A REPORT

OF

MERCURY USE IN PRODUCTS IN NIGERIA


By

Sustainable Research and Action for Environmental Development (SRADev Nigeria)

To

European Environmental Bureau / ZMWG

September 2014

"SRADev Nigeria acknowledges financial support by the Swedish Public Development Co-operation Aid through the Swedish Society for Nature Conservation and the European Commission via the European Environmental Bureau for this report. The sole responsibility for the content of this report lies with SRADev Nigeria. The Swedish Society for Nature Conservation and the European Commission are not responsible for any use that may be made of information contained therein."

Table of Content

LIST OF BOXES

LISTS OF FIGURES

LISTS OF TABLES

LIST OF ANNEXES

List of Acronyms

UNEP	United Nations Environmental Protection
UNEP GC	United Nation Environmental Protection Governing Council
INC	Intergovernmental Negotiating Committee
Dip Con	Diplomatic Conference
SRADev Nigeria	Sustainable Research and Action for the Environmental Development
NGO	Non Governmental Organisation
ZMWG	Zero Mercury Working Group
NESREA	National Environmental Standard Regulatory and Enforcement Agency
SON	Standard Organization of Nigeria
NAFDAC	National Agency for Food and Drug Administration and Control
FEPA	Federal Environment al Protection Agency
GMP	Good Manufacturing Practice
NEWMOA	Northeast Waste Management Officials' Association
CEMA	Customs & Excise Management Act
FMENV	Federal Ministry of Environment
LASUTH	Lagos State University Teaching Hospital
NCS	Nigerian Customs Service
ASGM	Artisanal Gold Mining
IPEN	International POPs Elimination Network

1.0 BACKGROUND

Literally all manufactured articles today, from consumer goods to machinery and construction materials, have chemicals included or added to them to enhance the appearance or performance of the product. Most of these chemicals are benign, with no known suspected risks. Research on the effects of chemicals, including some in common use, continues to identify hazards posed by them to human health and the environment. International trade of manufactured goods results in global distribution of the chemicals they contain. When used or discarded, these products can release chemicals to the environment, which can enter people's bodies through the air, water or food, as well as through direct skin contact. Addressing risks posed by these chemicals contained and transported in products requires action globally, on many levels and involving many actors.

Mercury and its compounds are such toxic substances which can have adverse effects on human health and the environment. It is one of those harmful chemicals that have a widespread of applications. The distribution of mercury globally is overwhelming due to its apparent applications in several items such as soap; cosmetics, antiseptics, paints, pesticides, pharmaceutical products, human and veterinary products and even in dental fixtures. Scientific evidence, including UNEP Global Mercury report, establishes mercury as an extremely toxic substance, which is a major threat to wildlife, ecosystem and human health at a global scale (Arvidson, Arvidsson &, Johansson 1994). It is also a major threat to fish that constitutes an all-important nutritious component of human diet. Populations who eat large amounts of fish and marine mammals are particularly at risk (Lutter and Irwin, 2002). Despite the risks due to mercury, Africans have very low awareness of this toxic substance which is used in products. Nigeria, like many Africa countries is a developing country whose citizens depend mainly on imported finished products, ranging from processed foods to medical equipment from developing and developed nations. This dependency made Africa region dumping grounds to many hazardous chemicals which include mercury.

The United Nations Environment Programme (UNEP) Chemicals Branch works to protect humans and the environment from adverse effects caused by chemicals throughout their lifecycle, including hazardous waste. There is need for information to understand the risks and how to control mercury at different stages in a product's life, from design and manufacturing via use, possibly recycling and ultimate waste disposal.

The evidences of the health risks, environmental impacts, the need for information and the regulation of mercury was what led to the UNEP Governing Council (UNEP GC) decision to start developing a global legally binding instrument on mercury (Decision 25/5). In February 2009, *An Intergovernmental Negotiating Committee (INC) was formed, under UNEP, to start formal deliberations in June 2010, leading to a legally binding Treaty on mercury on or before*

February 2013. The text for the future Minamata Convention on Mercury was agreed to on 19 January 2013, in Geneva. The diplomatic conference (Dip Con) where the treaty was adopted and opened for signature took place in Japan in October 2013. Nigeria became a signatory to the convention on 10 October 2013. This legally binding instrument would help control the use and handling of mercury.

SRADev Nigeria, an NGO focal point under the aegis of Zero Mercury Working Group (ZMWG) participated actively in all the stages of these negotiations until the Mercury Convention (INC6) carried out preliminary preparatory activities in support of ratification and implementation of the Mercury Treaty. This report is to present background information on the inventorisation of mercury-added product in the country to aid decision making in the ratification of the Minamata Convention. It will further contribute to investigations and initiatives aimed at bridging gaps between information demand and information availability in the global community as contained in article 18 paragraph 1 & 2 of the Minamata Convention.

*Box 1: The Mercury Convention (Article 4): **Mercury-added products** stipulate that……..*

1. Each Party shall not allow, by taking appropriate measures, the manufacture, import or export of mercury-added products listed in Part I of Annex A after the phase-out date specified for those products, except where an exclusion is specified in Annex A or the Party has a registered exemption pursuant to Article 6.

2. A Party may, as an alternative to paragraph 1, indicate at the time of ratification or upon entry into force of an amendment to Annex A for it, that it will implement different measures or strategies to address products listed in Part I of Annex A. A Party may only choose this alternative if it can demonstrate that it has already reduced to a *de minimis* level the manufacture, import, and export of the large majority of the products listed in Part I of Annex A and that it has implemented measures or strategies to reduce the use of mercury in additional products not listed in Part I of Annex A at the time it notifies the Secretariat of its decision to use this alternative. In addition, a Party choosing this alternative shall:

(a) Report at the first opportunity to the Conference of the Parties a description of the measures or strategies implemented, including a quantification of the reductions achieved;

(b) Implement measures or strategies to reduce the use of mercury in any products listed in Part I of Annex A for which a *de minimis* value has not yet been obtained;

(c) Consider additional measures to achieve further reductions; and

(d) Not be eligible to claim exemptions pursuant to Article 6 for any product category for which this alternative is chosen.

No later than five years after the date of entry into force of the Convention, the Conference of the Parties shall, as part of the review process under paragraph 8, review the progress and the effectiveness of the measures taken under this paragraph.

3. Each Party shall take measures for the mercury-added products listed in Part II of Annex A in accordance with the provisions set out therein.

4. The Secretariat shall, on the basis of information provided by Parties, collect and maintain information on mercury-added products and their alternatives, and shall make such information publicly available. The Secretariat shall also make publicly available any other relevant information submitted by Parties.

5. Each Party shall take measures to prevent the incorporation into assembled products of mercury-added products the manufacture, import and export of which are not allowed for it under this Article.

6. Each Party shall discourage the manufacture and the distribution in commerce of mercury-added products not covered by any known use of mercury-added products prior to the date of entry into force of the Convention for it, unless an assessment of the risks and benefits of the product demonstrates environmental or human health benefits. A Party shall provide to the Secretariat, as appropriate, information on any such product, including any information on the environmental and human health risks and benefits of the product. The Secretariat shall make such information publicly available.

7. Any Party may submit a proposal to the Secretariat for listing a mercury-added product in Annex A, which shall include information related to the availability, technical and economic feasibility and environmental and health risks and benefits of the non-mercury alternatives to the product, taking into account information pursuant to paragraph 4.

8. No later than five years after the date of entry into force of the Convention, the Conference of the Parties shall review Annex A and may consider amendments to that Annex in accordance with Article 27.

9. In reviewing Annex A pursuant to paragraph 8, the Conference of the Parties shall take into account at least:

(a) Any proposal submitted under paragraph 7;

(b) The information made available pursuant to paragraph 4; and

(c) The availability to the Parties of mercury-free alternatives that are technically and economically feasible, taking into account the environmental and human health risks and benefits.

2.0 INTRODUCTION

Mercury is a heavy, liquid metal at room temperature and a good conductor of electricity, it has unique characteristics that have historically been utilized in a wide variety of products, including barometers, numerous types of industrial equipment, measuring devices, convenience light switches in cars, batteries, light bulbs, flow meters at sewage treatment plants, and such novelty items as games and jewelry. Currently, various forms of mercury are used in fluorescent and other lighting, button-cell batteries, laboratory equipment, certain switches and relays, dental amalgam, chemical solutions, and a variety of other products. These mercury-added products are used in residential, commercial, as well as industrial environments. Additionally, elemental mercury is used in industrial processes, such as chlor-alkali production, artisanal gold mining, and certain religious and cultural ceremonies.

3.0 PROJECT JUSTIFICATION

The project was informed by the growing concern of the countries around the world moving to replace mercury-based devices with affordable, accurate and safer alternatives. National governments, provinces, states in Asia, Africa and Latin America are now moving forward to develop and implement policies to switch to mercury-free alternatives. The Nigeria governments through the Federal Ministry of Environment (*National Focal point on Mercury Convention)* has taken initiative in identifying hotspots and sectors involved in mercury consumption and emission and taking inventory of those hotspots using the UNEP "Toolkit for identification and quantification of mercury releases" *(Table 1),* but there is no known documented inventorisation of the amount of mercury-in-products categories and alternatives entering the country per annum from mercury-added products.

Therefore, the Report is intended to present background document useful for decisions making on Mercury use in products for Nigeria, applications and alternatives, in order to supplement and complement the government concerted effort for the complete inventorisation of mercury in the Nigeria state. The data gathering report on mercury products status would facilitate and strengthen the national coordinating mechanisms within the chemicals management infrastructure for efficient ratification and effective take off of Mercury Convention implementation in Nigeria.

Box 2: Annex A, Mercury-added products

The following products are excluded from this Annex:

(a) Products essential for civil protection and military uses;

(b) Products for research, calibration of instrumentation, for use as reference standard;

(c) Where no feasible mercury-free alternative for replacement is available, switches and relays, cold cathode fluorescent lamps and external electrode fluorescent lamps (CCFL and EEFL) for electronic displays, and measuring devices;

(d) Products used in traditional or religious practices; and

(e) Vaccines containing thiomersal as preservatives.

Part I: Products subject to Article 4, paragraph 1

Mercury-added Products || Date after which the manufacture, import or export of the product shall not be allowed (phase-out date)
Batteries, except for button zinc silver oxide batteries with a mercury content < 2%, button zinc air batteries with a mercury content < 2% || **2020**
Switches and relays, except very high accuracy capacitance and loss measurement bridges and high frequency radio frequency switches and relays in monitoring and control instruments with a maximum mercury content of 20 mg per bridge, switch or relay || **2020**
Compact fluorescent lamps (CFLs) for general lighting purposes that are ≤ 30 watts with a mercury content exceeding 5 mg per lamp burner || **2020**
Linear fluorescent lamps (LFLs) for general lighting purposes: (a) Triband phosphor < 60 watts with a mercury content exceeding 5 mg per lamp; (b Halophosphate phosphor ≤ 40 watts with a mercury content exceeding 10 mg per lamp || **2020**
High pressure mercury vapour lamps (HPMV) for general lighting purposes || **2020**
Mercury in cold cathode fluorescent lamps and external electrode fluorescent lamps (CCFL and EEFL) for electronic displays: (a) short length (≤ 500 mm) with mercury content exceeding 3.5mg per lamp (b) medium length (> 500 mm and ≤ 1 500 mm) with mercury content exceeding 5 mg per lamp (c) long length (> 1 500 mm) with mercury content exceeding 13 mg per lamp || **2020**
Cosmetics (with mercury content above 1ppm), including skin lightening soaps and creams, and not including eye area cosmetics where mercury is used as a preservative and no effective and safe substitute preservatives are available1/ || **2020**
Pesticides, biocides and topical antiseptics || **2020**
The following non-electronic measuring devices except non-electronic measuring devices installed in large-scale equipment or those used for high precision measurement, where no suitable mercury-free alternative is available: (a) barometers; (b) hygrometers; (c) manometers; (d) thermometers; (e) sphygmomanometers. || **2020**

1/ The intention is not to cover cosmetics, soaps or creams with trace contaminants of mercury.

