rd South Africa Environment Outlook Report; https://www.egsa.org.za/wp-content/uploads/2018/09/3.-SAEO_Pressures_13_09.pdf

DEAT. (2010). Emissions of Mercury Associated with Coal-Fired Power Stations in South Africa.

DWS (Department of Water and Sanitation) (2017). Water Quality Management Policies and Strategies for South Africa. Report No. 3.2. Edition 2. Integrated Water Quality Management (IWQM) Strategy. Water Resource Planning Systems Series, DWS Report No.: 000/00/21715/16. DWS: Pretoria, South Africa. Available from 3 rd. SAEO Report Page 93 September 2018 http://www.dwaf.gov.za/projects/iwqms/Documents/Report%203.2_Final%20 (Edition%202) %20IWQM%20Strategy.pdf [Accessed 16 February 2018].

Electus, 2016. Quarterly Strategy Note on South Africa's Cement Industry (October) Sappi Annual Report 2015 http://soshisha.org/english/koushoukan_e/acetalde_e.htm

Engler DE (2005). Letter to the editor: Mercury "bleaching" creams. Journal of the American Academy of Dermatology, 52(6):1113–1114.

Fine, B. & Z. Rustomjee, 1996. The political economy of South Africa – from minerals-energy complex to industrialisation. London: Hurst & Company.

Glahder CM, Appel PWU, Asmund G (1999). Mercury in soap in Tanzania. Copenhagen, Ministry of Environment and Energy, National Environmental Research Institute (NERI Technical Report No. 306).

Glahder CM, Appel PWU, Asmund G 1999. Mercury in soap in Tanzania. Copenhagen, Ministry of Environment and Energy, National Environmental Research Institute (NERI Technical Report No. 306; http://www2.dmu.dk/1_viden/2_publikationer/3_fagrapporter/rapporter/fr306.pdf).

Gounaris, V., Anderson, P.R., Holsen, T.M., (1993). Characteristics and environmental significance of colloids in landfill leachate. Environmental Science Technology, 27, 1381-1387.

Health Canada 2009. Draft guidance on heavy metal impurities in cosmetics. Ottawa, Ontario, Health Canada (http://www.hc-sc.gc.ca/cps-spc/legislation/consultation/_cosmet/metal-metaux- consult-eng.php).

Health Canada 201). Heavy metals in cosmetics—fact sheet. Ottawa, Ontario, Health Canada (http://www.hc-sc.gc.ca/cps-spc/pubs/indust/heavy_metals-metaux_lourds/index-eng.php).

Henry, J., and Heinke, G. (1996). Environmental Science Engineering. Prentice Hall, ISBN 0-13-120650-8.
http://www.srgw.demon.co.uk/CremSoc5/Stats/Interntl/2010/StatsIF.html, on September 25, 2012
IEA Clean Coal Centre, 2008. Economics of mercury control.

IPCS (2003). Elemental mercury and inorganic mercury compounds: human health aspects. Geneva, World Health Organization, International Programme on Chemical Safety (Concise International Chemical Assessment Document 50; http://www.who.int/entity/ipcs/publications/cicad/en/cicad50.pdf).

IPCS 2003. Elemental mercury and inorganic mercury compounds: human health aspects. Geneva, World Health Organization, International Programme on Chemical Safety (Concise International Chemical Assessment Document 50; http://www.who.int/entity/ipcs/publications/cicad/en/cicad50.pdf).
ITAC; https://www.gov.za/services/import/importing-chemicals),
Jennings N., 1999. Social and labour issues in small-scale mines: report for discussion at the Tripartite Meeting on Social and Labour Issues in Small-scale Mines, Geneva, 1999 / [written by Norman Jennings]; International Labour Organization, Sectoral activities Programme. ISBN: 9221114805

Jones, C.J., McGugan, P.L., Hazard, J., 1978. Mater. 2, 253.
Kjeldsen, P., Barlaz M.A., Rooker, A.P., et al (2002). Critical Reviews in Environmental Science Technology. 32, 297.

Ladizinski B, Mistry N, Kundu RV (2011). Widespread use of toxic skin lightening compounds: medical and psychosocial aspects. Dermatologic Clinics, 29:111–123.

Ladizinski B, Mistry N, Kundu RV (2011). Widespread use of toxic skin lightening compounds: medical and psychosocial aspects. Dermatologic Clinics, 29:111–123.

Leaner, J., Dabrowski, J., Mason, R., Ashton, P., Murray, K., Resane, T., Richardson, M., Ginster, G., Euripides, R., Masekoameng, E., Gericke, G. (2008). Mercury Emissions from Point Sources in South Africa, CSIR Report, http://www.htap.org/meetings/2008/2008_04/Presentations/07-04-08/5%20-%20J%20Leaner_UNEP%202008.pdf

Lindsey K, Balagizi I, Hirt HM (2009). Be black and beautiful. Winnenden, anamed international.

Matus, K., Namb, K-M., Selin, N.E., Lamsal, L.N., Reilly, J.M., Paltsev, S. (2012). Health damages from air pollution in China, Global Environmental Change 22 (2012) 55–66.

McKelvey W, Jeffery N, Clark N, Kass D, Parsons PJ (2011). Population-based inorganic mercury biomonitoring and the identification of skin care products as a source of exposure in New York City. Environmental Health Perspectives, 119(2):203–209.

MEC5. (2008). Economics of Mercury Control Technology as Applied to Combustion Sources, Connie Senior, Reaction Engineering International, 5th Mercury Experts' Conference (MEC5), June 26-27, 2008, Shoal Bay, Australia.

Mor, S., Vischher, A., Ravindra, K., et al., (2006). Induction of enhanced methane oxidation in compost: temperature and moisture response. Waste management. 26, (4), 381-388.

News 24, 2016: Potentially dangerous mercury levels in SA retail fish
https://www.health24.com/Lifestyle/Environmental-health/News/see-potentially-dangerous-mercury-levels-in-sa-retail-fish-20161101

Oosthuizen, M., John, J. and Somerset, V. 2010. Mercury exposure in a low-income community in South Africa. South African Medical Journal (100) 6: 34-39.

Pacyna, J.M., Sundseth, K., Pacyna, E.G., Jozewicz, W., Munthe, J., Belhaj, M., Astrom, S. (2010). An assessment of costs and benefits associated with mercury emission reductions from major anthjropogenic sources. J Air & Waste Mana Assoc, 60, (3), 302-315.

Pacyna, J.M., Sundseth, K., Pacyna, E.G., Munthe, J., Belhaj, M., Åström, S., Panasiuk, D., Glodek, A. (2008). Socio-economic costs of continuing the status-quo of mercury pollution, TemaNord 2008:580.

Papu-Zamxaka, V., Mathee, A., Harpham, T., Barnes, B., Rollin, H., Lyons, M., Jordaan, W., and Cloete, M., (2009). Elevated mercury exposure in communities living alongside the Inanda Dam, South Africa. J. Environ. Monit., 2010, 12, 472–477

Peregrino CP, Moreno MV, Miranda SV, Rubio AD, Leal LO (2011). Mercury levels in locally manufactured Mexican skin-lightening creams. International Journal of Environmental Research and Public Health, 8(6):2516–2523.

Slack, R.J., Gronow, J., Vulvulis, N., (2005). Household hazardous waste in municipality. Sci. Total Environ. 337, 119-137.

Spadaro, V.J., Rabl, A. (2008). Global health impacts and costs due to mercury emissions. Risk analysis. 28, 3 dio: 10,1111/j.1539-6924.2008.104x.

Streets, D.G., Hao, J., Wu, Y., Jiang, J., Chan, M., Tian, H., Feng, X., 2005. Anthropogenic mercury emissions in China. Atmos Environ 39, 7789-7806.

Sundseth, K., Pacyna, J.M., Pacyna, E.G., Munthe, J.M., Belhaj, S. Astromc, S. (2010). Economic benefits from decreased mercury emissions: Projections for 2020, J Cleaner Production 18, 386–394.

Tang HL, Chu KH, Mak YF, Lee W, Cheuk A, Yim KF, Fung KS, Chan HWH, Tong KL (2006). Minimal change disease following exposure to mercury-containing skin lightening cream. Hong Kong Medical Journal, 12(4):316–318.

The School of Natural Resources and Environment, University of Michigan (2000). Environmental Justice Case Study - Thor Chemicals and Mercury Exposure in Cato-Ridge, Kwazulu-Natal, South Africa, http://www.umich.edu/~snre492/Jones/thorchem.htm

Thorwarth, H., Käβ, (2008). Best Available Technologies, The Situation in Germany Guidance on Best Available Techniques and Best Environmental Practices to Control Mercury Emissions from Coal-fired Power Plants and Coal-fired Industrial Boilers. http://mercuryconvention.org/Portals/11/documents/BATBEP%20draft%20guidance/Coal_burning_power_stations_and_industrial_boilers.pdf

United Nations Environmental Programme (2008). Mercury in products and wastes. Geneva, United Nations Environment Programme, Division of Technology, Industry and Economics, Chemicals Branch http://www.unep.org/chemicalsandwaste/Portals/9/Mercury/AwarenessPack/English/UNEP_Mod1_UK_Web.pdf

United Nations Environmental Programme. (2013). Global Mercury Assessment 2013: Sources, Emissions, Releases and Environmental Transport. UNEP Chemicals Branch, Geneva, Switzerland.

United Nations Environmental Programme, 2013. Global Mercury Assessment 2013: Sources, Emissions, Releases and Environmental Transport. UNEP Chemicals Branch, Geneva, Switzerland

United Nations Environmental Programme. (2002). Global Mercury Assessment. IMOC – Inter organizational Programme for the Sound Management of Chemicals. A cooperative agreement among UNEP, ILO, FAO, WHO, UNIDO, UNITAR and OECD. Geneva, Switzerland, December 2002, 258 pp. (http://www.chem.unep.ch/MERCURY/Report/Final%20Assessment%20report.htm

United Nations Environmental Programme. (2005). Toolkit for Identification and Quantification of Mercury Releases. IMOC – Inter organizational Programme for the Sound Management of Chemicals. A cooperative agreement among UNEP, ILO, FAO, WHO, UNIDO, UNITAR and OECD. Geneva, Switzerland, November 2005, 282 pp. (http://www.chem.unep.ch/mercury/Toolkit/default.htm)

United Nations Environmental Programme. (2010). Study on mercury sources and emissions, and analysis of cost and effectiveness of control measures "UNEP Paragraph 29 study". http://www.unep.org/hazardoussubstances/Mercury/tabid/434/Default.aspx

United Nations Environmental Programme. (2013). Global mercury assessment. www.unep.org/PDF/PressReleases/GlobalMercuryAssessment2013.pdf IOL (2012) : Article: Decades of Toxic Waste not cleared up.

Uram E, Bischofer BP, Hagemann S (2010). Market analysis of some mercury-containing products and their mercury-free alternatives in selected regions. Gesellschaft für Anlagenund Reaktorsicherheit (GRS) mbH, March (GRS-253; http://www.ipen.org/ipenweb/documents/ipen%20documents/grs253.pdf).

US Geological Survey, 2009. Mineral Commodity Summaries, 2009: Internet Website: http://minerals.usgs.gov/minerals/pubs/commodity/gold/ mcs-2009-gold.pdf

US GS. (2014): Collaborative studies for mercury characterization in coal and coal combustion products, Republic of South Africa, Project report prepared by: U.S. Geological Survey (USGS), Eastern Energy Resources Science Center Reston, Virginia 20192 USA.

USFDA (2000). Cosmetics: ingredients prohibited & restricted by FDA regulations. Updated May 30, 2000. Silver Spring, MD, United States Department of Health and Human Services, Food and Drug Administration (http://www.fda.gov/Cosmetics/ProductandIngredientSafety/SelectedCosmeticIngredients/ucm127406.htm).

USFDA (2011). Import alert: Detention without physical examination of skin whitening creams containing mercury. Silver Spring, MD, United States Department of Health and Human Services, Food and Drug Administration (Import Alert No. 53-18; http://www.accessdata.fda.gov/cms_ia/importalert_137.html).

World Health Organisation (2007). Exposure to mercury: a major public health concern. Geneva, World Health Organization (Preventing disease through healthy environments series; http://www.who.int/phe/news/Mercury-flyer.pdf).

World Health Organisation (2008). Guidance for identifying populations at risk from mercury exposure. Geneva, World Health Organization (http://www.who.int/entity/foodsafety/publications/chem/mercury/en/).

Zhang, L., Zhuo, Y., Chen, L., Xu, X., Chen, C., 2008. Mercury emissions from six coal fired power plants in China. Fuel Processing Technology 89, 1033-1040.

# CHAPTER III: POLICY, REGULATORY AND INSTITUTIONAL FRAMEWORK ASSESSMENT

## 3.1. Policy and regulatory assessment

The legislative and regulatory framework in the management and control of hazardous substances and chemicals existed in South Africa before 1994, though not developed into a comprehensive environment and national resources management. The advent of the constitution particularly in 1996, highlighted national and international protocols and agreements in respect of safety to our environment, health of the nation, safety of the community of nations on the globe.

The period after 1994 signalled a new environmental discourse that factored in National and International agreements on a global scale. Regard was taken into account to the ease with which the transportation of hazardous and chemical substances in between countries is facilitated. These international protocols agreements and conventions provided the structured approach to invent structural synergies and complimentary regulatory framework from which the hazardous substances and chemical may be scientifically controlled and managed.

The advent of democracy in 1994 cemented the right of citizen to a clean environment through the introduction of constitutional guarantees in which issues of the protection of the environment and the safety of citizens were focused and entrenched. A provision in the 1996 Constitution established the basic human right to clean, safe and healthy environment. The Constitution of the republic of South Africa, 108 of 1996 provides for Chapter 2 on the Bill of Rights. It states that everyone has a right to:

a) an environment that is not harmful to their health or well-being; and

b) have the environment protected, for the benefit of the present and future generations, through reasonable and other measures that:

(i) prevent pollution and ecological degradation;

(ii) promote conservation; and

(iii) secure ecologically sustainable development and the use of natural resources while promoting justifiable economic and social development."

It can be submitted that the elevation of environmental protection through a body of comprehensive regulations and legislations find its roots in the Constitution of the Republic of South Africa. The various national legislations provide and form the basis for the application of the environmental laws. The application of the environmental laws is uniquely supported and complemented by provincial and municipal laws that are applicable in the respective provinces and local municipalities.