Part II: Products subject to Article 4, paragraph 3

Mercury-added products || Provisions

Dental amalgam Measures to be taken by a Party to phase down the use of dental amalgam shall take into account the Party's domestic circumstances and relevant international guidance and shall include two or more of the measures from the following list:

(i) Setting national objectives aiming at dental caries prevention and health promotion, thereby minimizing the need for dental restoration;

(ii) Setting national objectives aiming at minimizing its use;

(iii) Promoting the use of cost-effective and clinically effective mercury-free alternatives for dental restoration;

(iv) Promoting research and development of quality mercury-free materials for dental restoration;

(v) Encouraging representative professional organizations and dental schools to educate and train dental professionals and students on the use of mercury-free dental restoration alternatives and on promoting best management practices;

(vi) Discouraging insurance policies, and programmes that favour dental amalgam use over mercury-free dental restoration;

(vii) Encouraging insurance policies and programmes that favour the use of quality alternatives to dental amalgam for dental restoration;

(viii) (Restricting the use of dental amalgam to its encapsulated form;

(ix) Promoting the use of best environmental practices in dental facilities to reduce releases of mercury and mercury compounds to water and land.

4.0 AIM AND OBJECTIVE

The aim of this Report is to conduct a national inventory of systems for information provision of mercury-added products (goods/articles) and to describe government regulatory role for such information. By and large, the objective is to give an overview of the available data on the total amount of mercury products categories, applications, alternatives, destinations/manufacturers imported into the Nigeria towards efficient and effective ratification and implementation of Mercury Treaty.

Specifically, the report seeks to provide:

- Identify and describe mercury-added products of concern by the mercury convention;
- Provide an approximate amount of mercury products and alternatives entering into country in a year.
- Identify the country from which these products are imported.
- To provide baseline data that will help to institute partnership towards promoting safer mercury alternatives, shift in policy and proper management of mercury.

5.0 METHODOLOGY

The project design was an exploratory study and information was from secondary sources. Information was obtained from different stakeholders in charge of life cycle management of mercury products. The research methodology undertaken to complete this study included:

- Sending letters of collaboration and partnership to government institutions;
- Holding consultation visits/meetings to brief key stakeholders and government officials, in some cases making presentations on the project;
- An internet search were conducted to identify the function of mercury in products and to identify alternatives for mercury containing components and products.
- A review of literatures in the public domain conducted to provide data on mercury products and components.
- Assessing data base of key institutions such as the Nigerian Customs Service via http://www.nigeriatradehub.gov.ng/ (with special permission).
- Telephonic contact/interviews

5.1 CONSULTATION VISITS

Consultations and sensitization visits with focal agencies and institutions that are in charge in handling, intercepting and regulation of locally manufactured, imported, exported goods products were made. The intention was to start with a bird's eye perspective to know the amount of mercury-added product entering the country, the mandate of these various agencies with regards to the "positive list" of the Mercury Convention, with all products to be eliminated at a specified date and "negative list" prohibiting all mercury containing products at a specified date with exemptions for those where there are no alternatives.

Amongst the agencies consulted are FMENV, FMOH, NAFDAC, SON, NESREA and Nigerian Customs Service. These agencies/institutions were purposively chosen as sources of data due to their various statutory and legislative roles in the regulation of locally manufactured good, imported, exported and services they provide.

6.0 PREVIOUS REPORTS ON MERCURY-ADDED PRODUCTS IN NIGERIA

6.1 REPORT ON MERCURY-FREE HEALTHCARE

Very few studies have been conducted on mercury use in products in the country, generally information in this area are very scanty. Among the indigenous studies conducted so far in the healthcare sector on mercury is the "Establishing Framework for Mercury-Free Healthcare in Nigeria - *Alternatives to Mercury in the healthcare sector in Lagos*" in 2012 undertaken by SRADev with the support of IPEN (http://www.ipen.org/documents/isip-report-establishing-framework-%E2%80%9Cmercury-free-healthcare-nigeria%E2%80%9D-campaign-alternatives). The survey involved three public hospitals (*Lagos University Teaching Hospital (LASUTH), Lagos Island General Hospital and Primary Healthcare Centre, Festac Town*) in Lagos where a questionnaire was used accessed the knowledge of mercury use in healthcare among 40 medical personnel (mainly nurses and doctors) working particularly with thermometers and sphygmomanometers. The result showed that more than half of medical personnel working with particularly mercury related materials indicated that mercury is toxic to the body while about (97.5%) of the respondents identified mercury equipments in use that contains mercury in their hospitals such as the thermometer and Sphygmomanometers etc. However, majority of the medical personnel knowledge of approximate quantity of mercury in the instrument were generally very low.

On the number of mercury thermometers in their hospitals both in use and in stock, only 25% of respondents demonstrated knowledge on the number of mercury thermometers available in their hospitals, while as high as 62.5% were not aware. As for number of mercury thermometer in stock, 12.5% mentioned below 5 mercury thermometers in stock while 72.5% do not know. Similarly, as for Sphygmomanometer in use, 65% indicated that mercury Sphygmomanometer in use was below 5, while 25% expressed they do not know, while for number in stock, 10% mentioned below 5 and about 72.5% do not know. On the use of mercury-free thermometer, 60% of respondents affirmed to the use of non-mercury thermometers, while 40% never used in their clinics. From the respondents, it was also observed that majority of the respondent lack proper disposal etiquette of broken mercury containing devices.

6.2 REPORT ON DENTAL AMALGAM

Dental amalgam, sometimes referred to as "silver filling," is a silver-colored material used to fill (restore) teeth that have cavities, although it is known to contain 50% mercury and 50% silver. Amalgam is one of the most commonly used tooth fillings, and is considered to be an effective treatment for tooth decay. Deleterious health effect on children and women of child-

bearing age, the dangers of fetal and infant exposure to mercury via maternal dental amalgam have likewise been scientifically established. The result was why the Mercury Convention obligation requires a Phase-down approach as against a phased-out for products.

In terms of environmental contamination, the estimated Hg input, Kg Hg/y in use and disposal of dental amalgam fillings according to Federal Ministry of Environment data is 25,518.6 while the total mercury entering the air, water, land, by-products and impurities and general wastes due to dental amalgam are 510.4, 8,472.2, 0.0 (not determined), 918.7 and 4,899.6 respectively *(see Table 1)*.

6.3 REPORT ON COSMETICS

Skin-lighteners are sold as creams, lotions and soap. *Mercury-containing skin lightening cosmetics pose significant risks to users, Mercury absorbed through the skin from lightening products can damage the skin itself, the kidneys, and the nervous system (figure 2)*. According to the information on ZMWG fact sheet on "Mercury in Skin Lightening Cosmetics", mercury used as an active ingredient in soap and cream production is about 2-10% by weight. Products tested in different countries in Africa (including Nigeria) and other continents contains between 660 to 57,000 (ppm) mercury.

For example, a UNEP survey shows that skin lighteners are used by large fractions of the population, mainly women and young girls in Asia, Africa and Latin America: Senegal, 27 %; Mali, 25 %; Togo, 59 %; South Africa, 35 %; **Nigeria, 77 %;** Hong Kong, 45 %; Republic of Korea, 28 %; Malaysia, 41 %; The Philippines, 50 %; and Taiwan, 37 % (Adabajo, 2002). It was found that those cheapest ingredients used for the manufacture are the banned mercury and hydroquinone compounds. Significantly, Nigeria was implicated to have the highest majority user of skin lightening creams in all the countries studied. This report informed the immediate ban of mercury and hydroquinone use in cosmetics by NAFDAC.

In 2010, SRADev carried out a "Perception Study of Mercury in Cosmetic Products in some areas in Lagos state". From the cross-sectional survey of beauty salons located in *Anthony village, Oshodi International market* and *Ikeja (representing three local governments)*, a total of 36 (11 males and 25 females) beauty salon customers were interviewed, between 92–100% respondents used cosmetics of different ranges and as high as 38% agree to be using toning cosmetics products. Such products mentioned by the respondents with toning properties of choice were; *HT 26, Black Opal, Makari, DP Carrote, QE1, Olay, Neutrogena, DH7, Clinique, Sebamed, Clarins, Cevoclear, Fair & White, G & G, Bioclear, Damovate, Tempovate, Tura Gel, Tenovate Gel, Nivea, Beauty Fair, Fair White, Bio Claire, Skin Light, Clear Essence, Skin Beautifying milk, Top Gel, Hypro-Gel cream*. It is not unlikely that these products could still contain mercury additives. Although mercury used in cosmetics is banned in Nigeria, there

are fears that mercury added cosmetics products are still highly in use under cover. The survey also showed a low knowledge of the health effect of mercury in cosmetic products.

Respondent answering questionaire

Salon shop visited

Cosmetics shop visited

Figure 1: Cross section of the survey (SRADev 2010)

6.4 REPORT ON MERCURY EMISSION FROM ALL SOURCES PER ANNUM

The preliminary inventory undertaken by the Federal Ministry of Environment (focal Point) using the UNEP "Toolkit for identification and quantification of mercury releases" reveals the use of mercury in different sectors in Nigeria. The inventory dossier shows that **71,970,180**, Kg Hg/y are emitted into the air, **3,937,790 Kg Hg/y** into the water, **46,800.0 Kg Hg/y** into the land, while **46,760.0** Kg Hg/y are emitted into the environment via by-products and impurities, a plethora sum of **2,409,990 Kg Hg/y** are released through general waste disposal and lastly, **48,670.0 Kg Hg/y** is released via sector specific waste treatment /disposal. The overall total estimated environmental mercury emission in a year is **78,460,190 Kg Hg/y** in Nigeria (table 1)**.**

Table 1: SUMMARY OF ESTIMATED MERCURY RELEASES IN NIGERIA

Source category	Estimated Hg input, Kg Hg/y	Estimated Hg releases, standard estimates, Kg Hg/y					
		Air	Water	Land	By-products and impurities	General waste	Sector specific waste treatment /disposal
Coal combustion and other coal use	13.5	12.1	0.0	0.0	0.0	1.3	0.0
Other fossil fuel and biomass combustion	1,780.8	1,780.8	0.0	0.0	0.0	0.0	0.0
Oil and gas production	49,502.3	148.6	9,806.8	0.0	50.9	133.3	0.0
Primary metal production (excl. gold production by amalgamation)	123,743.6	12,387.8	3.3	37,179.0	37,084.4	6.9	37,082.2
Gold extraction with mercury amalgamation	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other materials production	43,521.0	26,112.6	0.0	0.0	8,704.2	8,704.2	0.0
Chlor-alkali production with mercury-cells	-	-	-	-	-	-	-
Other production of chemicals and polymers	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Production of products with mercury content	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Use and disposal of dental amalgam fillings	25,518.6	510.4	8,472.2	0.0	918.7	4,899.6	4,899.6
Use and disposal of other products	78,086,552.2	71,767,802.2	3,917,785.1	2,381.7	0.0	2,395,691.1	2,892.1
Production of recycled metals	1,198.6	395.5	0.0	407.5	0.0	395.5	0.0
Waste incineration and open waste burning*1	162,941.9	159,147.7	0.0	0.0	0.0	0.0	3,794.2
Waste deposition*1	16,425.0	164.3	1.6	0.0	-	-	-
Informal dumping of general waste *1*2	17,172.3	1,717.2	1,717.2	13,737.9	-	-	-
Waste water system/treatment *3	1,540.8	0.0	1,386.7	0.0	0.0	154.1	0.0
Crematoria and cemeteries	6,830.5	0.0	0.0	6,830.5	0.0	0.0	0.0
TOTALS	**78,358,310.0**	**71,970,180.0**	**3,937,790.0**	**46,800.0**	**46,760.0**	**2,409,990.0**	**48,670.0**

- As shown in the Table, the following source groups contribute with the major mercury inputs: Use and disposal of products containing mercury, Waste Incineration and Open Waste Burning, Primary metal production (excl. gold production by amalgamation) Oil and Gas Production and other materials production.
- The individual mercury release sub-categories contributing with the highest mercury inputs are Paints with Mercury Preservatives, Open fire waste burning (on landfills and informally), Production of Zinc from concentrates, Production of Lead from Concentrates, Oil Extraction and Cement Production.

Source: FMENV 2013

7.0 INSTITUTIONAL FRAMEWORK FOR MERCURY USE IN PRODUCT REGULATION

The Federal Government of Nigeria, concerned about the harmful and deleterious effects of this metal and its compounds on human health and the environment, empowered the Federal Ministry of Environment and other line ministries to recommend standards and regulations for the control and removal of this hazardous substances. The Government had also ratified and signed relevant international instruments and conventions such as the Stockholm and Basel Conventions. Nigeria signed the Mercury Convention on 10 October 2013 in Japan but is yet to ratify the Convention.

7.1 FEDERAL MINISTRY OF ENVIRONMENT

Towards the Ratification and Implementation of the Minamata Convention on Mercury in Nigeria, the Ministry of Environment (the focal point of the Mercury Treaty or Minamata Convention) has started preliminary activities and inventory starting with the UNEP "Toolkit for identification and quantification of mercury releases" and had identified sectors in which mercury is in use. The Ministry through its agency the National Environmental Standards and Regulations Enforcement Agency (NESREA), also has in place the "Standard for environmental media, actions and regulations that control releases from environmental sources that contain mercury, actions and regulations on products that contain mercury and other standards, actions and programmes relevant to mercury" **(see Annex A).**

The Ministry is presently undertaking a 12-month national project titled "*Ratification and Early Implementation of the Minamata Convention on Mercury in Nigeria"* with financial support from the Swiss Confederation. The objective of the on-going project is to accelerate the ratification of the Minamata Convention on Mercury, along with developing initial priorities for action to assist early implementation. Key elements and activities of the project process include:

1. Initial consultation with key stakeholders to ensure effective coordination on the project activities and to review the project workplan.

2. Development of an information package about the Minamata Convention with the aim to create awareness among national stakeholders about the Convention and its benefits for the country.

3. High-level briefing sessions

4. ***Development of a ratification dossier*** which comprises the following:

    a. Legal assessment, with input from relevant stakeholders at the national level, of the existing legal instruments /basis for mercury in Nigeria and the implications of ratification;

    b. Based on this assessment, a technical study considering the implications and benefits of ratification of the Minamata Convention and a legal analysis of steps needed to ratify it; and

c. A concise plan of priority areas and actions related to mercury management in Nigeria (also taking into account the overall national chemicals management situation and their linkages to national developments and/or poverty reduction strategies).

5. Organisation of a workshop convening relevant stakeholders to discuss the Convention, the obligations that will stem from being a Party, the benefits the Convention will bring, and endorse the ratification dossier for the Minamata Convention on Mercury.

The project/process outcome will essentially deliver among others a Ratification dossier, list of priority areas and actions for implementation, required framework for mercury in product regulation in Nigeria. The Ministry of Environment has duly put in place a committed Ratification process shown in the figure 2.

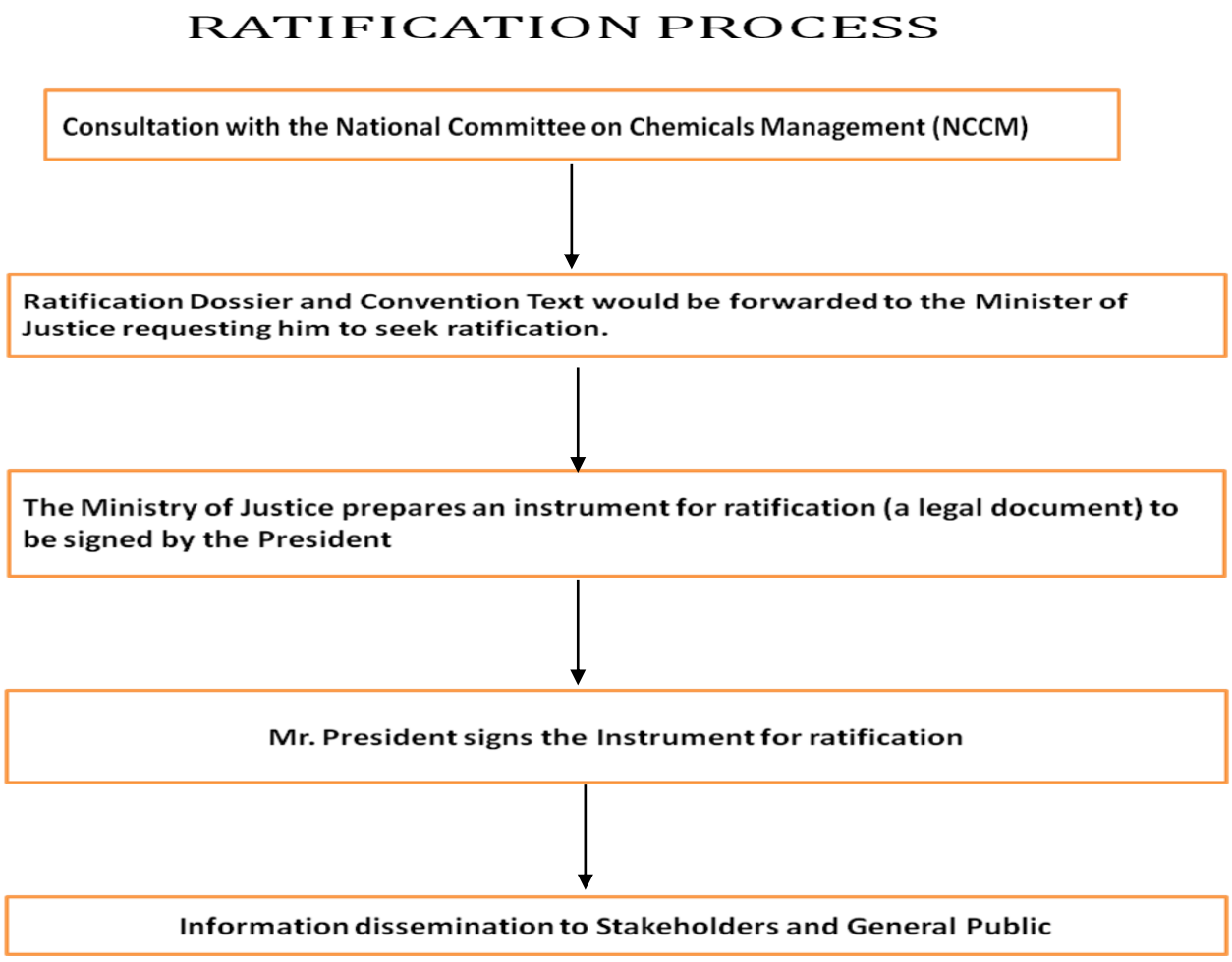

Figure 2: Nigeria Mercury Treaty ratification process

7.2 THE NAFDAC MANDATE

The National Agency for Food and Drug Administration and Control (NAFDAC) was established by Decree 15 of 1993 as amended, now Act. Cap N1 Laws of the Federation of

Nigeria (LFN) 2004, to regulate and control the manufacture, importation, exportation, distribution, advertisement, sale and use of food, drugs, cosmetics, **chemicals**, detergents, medical devices and all drinks including packaged water. The essence of regulation and control is to protect public health by ensuring that only regulated products that are safe, efficacious and wholesome reach the market, and ultimately, the consuming public. This is achieved through various processes which include product registration/listing, inspection of production facilities, good manufacturing practice (GMP), Hazard Analysis and Critical Control Points (HACCP).

There are regulations in place for cosmetic products in Nigeria as contained in NAFDAC Supplement to Official Gazette Extraordinary No. 31c, Vol. 82, 29th December, 1995 – Part B. Among several regulations of NAFDAC that regulates chemicals and mercury related products are the:

- Cosmetics products (Prohibition of Bleaching Agents) Regulations [S.1.20 of 1995] under sections 5 and 29. The regulation prohibits hydroquinone, corticosteroid, mercury and mercury compounds. This is referred as the ***Cosmetic Product (Prohibition of Bleaching Agents etc) Regulations, 1995***.
- The Guidelines for Registration of imported cosmetics in Nigeria; section A paragraph 2 states that it is necessary to emphasize that no cosmetics should be manufactured, imported, exported, advertised, sold or distributed in Nigeria unless it has been registered in accordance with provision of ACT CAP LFN 2004 formerly decree 19 of 1997.

The regulations among other things prohibit the inclusion of skin bleaching agents in cosmetic products manufactured, sold or distributed in the Nigerian market and further specify the penalty for any person who contravenes any of the provisions. The bleaching agents identified in the regulations were hydroquinone, corticosteroids, mercury and mercury compounds.

The regulations regarded cosmetic product as adulterated if it:

1. contains more than one trace of mercury or any mercury salt which under normal condition of manufacturing practice is unavoidable; or
2. contains more than a trace of mercury or any mercury salt calculated as the metal or preservative; or
3. contains hydroquinone; or
4. bears or contains any poisonous or deleterious substance as to render it injurious to a user under the conditions prescribed in its labeling or under such conditions of use as are customary or usual for the cosmetic product; or

5. has been prepared, packed or held under insanitary conditions, thereby rendering it likely to be injurious to health; or
6. the container in which it is packed is composed in whole or part of poisonous or deleterious substance which may render the contents injurious to health; or
7. contains more than the permissible limit of an ingredient.

Based on the above regulations and guidelines, below are listed mercury-containing creams and soaps banned from Nigeria: Brand/Trade Names: ***Tura, Crusader, A3, Mic, Peuclaire, Movate, Looking Good*** and ***Sivoclaire***. Tura soap was known to be very popular as you can see from the picture below in which a popular former Governor's of Oyo State (Mr. Alao Akala) advertised.

Figure 3: Some banned soaps and creams in Nigeria and the risk of skin bleaching

7.3 STANDARDS ORGANISATION OF NIGERIA (SON)

The organisation was set up under Decree No.56 of 1974 as amended by Decree No.32 of 1984 and subsequently re-enacted as Cap.412 of the 1990 Laws of the Federation. The basic aim of the enactment is to establish an umbrella organization for the standardization of methods and products in Nigerian industries and to provide for other matters relating thereto. Section 2 of the Act creates a Governing Council for the organization while section 3 endows it with far reaching functions. It is empowered:

- To advise the federal government generally on the national policy on standards, standards specifications, quality control and metrology;
- To designate, establish and approve standards in respect of metrology, materials, commodities, structures and process for the certification of products in commerce and industry throughout Nigeria;
- To provide the necessary measures for quality control of raw materials and products in conformity with the standard specification.

The organisation is assigned specific functions under section 4 of the Act which include, inter alia, the duty:

- To organize tests and do everything necessary to ensure compliance with standards
- Do undertake investigations as necessary into the quality of facilities, materials and products in Nigeria and establish quality assurance systems including the certification of factors, products and laboratories;
- To ensure reference standards for calibration verification of measures and measuring instruments;
- To develop methods for testing of materials, and equipment including items purchased for use of departments of the government of the federation or of a state and private establishments;
- To compile an inventory of products requiring standardization, and Nigerian standards specification;
- To register and regulate standards, marks and specifications;
- To undertake preparation and distribution of standards samples;
- Establish and maintain such number of laboratories and other institutions as may be necessary for the performance of its functions under the Act.

7.4 NATIONAL ENVIRONMENTAL STANDARDS AND REGULATION ENFORCEMENT AGENCY (NESREA) ACT 2007

Administered by the Ministry of Environment, the National Environment Standards and Regulation Enforcement Agency (NESREA) Act of 2007 replaced the Federal Environmental Protection Agency (FEPA) Act. It is the embodiment of laws and regulations focused on the protection and sustainable development of the environment and its natural resources. The following sections are worth noting:

Section 7 provides authority to ensure compliance with environmental laws, local and international, on environmental sanitation and pollution prevention and control through monitory and regulatory measures. Section 8 (1) (K) empowers the Agency to make and review regulations on air and water quality, effluent limitations, control of harmful substances and other forms of environmental pollution and sanitation. Section 27 prohibits, without lawful authority, the discharge of hazardous substances into the environment. This offence is punishable under this section, with a fine not exceeding, N1,000,000 (One Million Naira) and an imprisonment term of 5 years. In the case of a company, there is an additional fine of N50,000 for every day the offence persists.