The public is empowered through the Constitution to access information that is impugning on their right to a safe environment. This is made possible through an enabling Act of parliament Access to Information. Over and above, all citizens can request information from public institutions and organisations to effect access to relevant information that may be useful to the exercise of their rights or may assist in the investigation about the transgression of any safety standard or and expose them to hazards of any sort.

Table  to Table present a summary assessment of existing national policies and regulatory measures (in place and under development), their scope and to what extent they already meet the requirements as stipulated in the provisions of the Minamata Convention. In addition, these tables also provide an analysis of existing gaps that would need to be addressed to ensure compliance with the Convention. These legislations are cascaded through provincial, local government laws and by laws respectively to ensure their implementation at various areas of South Africa, in line with the cooperative and inter-dependence of various government spheres.

**Table 13: Policy and regulatory measures in place and remaining gaps in relation with Article 3**

| **Article 3 - Mercury Supply Sources and Trade** | |
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| **Description of article** | Article 3 of the Convention addresses mercury sources that are available for use and trade. This article also specifies conditions and procedures that must be met in circumstances where such trade is allowed. There are two major provisions of Article 3 including: (1) the phasing out and ultimate closing of primary mercury mines and; (2) restrictions on the supply of mercury from decommissioned chlor-alkali facilities. In addition, Parties to the Convention are asked to identify any other large stocks of mercury and mercury-containing compounds. |
| **Summary of provisions relevant to South Africa** | • Phase out existing primary mercury mining within 15 years.<br>• Not allow new primary mercury mining<br>• Prevent the import and use of mercury from primary mercury mining for artisanal and small-scale gold mining (ASGM).<br>• In accordance with Article 3.5(b), restrict the import and use of excess mercury from decommissioning chlor-alkali plants, and require environmentally sound disposal.<br>• Obtain information on stocks of mercury or mercury compounds exceeding 50 metric tons (MT), and mercury supply generating stocks exceeding 10 MT/yr15.<br>• Not allow the export of mercury unless the importing country provides written consent, 16 the mercury is for an allowed use or environmentally sound storage, and all other conditions of Article 3.6 are met.<br>• Not allow the import of mercury without government consent, ensuring both the mercury source and proposed use are allowed under the Convention (and applicable domestic law). |
| **Policy and regulatory measures in place that enable the country to comply with the above-listed provisions** | |
| **Title of policy and reference** | **Explanation on what aspects of the above provisions are being addressed by policy/regulatory measure** |
| *Hazardous substances Act (Act No. 15 of 1973) (HAS)* | HSA empowers the Minister of Health to provide for the prohibition and control of the importation, sale, use, application, modification, disposal or dumping of hazardous chemicals including mercury and to provide for matters connected therewith.<br>The Minister of Health has already set regulations that prohibits Mercury trade and use in ASGM. The only challenge is compliance and enforcement of the prohibition as per regulations. |

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| *Minerals Resources and Petroleum Development Act (Act No. 28 of 2002) (MPRDA)* | Empowers the minister responsible for Mining to deny any application for a permit or mining right for primary mercury mining. The law does not explicitly prohibit Hg mining. |
| *International Trade Administration Act (Act No. 71 of 2002) (ITAA) (chapter4 part A, B, C, D and E)* | Import control of mercury stocks could be facilitated by means of the permit system through ITAC, NRCS, the ITAA and the SARS list of restricted / prohibited articles. |
| *Foodstuffs, Cosmetics and Disinfectants Act (Act No. 54 of 1972) (FCDA) (Chapter 2 section 1 and 2)* | According to regulations published by the Minister of Health under the FCDA, mercury and its compounds may not form part of the composition of cosmetic products. Meaning that cosmetics manufacturers in South Africa are not allowed to use mercury as input to their product during manufacturing. |
| **Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions** | |
| • There is currently no primary mining of Hg in South Africa, but the law does not explicitly prohibit it. An explicit ban on primary mercury mining could be introduced into South African legislation by amending MPRDA so that the Act is clear that no primary mining of Hg is allowed. Another option would be to refrain from any legal measure with a view on the fact that no relevant mining activity is to be expected, and that compliance may be regarded as sufficient for a Party to comply with the obligation of Article 3(3).<br>• There is no current South African legislation directly addressing mercury export and import ban from non-parties, including waste imports. | |

**Table 14: Policy and regulatory measures in place and remaining gaps in relation with Article 4**

| **Article 4 - Mercury Added Products (MAPs)** | |
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| **Description of article** | Article 4 seeks to reduce demand for mercury through a combination of measures that phase down and ultimately phase out the use of mercury during the manufacturing of certain products. A mercury-added product (MAP) is defined by the convention as a "product or product component that contains mercury or a mercury compound that was intentionally added" (Article 2, paragraph f). |
| **Summary of provisions relevant to South Africa** | • Prohibition of manufacture / import / export of mercury-added products (Annex A, Part I) after the phase-out date. |

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| | • Measures with respect to mercury-added products (in accordance with Annex A, Part II) (Dental Amalgam)<br>• Phase down of the use of Mercury in dental amalgams.<br>• Preventing the incorporation of mercury-added products in assembled products<br>• Obligation to discourage manufacture and distribution of new mercury-added products |
| **Policy and regulatory measures in place that enable the country to comply with the above-listed provisions** | |
| **Title of policy and reference** | **Explanation on what aspects of the above provisions are being addressed by policy/regulatory measure** |
| *National Environmental Management Act (Act No. 107 of 1998) (NEMA)* | NEMA lists activities that activities may be restricted, or even prohibited, if the Minister (DEA) determines it is necessary to ensure the protection of the environment, the conservation of resources or sustainable development. As such, NEMA provides a mechanism through which Mercury manufacturing activities can be listed and prohibited. |
| *National Health Act (Act No, 63 of 1977) (NHA)* | The National Health Council is empowered to provide advice to the Minister for Health on policy development, on the procurement and use of health technology including machinery and equipment (thermometers and sphygmomanometers). As such, this council can advise the Minister on the use of Mercury containing health equipment such as thermometers and dental amalgams. |
| *International Trade Administration Act (Act No. 71 of 2002) (ITAA) (chapter4 part A, B, C, D and E)* | Import control of mercury -added products could be facilitated by means of the permit system through ITAC, NRCS, the ITAA and the SARS list of restricted / prohibited articles. |
| *Foodstuffs, Cosmetics and Disinfectants Act (Act No. 54 of 1972) (FCDA) (Chapter 2 section 1 and 2)* | According to regulations published by the Minister of Health under the FCDA, mercury and its compounds may not form part of the composition of cosmetic products. |
| *FCDA (Chapter 9 section 1 and 2)* | The import of mercury-added cosmetics, pesticides, biocides and topical antiseptics, which according to Annex A of the Convention may not be imported after 2020, can be prohibited through the FCDA and HSA and added to the SARS list of prohibited articles. |
| *HSA* | The HSA empowers the Minister of Health to provide for the prohibition and control of the importation, sale, use or application of mercury and to provide for matters connected therewith |
| **Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions** | |

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| • Manufacture of mercury added products contained in Annex A Part I may need to be listed under the NEMA, or the Minister of Health may prohibit their manufacture under the HSA.<br>• The NHC must advise on policy development on the use of Mercury containing health equipment such as thermometers and in dental amalgams.<br>• Import can be prohibited, after the phase-out date specified for those products in the Convention, by including them in the SARS consolidated list of Prohibited and Restricted Exports and Imports.<br>• The Minister of Health may prohibit the incorporation of mercury-added products in assembled products under the HSA. |

**Table 15: Policy and regulatory measures in place and remaining gaps in relation with Article 5**

| **Article 5 - Manufacturing processes in which mercury or mercury compounds are used** | |
|---|---|
| **Description of article** | Article 5 and its associated Annex B of the Convention identify manufacturing processes where mercury use will not be allowed and must be phased out (paragraph 2) and where the use of mercury and mercury compounds will be restricted (paragraph 3). |
| **Summary of provisions relevant to South Africa** | • Prohibition of mercury use in the processes listed in part I of Annex B & Obligation to restrict the use of mercury in the processes listed in part II of Annex B<br>• Obligation to take measures to address emissions and releases from all processes in Annex B<br>• Endeavour to identify facilities from Annex B and report on the annual amount of mercury used in these facilities.<br>• Prohibition of using mercury in new Annex B facilities<br>• Discouraging the development of new facilities using any other mercury - based manufacturing process |
| **Policy and regulatory measures in place that enable the country to comply with the above-listed provisions** | |
| **Title of policy and reference** | **Explanation on what aspects of the above provisions are being addressed by policy/regulatory measure** |
| *NEMA* | NEMA lists activities that activities may be restricted, or even prohibited, if the Minister (DEA) determines it is necessary to ensure the protection of the environment, the conservation of resources or sustainable development. As such, NEMA provides a mechanism through which any manufacturing activities that uses Mercury can be listed and prohibited. |

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| *NEM:AQA Listed Activities* | In terms of the NEM:AQA, listed activities require an Atmospheric Impact Assessment Report, an Atmospheric Emissions Licence and they need to comply with emission limits. AQA provisions can be used to ensure that existing manufacturing activities in Annex B put measures in place to reduce Mercury emissions. |
| *NEM: WA* | National norms and standards have been set for the storage, treatment and disposal of hazardous waste. These standards will ensure that the release of Mercury into the environment is minimised. |
| *HSA* | The HSA empowers the Minister of Health to provide for the prohibition and control of the disposal or dumping of mercury and to provide for matters connected therewith |
| *NWA* | Under the NWA, a responsible authority may, if it is necessary for the protection of the water resource, require the applicant to give security in respect of any obligation or potential obligation arising from a licence to be issued under this Act. In this way the DWS is mandated to ensure that the impacts are reduced or eliminated. Wastewater limits set in terms of the National Water Act can be used to minimise releases into water ecosystems of Mercury associated with existing facilities listed in annexure B. |
| *NEMA Sections 24(2) and 24D* | Through the NEMA environmental impact assessment and management system, effective and proactive management, minimisation and mitigation against potential negative impacts of significant activities is encouraged. |
| *HSA* | The HSA empowers the Minister of Health to provide for the prohibition and control of the importation, sale, use or application of mercury and to provide for matters connected therewith. |
| **Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions** | |
| • The processes listed in Annex B of the Convention may need to be listed under the NEMA. Or the Minister of Health may prohibit or restrict the use of mercury in these processes under the HSA<br>• Annex B facilities may need to be listed under the NEMA as requiring an environmental impact assessment. Reporting on the annual amount of mercury used may then be required as part of permissions granted. Use of mercury may be prohibited as part of permissions given.<br>• Specific listing (under the NEM:AQA) of Annex B processes, with mercury emission limits, may be required.<br>• Annex B processes may need to be declared to be controlled activities under the NWA<br>• Policies for the prohibition and control of the importation, sale, use or application of mercury need to be developed. | |

**Table 16: Policy and regulatory measures in place and remaining gaps in relation with Article 7**

| **Article 7 - Artisanal and Small-scale Gold Mining** | |
|---|---|
| **Description of article** | Article 7 deals with artisanal and small-scale gold mining and processing in which mercury amalgamation is used to extract gold from ore. The Convention defines artisanal and small-scale gold mining (ASGM) as "gold mining conducted by individual miners or small enterprises with limited capital investment and production" (Article 2). |
| **Summary of provisions relevant to South Africa** | • Reduce / eliminate the use of mercury and mercury compounds in artisanal and small-scale gold mining (ASGM)<br>• Determination of significance of ASGM / Developing and Implementing a national action plan<br>• Development of strategies to prevent the diversion of mercury or mercury compounds for use in artisanal and small-scale gold mining and processing<br>• Education, outreach and capacity-building initiatives in the ASGM sector<br>• Promotion of research into sustainable non-mercury alternative practices |
| **Policy and regulatory measures in place that enable the country to comply with the above-listed provisions** | |
| **Title of policy and reference** | **Explanation on what aspects of the above provisions are being addressed by policy/regulatory measure** |
| *MPRDA (Chapter 2 section 5 and 5A)* | The MPRDA prohibits any form of mining without a permit. This renders all ASGM activities in South Africa Illegal. |
| **Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions** | |
| • Methods to promote compliance by the ASGM sector needs to be developed as set out in the NAP<br>• Functions of the MHSC and the terms of the Mine Health and Safety Act (MHSA) may need to be specifically extended to include a focus on small-scale mining. | |

**Table 127: Policy and regulatory measures in place and remaining gaps in relation with Article 8**

| **Article 8 – Emissions** |
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|---|---|
| **Description of article** | Article 8 aims to control and, where feasible, reduce emissions of mercury and mercury compounds to the atmosphere, through measures to control emissions from the point sources listed in Annex D and differentiates between measures required for new sources and those required for existing sources. |
| **Summary of provisions relevant to South Africa** | • Controlling emissions: Develop National Plan<br>• Require BAT / BEP for new Annex D sources<br>• Emission control measures for existing Annex D sources<br>• Establish emissions inventory of Annex D sources |
| **Policy and regulatory measures in place that enable the country to comply with the above-listed provisions** | |
| **Title of policy and reference** | **Explanation on what aspects of the above provisions are being addressed by policy/regulatory measure** |
| *NEMA: AQA* | The AQA provides various mechanisms for addressing emissions from point sources. |
| **Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions** | |
| • A national plan needs to be developed in accordance to NEMA: AQA and the National Framework for Air Quality Management in South Africa.<br>• BAT / BEP for new Annex D sources may need to be added as a requirement for the issue of an atmospheric emissions licence | |