NESREA has about 28 regulations to protect, maintain, and sustainability of the environment. The noticeable ones for chemical in products regulations are listed below:

- Electrical and Electronic Sector Regulation on E-waste Management
- National Effluent Limitation Regulations.
- National Environment Protection (Pollution abatement in industries and facilities producing waste) Regulations (1991).
- Harmful Waste (special criminal provisions) Act
- Hydrocarbon Oil Refineries Act, Cap H5, LFN 2004.
- Oil in Navigable Waters Act, Cap 06, LFN 2004.
- Associated Gas Re-injection Act, Cap 20, LFN 2004.
- Petroleum Act, Cap P10, LFN 2004

7.5 NIGERIA CUSTOMS SERVICE (NCS)

The Customs & Excise Management Act (CEMA) Cap 45, Law of the Federation of Nigeria, 2004 vests Legal Authority in the Nigeria Customs Service to act on behalf of the Federal Government of Nigeria in all Customs matters. This is supported by various supplementary legislations, including:

- Customs and Excise (Special Panel and other Provisions) Cap 45, Law of the Federation of Nigeria, 2004;
- Customs Duties (Dumped and Subsidized Goods) Act Cap 87 Laws of the Federation of Nigeria;

- Nigeria Pre-shipment Inspection Decree No. 36 of November, 1979 further amended by Decree No. 11 of 19th April, 1996;
- Decree No. 45 of 1st June, 1992 as amended by Decree No, 77 of 29th August, 1993;
- Customs and Excise Management (Amendment) Act No. 20 of 2003; and
- Constitution of the Federal Republic of Nigeria.

The law relating to Customs Agents is contained in the Customs & Excise Management Act (CEMA) Cap 45, Law of the Federation of Nigeria, 2004 and the Customs and Excise Agents (Licensing) Regulations 1968 (Legal Notice 95/1968 as amended).

Nigeria Customs Service has a full-fledged unit called IPR/Environment. The unit amongst many other responsibilities provide the platform for regional cooperation on intelligence information sharing and collaborative enforcement action, partnering with FMENV, NESREA, FMOH etc on environment and health issues on products imported or exported, monitors the importation aspects of goods that will affect the environment, and oversees the enforcement of those legislations that banned some certain chemicals and goods that will harm the environment such as mercury use in products when the Mercury Convention comes into force in Nigeria after ratification.

8.0 DESCRIPTION OF THE USE OF MERCURY IN EQUIPMENT (MERCURY IN PRODUCTS) AS BACKGROUND INFORMATION FOR THE ANALYSIS OF POLICY OPTIONS

According to the Mercury Convention, a mercury-added product is any product that contains mercury, a mercury compound, or a component containing mercury, when the mercury is intentionally added to the product (or component) for any reason. These products include ***fabricated*** *and* ***formulated mercury-added products.***

A fabricated product is a combination of individual components, one or more of which has mercury added, that combine to make a single unit. These equipment categories include: measuring devices, thermostats, switches and relays, dental amalgam, lamps, and batteries. Table 2 presents the major fabricated mercury-added products also found in Nigeria and will be regulated according to the Mercury Convention (*Article 4 in Boxes 1 & 2 requirements for "Mercury-added Products" above*) as at when Nigeria becomes a party to the Treaty. However, local manufacturing of any of these products is not known, but data exist on the amount of importation and the respective importers as well as exporting countries. These product categories are discussed in detail below. *Table 2* & 3 indicates examples of the major fabricated and formulated mercury-added components and products with manufacturer's reports on mercury amounts in individual products.

Table 2: FABRICATED MERCURY-ADDED COMPONENTS AND PRODUCTS

Component or Product	Amount of Mercury in Individual Component or Product (grams)
Measuring devices	
Barometers	400 – 620
Sphygmomanometers	50 – 140
Manometers	30 – 75
Psychrometers	5 – 6
Thermometers	0.5 – 54
Switches & Relays:	
Flame Sensors	>1
Float Switches	0.1 – 70
Tilt Switches	0.05 – 5
Relays	0.005 - >1
Dental Amalgam	>0.1 – 1
Lamps:	
Fluorescent	<0.10
Compact Fluorescent	<0.01
High Intensity Discharge (metal halide, ceramic metal halide, mercury vapor, high pressure sodium)	<1
Mercury Short Arc	0.1 – 1
Button-cell Batteries	<0.05

Source: Extracted from Galligan *et al* (2003).

Barometers and sphygmomanometers (commonly called blood pressure cuffs) contain the highest volume of mercury in this group of between 400-620 grams and 140 grams respectively.

On the other hand, *a formulated product* is a chemical product, including, but not limited to, laboratory chemicals, cleaning products, cosmetics, pharmaceuticals, and coating materials that are sold as a consistent mixture of chemicals, acids, alkalis, bleach, stains, reagents, preservatives, fixatives, buffers and dyes. Formulation or re-formulation of these products is known to take place locally in Nigeria in both formal and informal settings. Some of these products are known to be in the market through regulated and unregulated (illegal) process.

TABLE 3: FORMULATED MERCURY-ADDED PRODUCTS

Component or Product	Amount of Mercury in Individual Component or Product (ppm)
Preservatives & Reagents	>0 - >250
Mercury Compounds	>0 - >250

Source: Galligan *et al* (2003).

8.1 APPLICATIONS OF MEASURING DEVICES AND ALTERNATIVES

8.1.1 THERMOMETER

Mercury thermometers are used to read almost all temperature measurements from the freezing point of mercury, -39°C, up to about 800°C, with an accuracy of 0.01°C. For measurements at lower temperatures, down -58°C, hydrocarbons like toluene or pentane are used. For higher temperatures than 800°C, thermometers with a gallium filling are used. In Nigeria, three types of mercury-containing thermometers have traditionally imported into the market, these are:

i. Mercury-in-glass thermometers:
    a. Medical thermometers;
    b. Ambient temperature thermometers (wall thermometers);
    c. Laboratory thermometers;
    d. Thermometers for combustion and industrial processes.
ii. Mechanical mercury thermometers with a dial; and
iii. Contact thermometers (electric thermo-regulators)

The mercury content of medical thermometers ranges from 0.5 to 1.5 grams (Floyd et al. 2003). The mercury contents of thermometers use in laboratories and in industries ranges from 1 to 20 g Hg per thermometer, with an average content of 3-4 g. Mercury dial thermometers consists of a mercury filled metal tube with a bourdon coil and a pen or needle for reading the temperature. They are applied mostly in the process industry and for marine applications. The mercury content ranged from about 5 to 200 g (Maag *et al.* 1996). These thermometers have mainly been used for marine engines and within the power sector.

Figure 4: Shows some examples of mercury-containing thermometers

A number of different types of mercury-free thermometers as alternatives to the mercury types are imported and marketed in the country, among these: Mercury-free liquid-in-glass thermometers; Dial thermometers; Electronic thermometers (thermocouple and resistance thermometers) and Infrared thermometers. The liquid-in-glass thermometer is the most common replacement of the mercury thermometer at temperatures up to 250^{0}C. The liquid high-precision thermometer, meets all standards for accuracy, tolerance and uncertainty. It

has high precision as mercury in glass thermometer hence it is recommended as a viable alternative. The thermocouple thermometers, platinum resistance thermometers and infrared thermometers are all based on a thermoelectric principle and can, via an analogue-to-digital converter, be connected to a data logger.

Figure 5: Non-mercury thermometers commonly in use in the hospitals (SRADev 2012)

8.1.2 MANOMETERS

Manometers measure the difference in gas pressure between the measured environment and a reference. The difference in the levels of mercury in each side of the tube indicates the pressure of the gas being measured. The filled volume varies, but it was estimated that each manometer was filled with 70-140 g mercury.

A number of different pressure-measuring instruments as alternative are marketed as Bourdon tube manometers; Electronic manometers (or digital manometers); Pressure gauges with diaphragm elements.

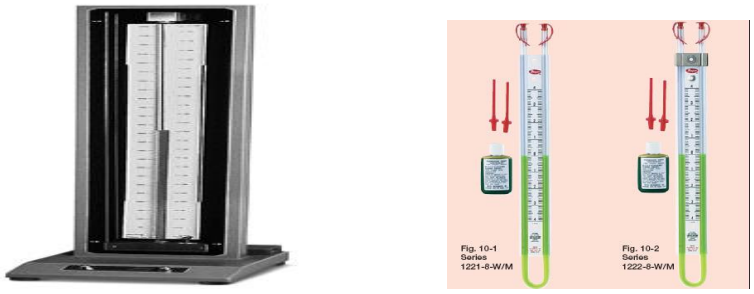

Figure 6: Examples of mercury containing Manometers in use

8.1.3 BAROMETERS

Barometers are used for a number of professional applications including weather stations, meteorological departments, airports and airfields, wind tunnels, oil refineries, engine manufacturing, sporting sites, offshore installations (e.g. windmill parks) and on ships. A typical mercury barometer consists of a one-metre glass tube filled with mercury. One end of the tube is sealed while the other end of the tube is submerged in a container filled with

mercury. A barometer for private households typically contains 60-75 g mercury, whereas large barometers for laboratory use may contain up to 1.1 kg of mercury.

A number of alternative barometers are marketed, among these are: Electronic barometers (e.g. aneroid displacement transducers, digital piezo-resistive barometers or cylindrical resonator barometers); Electronic resistance or capacitance barometers; Aneroid mechanical barometers; Mercury-free liquid barometers.

Figure 7: An example of a direct reading barometer in use

8.1.4 BLOOD PRESSURE MEASURING DEVICES – SPHYGMOMANOMETERS

A mercury sphygmomanometer (from Greek "sphygmos" for pulsation) includes a mercury manometer, an upper arm cuff, a hand inflation bulb with a pressure control valve and requires the use of a stethoscope. The method relies on the auscultatory technique, in which a clinician determines systolic and diastolic blood pressures (SBP and DBP) by listening (auscultate) for sounds that characterize different stages of blood flow during cuff deflation (so-called Korotkoff sounds). Mercury sphygmomanometers have been used for more than 100 years for blood pressure measurements in Nigeria and are still in use today by many clinics/hospitals especially in the rural areas. Mercury sphygmomanometers manufactured in the EU typically contain 85 to 100 g mercury.

Figure 8: An example of a Freestyle Mercury Sphygmomanometer available

Alternatives to mercury-containing sphygmomanometers on the market can roughly be divided into the following groups:

- Equipment for blood pressure measurements based on the auscultatory technique
  - ✓ Aneroid sphygmomanometers for manual reading
  - ✓ Digital sphygmomanometers for manual reading
- Equipment for blood pressure measurements based on the oscillometric technique or other techniques.
- Semiautomatic devices for clinical use and home/self assessment;
- Automatic blood pressure devices for hospital use.

Figure 9: Some non-mercury Sphygmomanometers in use at LASUTH (SRADev 2012)

8.1.5 BLOOD PRESSURE MEASURING DEVICES – STRAIN GAUGES

Mercury strain gauges are used for blood flow and blood pressure measurements in body parts. The mercury strain gauge consists of a fine rubber tube filled with mercury which is placed around the body part in which the blood pressure or blood flow is measured. The method is used for diagnosing certain kinds of arteriosclerosis, a chronic disease in which thickening, hardening, and loss of elasticity of the arterial walls result in impaired blood circulation.

Available alternatives to mercury-containing strain gauges for plethysmography can be divided into the following groups:

- Strain gauges with indium-gallium;
- Photo cell or laser-Doppler techniques

8.1.6 HYGROMETERS

Hygrometers (or Psychrometers) are used in the measurement of relative humidity. They consist of two (often mercury) thermometers mounted together, one of which has a cloth wick over its bulb and is called a wet-bulb thermometer. Alternatives to mercury hygrometers are ***spirit-filled hygrometers*** and ***electronic hygrometers***. The price of spirit-filled hygrometers is approximately the same as the price of mercury hygrometers

(Gallican *et al*. 2003). Electronic hygrometers are widely available and very much in use today.

Figure 10: Showing a wet and dry bulb hygrometer for indoor or outdoor use with mercury filling.