**Table 18: Policy and regulatory measures in place and remaining gaps in relation with Article 9**

| **Article 9 – Releases** | |
|---|---|
| **Description of article** | Addresses the releases of mercury and mercury compounds to land and water and aims at controlling, and where feasible, reducing releases of mercury and mercury compounds from significant anthropogenic point sources that are not addressed in other provisions of the Convention |
| **Summary of provisions relevant to South Africa** | • Releases control<br>• Establish release inventory |
| **Policy and regulatory measures in place that enable the country to comply with the above-listed provisions** | |

| **Title of policy and reference** | **Explanation on what aspects of the above provisions are being addressed by policy/regulatory measure** |
|---|---|
| *National Water Act (Act No. 36 of 1998) (NWA)* | Wastewater limits for mercury have been prescribed for general authorisations under the NWA |
| *NWA* | According to the National Water Resource Strategy 2 (DWA, 2013), a targeted discharge regulatory strategy would be developed and implemented by the Department of Water Affairs, Catchment Management Agencies and Water Services Authorities. This strategy is focused on ensuring compliance with discharge standards by high-impact wastewater dischargers. |
| *HSA* | The HSA empowers the Minister of Health to provide for the prohibition and control of the disposal or dumping of mercury and to provide for matters connected therewith. |
| *NWA (Chapter 3 Part 4 and 5)* | Controlled activities under the NWA require authorisation. Specific conditions may include the requirement that waste treatment, pollution control and monitoring equipment must be installed, maintained and operated; and that particular management practices must be followed to prevent the pollution of any water resource. An environmental or other assessment may also be required |
| *NEM: WA* | National norms and standards have been set for the storage, treatment and disposal of hazardous waste. These standards will ensure that the release of Mercury into the environment is minimised. |
| **Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions** | |
| • Annex D processes may need to be declared to be controlled activities under the NWA. | |

**Table 19: Policy and regulatory measures in place and remaining gaps in relation with Article 10**

| **Article 10 - Environmentally Sound Interim Storage of Mercury** | |
|---|---|
| **Description of article** | The environmentally sound interim storage of mercury other than waste mercury. |
| **Summary of provisions relevant to South Africa** | • Storage of non- waste mercury taking into account any relevant guidelines developed under the Basel Convention |
| **Policy and regulatory measures in place that enable the country to comply with the above-listed provisions** | |

| **Title of policy and reference** | **Explanation on what aspects of the above provisions are being addressed by policy/regulatory measure** |
|---|---|
| *HSA* | The HSA empowers the Minister of Health to provide for the prohibition and control of the importation, sale, use, application or modification of mercury and to provide for matters connected therewith. AS such, this Act provides a mechanism for the Minister of Heath to control the matters related to the environmentally sound storage of Mercury. |
| *NEM:WA*<br>*(chapter 4)* | The NEM:WA prescribes duties for the transport of hazardous waste for purposes other than disposal. |
| **Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions** | |
| • None | |

**Table 20: Policy and regulatory measures in place and remaining gaps in relation with Article 11**

| **Article 11 - Mercury Wastes** | |
|---|---|
| **Description of article** | Article 11 deals with mercury wastes, including their definition, their management in an environmentally sound manner and transportation across international boundaries |
| **Summary of provisions relevant to South Africa** | • Mercury waste management taking into account any relevant guidelines developed under the Basel Convention |
| **Policy and regulatory measures in place that enable the country to comply with the above-listed provisions** | |
| **Title of policy and reference** | **Explanation on what aspects of the above provisions are being addressed by policy/regulatory measure** |
| *NEMA* | All hazardous waste management activities require the submission of a basic assessment process, as stipulated in the environmental impact assessment regulations. |
| *NEM:WA* | All hazardous waste management activities are required to have a Waste Management License.<br>The minister (DEA) has set national norms and standards for the storage, treatment and disposal of hazardous waste.<br>The NEM:WA prescribes duties for the transport of hazardous waste for purposes other than disposal. |

| | |
|---|---|
| *HSA*<br>*(chapter 29 section 1)* | The HSA empowers the Minister of Health to provide for the prohibition and control of the disposal or dumping of mercury and to provide for matters connected therewith |
| *ITAAC*<br>*(chapter 4-part C and D)* | Used goods, including used electronic equipment and waste and scrap require import permits. Although not all of these goods will contain mercury, the import permit requirements for these two classes of goods could be modified to be dependent on the requirements of the Convention that mercury wastes be managed or disposed of in an environmentally sound manner. |
| **Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions** | |
| • Minister of Environmental Affairs need to declare Mercury as a priority waste in terms of section 14 of the Waste Act<br>• Import permits for used goods, including used electronic equipment and waste and scrap, containing mercury may have to be modified to be dependent on the requirements that mercury wastes be managed or disposed of in an environmentally sound manner | |

**Table 21: Policy and regulatory measures in place and remaining gaps in relation with Article 12**

| **Article 12 - Contaminated Sites** | |
|---|---|
| **Description of article** | Deals with contaminated sites by having each state endeavouring to develop appropriate strategies for identifying and assessing sites contaminated by mercury or mercury compounds |
| **Summary of provisions relevant to South Africa** | • Contaminated sites assessment and remediation |
| **Policy and regulatory measures in place that enable the country to comply with the above-listed provisions** | |
| **Title of policy and reference** | **Explanation on what aspects of the above provisions are being addressed by policy/regulatory measure** |
| *NEMA* | All hazardous waste management activities require the submission of a basic assessment process as stipulated in the environmental impact assessment regulations and the issue of a waste management licence. |
| *NEM:WA*<br>*(chapter 4 part 8)* | NEM:WA makes provisions for the Minister of Forestry, Fisheries and Environment to require any person to remediate land where contamination presents, or may present, a significant risk of harm to health or the environment. |

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| | National norms and standards for the remediation of contaminated land and soil quality have been promulgated in terms of the NEM:WA and include screening values for mercury |
| **Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions** | |
| • None | |

**Table 22: Policy and regulatory measures in place and remaining gaps in relation with Article 16**

| **Article 16 - Health Aspects** | |
|---|---|
| **Description of article** | Article 16 encourages parties to promote the development and implementation of strategies and programmes to identify and protect populations at risk. It also encourages parties to adopt and implement science based educational and preventive programmes on occupational exposure to mercury and mercury compounds, promote appropriate health-care services for prevention, treatment and care for populations affected by the exposure to mercury or mercury compounds & to establish and strengthen institutional and health professional capacities. |
| **Summary of provisions relevant to South Africa** | • Promote the development and implementation of strategies and programmes to identify and protect populations at risk.<br>• Promote the development and implementation of science-based educational and preventive programmes on occupational exposure to mercury and mercury compounds.<br>• Promote appropriate health-care services for prevention, treatment and care for populations affected by the exposure to mercury or mercury compounds.<br>• Establish and strengthen, as appropriate, the institutional and health professional capacities for the prevention, diagnosis, treatment and monitoring of health risks. |
| **Policy and regulatory measures in place that enable the country to comply with the above-listed provisions** | |
| **Title of policy and reference** | **Explanation on what aspects of the above provisions are being addressed by policy/regulatory measure** |

| | |
|---|---|
| *NHA*<br>*(Chapter 3 section 23)* | In accordance with national health policy, the Director General of the DoH must issue, and promote adherence to, norms and standards on health matters including environmental conditions that constitute a health hazard. The Minister may, in any regulation made under NHA, designate as authoritative any methodology, procedure, practice or standard that is recognised as authoritative by internationally recognised health bodies within the relevant profession. |
| *NHA*<br>*(Chapter 11 section 90)* | The National Health Council is responsible for advising the Minister of Health on an integrated national strategy for health research including research into the causes of disease and the effects of the environment on the human body. It is a provincial responsibility to conduct or facilitate research on health and health services. |
| *MHSA* | The promotion of training and human resources development object of the MHSA could also extend to the ASGM sector. |
| *Occupational health and Safety Act (Act No. 85 of 1993) (OHSA)* | • In terms of the OHSA the employer must provide such information, instructions, training and supervision as may be necessary to ensure, as far as is reasonably practicable, the health and safety at work of his employees.<br>• The Hazardous Substances Regulations promulgated under the OHSA, provide occupational exposure limits - recommended limits for mercury alkyls (skin absorption) and for mercury & compounds. These prescribed limits give the levels below which occupational exposure risk is negligible. Biological exposure indices for mercury are also provided in the regulations. |
| *NHA*<br>*(Chapter 6 section 41)* | The NHA commissions the Minister of Health to endeavour to protect, promote, improve and maintain the health of the population by determining policies that will ensure the provision of essential health services. |
| *NHA*<br>*(Chapter 4 & chapter 7)* | In terms of the NHA, the National Health Council must advise the Minister on policy including human resources planning, management and development. The planning, management and development of human resources for the rendering of health services is a Provincial health department function. |
| FCDA (Chapter 10, 11, 12, 13 14) | Regulations under this act sets the maximum levels of metals in foodstuffs. Maximum levels of mercury in natural mineral waters and food grade salt; and maximum levels of methyl-mercury in fish and predatory fish have been prescribed in the regulations. |
| **Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions** | |
| • Methodologies, procedures, practices or standards that are recognised as authoritative by internationally recognised health bodies must be identified and regulations made | |

| |
|---|
| • Programmes need to be developed in accordance to article 16.1b.<br>• Health-care services may need to be adapted to deal with exposure to mercury.<br>• Adequate facilities may need to be made available for the training of human resources in the treatment of people affected by exposure to mercury. |

**Table 23: Policy and regulatory measures in place and remaining gaps in relation with Article 17**

| **Article 17 - Information Exchange** | |
|---|---|
| **Description of article** | Deals with information exchange where each party shall facilitate the exchange of information |
| **Summary of provisions relevant to South Africa** | • Information Exchange |
| **Policy and regulatory measures in place that enable the country to comply with the above-listed provisions** | |
| **Title of policy and reference** | **Explanation on what aspects of the above provisions are being addressed by policy/regulatory measure** |
| *NHA*<br>*(chapter 9)* | The DoH can cooperate with the DFFE with regard to the exchange of epidemiological information concerning health impacts associated with exposure to mercury and mercury compounds, in close cooperation with the World Health Organization and other relevant organizations, as appropriate. |
| **Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions** | |
| • None | |

**Table 134: Policy and regulatory measures in place and remaining gaps in relation with Article 18**

| **Article 18 – Public Information, Awareness and Education** | |
|---|---|
| **Description of article** | Article 18 emphasises the importance of public information, awareness and education |
| **Summary of provisions relevant to South Africa** | • Public information, awareness and education |
| **Policy and regulatory measures in place that enable the country to comply with the above-listed provisions** | |

| **Title of policy and reference** | **Explanation on what aspects of the above provisions are being addressed by policy/regulatory measure** |
|---|---|
| *NEMA* | The NEMA requires that wellbeing and empowerment must be promoted through environmental education, the raising of environmental awareness, the sharing of knowledge and experience and other appropriate means. |
| *NEM:WA* | One of the objects of the NEM:WA is to ensure that people are aware of the impact of waste on their health, well-being and the environment. Guidance on raising this awareness is provided by the National Waste Management Strategy (NWMS) that has been developed in terms of NEM:WA. |
| *MHSA* | The promotion of training and human resources development object of the MHSA could also extend to the ASGM sector. |
| *NHA*<br>*(chapter 8 part 2)* | The NHA makes provision for the establishment of the National Consultative Health Forum as well as provincial consultative bodies. These institutions are mandated to promote and facilitate interaction, communication and the sharing of information on national and provincial health issues to organisations contemplated in health promotion and public education from national to municipal levels. |
| **Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions** | |
| • Public awareness and education programmes need to be developed and implemented. | |

**Table 25: Policy and regulatory measures in place and remaining gaps in relation with Article 19**

| **Article 19 - Research, Development and Monitoring** | |
|---|---|
| **Description of article** | Article 19 relates to research, development and monitoring. |
| **Summary of provisions relevant to South Africa** | • Inventories of use, consumption, and anthropogenic emissions to air and releases to water and land of mercury and mercury compounds.<br>• Modelling and geographically representative monitoring of levels of mercury and mercury compounds in vulnerable populations and in environmental media, including biotic media such as fish, marine mammals, sea turtles and birds, as well as collaboration in the collection and exchange of relevant and appropriate samples.<br>• Assessments of the impact of mercury and mercury compounds on human health and the environment. |

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| | • Harmonized methodologies for the activities undertaken under subparagraphs (a), (b) and (c).<br>• Information on the environmental cycle, transport (including long-range transport and deposition), transformation and fate of mercury and mercury compounds in a range of ecosystems, taking appropriate account of the distinction between anthropogenic and natural emissions and releases of mercury and of remobilization of mercury from historic deposition.<br>• Information on commerce and trade in mercury and mercury compounds and mercury-added products.<br>• Information and research on the technical and economic availability of mercury-free products and processes and on best available techniques and best environmental practices to reduce and monitor emissions and releases of mercury and mercury compounds. |
| **Policy and regulatory measures in place that enable the country to comply with the above-listed provisions** | |
| **Title of policy and reference** | **Explanation on what aspects of the above provisions are being addressed by policy/regulatory measure** |
| NEM:WA | The National waste information regulations and the South African Waste Information System (SAWIS) will facilitate, in part, the inventory requirements of the Convention |
| NEM:AQA (chapter 4 part 1, 2 and 3) | Monitoring and enforcement of compliance with specific environmental statutes that fall under the NEMA framework, is provided for in the NEMA through the designation of Environmental Management Inspectors. |
| FCDA (Chapter 10, 11, 12, 13 14) | Regulations under this act have been published relating to the maximum levels of metals in foodstuffs. Maximum levels of mercury in natural mineral waters and food grade salt; and maximum levels of methyl-mercury in fish and predatory fish have been prescribed by these regulations. |
| NHA (Chapter 9 section 71) | This act provides responsibility to the National Health Council for advising the Minister of Health on an integrated national strategy for health research including research into the causes of disease and the effects of the environment on the human body. |
| HSRC Act (chapter 4 section 1, 2 and 3) | Basic research is a key shared function of the Department of Higher Education and Training and the Department of Science and Technology. Universities provide a basic platform for research in manufacturing technology, mining and minerals research |
| **Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions** | |
| • none | |

**Table 26: Policy and regulatory measures in place and remaining gaps in relation with Article 21**

| **Article 21- Reporting** | |
|---|---|
| **Description of article** | Parties shall report to the Conference of the Parties, through the secretariat on the measures taken to implement the provisions of the Convention and the effectiveness of those measures as well as the possible challenges in meeting the objectives of the Convention &Parties shall include in their reporting the information called for in the different articles of the Convention |
| **Summary of provisions relevant to South Africa** | • Each Party shall report to the COP, through the Secretariat, on the measures it has taken to implement the provisions of this Convention and on the effectiveness of such measures and the possible challenges in meeting the objectives of the Convention. |
| **Policy and regulatory measures in place that enable the country to comply with the above-listed provisions** | |
| **Title of policy and reference** | **Explanation on what aspects of the above provisions are being addressed by policy/regulatory measure** |
| | None |
| **Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions** | |
| • The COP shall decide upon the timing and format of the reporting to be followed by the Parties. | |

## 3.2. Institutional assessment

There are various governmental, research, surveillance and assessment institutions funded by the national fiscus whose mandate is linked to the guaranteeing of the safety of both the citizens and its environment. For example, any transportation of substances/chemicals is sanctioned by the transportation department whose responsibilities is among others to ensure that it acquires information regarding the transportation of any substance within national borders and transnational borders. To this end, it is supported by various enforcement officials from the other complimenting department such as Home Affairs, Health, Agriculture, Trade and Industry and International Relations. The complementary arrangement ensures that not only is the country alive but also acts against any threat of influx of chemicals outside the standing compliance protocol and in contravention of international agreements and protocol. The existence of the regional body SADC (Southern African Development Community) presents an extra structure through which to coordinate and enforce laws and regulations including international agreements and protocol.

**Table 147: Existing National Institutional Capacity and Remaining Gaps in relation to Article 3**

| **Article 3 - Mercury Supply Sources and Trade** | |
|---|---|
| **Description of article** | Article 3 of the Convention addresses mercury sources that are available for use and trade. This article also specifies conditions and procedures that must be met in circumstances where such trade is allowed. There are two major provisions of Article 3 including: (1) the phasing out and ultimate closing of primary mercury mines and; (2) restrictions on the supply of mercury from decommissioned chlor-alkali facilities. In addition, Parties to the Convention are asked to identify any other large stocks of mercury and mercury-containing compounds. |

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| **Summary of provisions relevant to South Africa** | • Phase out existing primary mercury mining within 15 years.<br>• Prevent the import and use of mercury from primary mercury mining for artisanal and small-scale gold mining (ASGM).<br>• In accordance with Article 3.5(b), restrict the import and use of excess mercury from decommissioning chlor-alkali plants, and require environmentally sound disposal.<br>• Obtain information on stocks of mercury or mercury compounds exceeding 50 metric tons (MT), and mercury supply generating stocks exceeding 10 MT/yr15.<br>• Not allow the export of mercury unless the importing country provides written consent, 16 the mercury is for an allowed use or environmentally sound storage, and all other conditions of Article 3.6 are met.<br>• Not allow the import of mercury without government consent, ensuring both the mercury source and proposed use are allowed under the Convention (and applicable domestic law). |
| **Relevant national stakeholder** | |
| **Department of Environmental Affairs** | **Role in relation to the above**<br>• Developing and implementing processes and system for efficient and effective administration of MC.<br>• Creating or strengthening institutional enforcement arrangements.<br>• Facilitating inter-agency coordination structures.<br>• Liaise with Department of Trade and Industry and ITAC on matters related to import and export of Mercury and mercury-containing products. |
| | **Existing capacities**<br>• DFFE has the capacity to identify products whose supply and trade needs to be regulated; and communicate this to ITAC and DTI. |
| **Department of Trade and Industry (DTI)** | **Role in relation to the above**<br>• DTI administers the International Trade Administration Act (ITAA) which makes provision for the establishment of the International Trade Administration Commission (ITAC) and for the control, through a permit system, of the import and export of goods specified by regulation. |

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| | **Existing capacities**<br>• Permitting system exist for import and export of goods specified in the regulations. |
| **International Trade Commission of South Africa (ITAC)** | **Role in relation to the above**<br>• ITAC host the permitting system for import and exports of regulated and /or controlled goods, including Mercury. |
| | **Existing capacities**<br>• Permitting system exist for import and export of goods specified in the regulations. |
| **National Regulator for Compulsory Specification (NRCS)** | **Role in relation to the above**<br>• Promoting public health and safety, environmental protection and ensuring fair trade. |
| | **Existing capacities**<br>• NRCS has an online system, which enables online approvals for Letters of Authorisation required for the import or export of items/substances listed by the Customs and Excise division of SARS. |
| **Department of Health (DoH)** | **Role in relation to the above**<br>• Make regulations controlling, restricting or prohibiting the importation and transportation of Mercury |
| | **Existing capacities**<br>• The DoH has already developed and published regulations that control trade of Mercury. The regulations require that a person trading in Mercury to have a license. |
| **South African Revenue Service (SARS)** | **Role in relation to the above**<br>• In terms of the Customs and Excise Act, 1964, SARS administers prohibitions or restrictions on imports and exports on behalf of a number of government departments, institutions or bodies. Prohibitions and restrictions are applicable on all modalities of transport (road, rail, air, sea, post or other). |
| | **Existing capacities**<br>• SARS has the capacity to list Mercury as a prohibited product for trade after the phase-out date. |
| **Remaining Capacity Gaps at National Level that need to be addressed before provisions can be met** | |

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| • A national focal point for trade-related consent needs to be designated under Article 17.4 of the Convention. Where the importing country provides written consent, or mercury is imported for an allowed use or environmentally sound storage, and all other conditions of Article 3.6 are met; South African government may consider adoption of a mercury trade licensing system to meet the PIC requirements, the source/use restrictions, and the reporting obligations of Article 3.<br>• The current permitting system for the import of Mercury needs to be improved to ensure proper control of the movement of Mercury.<br>• Reporting mechanisms needs to be properly coordinated across various stakeholders and institutions. |

**Table 28: Existing National Institutional Capacity and Remaining Gaps in relation to Article 4**

| **Article 4 - Mercury Added Products (MAPs)** | |
|---|---|
| **Description of article** | Article 4 seeks to reduce demand for mercury through a combination of measures that phase down and ultimately phase out the use of mercury during the manufacturing of certain products. A mercury-added product (MAP) is defined by the convention as a "product or product component that contains mercury or a mercury compound that was intentionally added" (Article 2, paragraph f). |
| **Summary of provisions relevant to South Africa** | • Prohibition of manufacture / import / export of mercury-added products (Annex A, Part I) after the phase-out date.<br>• Measures with respect to mercury-added products (in accordance with Annex A, Part II) (Dental Amalgam).<br>• Preventing the incorporation of mercury-added products in assembled products.<br>• Obligation to discourage manufacture and distribution of new mercury-added products. |
| **Relevant national stakeholder** | |
| **Department of Forestry, Fisheries and Environment** | **Role in relation to the above**<br>• Developing and implementing processes and system for efficient and effective administration of MC.<br>• Creating or strengthening institutional enforcement arrangements.<br>• Facilitating inter-agency coordination structures.<br>• Liaise with Department of Trade and Industry and ITAC on matters related to import and export of Mercury and mercury-containing products. |
| | **Existing capacities** |

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|---|---|
| | • DEA has the capacity to identify products whose supply and trade needs to be regulated; and communicate this to ITAC and DTI. |
| **Department of Trade and Industry (DTI)** | **Role in relation to the above**<br>• See information under ITAC in the row below DTI administers the International Trade Administration Act (ITAA) which makes provision for the establishment of the International Trade Administration Commission (ITAC) and for the control, through a permit system, of the import and export of goods specified by regulation. |
| | **Existing capacities**<br>• Permitting system exist for import and export of goods specified in the regulations. |
| **International Trade Commission of South Africa (ITAC)** | **Role in relation to the above**<br>• ITAC host the permitting system for import and exports of regulated and /or controlled goods. |
| | **Existing capacities**<br>• Permitting system exist for import and export of goods specified in the regulations. |
| **National Regulator for Compulsory Specification (NRCS)** | **Role in relation to the above**<br>• Promoting public health and safety, environmental protection and ensuring fair trade. |
| | **Existing capacities**<br>• NRCS has an online system, which enables online approvals for Letters of Authorisation required for the import or export of items/substances listed by the Customs and Excise division of SARS. |
| **Department of Health (DoH)** | **Role in relation to the above**<br>• Make regulations regarding mercury in equipment such as thermometers and sphygmomanometers that are used in the provision of health services.<br>• Controls the use of Mercury in manufacturing processes |
| | **Existing capacities**<br>• DoH, through the Medical Control Council can advise the Minister of health to remove Mercury-containing health care equipment. This will phase down and subsequently phase out the supply of this devices into the country. |

| **South African Revenue Service (SARS)** | **Role in relation to the above**<br>• In terms of the Customs and Excise Act, 1964, SARS administers prohibitions or restrictions on imports and exports on behalf of a number of government departments, institutions or bodies. Prohibitions and restrictions are applicable on all modalities of transport (road, rail, air, sea, post or other).<br>• SARS manages the assignment of tariff identity codes to various imports and exports. By means of this system, it is possible to assign specific environmental controls, import restrictions or permitting requirements to articles or substances. |
|---|---|
| | **Existing capacities**<br>• SARS has the capacity to list products that are listed in Part I of Annex A (Article 4.1) to be prohibited after the phase-out date specified in those products. |
| **Remaining Capacity Gaps at National Level that need to be addressed before provisions can be met** | |
| • MAPS needs to be prohibited through a regulation under NEMA in line with the requirements of the Convention.<br>• Tariff codes needs to be developed for the prohibited MAPS to be listed under International Trade Administration Act (ITAA) and for SARS list of prohibited items. Many of the products listed in Annex A, Part I are already explicitly subject to South African legislation, with the mercury content being subject to maximum limit values. However, market-based South African laws address the "placing on the market" of the item in question only. This covers "import", but neither "export" no "manufacture", and thus leaves a gap between the MC requirements and current South African legislation.<br>• The tariff codes in most instances are not clear enough to enable one to discern whether the product imported contains Mercury or other liquids. Hence, the need to work with ITAC to develop and where necessary improve tariff codes.<br>• Low public awareness of the hazards of mercury and the benefits of using mercury-free alternatives is a factor in the low substitution rate. There is also an unfounded perception that mercury-free alternatives do not perform as accurately as their mercury-containing counterparts. There is therefore a research gap that needs to be addressed in this area.<br>• The electrical and energy sector also make use of several Mercury added products (MAPs). Additionally, the increasing availability of mercury-free and mercury-reduced alternatives is not fully reflected in the public usage of MAPs.<br>• An inventory of the mercury added products is crude and therefore needs to be updated.<br>• Adequate reporting mechanisms needs to be developed to track progress on the phase out of MAPs. | |

**Table 29: Existing National Institutional Capacity and Remaining Gaps in relation to Article 5**

| **Article 5 - Manufacturing processes in which mercury or mercury compounds are used** | |
|---|---|
| **Description of article** | Article 5 and its associated Annex B of the Convention identify manufacturing processes where mercury use will not be allowed and must be phased out (paragraph 2) and where the use of mercury and mercury compounds will be restricted (paragraph 3). |
| **Summary of provisions relevant to South Africa** | • Prohibition of mercury use in the processes listed in part I of Annex B & Obligation to restrict the use of mercury in the processes listed in part II of Annex B<br>• Obligation to take measures to address emissions and releases from all processes in Annex B<br>• Endeavour to identify facilities from Annex B and report on the annual amount of mercury used in these facilities.<br>• Prohibition of using mercury in new Annex B facilities<br>• Discouraging the development of new facilities using any other mercury - based manufacturing process |
| **Relevant national stakeholder** | |
| **Department of Environmental Affairs** | **Role in relation to the above**<br>• Facilitating the development of environmental management legislation, national policies, strategies, norms and standards.<br>• Developing and implementing processes and system for efficient and effective administration of MC<br>• Creating or strengthening institutional enforcement arrangements<br>• Facilitating inter-agency coordination structures |
| | **Existing capacities**<br>• DFFE has the capacity, through the National Environmental Management Act, to control or prohibit activities that use Mercury in manufacturing |
| **Department of Health (DoH)** | **Role in relation to the above**<br>• Making regulations and licensing the use of Mercury in manufacturing processes in accordance the National Health Act |

| | |
|---|---|
| | • Make regulations prohibiting, restricting or otherwise regulating the use or employment of mercury in connection with the manufacture of any foodstuff, cosmetic or disinfectants.<br>• Issue and promote adherence to, norms and standards relating to environmental conditions that constitute a health hazard. |
| | **Existing capacities**<br>• DoH, through the Medical Control Council can advise the Minister of health to remove Mercury-containing health care equipment. This will phase down and subsequently phase out the supply of this devices into the country. |
| **Remaining Capacity Gaps at National Level that need to be addressed before provisions can be met** | |
| • Identification of acetaldehyde production facilities still needs to be carried out.<br>• Lack of a comprehensive database regarding the use mercury or mercury compounds for manufacturing processes listed in Annex B. | |

**Table 150: Existing National Institutional Capacity and Remaining Gaps in relation to Article 7**

| **Article 7 - Artisanal and Small-scale Gold Mining** | |
|---|---|
| **Description of article** | Article 7 deals with artisanal and small-scale gold mining and processing in which mercury amalgamation is used to extract gold from ore. The Convention defines artisanal and small-scale gold mining (ASGM) as “gold mining conducted by individual miners or small enterprises with limited capital investment and production” (Article 2). |
| **Summary of provisions relevant to South Africa** | • Reduce / eliminate the use of mercury and mercury compounds in artisanal and small-scale gold mining (ASGM)<br>• Determination of significance of ASGM / Developing and Implementing a national action plan<br>• Development of strategies to prevent the diversion of mercury or mercury compounds for use in artisanal and small-scale gold mining and processing<br>• Education, outreach and capacity-building initiatives in the ASGM sector<br>• Promotion of research into sustainable non-mercury alternative practices |
| **Relevant national stakeholder** | |
| | **Role in relation to the above** |

| | |
|---|---|
| **Department of Forestry, Fisheries and the Environment** | • Developing and implementing processes and system for efficient and effective administration of MC<br>• Creating or strengthening institutional enforcement arrangements<br>• Facilitating inter-agency coordination structures<br>• Developing mercury strategies and implementation plans.<br>• Ensuring that mercury waste management policies and legislation are implemented and enforced in compliance with chemicals and waste management authorisations, directives and agreements.<br>• Ensuring reduced releases of hazardous waste streams into the environment.<br>• Ensuring that contaminated land is remediated. |
| | **Existing capacities**<br>• DFFE has the capacity to develop an action plan or strategy to address Mercury releases from ASGM activities |
| **Department of Mineral Resources and Energy (DMRE)** | **Role in relation to the above**<br>• DMRE is responsible for, amongst others, developing mineral policies, norms and standards as well as drafting and amending mineral and related legislation. |
| | **Existing capacities**<br>• The DMRE has a dedicated Directorate that assists small-scale mining operators.<br>• DMRE has implemented a mining permit in order to allow small-scale miners to operate within the required regulatory framework. |
| **MINTEK** | **Role in relation to the above**<br>• Undertakes research and development activities specialising in all aspects of mineral processing, extractive metallurgy and related technology |
| | **Existing capacities**<br>• MINTEK has developed the *iGoli* Technology which is a mercury-free gold extraction process, developed to eliminate the use of mercury in the ASGM sector. The iGoli technology uses pool acid and bleach to extract gold with recoveries of 99%. |