8.1.7 MERCURY-CONTAINING REFERENCE ELECTRODES

Mercury-containing reference electrodes are used for a variety of measurements. The main differences between reference electrodes are the type of reference system and the liquid junction. Marketed mercury-containing reference electrodes include calomel (Hg/Hg^2Cl_2), mercurous sulphate (Hg/Hg^2SO_4) and mercuric oxide (Hg/HgO) electrodes. The *calomel electrode* is widely used for pH measurements, and this is very widely used in Nigeria by battery technicians/artisans *"battery chargers"* while **mercurous sulphate** is used e.g. for silver halides and COD titrations most common in universities, research institutions and chemical laboratories.

The total mercury use in electrodes for medical equipment is 2-10 kg/year and in monitoring and control instruments are about 3 kg/year (Goodman and Robertson 2006). Other types are the Hanging drop mercury electrodes used to analyze trace elements in water, environmental samples or ultrapure chemicals. The total annual consumption of mercury for hanging drop electrodes is approximately 1.4 kg (Høj 2008). Mercury-free alternatives (gyrocompass) have been available for many years.

Figure 11: Example of reference electrodes widely used and its alternative (gyrocompass)

8.1.8 HYDROMETER

Hydrometer is a device that measures the density or specific gravity of a liquid. The hydrometer is used for many applications in Nigeria. From the U.S.A. it was reported that mercury may be used in hydrometers (Gallican *et al.* 2003). A major manufacturer estimates that the total EU consumption of mercury in thermometers in hydrometers today is about 24 kg.

8.2 SWITCHES, RELAYS AND OTHER ELECTRICAL COMPONENTS

Mercury has traditionally been used in a great variety of electrical switches, relays, arc rectifiers and thermostats. These components have been used in a variety of electrical and electronic equipment and vehicles. In Nigeria, these products (e-wastes and second-hand cars) continued to be dump into the country with little or no end-of-life management control.

E-waste off-load

Popular e-waste warehouse in computer village

Waste components of electronics to waste dumps

Figure 12: Common E-waste stream identified from SRADev survey in Lagos (2009)

Generally, mercury is a component of the following products all which have been found to be imported into the country at various times all year round. According to Basel Action Network (BAN 2005) study in conjunction with Basel Convention Coordinating Centre for the African Region (BCRCC) Nigeria. Nigeria imports about 500,000 used computers annually through the Lagos port alone. About 25% of the imports are functional used

computers while the remaining 75% is junk or unserviceable. The junk have no value and therefore end up being discarded before any re-use takes place. In one survey, it was estimated that by the end of 2007, there would be at least 30 million cell phones in use in Nigeria, and at least 20 million older models stockpiled in drawers awaiting disposal, if the rate of market explosion recorded by the Telecommunication industry in Nigeria continues at the current pace. This is seven years after that projection.

a) Tilt switches
   - Medical devices, laboratory equipment, alarm equipment, certain clocks, lifeboats, motion/vibration sensors, thermostats, G-force sensors and other applications;
   - Float switches and level sensors;
   - Thermostats.
b) Thermoregulators;
c) Mercury wetted reed relays
d) Mercury displacement relays.
e) G force-sensors in ABS brake systems and other applications in vehicles;
f) Mercury pressure switches and displacement relays.

8.2.1 MERCURY TILT SWITCHES

Mercury tilt switches are small tubes with electrical contacts at one end of the tube. As the tube tilts, the mercury collects at the lower end, providing a conductive path to complete the circuit. Mercury **tilt switches** are used for the following applications:

- In some medical devices and laboratory equipment like x-ray machines;
- Motion/vibration sensors;
- Float switches and level switches;
- Lifeboats;
- Thermostats.

The tilt switches typically contain from 0.5 g to 10 g mercury per switch.

Motion/vibration sensors are very similar in design to tilt switches. Applications of vibration sensors include anti-theft devices, man-down alarms to detect non motion, smart appliances to turn off power when not in use and portable equipment to do the same. There are two basic types of float switches:

- Float switches located in a buoyant float housing and actuated by rising and falling liquid levels;
- Stationary float switches that is actuated by the presence or absence of liquid (level detectors).

Float switches are used for liquid monitoring and control of the liquid level in tanks, wells, chambers, drillings, and other containers. Float switches are used to actuate alarm and control circuits. Float switches have been used for monitoring various liquids including,

among others, water, sewage, wet sludge, oil etc. In Nigeria, most homes and industries source their water from underground wells and boreholes to be stored in storage tanks above ground, as a result float switches which helps to regularly pump the water are commonly used. ***Cut-off switch for lifeboats*** that is activated if the life boat capsizes preventing the engine from flooding. **Electrical switches** as spare parts for personal motion alarms which emit a radio signal indicating that the person is immobile if no change in position takes place within a certain period (Kemi 2004). Position safety switches are also used in certain X-ray equipment.

Figure 13: A typical use of tilt switch is in a thermostat.

Figure 14: Float switches plastic, float switches stainless steel

8.2.2 THERMOREGULATORS

A thermoregulator (also designated contact thermometer or accustat) is a kind of thermostat, but applies another principle than the thermostats described under tilt switches. The thermoregulator may according to a producer be applied for providing a constant temperature in baths, ovens, incubators, circulating systems, alarm circuits, petroleum and asphalt testing etc.

8.2.3 MERCURY WETTED REED SWITCHES AND RELAYS

A relay is an electrically controlled device that opens or closes electrical contacts to effect the operation of other devices in the same or another electrical circuit. Relays are often used to switch large current loads by supplying relatively small currents to a control circuit. A mercury wetted reed relay is a type of electro-mechanical relay that employs a hermetically sealed mercury reed switch. Reed relays are primarily used in test, calibration, and measurement equipment applications where stable contact resistance over the life of the product is necessary.

The main market for mercury reed relays and switching devices are:

- Maintenance of older equipment;
- ATE markets: automatic test equipment, cable testers, high voltage testers, in-circuit testers
- Industrial instrumentation and control equipment, power plants;
- Transportation systems: railway circuits;
- Medical equipment.

The mercury content of the reed switches varies among the different types. From manufacturers information of mercury reed switches the mercury content of 5 basic types of mercury reed switches is as follows: HG switch (3 g Hg), HGW switch (0.32 g), HGX switch (0.071 g), MH4 switch (0.041 g) and MH5 switch (0.0095) (Comus 2008b).

Figure 15: Mercury Wetted Relays and Mercury wetted reed switches also available in Nigeria

MERCURY-FREE ALTERNATIVES

There are several alternatives to mercury wetted reed relays available which include field effect transistors (FETs), electromechanical switches, coaxial switches and standard radio frequency microelectromechanical systems (RF MEMS).

8.2.3.1 MERCURY DISPLACEMENT RELAY AND CONTACTORS

Mercury displacement relays and contactors have been used in high-current, high-voltage applications such as industrial process controllers, power supply switching, resistance heating, tungsten lighting, welding, high current/voltage lighting, flood lights, copiers, battery chargers, energy management systems, and industrial ovens. The mercury content reported by manufacturers of relays is in the range of greater than 1 g.

Mercury relays and contactors from Mercury Displacement Industries are used for (ICD 2008):

- Electric heaters on plastic extruders, drying ovens, injection moulding machines and glass furnaces;
- Lighting for street lamps, airport runways, stage lighting and flood lights;
- Motor starting, air conditioning, battery chargers, test panels and mining equipment.

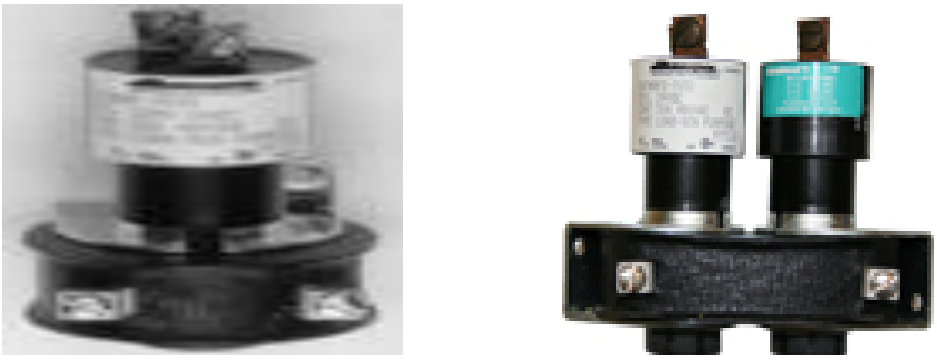

Figure 16: Examples of BB and BB2 mercury contactors

MERCURY-FREE ALTERNATIVES

A large number of different relays and contactors are marketed as alternatives to mercury relays and contactors. An example of relays specifically marketed as cost-effective alternatives to mercury contactors is the E-SAFE mercury-free relays system from Watlow (former producer of mercury relays and contactors).

8.2.3.2 PRESSURE SWITCHES

The mercury pressure switch typically uses a piston, diaphragm, or bellows acting as the pressure sensor to actuate the mercury switch. The mercury consumption with pressure switches, if any, is less than 50 kg. They are widely reported to have applications in:

- Heating, ventilation, and air conditioning: electrostatic air cleaners, filter indicators, reserve oil level, gas-fired heating, ventilation, utility heaters, heat pumps, furnaces, flue gas, fuel delivery, etc.
- Medical: respiratory sensors, therapy tent nebulizers, automated blood pressure systems, sip-and-puff movement controls, anaesthesia leak detection, saline pumps,

tourniquet systems, reverse osmosis purification systems, dental aspirator pumps, respiratory therapy, disposable surgical vacuum systems, etc.

- Appliance: floor scrubbers, vacuum cleaners, food storage sealers, air conditioners, hot water dispensers, hot water heaters, etc.
- Other: venting hoods, tape braking systems, tape tension controls, door safety, spa pumps, boilers, garage doors, vacuum radon detection, pump control, pressurized air systems, sanitary systems, altitude sensing, fire protection systems.

MERCURY-FREE ALTERNATIVES

There are a couple of mercury-free alternative technologies (below) currently in use for pressure switch products and applications, which appear to be cost competitive and can meet the functional requirements for new pressure switch products and applications. However, they may not be suitable for all retrofits.

8.2.3.3 G-FORCE SENSORS AND LIGHT SWITCHES IN VEHICLES

Mercury has been extensively used in vehicles for tilt light switches and G-force sensors in ABS systems, air bag sensors and auto seat belt mechanisms. The average amounts of mercury switches per car in vehicles produced in the USA increased from 1997 to 2002 from 0.3 to 0.6 (Clean Car Campaign 2004).

8.2.3.4 FLAME SENSORS

Flame sensors, also called automatic gas shut-off or safety valves have been used as safety devices in gas and gas-electric ranges and other appliances.

8.2.3.5 MERCURY ARC RECTIFIERS

Mercury arc rectifiers are used to convert alternating current into direct current. Mercury rectifiers were used in electric motor power supplies for industry, in electric railways, streetcars and diesel-electric locomotives. Small rectifies were also used in different electronic equipment. Mercury content of rectifiers used for industry welding unit, old IT equipment and sound systems, and projectors is reported to be up to 1 kg.

8.3 MERCURY CHEMICALS

Mercury chemicals are defined here to include both metallic mercury and mercury compounds used for a wide range of process, additive, reactive and laboratory applications. The main applications of mercury compounds are:

- Production of batteries or parts of batteries;
- Production of reference electrodes;
- Catalyst in production of polyurethanes;
- Chemical intermediate in the pharmaceutical industry;
- Chemical intermediate for production of other mercury compounds;

- Laboratory chemical reagents for COD analyses and a number of analyses in the medical and food sector;
- Mercury standards for calibration;
- Preservative in vaccines, eye/nasal preparations;
- Preservative and fungicide in paints;
- Disinfection of medical equipment and process equipment;
- Disinfectants for veterinary uses;
- Pigment for artwork and restoration.
- Mercury fulminate, Hg(ONC)2, used as a detonator for explosives, in ammunition and in fireworks;
- Certain types of colour photograph paper;
- Fireworks;
- Pesticides containing mercury;

8.3.1 KEY MERCURY CATALYSTS

It was found that mercury compounds are used almost exclusively in polymer-based products as hardeners and resins for plastic materials, plastic flooring materials, jointing compounds, etc. The majority of uses involved the compound phenylmercuric neodecanoate. Thorcat 53 are used as a catalyst in the manufacture of urethane" and also used by the manufacturer for production of polyurethane polymers and coating applications in automotive, electronic, sealant, and shoe sole end-use markets.