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| | • MINTEK's Small-Scale Mining and Beneficiation Division (SSMB) have also established a training school that will give Artisanal and Small-Scale Miners theoretical and practical training on safe, efficient and environmentally friendly operations. |
| **Department of Health (DoH)** | **Role in relation to the above**<br>• Issue and promote adherence to, norms and standards relating to environmental conditions that constitute a health hazard.<br>• Develop the required public health strategy element of the national action plan to reduce the health impacts of mercury use in artisanal and small-scale gold mining.<br>• Assess the risks to health of mercury contaminated sites.<br>• Facilitate research which contributes to knowledge of the effects of mercury in the environment on the human body.<br>• Distribute information creating public awareness and education on the impacts of exposure to mercury on the human body. |
| | **Existing capacities**<br>• DoH has the capacity to develop awareness material and conduct awareness activities relating to the health impacts on Mercury; and administer such to ASGM communities. |
| **Remaining Capacity Gaps at National Level that need to be addressed before provisions can be met** | |
| • Information on number of ASGM miners, mining sites, community members, and thus limited information on related hazards.<br>• A collaborative structure between a number of ministries, departments and agencies as well as non-government organisations. This will provide an opportunity to gather more data in this sector and develop and action plan<br>• Education and awareness raising activities must be provided to ASGM communities<br>• The NHC may need to initiate research on the health-related aspects of the national action plan<br>• Other strategies to increase compliance may need to be devised<br>• Mine Health and Safety Inspectorate focus may be extended to ASGM operations for the purposes of implementing the Minamata Convention | |

**Table 31: Existing National Institutional Capacity and Remaining Gaps in relation to Article 8**

| **Article 8 - Emissions** | |
|---|---|
| **Description of article** | Article 8 aims to control and, where feasible, reduce emissions of mercury and mercury compounds to the atmosphere, through measures to control emissions from the point sources listed in Annex D and differentiates between measures required for new sources and those required for existing sources. |
| **Summary of provisions relevant to South Africa** | • Controlling emissions: Develop National Plan<br>• Require BAT / BEP for new Annex D sources<br>• Emission control measures for existing Annex D sources<br>• Establish emissions inventory of Annex D sources |
| **Relevant national stakeholder** | |
| **Department of Forestry, Fisheries and Environment** | **Role in relation to the above**<br>• Development of air quality legislation and emission standards/limits |
| | **Existing capacities**<br>• DFFE has the capacity to develop emission control measures<br>• DFFE hosts the National Atmospheric Emissions Inventory System (NAEIS) to track emissions from listed activities |
| **Power generation facilities** | **Role in relation to the above**<br>• The South African Mercury inventory shows that power generation is the largest source of Mercury emission. Hence the role of power utilities in reducing emissions is key. |
| | **Existing capacities**<br>• Various power utilities in South Africa has some capacity to undertake research on BAT for the control of emissions but may need financial support. |
| **Remaining Capacity Gaps at National Level that need to be addressed before provisions can be met** | |

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| • High ash coals can be more challenging for mercury control, for example - coal cleaning may not be an appropriate option.<br>• The country often faces a high electricity demand makes taking plants off-line for retrofitting challenging.<br>• Limited water availability may make some control options less viable.<br>• An uncertain energy future where demand may decline or increase and the potential input from renewable sources is, as yet, undefined.<br>• Economic challenges - South Africa must absorb the cost of control technologies and the resulting impact on the national economy whilst ensuring electricity demands are met. |

**Table 32: Existing National Institutional Capacity and Remaining Gaps in relation to Article 9**

| **Article 9 - Releases** | |
|---|---|
| **Description of article** | Addresses the releases of mercury and mercury compounds to land and water and aims at controlling, and where feasible, reducing releases of mercury and mercury compounds from significant anthropogenic point sources that are not addressed in other provisions of the Convention |
| **Summary of provisions relevant to South Africa** | • Releases control<br>• Establish release inventory |
| **Relevant national stakeholder** | |
| **Department of Forestry, Fisheries and Environment** | **Role in relation to the above**<br>• Ensuring that mercury waste management policies and legislation are implemented and enforced in compliance with chemicals and waste management authorisations, directives and agreements.<br>• Ensuring reduced releases of hazardous waste streams into the environment.<br>• Ensuring that contaminated land is remediated. |
| | **Existing capacities**<br>• DFFE has the capacity to manage Mercury releases through certain provisions of the Waste Act |

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| | • DFFE has set national norms and standards for the storage, treatment and disposal of waste and hazardous waste. |
| **Department of Water and Sanitation (DWS)** | **Role in relation to the above**<br>• DWS is responsible for the formulation and implementation of policy governing both water quality and quantity.<br>• DWS is responsible for controlling releases/discharge of contaminated water into natural water bodies |
| | **Existing capacities**<br>• DWS has the capacity to develop water quality objectives/discharge limits and monitor mercury releases in the water environment as required by Article 9.6 of the Convention.<br>• DWS will be developing a National Water Resource Strategy 2 focused on ensuring compliance with discharge standards by high-impact wastewater dischargers, including the regulation of discharges from municipal wastewater treatment works, mines and other high impact users. |
| **Department of Health (DoH)** | **Role in relation to the above**<br>• Make regulations controlling, restricting or prohibiting the, storage and disposal of mercury. |
| | **Existing capacities** |
| **Remaining Capacity Gaps at National Level that need to be addressed before provisions can be met** | |
| • Information on the applicability of various BAT in South African context from selected activities with potentially high mercury releases.<br>• Although wastewater limits have been prescribed for general authorisations by the DWS, water quality legislation does not explicitly identify relevant anthropogenic point sources in a survey repeated every three years. | |

**Table 33: Existing National Institutional Capacity and Remaining Gaps in relation to Article 10**

| **Article 10 – Environmentally sound interim storage** | |
|---|---|
| **Description of article** | The environmentally sound interim storage of mercury other than waste mercury. |
| **Summary of provisions relevant to South Africa** | • Storage of non- waste mercury taking into account any relevant guidelines developed under the Basel Convention |

| **Relevant national stakeholder** | |
|---|---|
| **Department of Forestry, Fisheries and Environment** | **Role in relation to the above**<br>• Ensuring that mercury waste management policies and legislation are implemented and enforced in compliance with chemicals and waste management authorisations, directives and agreements.<br>• Ensuring reduced releases of hazardous waste streams into the environment. |
| | **Existing capacities**<br>• DFFE has set national norms and standards for the storage, treatment and disposal of waste and hazardous waste. |
| **Department of Health (DoH)** | **Role in relation to the above**<br>• Make regulations controlling, restricting or prohibiting the storage and disposal of mercury. |
| | **Existing capacities**<br>• |
| **Remaining Capacity Gaps at National Level that need to be addressed before provisions can be met** | |
| • The DFFE is not aware of the presence nor availability of adequate facilities/infrastructure in the country for environmentally sound storage of Mercury | |

**Table 16: Existing National Institutional Capacity and Remaining Gaps in relation to Article 11**

| **Article 11 – Mercury wastes** | |
|---|---|
| **Description of article** | Article 11 deals with mercury wastes, including their definition, their management in an environmentally sound manner and transportation across international boundaries |
| **Summary of provisions relevant to South Africa** | • Mercury waste management taking into account any relevant guidelines developed under the Basel Convention |
| **Relevant national stakeholder** | |
| | **Role in relation to the above** |

| | |
|---|---|
| **Department of Forestry, Fisheries and Environment** | • Ensuring that mercury waste management policies and legislation are implemented and enforced in compliance with chemicals and waste management authorisations, directives and agreements.<br>• Ensuring reduced releases of hazardous waste streams into the environment.<br>• Ensuring that contaminated land is remediated. |
| | **Existing capacities**<br>• DFFE has the capacity to manage Mercury containing waste through certain provisions of the Waste Act<br>• DFFE has set national norms and standards for the storage, treatment and disposal of waste and hazardous waste.<br>• DFFE administers the licencing system for hazardous waste disposal activities. |
| **International Trade Commission (ITAC)** | **Role in relation to the above**<br>• ITAC administers the permitting system related to the import of used goods, including used electronic equipment and waste and scrap. Although not all of these goods will contain mercury, the import permit requirements for these two classes of goods could be modified to be dependent on the requirements of the Convention that mercury wastes be managed or disposed of in an environmentally sound manner. |
| | **Existing capacities**<br>• A permitting system related to the import of used electronic equipment and waste and scrap waste is in place. |
| **Department of Health (DoH)** | **Role in relation to the above**<br>• DoH makes regulations controlling, restricting or prohibiting the, storage and disposal of mercury. |
| | **Existing capacities** |
| **Remaining Capacity Gaps at National Level that need to be addressed before provisions can be met** | |
| • Thresholds need to be developed to characterise Hg waste.<br>• Specifications must be developed for treatment facilities that involve Mercury in waste.<br>• Encourage and enable separation of waste to avoid dumping of Mercury containing waste at general landfill sites. | |

**Table 35: Existing National Institutional Capacity and Remaining Gaps in relation to Article 12**

| **Article 12 - Contaminated Sites** | |
|---|---|
| **Description of article** | Deals with contaminated sites by having each state endeavouring to develop appropriate strategies for identifying and assessing sites contaminated by mercury or mercury compounds |
| **Summary of provisions relevant to South Africa** | • Contaminated sites assessment and remediation |
| **Relevant national stakeholder** | |
| **Department of Forestry, Fisheries and Environment** | **Role in relation to the above**<br>• Ensuring that mercury waste management policies and legislation are implemented and enforced in compliance with chemicals and waste management authorisations, directives and agreements.<br>• Ensuring reduced releases of hazardous waste streams into the environment.<br>• Ensuring that contaminated land is remediated. |
| | • DFFE has the capacity to manage Mercury contaminated sites through part 8 of the Waste Act<br>• DFFE has set national norms and standards for the storage, treatment and disposal of waste and hazardous waste. |
| **Department of Mineral Resources and Energy (DMRE)** | **Role in relation to the above**<br>• DMRE can assist in the identification and management of contamination sites associated with historical gold mining and ASGM |
| | **Existing capacities** |
| **Remaining Capacity Gaps at National Level that need to be addressed before provisions can be met** | |
| • There is currently a high degree of uncertainty regarding the size and scale of mercury contamination hence there is a need for capacity on contamination test methods.<br>• Lack of expertise and skilled personnel that has the knowledge about mercury contaminated sites. | |

| |
|---|
| • Capacity on various aspects of Mercury monitoring on contaminates water and land.<br>• There is a need to identify entities or persons who should assume liability for remediation costs, a\especially for historical activities and historical gold mines that are ownerless. |

**Table 36: Existing National Institutional Capacity and Remaining Gaps in relation to Article 13**

| **Article 13 – Financial resources and mechanisms** | |
|---|---|
| **Description of article** | Article 13 deals with financial resources and mechanisms in support of the implementation of the Minamata Convention |
| **Summary of provisions relevant to South Africa** | • Allocating resources for implementation of the MC, taking into account national policies, priorities, plans and programmes using a variety of funding sources, including multilateral, regional and bilateral sources |
| **Relevant national stakeholder** | |
| **Department of Forestry, Fisheries and Environment** | **Role in relation to the above**<br>• Developing and implementing processes and system for efficient and effective administration of MC<br>• Creating or strengthening institutional enforcement arrangements<br>• Facilitating inter-agency coordination structures<br>• Developing mercury strategies and implementation plans. |
| | **Existing capacities**<br>• DFFE has the capacity to coordinate matters relating to the implementation of MC, including harnessing of funds through bilateral agreements, regional, international and multilateral instruments |
| **Remaining Capacity Gaps at National Level that need to be addressed before provisions can be met** | |
| • South Africa is yet to develop a National Implementation Plan (NIP) with budget requirements.<br>• No clear financial mechanisms and long-term plans are currently in place.<br>• Current national budget will not be sufficient for full implementation of the NIP. | |

**Table 37: Existing National Institutional Capacity and Remaining Gaps in relation to Article 16**

| **Article 16 - Health Aspects** | |
|---|---|
| **Description of article** | Article 16 encourages parties to promote the development and implementation of strategies and programmes to identify and protect populations at risk. It also encourages parties to adopt and implement science based educational and preventive programmes on occupational exposure to mercury and mercury compounds, promote appropriate health-care services for prevention, treatment and care for populations affected by the exposure to mercury or mercury compounds & to establish and strengthen institutional and health professional capacities. |
| **Summary of provisions relevant to South Africa** | • Promote the development and implementation of strategies and programmes to identify and protect populations at risk.<br>• Promote the development and implementation of science-based educational and preventive programmes on occupational exposure to mercury and mercury compounds.<br>• Promote appropriate health-care services for prevention, treatment and care for populations affected by the exposure to mercury or mercury compounds.<br>• Establish and strengthen, as appropriate, the institutional and health professional capacities for the prevention, diagnosis, treatment and monitoring of health risks. |
| **Relevant national stakeholders** | |
| **Department of Forestry, Fisheries and Environment** | **Role in relation to the above**<br>• Promote the development and implementation of strategies and programmes to identify and protect populations at risk. |
| | **Existing capacities**<br>• DFFE has the capacity to identify populations at risk and coordinate matters relating to the management of exposed populations |
| **Department of Science and technology in collaboration** | **Role in relation to the above**<br>• Undertake Mercury related research including exposure analysis and health impact assessments |
| | **Existing capacities** |

| | |
|---|---|
| **with Research institutions (CSIR, Universities, etc.)** | • DST has the capacity to promote the development and implementation of science-based educational and preventive programmes on occupational exposure to mercury and mercury compounds. |
| **Department of Health (DoH)** | **Role in relation to the above**<br>• Issue and promote adherence to, norms and standards relating to environmental conditions that constitute a health hazard.<br>• Develop the required public health strategy element of the national action plan to reduce the health impacts of Mercury.<br>• Facilitate research which contributes to knowledge of the effects of Mercury in the environment on the human body.<br>• Distribute information creating public awareness and education on the impacts of exposure to Mercury on the human body. |
| Department of Education (DoE) | • Educate school children on the harmful effects of Mercury<br>• Ensure that the health impacts of mercury are covered in curriculum of specific qualifications and or subjects |
| Department of Labour | • Ensure that workers are protected from the harmful impacts of Mercury |
| **Remaining Capacity Gaps at National Level that need to be addressed before provisions can be met** | |
| • South Africa needs to develop a National Implementation Plan (NIP) with specific actions required to address health aspects.<br>• Training of healthcare professionals on the prevention, diagnosis, treatment and monitoring of health risks is required. | |

**Table 38: Existing National Institutional Capacity and Remaining Gaps in relation to Article 17**

| **Article 17 – Information exchange** | |
|---|---|
| **Description of article** | Requires parties to facilitate the exchange of various types of information |
| **Summary of provisions relevant to South Africa** | • Collecting and disseminating information on annual quantities of mercury and mercury compounds emitted, released, or disposed; and other information specified in Article 18.<br>• Sharing information on the health and safety of humans and the environment as non-confidential, in accordance with Article 17.5.<br>• Reporting to the COP on progress in implementing Convention obligations under Article 21. |
| **Relevant national stakeholders** | |
| | **Role in relation to the above**<br>• Developing and implementing processes and system for efficient and effective administration of MC. |

| | |
|---|---|
| **Department of Forestry, Fisheries and Environment** | **Existing capacities**<br>• DFFE is the designated focal point for MC |
| **Remaining Capacity Gaps at National Level that need to be addressed before provisions can be met** | |
| • None | |

**Table 3917: Existing National Institutional Capacity and Remaining Gaps in relation to Article 18**

| **Article 18 – Public Information, Awareness and Education** | |
|---|---|
| **Description of article** | Article 18 emphasises the importance of public information, awareness and education |
| **Summary of provisions relevant to South Africa** | • Public information, awareness and education |
| **Relevant national stakeholder** | |
| **Department of Forestry, Fisheries and Environment** | **Role in relation to the above**<br>• Undertaking awareness raising activities in accordance with the NEM:WA and the National Waste Management Strategy. Such awareness can have directed focus on Mercury waste. |
| **Department of Health (DoH)** | **Role in relation to the above**<br>• Distribute information creating public awareness and education on the impacts of exposure to mercury on the human body. |
| **Remaining Capacity Gaps at National Level that need to be addressed before provisions can be met** | |
| • Coordination of activities between the relevant stakeholders is necessary.<br>• There must be various initiatives, including a program to train customs officials to help them address transboundary movement issues.<br>• There is no dedicated section at DEA to implement Public Education, Communication and Outreach programs on Mercury/chemicals topics. | |

**Table 180: Existing National Institutional Capacity and Remaining Gaps in relation to Article 19**

| **Article 19 - Research, Development and Monitoring** | |
|---|---|
| **Description of article** | Article 19 relates to research, development and monitoring. |

| | |
|---|---|
| **Summary of provisions relevant to South Africa** | • Inventories of use, consumption, and anthropogenic emissions to air and releases to water and land of mercury and mercury compounds.<br>• Modelling and geographically representative monitoring of levels of mercury and mercury compounds in vulnerable populations and in environmental media, including biotic media such as fish, marine mammals, sea turtles and birds, as well as collaboration in the collection and exchange of relevant and appropriate samples.<br>• Assessments of the impact of mercury and mercury compounds on human health and the environment.<br>• Harmonized methodologies for the activities undertaken under subparagraphs (a), (b) and (c).<br>• Information on the environmental cycle, transport (including long-range transport and deposition), transformation and fate of mercury and mercury compounds in a range of ecosystems, taking appropriate account of the distinction between anthropogenic and natural emissions and releases of mercury and of remobilization of mercury from historic deposition.<br>• Information on commerce and trade in mercury and mercury compounds and mercury-added products.<br>• Information and research on the technical and economic availability of mercury-free products and processes and on best available techniques and best environmental practices to reduce and monitor emissions and releases of mercury and mercury compounds. |
| **Relevant national stakeholders** | |
| **Department of Forestry, Fisheries and Environment** | **Role in relation to the above**<br>• Compilation of Mercury inventories and continuously update such inventories |
| | **Existing capacities**<br>• The initial Mercury inventory (level 2) is already in existent.<br>• DFFE hosts the National Atmospheric Emissions Inventory System (NAEIS) that provide Mercury information from some of the atmospheric emission listed activities. |
| **Research institutions (CSIR, WRC, Universities, etc.)** | **Role in relation to the above**<br>• Undertake Mercury related research including the impact of mercury and mercury compounds on human health and the environment |
| | • Various research capabilities |
| **Department of Health (DoH)** | **Role in relation to the above** |

| | |
|---|---|
| | • Facilitate research which contributes to knowledge of the effects of Mercury in the environment on the human body. |
| **Remaining Capacity Gaps at National Level that need to be addressed before provisions can be met** | |
| • Government needs to influence research direction and agenda to Mercury and support universities in soliciting funding for such research<br>• Financial resources and support are required to undertake impactful mercury research | |

**Table 41: Existing National Institutional Capacity and Remaining Gaps in relation to Article 21**

| **Article 21- Reporting** | |
|---|---|
| **Description of article** | Parties shall report to the Conference of the Parties, through the secretariat on the measures taken to implement the provisions of the Convention and the effectiveness of those measures as well as the possible challenges in meeting the objectives of the Convention &Parties shall include in their reporting the information called for in the different articles of the Convention |
| **Summary of provisions relevant to South Africa** | • Each Party shall report to the COP, through the Secretariat, on the measures it has taken to implement the provisions of this Convention and on the effectiveness of such measures and the possible challenges in meeting the objectives of the Convention. |
| **Relevant national stakeholders** | |
| **Department of Forestry, Fisheries and Environment** | **Role in relation to the above**<br>• Facilitating inter-agency coordination structures.<br>• Developing and implementing processes and system for efficient and effective administration of MC |
| | **Existing capacities**<br>• Chemicals Management unit of DFFE has the capacity to coordinate reporting under MC |
| **Remaining Capacity Gaps at National Level that need to be addressed before provisions can be met** | |
| • None | |

# CHAPTER IV: IDENTIFICATION OF POPULATIONS AT RISK AND GENDER DIMENSIONS

## 4.1. Preliminary review of potential populations at risk and potential health risks

The populations that are at risk of the health impacts of Mercury are (i) those who are more sensitive to the effects of mercury and (ii) those who are exposed to higher levels of mercury. With regard to sensitive populations, it has been demonstrated that the fetus, new-born and children are especially susceptible to mercury exposure because of the sensitivity of the developing nervous system. In addition to in utero exposure, neonates can be further exposed through mercury contaminated breast milk, although only a small percentage of maternal mercury is excreted in breast milk. Pregnant women and women who might become pregnant are considered to be potential high-risk groups because of potential exposure to the fetus. Individuals with preconditions, such as diseases of the liver, kidney, nervous system, and lung are also at higher risk of suffering from the toxic effects of mercury.

With regard to exposure, populations that are more at risk are those exposed to higher levels of mercury, either through occupational, mercury-added products or environmental exposure. This group also includes those who regularly consume a regular diet of fish and other seafood, particularly larger predatory fish. This is explained in the paragraphs below within the South African context.

### 4.1.1. Populations relying on fish in diet

In South Africa, communities living along the coastal areas, such as Cape Town and Durban, are likely to be more exposed to Mercury than the majority of the nation that lives inland. This is because by virtue of their proximity to the coast, they incorporate more fish and sea food in their diet than the rest of the population in the country.

Communities that consume fish from contaminated rivers are also at risk. A study of Mercury in catfish samples obtained from Inanda Dam (near a historical chlor-alkali plant) showed fish Mercury levels in the range 0.2-1.78 µg/g (PapuZamxaka, et al., 2010). The upper limit of this range is higher than the US FDA limit of 1.0 mg /kg.

Meanwhile, a study by the Council for Scientific and Industrial Research (CSIR) showed that the fish sold in South Africa's retail stores contains mercury levels well above the World Health Organisation (WHO) guidelines (News 24, 2016). The study determined the average mercury concentration in the fish analysed and found that the concentration for swordfish to exceed 1mg/kg. Accordingly, the limit that is allowable for fish products sold to the public is 0.5mg/kg for most fish, but allowance is made for naturally higher mercury accumulation in large predatory fish such as swordfish, tuna and others, and for these the guideline is 1mg/kg.

### 4.1.2. Communities subsiding on ASGM

Mercury is often used in ASGM to help separate gold from sediments or ore using rudimentary processing methods. In South Africa, ASGM is an illegal activity, it continues to occur in specific areas, especially near historical gold mines. It has been estimated that between 8 000 to 20 000 small-scale gold miners are operating in the country: with operations mainly in Mpumalanga, Gauteng and Limpopo provinces (CoMSA, 2006).

When workers combine mercury with gold-laden material, mercury forms an amalgam with gold and some other precious metals, allowing their extraction from the mixture. The amalgam is then heated, often in or near homes, to evaporate the mercury and recover the gold. During this process, mercury losses to the environment occur at two stages:

1. During the amalgamation process, miners, because of misunderstanding of the techniques, use excess mercury or worse, apply mercury to whole ore (the raw output of the crushing step without pre-concentration). Because of poor awareness on the dangers of mercury, miners do not attempt to recover the excess mercury and it is released directly into the environment. The ratio of mercury uses to gold produced, in case of whole ore amalgamation has been reported to reach 20kg of mercury used for 1kg of gold produced (20:1) but figures as high as 50:1 have been reported in extreme case (Practical Guide: Reducing mercury use in Artisanal and Small-Scale Gold Mining, AGC, 2012).
2. During the amalgam roasting process, mercury is released into the air and the surrounding environment and is directly inhaled by workers and their families. In this

step of the process, because the amalgam is about 50% mercury – 50% gold, the mercury loss to the atmosphere when no control mechanism is used, is equivalent to the amount of gold produced. However, higher values have been reported when the excess mercury is not properly removed from the amalgam or when silver is occurring with gold in the ore as the mercury will form an amalgam with both metals.

South Africa, which is a global mining powerhouse has put in place structures to safeguard the interests of artisanal and small-scale miners under the Mineral and Petroleum Resources Development Act (MPRDA), Act 28 of 2002. However, pertinent issues such as lack of a common definition of ASM; being unable to distinguish and categorize the different types and levels of artisanal and small-scale miners; the high standards or benchmarks for environmental and social regulations; and other geo-political dynamics, also make providing tailored solutions to ASM difficult.

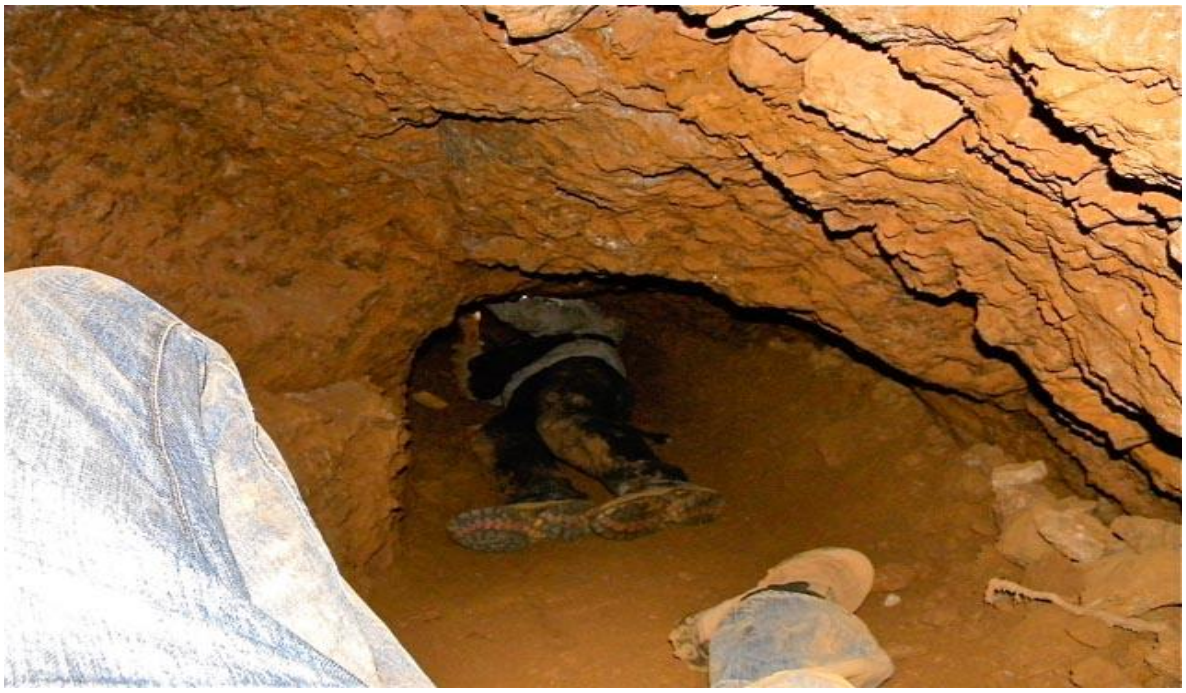

**Figure 10: Interior of an artisanal mine/tunnel near Low's Creek, Mpumalanga Province, South Africa**

The fact that miners are not aware of the risks associated with Mercury use also reduces community led drivers to move to alternative techniques. In many countries, limited health resources are concentrated in urban areas. Despite improvements in recent years, overall, many people still do not have access to improved drinking water or sanitation facilities let

alone proper health care facilities and well-trained professionals that can identify and treat Mercury poisoning.

The informality in which the sector often operates is one of the root causes of mercury use and more importantly the difficulty for the ASGM communities to apply extraction methods that use less or no mercury. The informality barrier has caused past interventions to focus their efforts on already formalized communities, limiting the potential for replication of the successes to ASGM communities which are still informal and represent the largest share of ASG miners. Informality also allows ASGM communities to operate in the absence of appropriate environmental impact assessment and oversight, which contributes to deforestation and land-degradation, in turn affecting water resources and compounding mercury related human health impacts.