8.3.2 PRESERVATIVE IN VACCINES AND EYE/NASAL PRODUCTS

Thimerosal (or thiomersal, 2-mercapto-benzoic acid) is a organomercuric preservative mainly used in vaccines and some eye/nasal medical products. The compound contains 49.6% mercury.

8.3.3 DISINFECTANTS

Traditionally a number of mercury compounds have been used as disinfectants including mercurochrome (Merbromin), thimerosal (Merthiolate), mercury iodide, mercury oxycyanide, and mercury-II-chloride. One clinic for transfusion medicine states that 29 g of thimerosal was used in 2003 in the case of transfusion equipment and for dialysis equipment a further 40 g was used (KemI 2004)

8.3.4 PIGMENTS

The pigment vermillion or cinnabar (mercuric sulphide, HgS) has been used since prehistory as a red colour for paint and fabric dye. Vermillion is e.g. available from Kremer Pigmente, Germany, a company specialised in products used for restoration work and art. Cinnabar pigment, based on mercury sulphide from China, is marketed for use in oil, tempera, water colours/gouache or lime/fresco in the series of "historical pigments".

8.4 OTHER APPLICATIONS

Mercury compounds are used Skin lightening soaps as discussed in section 6.3 above, mining production (ASGM). This is also a common practice known in Nigeria.

8.5 MERCURY LAMPS USED IN ELECTRONICS

Millions of energy-efficient lamps are also used in electronic devices (see table 4 summarised below). While these lamps are typically small, for technical reasons they often contain nearly the quantity of mercury as do larger CFLs, and for some devices such as laptop or TV displays, there may be 6 or more lamps in one display.

TABLE 4: Mercury lamps in electronic devices (derived from AEA 2007)

Device	Mercury content product range (mg)
Multi-media monitor	75.0
LCD display monitor	2.5
	7.5
	30.0
LCD TV flat panel	2.5
	7.5
	30.0
Digital picture frame	2.5
LCD projector	75.0
Laptop/notebook	2.5
	30.0
Fax/copier/printer	2.5
	30.0
Fax	2.5
Scanner	2.5
Copier	30.0
	2.5
Camcorder/camera	7.5
Audio equipment	2.5
DVD/VCR players	2.5
Telephones	2.5

ALTERNATIVES

LEDs Light emitting diodes have been available for decades as alternatives, but in colours unfit for room lighting and similar uses Nano-scale LEDs. LEDs for general lighting purposes use 230 and 110 volts directly. Others are **Field emission lamps, High-efficiency incandescent, OLEDs** Organic light-emitting diode (OLED) lighting devices. While **HID mercury vapour**

lamps can generally be replaced by high-pressure sodium or metal halide lamps, both of the latter are now available in mercury free versions, including in most of the higher wattages.

In backlights for flat LCD screens, traditionally lighted by small fluorescent lights, LCD flat screens are now available with LED backlights for high end computers, flat screen TVs and computer game stations. **In automobile headlamps,** the high-intensity effect of mercury lamps used as auto headlamps can be achieved or bettered by xenon headlamps without mercury. The first use of LEDs in automobile headlights was introduced in 2004 (by high-end brand Audi).

9.0 RESULTS/FINDINGS

This Section summarizes the information available on the quantity of mercury products by category that enter Nigeria for the duration of approximately four years, the countries from where these products were shipped from, identification of mercury alternatives and assessment of the strength of the available policy that regulates the influx of these products while the Nigerian market. The data presented in this report represents all of the possible information available to SRADev team mainly from the Nigerian Customs Service data base and a few other regulating agencies.

For clarity, since there are thousands of products that contain mercury, the project focused on identifying a core set of priority products or common components that could be easily identified with plausible substitution within the Minamata Convention obligations. For the purpose of understanding this session therefore, the terms *product* and *component* is simply defined here.

BOX 3: Differentiating Product and Component

Product: A product is predominately sold to the consumer in its final product state. For example, a thermometer is sold to the consumer for temperature measuring purposes e.g. Sphygmomanometers, manometers, thermometers (non-fever), barometers etc.

Component: A component is predominately sold to an original equipment manufacturer to be incorporated within another product. For example, the tilt switch is sold to automobile manufacturers to be incorporated into an automobile e.g. Float switches, tilt switches, pressure switches, temperature switches, displacement relays etc.

Source: Lowel Center for Sustainable Production (The Maine Department of Environmental Protection 2003)

Annex B presents a summary of the raw data of all available information sourced on various categories of mercury products and components with their HS codes, country of importation and quantity in mass/Kg of importation per country for the last four years. From the raw data, we estimated the grand total of importation of all mercury products that enter the country at **614,549,601**kg (614,549.601 tons). On an annual basis, it is estimated that 153,637.40 tons of mercury-added products are imported into the Nigeria from over 71 countries. This represents about 36% of the countries across the seven continents of the world.

Processing Annex B data further gives a simplified and disaggregated breakdown (further analysed in subsequent sections) of these products sector by sector, therefore, *Table 5* below

helps to summarize the data acquired on all imported mercury products of different categories which includes Measuring devices, Lamps/lighting, Electrical/electronic devices, elemental mercury, Batteries etc identified as priorities in this report. The information gathered thus far indicates that limited data is available on mercury imported on an individual products basis. More information is available on mercury imported by product category according to the HS code of the NCS. Also, it was not equally possible to obtain the exact mercury contents of specific products imported as this information was not readily available in the NCS database, but it is however possible on the bases of the preliminary information below to further make some extrapolation (perhaps in further survey) based on established literature mercury contents provided by manufacturers in column 2 (Annex C) This is however beyond the scope of this Report at this time.

This data is however limited by the fact that, it was not possible to clearly identify through the HS code the alternatives of some of the products imported as there was no specific code for the mercury alternatives.

TABLE 5: SUMMARY DATA OF QUANTITY OF IMPORT PER CATEGORY OF MERCURY RELATED PRODUCTS FROM JAN.2010-APRIL 2014

S/N	Product category/ components	Mercury contents(gm)	Quantity of products imported	Alternative identified		Existing regulation			Priority	
				no	*yes*	*strong*	*weak*	*none*	*yes*	*no*
1	**Measuring Devices:**		5,969,257							
	Barometers	400 – 620						✓	✓	
	Sphygmomanometers	50 – 140			✓			✓	✓	
	Manometers	30 – 75						✓	✓	
	Fever and Non Fever Thermometers	0.5 – 54			✓			✓	✓	
	Hygrometer/Psychrometer	5 – 6						✓	✓	
	Flow Meter							✓		✓
	Pyrometer							✓		✓
	Hydrometer							✓		✓
2	**Dental Amalgam**		**-**		✓			✓	✓	
	Dental cements and fillings *Pre-measured capsules* *Liquid mercury*	>0.1 – 1								
3	**Lamps/Lighting**				✓					
	Linear fluorescent	<0.10	18,355,971					✓	✓	
	Compact fluorescent	<0.01						✓	✓	
	High intensity discharge	<1	892,784					✓	✓	

	Sealed beam		3,967,881					✓	✓	
	Other		62,806,021					✓	✓	
	Tungsten halogen filament lamps		197,079,802					✓	✓	
4	**Electrical/Electronic Devices**									
	Flame sensors	>1	142,970,930					✓	✓	
	Temperature switch							✓	✓	
	Tilt/vibration switch	0.05 – 5						✓	✓	
	Float switch	0.1 – 70						✓	✓	
	Pressure switch							✓	✓	
	Thermostat		104,647,123					✓	✓	
	Displacement relay	0.005 - >1	4,287,261					✓	✓	
	Wetted reed relay	0.005 - >1						✓	✓	
	Contact relay	0.005 - >1						✓	✓	
5	**Batteries**									
	Button cell, silver oxide	<0.05	293,084					✓	✓	
	Button cell, zinc air		230,636					✓	✓	
	Alkaline manganese (manganese dioxide)		86,636,924					✓	✓	
	Lithium		2,452,397					✓	✓	
	Mercuric oxide batteries		1,497,572					✓	✓	
	Button cell, zinc carbon		722,396					✓	✓	
	others									
	Product category/ components	**Amount of Mercury in Individual Component or Product (mg or ppm)**								
6	**Cosmetics**									
	Skin Care Products (creams, soaps, lotions)	>0 - >250	Nil	✓			✓		✓	
7	**Paints**									
	Interior/exterior paints (phenylmercuric acetate, biocide)	>0 - >250	ND					✓		✓
8	**Pesticides**									
	Agricultural applications (organomercurial compounds, biocide)	>0 - >250	ND					✓	✓	
9	**Chemicals**									
	Chemical intermediate and catalyst (excl PU) *1	>0 - >250	95,633					✓		✓
	Laboratories and pharmaceutical industry	>0 - >250						✓		✓

	Preservatives in vaccines and cosmetics	>0 - >250	ND					✓		✓
	Disinfectant	>0 - >250	ND					✓		✓
10	**Miscellaneous uses**									
	Porosimetry and pycnometry		ND					✓		✓
	Gold production (illegal)	**varies**	ND					✓	✓	
	Other applications		ND							
	Pressure Transducers	>100 mg up to 1000 mg	ND					✓	✓	
	Film	>0 – 10 ppm; >0 – 5 mg	ND					✓	✓	
	Imaging Devices	>0 – 5 mg	ND					✓		✓
	Electric Heat Contactors	>1000 mg	ND					✓	✓	
	Electrical Connectors	500 mg to >1000 mg	ND					✓	✓	
	Permeation Tubes/Mercury Probe Systems	>50 mg – >1000 mg	ND					✓	✓	
	Scanning Electrodes	>0 – 5 mg	ND					✓		✓

ND: Not determined

9.1 ELECTRICAL/ELECTRONIC PRODUCTS

In this category, which involve various mercury product components such as ***relays*** used to turn on and off large current loads by supplying relatively small currents to a control circuit, finding show import of about 4,287,261 mass/kg (4,287.261 tons), ***switches and fuses*** used to regulate current of different voltage, have about 142,970,930 mass/kg (142,970.930 tons) quantity and ***thermostats*** to control temperature especially in heating, ventilating, and air conditioning (HVAC) systems, has about 104,647,123 mass/kg of importation. The grand total importation of this category is 251,905,314 kg (251,905.314 tons) in the past 4 years.

This indicates that Nigeria imports on an annual average of 62,976.3228 tons of mercury added product components (relay, switches, fuses, thermostats only) from the electrical/electronic category. Within the group of the electrical/electronics, switches have the highest quantity of importation followed by thermostat (*figure 15)*, while in *figure 16*, it could be seen that of the total importation of 251,905,314 mass/kg, United Kingdom exported higher to Nigeria (43%) followed by China (37%). Other countries from which these mercury products components were imported were: India, Belgium, USA, Austria, Germany, Emirates and Hongkong.

9.1.1 LED (MERCURY-FREE) ALTERNATIVES

In the study, data of LED alternatives (described in section 8.5 above) imported into the country are also documented. Of the total of 72,390,397kg of LED imported from 46

countries in 4 years, 61,094,772kg were imported from China (90% of import). From table 6, only 10 countries (including China) accounted for 68,887,155kg (95% of import) of LED imported into Nigeria within the period. The other 36 countries (including Senegal and South Africa) accounted for the rest 3,503,242kg (5% of import). What is significant here is that a huge amount of LED mercury-free alternatives is already entering the country, although dominated by China, on an annual basis, this is an encouraging development.

Table 6: Showing amount of LED alternatives imported and countries

Countries	LED Products (mass/kg)
China	61,094,772
UK	2,452,414
Germany	1,321,676
USA	1,236,163
Korea Republic	1,009,591
UAE	848,898
Malaysia	273,028
Sweden	254,745
Belgium	223,469
Singapore	172,399
OTHERS (36 countries)	3,503,242
TOTAL	**72,390,397**

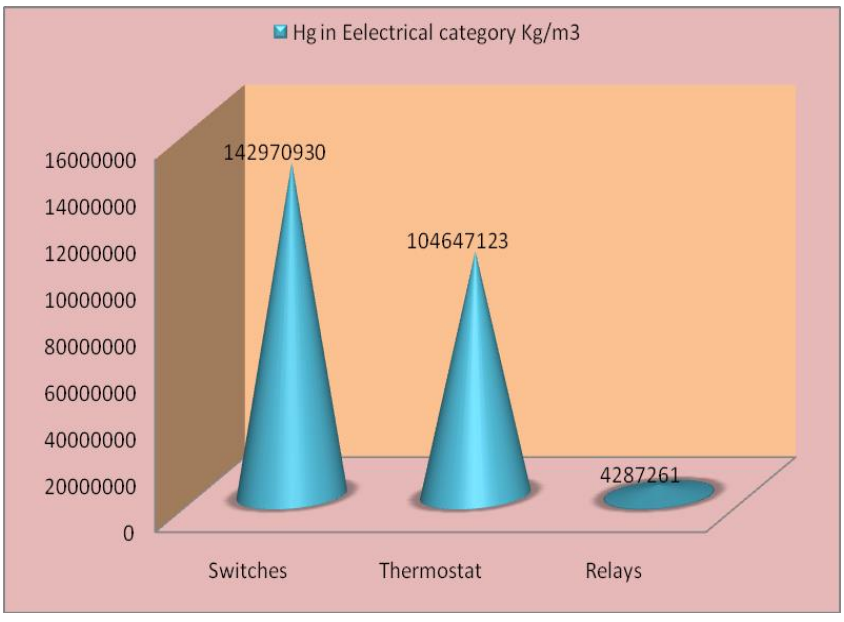

Figure 17: Chart illustrating the quantity of importation of against Electrical product components

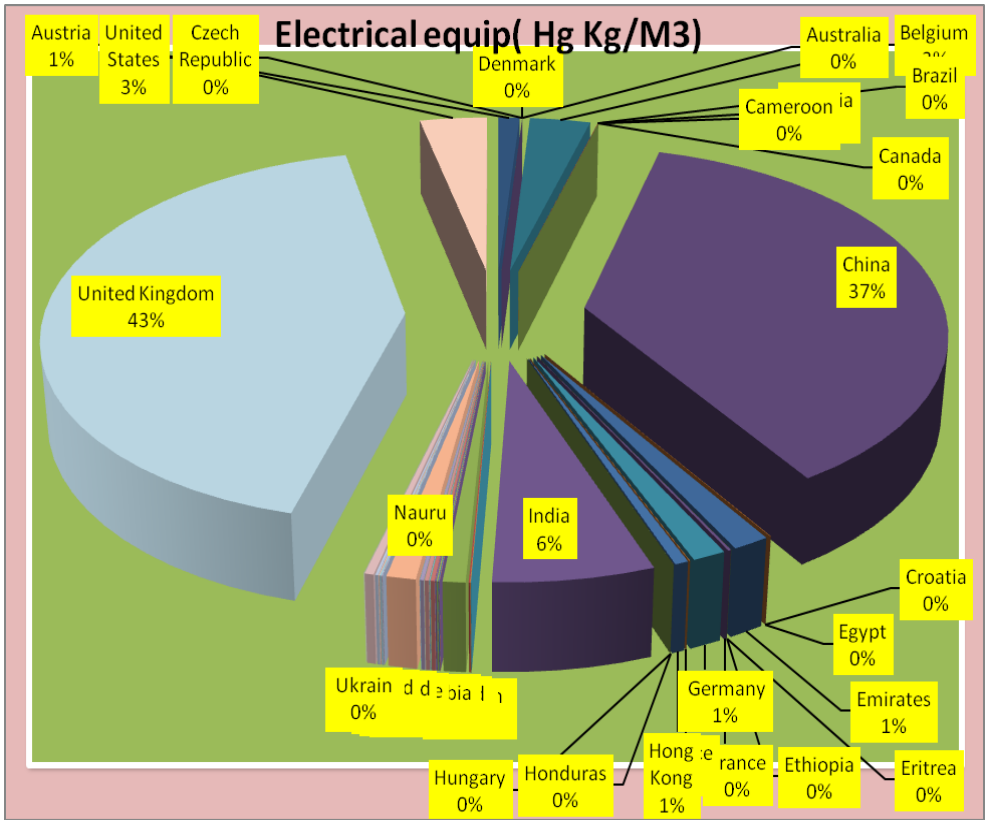

Figure 18: Percentage of Electrical/Electronic category (mass/kg) against country of Importation.

9.2 BATTERY PRODUCTS

In the category of mercury battery products, where we have five major types of the batteries that contain mercury as Zinc air, Mercuric oxide, Lithium, Silver oxide and Alkaline manganese. *Table 7* below shows the countries that exported the products into Nigeria and the respective quantities shipped. Data obtained showed that the total imported into the country from January 2010-April 2014 is 91,832,909 kg (91,832.909 tonnes) with Alkaline manganese products identified as predominant in this group with about 86,636,924 mass/kg.

Of the 22 countries importing mercury battery products into the country, China alone has the highest shipment of about 91% (81,765,507kg) of the total importation in this category (*figure 19)* followed by Belgium. It is also striking to know from that, Africa countries such as Egypt, Congo, and Ghana also import reasonable amounts of these products into Nigeria.

Table 7: Data showing countries and amount (kg) of battery products imported from Jan. 2010-April 2014

Country	Africa	Armenia	Belgium	Czech Republic	Canada	China	Congo	Denmark	Egypt	France	Ghana	Germany
Mass/kg	2,112	1,300	4,476,619	1	20	81,765,507	150	665	1,451,430	333,432	50	51,485
Country	Haiti	Hong Kong	India	Indonesia	Israel	Italy	Japan	Korea	South Africa	Singapore	Slovakia	Spain
Mass/kg	75	195,525	251,091	4,639	385	11,204	21,830	43,843	33,035	460,800	13,126	530
Country	Sweden	Switzerland	Taiwan	Thailand	Turkey	UAE	U.K	United States				
Mass/kg	460	2,858	135,519	42,512	172,157	30,953	10,072	83,809				

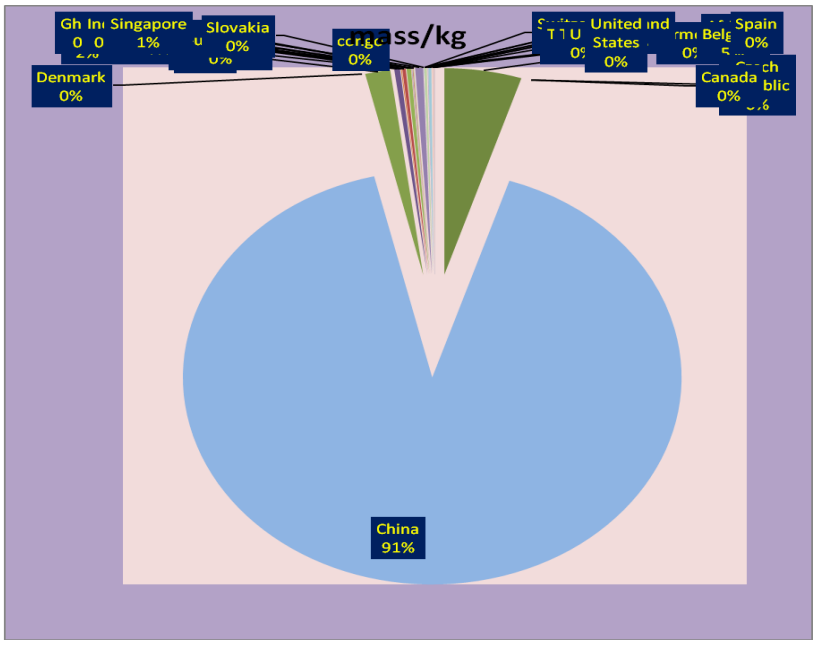

Figure 19: Chart of percentage of imported battery products against country of importation

9.3 LAMPS/LIGHTING PRODUCTS

Mercury in light bulbs (typically called lamps), in both indoor and outdoor applications is also commonly found in the country. Mercury-added lamps of the following categories: Linear fluorescent and Compact fluorescent (fluorescent hot cathode), High intensity discharge (includes metal halide, ceramic metal halide, high pressure sodium, and mercury vapor), Mercury short-arc are all known to be in the market. A total amount of 264,746,488 kg (264,746.488 tonnes) of lamps had been shipped into the country for the period of interest, approximately 66,186.622 tonnes annually. Of this amount, 87% of the total importations

were from China while the remaining 13% were from other 45 countries, including Ghana, Egypt and South Africa.

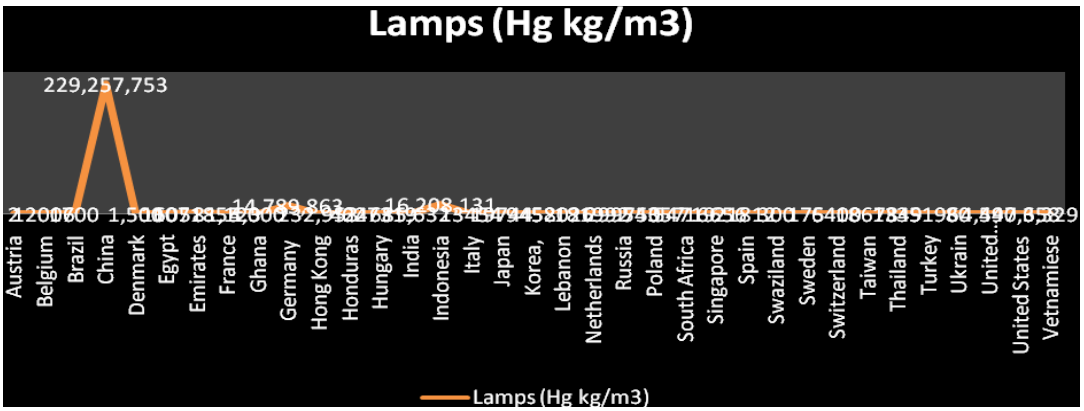

Figure 20: A line graph of Mercury Lamps products imported (kg) against country of import

10.0 COMPARING ALL TOTAL MERCURY IN PRODUCT CATEGORIES IMPORTED INTO NIGERIA (JAN 2011 – APR 2014)

In comparing all the total of 614,549,601kg mercury product categories imported into Nigeria from 71 countries, the lamps products has the highest quantity of about 35% of the total followed by battery products and electrical equipment products of 32% and 32% respectively *(figure 21)*. The measuring device products quantity of 5,969,257kg is just 1% of the total while mercury chemical solution amount of approximately 95 tonnes (*U.S - 92,896 kg, South Africa 1,948 and Egypt 789 kg*) appears low compared to others *(table 8)*. However, this quantity is very significant because with regards to the elemental chemical form in which it was imported as non-product added chemical. This is the form in which mercury can be directly used in ASGM, dental amalgam, schools, and other industrial processes.