Another barrier to the adoption of better mining practices is the difficulty in accessing capital to finance the initial investments that are needed to switch to low or no mercury alternative techniques and technologies. Due to the lack of proper prospection on the extractable stocks of gold and the fact that ASGM operations are often located in remote areas where support services are not available, miners are not aware of the financing opportunities, cannot communicate investment opportunities with potential investors or cannot provide the guarantees required to secure traditional/commercial bank loans to shift to mercury free technologies. On the other hand, financial institutions often do not have the proper tools to assess the risks of investing in small-scale mining operations as the lack of stock prospects is often synonymous with excessive risk.

### 4.1.3. Communities living next to coal mining areas and coal-fired electricity plants

Burning coal for power and heat is a major source of Mercury. Coal contains Mercury and other hazardous air pollutants that are emitted when the coal is burned in coal-fired power plants, industrial boilers and household stoves. Coal-fired electricity plants are the highest contributors to mercury emissions in South Africa and may result in exposure to communities residing near Power plants.

A CSIR study on evidence of mercury exposure in a particular low-income community in South Africa, determined the extent of mercury exposure in a community close to mercury sources. The community was situated in an area where there are coal-fired power stations and within 5km of artisanal gold mining activities. The houses in the community were situated far apart amongst dense vegetation (Oosthuizen, MA *et al*, 2010).

Levels of mercury in urine and blood samples were compared to the South African guidelines for individuals who are not exposed to mercury in the workplace1. The following were found:

- 57.1% (16 out of 28) of the urine sample levels were at or above the guideline of 5 µg/g creatinine. The maximum urine level detected was 63.5 µg/g creatinine.
- 21% (3 out of 14) of the blood sample levels were at or above the guideline of 10 µg/l. The maximum blood level detectedwas 24.0 µg/l.

The urine and blood maxima were also above the occupational Biological Exposure Index (BEI) for South Africa, which are 35 µg/g creatinine for urine and 15 µg/l for blood1 (Oosthuizen, MA et al, 2010).

**Table 42: South African guidelines for mercury in blood and urine**

| Sample | Not Occupationally Exposed | Occupationally Exposed: prior to shift BEI* |
|---|---|---|
| **Urine** | <5.0 *u*g/g Creatinine | <35 *u*g/g Creatinine |
| **Blood** | <10 *u*g/l | 15 *u*g/l |
| *Based on South African Biological Exposure Index (BEI) Occupational Safety and Health Act (Act 85 of 1993) | | |

A major factor affecting the amount of mercury emitted into the atmosphere is the type and efficiency of emissions abatement equipment at a power station. Eskom (a major power utility in South Africa) employs particulate emission control technology at all its currently operating coal-fired power stations, and new power stations are being built with sulphur dioxide abatement technology. A co-beneficial reduction of mercury emissions exists as a result of the implementation of emission control technology (Roos BL, 2012).

### a) Burning of coal and waste in low income communities

In South Africa, more than 4.7 million people live in informal settlements without basic services such as clean energy, water and sanitation/waste collection (Huchzermeyer et al.,

2011). What is known is that these communities often resort to the use of coal, wood and other fossil fuels for cooking and warming. This is because coal is very cheap in some areas, especially near mining areas, which makes it a favoured source of fuel for such communities. Since Mercury exist is known to exist in South African coals, these communities are at risk of Mercury exposure as they burn coal for cooking and heating. The extent of Mercury exposure by these communities is not fully understood. Hence, there is a need therefore to undertake an assessment of Mercury exposure in these communities.

Typical in these communities is also the issue of open burning of waste. This is because informal settlements seldom receive proper waste collection services, hence they resort to the open burning of uncollected waste. This makes these communities be exposed to the double burden of Mercury exposure.

**b) Communities using mercury for traditional medical practices**

In some traditional medicine, it was noted that Mercury is sometimes used as part of some traditional medicines, purely based on this fascinating property; it being a liquid metal, heavy and shining and not easily contained. A study done in South Africa has shown that metallic mercury is being use by South African Traditional Health Practitioners for healing purposes, and two main routes of administration were oral and sub-cutaneous implantations. The most common responses for mercury administration were for childbirth and protection against guns. That is, it is believed that oral consumption of Mercury provides ease of childbirth for pregnant women. It is also believed that Mercury can protect one against gun shots if one is involved with dangerous/criminal activities. The significance of mercury uses in South African traditional medicine reported by South African traditional health practitioners is due to cultural practice. This socio-cultural mercury use is a potential source of exposure to both traditional healers and their patients.

**c) Communities living near industrial activities that formerly or currently use mercury**

As indicated earlier, South Africa has a history of mercury use in industrial processes. This include former use of mercury in chlor-alkali production. A study by Papu-Zamxaka et al. (2009) showed high levels of Mercury in various environmental and human samples from

communities that lives near a historical chlor alkali plant (Thor Chemicals plant) near Mngceweni River which joins the uMgeni River and flows into Inanda Dam). The study found elevated levels of Mercury in sediments (mean 154 ug/g)(max 987 ug/g) in Mngceweni River, fish from the Inanda Dam (up to 1.78 ug/g) and hair (up to 51ug/g hair) from samples collected from residents of three villages along the banks of the Inanda Dam. The study results showed that 50% of the fish samples and 17% of hair samples collected from villagers had mercury concentrations that exceeded guideline levels of the World Health Organization.

## 4.2. Assessment of potential gender dimensions related to the management of mercury

Women of childbearing age as well as children have been found to be more vulnerable to the Mercury exposure compared to other groups. In pregnant women in particular, Mercury can cross the placenta into the foetus, accumulating in the fatal brain and other tissues. Subsequently, foetuses are most susceptible to developmental effects due to mercury. Methylmercury exposure in the womb can result from a mother's consumption of fish and shellfish.

Methyl mercury can also be passed to infants through breast milk. Once consumed, the methylmercury will cause impaired neurological development in these infants. Therefore, cognitive thinking, memory, attention, language, and fine motor and visual spatial skills may be affected in children who were exposed to methylmercury.

Additionally, women are more exposed to Mercury through the use of Mercury-added cosmetics and personal products such as soaps, creams and shampoos. The use of skin lightening creams in South Africa is quite relevant due to prevailing beauty perception, with particular preferences for lighter, unblemished skin. Although there is no recent data on the number of women using skin lightening, historical report by Barr (1972) suggested that 35% of South African women use these products. Local women do use skin lightening creams to remove blemishes due to excessive sun damage. Local women generally have limited knowledge of the use of harmful chemicals in cosmetics.

# CHAPTER V: AWARENESS/UNDERSTANDING OF WORKERS AND THE PUBLIC; AND EXISTING TRAINING AND EDUCATION OPPORTUNITIES OF TARGET GROUPS AND PROFESSIONALS

The use or working around chemicals have inherent effects to human health, regardless of which chemicals they are. It is even more dangerous when exposure is prolonged. Many if not all members of the societies in South Africa and the developing countries have very little knowledge of these impacts.

Article 18 of the Minamata Convention requires Parties, within their capabilities, to:

> (a) Promote and facilitate provision to the public of available information on:
>
> > (i) The health and environmental effects of mercury and mercury compounds;
> >
> > (ii) Alternatives to mercury and mercury compounds;
>
> (b) Educate, train and undertake public awareness related to the effects of exposure to mercury and mercury compounds on human health and the environment in collaboration with relevant intergovernmental and non-governmental organizations and vulnerable populations including women and children, as appropriate.

In this chapter we highlight perceived understanding of the general public and workers regarding mercury impacts. This is more perceived than factual as there was no actual survey undertaken to evaluate the knowledge or understanding thereof, however, during various activities in the development of this document, some assessment of how much people know about mercury itself was done.

## 4.1. Understanding of workers and the public

Mercury is generally only seen as a fascinating element by the public due to its physical properties. The general public and workers do not know where mercury comes from and what its uses are. Those that have done some science at school would know that it exists in thermometers and those in the AGSM appreciate its use in Gold refining. In some traditional medicine, it was noted that Mercury is sometimes used as part of some traditional medicines,

purely based on its fascinating properties; it being a liquid metal, heavy and shining and not easily contained.

One study to describe the prevalence and practice of mercury use in South African traditional medicine showed that the two main routes of administration were oral and sub-cutaneous implantations. The most common responses for mercury administration were for childbirth and protection against guns. Socio-cultural mercury use is a potential source of exposure to both traditional healers and their patients. In light of such findings, public education messages and regulatory measures need to be affected.

Several International Conference on Mercury as a Global Pollutant have gone a long way in sharing knowledge and continue to have stimulating discussions to push forward the field of mercury science. Another element of these conferences is to promote better understanding and effective management of mercury releases and emissions to decrease human and wildlife exposure. However, this information continues to circulate only in the few high-level scientific personnel and does not effectively trickle down to ordinary citizens.

## 4.2. South Africa's Mercury Awareness Strategy

South Africa is in the final process of compiling a "Strategy for awareness raising on mercury and mercury compounds aimed at national stakeholders". The Goal of awareness raising is generally to increase concern, informing the targeted audience, creating a positive image, and attempt to change their behaviour. There exist opportunities therefore, with an awareness program:

- To highlight the health impacts of Mercury and its compounds to the general public of South Africa over a years' time.
- To inform the entire population about the Minamata Convention on Mercury.
- To teach the vulnerable groups about ways of managing Mercury and its compounds in order to minimize or remove exposure to Mercury emissions.
- To facilitate the integration of mercury management into the national environmental agenda in South Africa, and facilitate the transition to sustainable development designs and processes

- To ensure that populations make informed choices about the handling and exposure to mercury and mercury-containing products.
- To positively highlight SA MIA project achievements, good practices and lessons learned for South Africa.

The following activities will be integral to the implementation of the strategy:

- Undertaking training to educate workers about mercury exposure, safe practices for working with fluorescent bulbs
- Outreach activities focused on ASGM sector aimed at reducing exposure to mercury and promoting alternatives.
- The mercury risk communication activities directed toward raising awareness about sources of mercury as well as environmental and health impacts of mercury and make it a priority to provide consumers with reliable risk information about mercury exposure so that they can make informed choices.
- Conducting risk communication in conjunction with mercury reduction activities, such as school clean-outs or thermometer collection programs and these mercury outreach to schools and communities should occur with Department of Education and Department of Health assistance.
- National efforts on mercury risk communication aiming at making information widely available to the public and holding national workshops that bring together people from across the country to share information on mercury risk communication.

Two major categories of stakeholders are as follows.

***Category 1: Those that will Implement the Convention and enforce its domestication, thus execution of the strategy***

This category comprises of the Government departments and Agencies as well as Non-governmental organizations, whom by nature of their work impinge on the awareness raising and control of substances of importance to the health and environment.

***Category 2: Those that are recipients of the information due to their activity or vulnerability***

This category comprises the general public, groups in the workplaces, as well as clients and partners of category I stakeholders.

**Table 43: Stakeholders to be targeted for awareness raising based on their activity or vulnerability**

| Target group | Message category: | Key Tools |
|---|---|---|
| Environmental Inspectors | Minamata Convention obligations and Domestication Regulations<br>Hg Source categories<br>Protection of Workers | Workshops<br>Work Toolkits |
| South African Police Services | Minamata Convention obligations and Domestication Regulations<br>Hg Source categories | Workshops<br>Work Toolkits |
| Power plant workers | Hg Source in a power plant<br>Protection of Workers | Workshops and labour Meetings<br>Standard Operating Procedures |
| Mining Engineers and Inspectors | Minamata obligations and Domestication regulations<br>Hg Source categories<br>Protection of Workers | Workshops<br>Work Toolkits |
| Manufacturing workers | Hg Source categories<br>Protection of Workers | Workshops and labour meetings<br>Standard Operating Procedures<br>Posters and Pamphlets |
| Miners | Minamata obligations<br>Hg source categories<br>Protection of Workers | Workshops and labour meetings<br>Standard Operating Procedures<br>Posters and Pamphlets |
| Teachers | Minamata obligations<br>Hg Source categories<br>Protection of Workers | Workshops and labour meetings<br>Standard Operating Procedures<br>Posters and Pamphlets |
| All health professionals | Minamata Convention obligations and Domestication regulations<br>Hg Source categories<br>Protection of Workers | Workshops and labour meetings<br>Standard Operating Procedures<br>Posters and Pamphlets |
| Waste Pickers and Recyclers | Hg Source categories<br>Protection of Workers | Group meetings<br>Standard Operating Procedures<br>Posters and Pamphlets<br>Radio and TV |
| General public | Minamata Convention obligations and Domestication regulations<br>Hg Source categories<br>Protection of Workers | Community meetings in Vulnerable points<br>Posters, Pamphlets and T shirts<br>Radio and TV,<br>Social Media, billboards, website, explanatory plaques, public events, leaflets, t-shirts and print materials |
| Children and Women | Hg Source categories<br>Protection of Women and Children | Community meetings in Vulnerable points<br>Posters, Pamphlets and T shirts<br>Radio and TV |

The following outreach activities will be critical for effective implementation of the awareness strategy:

**Outreach Activities to Consumers on Mercury-containing Products and Mercury-free Substitutes**: DEA have already developed an inventory of mercury containing products and mercury-free substitutes and will make the information available through the website and brochures which will be developed and be distributed to various stakeholders and the public.

**Outreach to Health Professional**: Dentistry is another major area of intentional Hg use. Department of Health and Health professionals are an important partner in the dissemination of mercury risk information. There is a need to work with the department of health to educate health professionals about the negative health impacts that mercury is causing and also partner with health care associations and universities to disseminate mercury risk information and to educate future health professionals of proper disposal of mercury containing medical equipment. A focus on the presence of methyl-mercury (MeHg) in fish is also crucial in order to raise awareness and communicate appropriate dietary guidelines, especially for vulnerable populations such as pregnant women and small children with the help of department of health.

**Outreach to Schools:** As part of awareness there is a need to work with Department of Education and Science and Technology to promote Mercury-containing Products and mercury reduction in school more specifically the science teachers and students and make them aware of the risks of exposure to mercury and the availability of mercury-free alternatives.

# CHAPTER VI: IMPLEMENTATION PLAN & PRIORITIES FOR ACTION

South Africa is yet to develop a National Implementation Plan (NIP) for the implementation of the Convention. The objective of the NIP is to reduce human exposure from anthropogenic Mercury sources identified in the inventory level 2 study. The plan will contain strategies and measures to phase out the use of non-essential mercury-containing products and implement safe handling, use and disposal of remaining mercury-containing products.

The priority actions below set out an initial set of priority actions that arise from the initial assessment described in the previous chapters. The first priority will be actions, largely within government, to establish a sound regulatory and/or administrative framework for the implementation of the convention.

**Priority 1:** Ratification and domestication of the Minamata Convention on Mercury.

**Priority 2:** Phasing down/out of the Dental Amalgam use in the health sector.

**Priority 3:** Development of the ASGM National Action Plan.

**Priority 4**: Reducing emissions from coal-fired power plants and industrial boilers.

**Priority 5**: Effective management of mercury containing waste.

**Priority 6:** Strengthening and upgrading of relevant laboratories for detection of mercury.

**Priority 7:** Awareness and Training.

Details on how these priorities could be accounted for in the implementation plan are provided in Table below.

**Table 44: Proposed Aspects of SA's National Action Plan**

| PRIORITY | DEFINITION | OBJECTIVES | OUTPUTS | ACTIVITIES |
|---|---|---|---|---|
| **Priority 1** | Ratification and domestication of the Minamata Convention on Mercury. | Establishment of an effective administrative and legal framework for the implementation of the Minamata Convention, | • Minamata Convention on Mercury ratified,<br>• National policy on mercury management developed,<br>• Legal and Regulatory changes to address the Minamata Convention and the obligations set out in its articles enacted.<br>• Administrative responsibilities assigned.<br>• Sustainable systems for continuing and comprehensive inventory and reporting established. | • Ratification and domestication of the Minamata Convention on Mercury.<br>• Development of a national policy addressing the management of mercury throughout its life-cycle, compatible with the Minamata Convention and setting out short, medium and long-term priorities for action, agreed by all stakeholders.<br>• Development, amendment and enactment of legislation to address the Minamata Convention and the obligations set out in its articles.<br>• Reviewing of terms of reference coordinating structures.<br>• Assignment of administrative responsibilities.<br>• Establishment of sustainable system for continuing and comprehensive inventory and reporting. |
| **Priority 2** | Phasing down/out of the Dental Amalgam use in the health sector. | Reduce use of dental amalgam. | • Improve dental health.<br>• Continued growth in the use of alternative dental restorative materials.<br>• Amalgam use discontinued for vulnerable patients.<br>• Dental professionals trained to prefer alternatives to amalgam.<br>• Reduced releases of amalgam wastes from dental clinics. | • Trade study and survey of dental amalgam waste management practices.<br>• Setting national guidelines aiming at minimizing the use of dental amalgam, particularly in the care of children's primary teeth and of pregnant women.<br>• Restricting the use of dental amalgam to is encapsulated form.<br>• Promoting the use of cost effective and clinically effective mercury-free alternatives for dental restoration taking into consideration national circumstances. |

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| | | | | Encouraging and promoting research and development on alternative methods for dental amalgam. |
| **Priority 3** | Development of the ASGM National Action Plan | Reduced use of mercury amalgamation in ASGM | • National coordination mechanism (NCM) and organizations process for NAP preparation established.<br>• National overview of the ASGM sector undertaken, including analysis and characterization of the sector and the level of formalization of miners.<br>• ASGM's mercury baseline estimates, use and practices undertaken in South Africa.<br>• Worst practices of mercury amalgamation eliminated.<br>• Miners trained in and using alternative processing techniques that minimize or eliminate mercury emissions and releases.<br>• Vulnerable populations protected from mercury exposure.<br>• Mercury emission and releases to the environment minimized or eliminated. | • Establishment of the National Coordinating Committee and Coordinator.<br>• Training of a technical experts and government officials on data collection methodologies, reliability, credibility, data analysis etc.<br>• Identification and assessment of the amounts of emission sources of mercury and release sources of mercury to land and water.<br>• Identification of old, historical source of mercury contamination (such as abandoned mining sites) and known information about impacts and exposure to mercury.<br>• Identification of key sectors, municipalities, communities and other stakeholders affected by or involved with important mercury sources and/or emissions.<br>• Review of existing legislation and policies, identification of gaps for meeting the Minamata Convention requirements for the ASGM sector and the elimination/reduction of Hg in this sector.<br>• Development of the public health strategy on exposure and prevention of miners and vulnerable populations (especially women and children).<br>• Dissemination of information and training to miners. |
| **Priority 4** | Reducing emissions from coal-fired power plants and industrial boilers | Reduce emissions of mercury from point of source categories. | • Emissions from coal-fired power plants and industrial boilers minimized. | • Development of National Hg reduction plan with emission targets. |

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| | | | • Investment in new facilities incorporates BAT/BEP to minimize emissions. | • Best Available Technique (BAT) and Best Environmental Practices (BEP) adoption.<br>• Reinforcement of mercury emission monitoring standard system.<br>• Development of environmental registration system.<br>• Improvement of the management system for industrial boilers |
| **Priority 5** | Effective management of mercury waste | Reduction of a negative impact of mercury waste | • Coordinated mercury waste disposal processes of mercury waste across various stakeholders.<br>• Improved mercury waste disposal processes. | • Separation of mercury-containing products from municipal waste streams.<br>• Establishment of effective medical waste separation at source in clinics.<br>• Application to e-waste practices to techniques that minimize or prevent mercury emission and release.<br>• Development of environmentally sound interim storage for mercury waste prior to disposal under the terms of the Basel Convention. |
| **Priority 6** | Strengthening and upgrading of relevant laboratories for detection of mercury. | Selection and upgrading of laboratories for specialized chemical analysis that will include mercury. | • Identified laboratories for specialized chemical analysis that will include mercury.<br>• Upgraded laboratories with certification by South African Bureau of Standards (SABS), South African National Accreditation System (SANAS) and International Organisation for Standards (ISO) | • Conducting an inventory of existing laboratories with capacity to analyse mercury.<br>• Upgrading of selected laboratories to meet international best practices to analyse mercury emissions and releases.<br>• Certification of the upgraded laboratories by South African Bureau of Standards (SABS), South African National Accreditation System (SANAS) and International Organisation for Standards (ISO). |

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| **Priority 7** | Awareness and Training | Awareness building on the impacts of mercury through training. | • Training programs developed and awareness raising campaigns implemented across various disciplines against mismanagement of mercury.<br>• Awareness campaigns against waste trafficking.<br>• | • Training of analytical professionals on the use of the upgraded equipment for analysing mercury and its compounds.<br>• Training of hospital and clinic officials on medical waste separation at source programs.<br>• Training of customs officials on the inspection of mercury on goods and their permissible limits. |

# CHAPTER VII: CONCLUSION

This report contains information from the initial assessment of Mercury for South Africa. The assessment identified the major sources of Mercury that needs to be prioritised in the implementation of the convention i.e. power generation, artisanal gold mining activities, as well as the use of Mercury in products and processes. The assessment also suggests the following needs for South Africa, in its efforts towards the implementation of the Minamata convention:

- Development of a National Implementation Plan (NIP) with clear resource requirements;
- Assessment of environmental and human exposure to mercury (assess exposure pathways for different sources, determine exposure concentrations and identify vulnerable populations);
- Undertaking epidemiological studies to support human exposure assessments above;
- Assessment of Mercury emissions and exposure in low-income communities that use coal for cooking and space heating;
- Assessment of the cost of implementing Best Available Technologies and Techniques (sector specific) and the benefits thereof;
- Assessment of the socioeconomic implications of phasing out specific Hg-containing products (Various sectors e.g. health, pharmaceuticals, etc);
- Assessment of the suitability of South Africa's treatment and disposal facilities to safely handle different types of Mercury waste;
- Assessment and screening of Mercury levels at suspected contaminated sites;
- Assessment of options available to the country for final disposal (grave) of recovered Mercury (e.g. encapsulation, deep mine storage etc.), as well as the pros and cons);
- Assessment of environmental practices that are conducted by e-waste recycles and other recyclers to avoid Mercury contamination and formulation of best practice guide;
- Implementation of awareness raising strategy;

- Establishment of a system for continued inventory and reporting;
- Establishment of tariff codes and legislation for the control of import and export of Mercury products;
- Listing of Minamata Convention Annex B and D activities under the relevant regulations of NEMA, NWA, NEMWA and NEMAQA.

# ANNEXURES

## ANNEX I: Stakeholder Engagement process

DFFE has followed a consultative approach in the development of SA MIA. The initial assessments were introduced in the Multistakeholder Committee on Chemicals Management (MCCM) meeting in 2016, and launched in November 2017, in Durban, whereby stakeholders were invited and most of them attended.

A Subsidiary Technical Committee on the Minamata Initial Assessment (MIA) on Mercury for South Africa, under the Multistakeholder Committee on Chemicals Management (MCCM), was established so that the study could be discussed in detail by a focused group of experts. Several meetings of the Subsidiary Technical Committee were held, whereby progress was presented. These are 05 October 2017; 12-16 February 2018; 10 April 2018; 2-4 July 2018; 9 December 2019.

Request for data or samples was emphasized again during the meetings as the study was ongoing as very few industries or institutions were providing data or samples. When presenting the results of the study, the consultant also explained on several occasions how the Mercury Level 2 Toolkit works, and the importance of getting industry-specific data.

Progress on South African MIA activities was also reported quarterly to the MCCM. A list of MCCM members is provided in the table below.

| INSTITUTION | NAME OF REPRESENTATIVE | DESIGNATION | E-MAIL ADDRESS |
|---|---|---|---|
| **RELEVANT GOVERNMENT DEPARTMENTS** | | | |
| Department of Forestry, Fisheries, and Environment | Mr Obed Baloyi | Chief Director: Chemicals Management | OBaloyi@environment.gov.za |
| | Ms Noluzuko Gwayi | Director: International Chemicals and Waste Cooperation | NGwayi@environment.gov.za |
| | Mr Teboho Sebego | Deputy Director: International Chemicals and Waste Cooperation | TSebego@environment.gov.za |
| | Dr Vincent Gololo | Specialist: Industrial Process Engineer | VGololo@environment.gov.za |
| | Dr Shauna Costley | Deputy Director: Healthcare Waste | SCostley@environment.gov.za |
| | Mr Zama Mtembu | Deputy Director: Hazardous Waste | ZMtembu@environment.gov.za |
| | Mr Gordon Khaoue | Policy Analyst | GKhaoue@environment.gov.za |
| | Ms Brenda Maphanga | Assistant Policy Analyst | BMaphanga@environment.gov.za |
| Department of Health | Ms Flavia Makobe | Assistant Director | MakobFK@health.gov.za |
| | Mr Ramsook Loykisoonlal | Deputy Director | RLoykisoonlal@health.gov.za |
| Department of Science and Technology | Dr Mahlori Mashimbe | Director | Mahlori.mashimbe@dst.gov.za |
| | Dr Alufelwi Tshavhunwe | Deputy Director | Alufelwi.tshavhungwe@dst.gov.za |
| Department of Mineral Resources and Energy | Mr Morokane Molefe | Director | Molefe.Morokane@dmr.gov.za |

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|---|---|---|---|
| | Mr Joseph Legadima | Deputy Director | Joseph.Legadima@dmr.gov.za |
| Department of Water and Sanitation | Dr David Odusanya | Assistant Director | Odusanyad@dwa.gov.za |
| Department of Agriculture, Land and Rural Affairs | Ms Portia Dwane | Assistant Director | PortiaDW@daff.gov.za |
| Department of Employment and Labour | Ms Elize Laurens | Deputy Director | Elize.Lourens@labour.gov.za |
| **PARASTATALS** | | | |
| ESKOM | Maluta Mbedzi | Senior Advisor: Environment | mbedzim@eskom.co.za; MakhalMO@eskom.co.za / |
| | Olga Makgalemele | Advisor: Environment | olga.makhalemele@eskom.co.za |
| South African Weather Service (SAWS) | Dr Lynwill Martin | Senior Scientist: GAW program | Lynwill.Martin@weathersa.co.za |
| Council for Scientific and Industrial Research (CSIR) | | | |
| SABS | Tondani Tshamano | | Tondani.Tshamano@sabs.co.za |
| National Regulator for Compulsory Specifics (NRCS) | Langa Jele | Technical Specialist (Regulatory Research and Development) | Langa.Jele@nrcs.org.za |
| | Lancerlot Riyano | Technical Specialist (Electrotechnical) | Lancerlot.riyano@nrcs.org.za |
| **INDUSTRY** | | | |
| South African Dental Association (SADA) | Dr Nirvada Niranjan | Director | NNiranjan@sada.co.za |
| Association of Cementitious Material Producers (ACMP) | Dr Dhiraj Rama | Executive Director | Tel: 0823737706 dhirajr@acmp.co.za |
| Chamber of Mines | Matome Makwela | Environmental Advisor | MMakwela@chamberofmines.org.za |
| | Reginald Mabalane | Environmental Advisor | Rmabalane@chamberofmines.org.za |
| | Ms Stephina Mudau | Director | SMudau@chamberofmines.org.za |

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| Chemicals and Allied Industries Association (CAIA) | Mr Glen Malherbe | Head: Policy Analysis | glen.malherbe@caia.co.za |
| Cosmetics, Toiletries and Fragrances Association (CTFA) | Adelia Piementel | Executive Director | adelia@ctfa.co.za |
| | Dershana Valla | Head: Regulatory Services | dershana@ctfa.co.za |
| The Illumination Engineering Society of South Africa (IESSA) | Natasha Nel-Sakharova (Pr.Phys) | Director: Electricity and Magnetism Division | NNelSakharova@nmisa.org |
| Association for Representative Electrical/electronics Industry (AREI) | Warren Muir/Dennis Walden | President | warrenm@muirlen.co.za |
| **Non-Governmental Organizations (NGOs)/IGO** | | | |
| Groundworks | Mr Rico Euripidou | | rico@groundworks.org.za |
| World Health Organization | Dr Chatora | Executive Director | petjal@who.int |
| Africa Institute | Mr James Mulolo | Project Coordinator | JMulolo@environment.gov.za |
| | Dr Koebu Khalema | Program officer | kkhalema@environment.gov.za |
| **Academia** | | | |
| Cape Peninsula University of Technology | Dr Vernon Somerset | Senior Lecturer/Researcher | vsomerset@gmail.com |

## ANNEX II: UNEP Toolkit Calculation Spreadsheet

Submitted as a separate Excel file