Table 8: Total of different mercury in product in mass/kg

Product category	mass (kg/m^3)
Chemical	95,633
Measuring device	5,969,257
Battery	91,832,909
Lamps and Light	264,746,488
Electrical equip	251,905,314

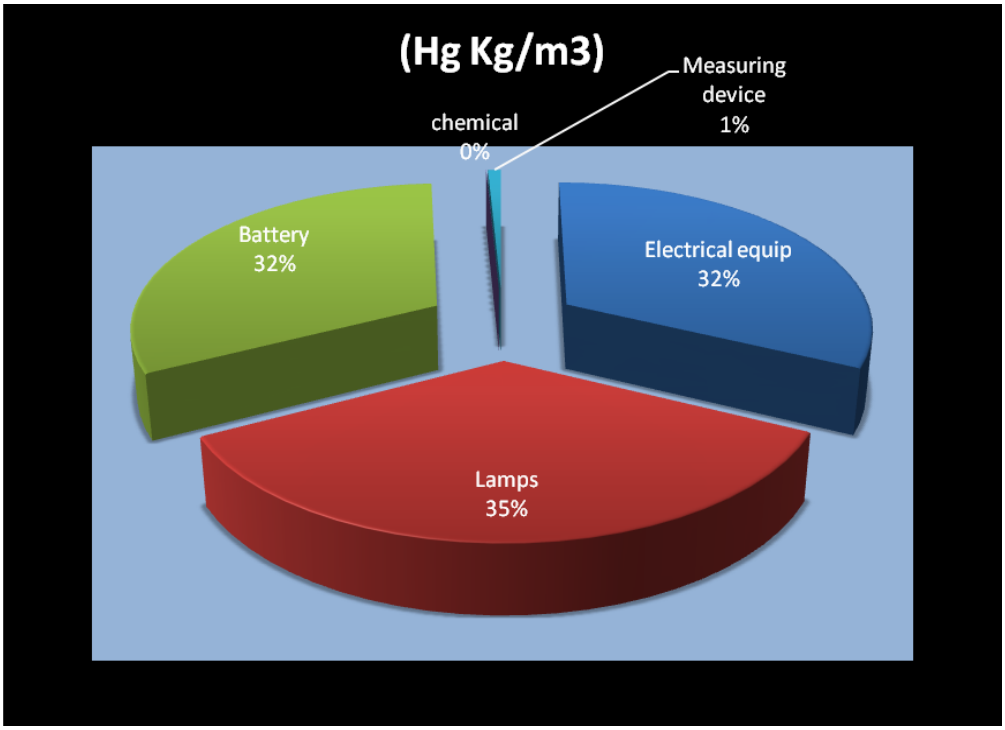

Figure 21: Pie chart of total of different mercury in product importation

11.0 TOTAL MERCURY PRODUCT CATEGORIES IMPORTED AND COUNTRIES

The general assessment of the mercury products imported from all 71 countries across the seven continents within the period in question shows that 73% of all the products shipment came from China while 14% came from United Kingdom. The remaining 13% were spread across 69 countries of the world *(figure 22)*.

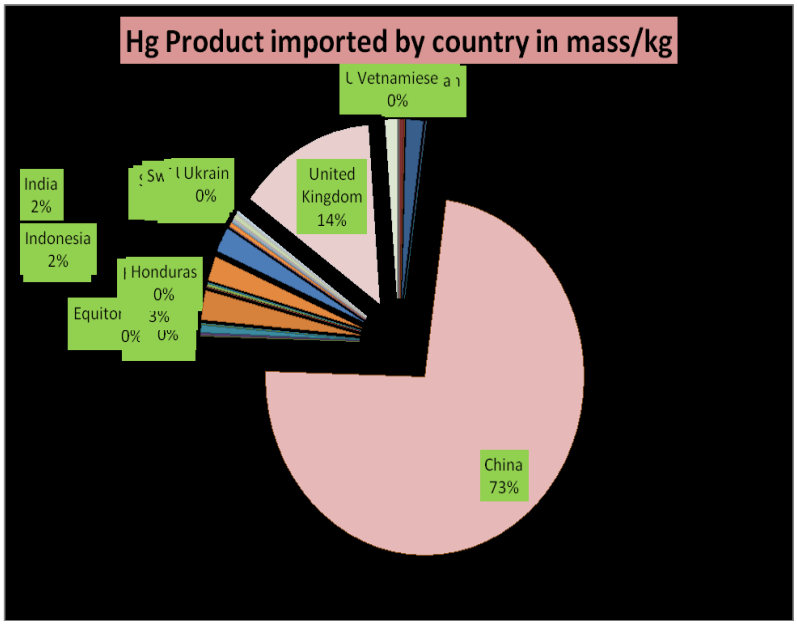

Figure 22: Percentage of all mercury in product categories and country of importation.

12.0 CONCLUSION

From the data explained so far, it could affirm that virtually all mercury-added products that enter the country legally on average annual basis is 153,637,400 mass/kg (153,637.4 tons) of which 73% of them is 112,155,302.2kg (112,155.3 tonnes) comes from China alone. The mercury contents of this total can actually be extrapolated or estimated in other to know how much mercury pollution is discharged into Nigerian Environment (water, soil, air etc) during life cycle use of these mercury-added products in residential, commercial, as well as industrial environments. This amount is devoid of the quantity of products unknown to be entering illegally through the porous borders by smugglers, or those that are non-commercial and brought into the country for personal or domestic uses.

Also, it is inferred that lamps and electrical equipment products constitutes 67% of the total importation in Nigeria. This is explained by the numerous use and applications of these products/components domestically, commercially and industrially. Although switches, relays, thermostat and lamps are known not to contain the greatest amount of mercury per component or product, the sheer volume of import, sales and applications of these products categories accounts remain significant in terms of mercury release into air, water, land, general waste etc.

Measuring devices (*e.g. Barometers 400-620g, Sphygmomanometers 50-75g and manometers 30-75g of mercury per article*), which typically contains the largest amounts of mercury per

individual item, importation of these items at 5,969,257kg (5,969.2 tonnes) at an average of 1,492.3 tonnes annually is significant high in terms of mercury eventual releases to the Nigerian environment.

This report indicatively shows that the amount of mercury in product entering the country is very high when compared to the developed countries where better chemical and waste management infrastructure exists. For example, in America between 2001 and 2004 the amount of mercury used in chemical solution was 1.9 tons (633 Hg kg/yr) from twenty manufacturers (Galligan *et al,* 2003) compared to 95.6 tons of mercury solution imported into Nigeria from only three countries (USA, India and South Africa) equivalent of 23,900 Hg kg/yr within 2010-2014. The plethora of these products can be attributed to the dependency of Nigeria on imported finished goods and most times substandard products mainly from the Asian countries such as electrical/electronics from China. It is also partly due to weak or comprehensive regulation of mercury in products, despite the FMENV regulation *(Annex A)* standards on mercury in battery, dental amalgam etc.

In Nigeria, there are laws that addresses toxic and hazardous substances but there is yet no law that addresses the peculiarity of the hazardous nature of mercury in all facets although some agencies such as NAFDAC has placed embargo on cosmetic products that contain mercury but has had little influence on the staggered influx of mercury-added products from other sources and the porosity of the Nigeria's ports.

In most developed countries, legislation to address mercury containing products has been in existence since the early 1990s. In 1993, Sweden banned or phased-out the manufacture, import, or sale of thermometers, barometers, manometers, tilt switches, float switches, pressure switches, thermostats, relays and other types of measuring instruments. Other European countries have banned or restricted the import, sale, and/or use of various mercury containing products *(UNEP, 2002)*. In the United States, there is legislation at the state level that addresses the sale of various mercury containing products. For example, Rhode Island and Connecticut have recently adopted into law mercury product phase-out legislation.

13.0 RECOMMENDATIONS

From the data presented thus far and the conclusions drawn, the following recommendations are made:

- Further detail survey is required to specifically quantify the amount of mercury in products entering the Nigerian market and their life cycle management.
- Mercury specific legislation in line with Minamata Convention domestication, including national emissions/releases standards, standard minimum mercury in products and protocols for permits/license be developed and implemented.
- There is urgent need to build capacity of regulatory officials of the Customs (NCS) and NESREA in other to understand, identify and interpret those mercury-added products. Non-mercury alternatives have been researched and recommended for the following products: sphygmomanometers, manometers, barometers, non-fever thermometers, hygrometers, psychrometers, hydrometers, flow meters, and pyrometers, lamps. The two products where alternative replacements cannot be recommended for all applications are gastrointestinal tubes and industrial thermostats.
- There is need for stringent policy that will regulate the influx of products based on the convention obligations: no mercury-added products would be allowed unless they are listed in an annex (the negative list), all mercury-added products would be allowed unless they are listed in an annex (the positive list).
- Best in-house environmental practices and use of best environment friendly technologies be encouraged. Standard operating procedures (SOPs) for mercury handling collection, transport and use, be developed and implemented.
- Mercury specific occupational and health safety, mercury releases and emissions control, environmentally sound mercury waste management, non-mercury dental fillings and alternate material and capsulated mercury amalgam & mechanized mixing technologies.
- Proper networking amongst stakeholders to foster synergistic cooperation on the brands of product in which they deal.
- Public enlightenment to enable people recognize a brand value advantage in the offering of mercury-free alternatives to their traditionally mercury-added products.

References:

Adabajo, S.B. (2002). An epidemiological survey of the use of cosmetic skin lightening cosmetics among traders in Lagos, Nigeria. *West African Journal of Medicine* **21**(1):51-55.

Arvidson .B, Arvidsson .J, Johansson .K (1994). Mercury deposits in neurons of the trigeminal ganglia after insertion of dental amalgam in rats." *Biometals* 7, 261-263

Chemos (2008). CHEMOS GmbH. Accessed at: http://www.chemos.de

Clean Car Campaign (2004). Mercury in Vehicles Update. Automotive Mercury Releases to the Environment Reach Record Levels. Clean Car Campaign.

Comus (2007). Motion/Vibration Sensors. Comus International Bvba, Belgium. Accessed at: http://www.comus.be/productpages/movement_vibration_switches_be.asp

Comus (2008b). Personal communication with Patrick Jooken, Comus International Bvba, Belgium. March 2008.

Demag-Hamilton (2008). True temp positive/negative pressure TCU. Accessed at: http://www.demag-hamilton.co.uk/home/products/aec/sb-aec-positive---negative-tcu.pdf

Evisa (2008). ESA Inc. - Model 3010B Blood Lead Analyzer. Accessed at: http://www.speciation.net/Appl/Techniques/technique.html?id=2482

Floyd, P., Zarogiannis, P. Crane, M. Tarkowski, S. Bencko, V. (2002). Risks to health and the environment related to the use of mercury products. RPA Technology for the European Commission, DG Enterprise.

Galligan, C., Morose. G, Giordani, J. (2003). An investigation of alternatives to mercury containing products. Lowell Center for Sustainable Production for The Maine Department of Environmental Protection.

Giordani, J. (2000). Guide for identifying mercury switches/thermostats in common applications. Burlington Board of Health, Vermont. Accessed at: http://www.newmoa.org/prevention/topichub/22/burlington_report.pdf

Goodman, P. & C. Robertson (2006). Review of Directive 2002/95/EC (RoHS) categories 8 and 9. Final report. ERA Technology for the European Commission.

Hansen, E. C. Lassen, Maxson, P. (2005). RoHS substances (Hg, Pb, Cr(VI), Cd, PBB and PBDE) in electrical and electronic equipment in Belgium. Federal Public Service Health, Food Chain Safety and Environment, Brussels.

ICD (2008). Mercury Relays and Contactors. ICD Controls Limited, Tring, UK. Accessed at: http://www.icdcontrols.co.uk/mercury_contactors.htm

IFS (2008). IFS Chemicals Ltd., Station Rd., Roydon, King's Lynn, Norfolk PE32 1AW, England. Accessed at: http://www.ifs-group.com.

KemI (2004). Mercury - Investigation of a general ban. KemI Report 4/04. Swedish Chemicals Inspectorate, Sundbyberg.

KemI (2005). Phase-out of dental amalgam in Sweden. Presentation by Petra Ekblom, Swedish Chemicals Inspectorate. Accessed at: http://www.zeromercury.org/EU_developments/Amalgam%20phaseout%20in%20Sweden_Brussels%20May%2007.pdf

Kremer Pigmente (2007). Zinnober. [Cinnabar] Kremer Pigmente GmbH & Co. KG, Germany. Accessed at: http://kremer-pigmente.de/shopint/index.php?cat=0102&product=42000 [In German]

Lutter, R., and E. Irwin (2002). “Mercury in the Environment: A Volatile Problem,” *Environment*, Vol. 44, No. 9, pp. 24-40.

Maag J., L.D. Hylander, N. Pirrone, N. Brooks, J. Gilkeson, M. Smith, M. Asari M and P. Maxson (2007). Mercury substitution priority working list - An input to global considerations on mercury management. Nordic Council of Ministers, Copenhagen. Accessed at http://norden.org/pub/miljo/miljo/sk/TN2007541.pdf.

Metrohm (2008). Electrodes for Voltammetry and Polarography. Metrohm Ion Analysis, Switzerland. Accessed at: http://www.metrohm.com/applications/va/va_electrodes.html

Miller and Weber (2008). Introducing PerformaTherm™. Miller and Weber, Inc. Accessed at: http://www.millerweber.com/newprod.htm

Naturvårdsverket (2003). Hittakvicksilvertekniskavarorochprodukter [Find mercury in technical goods and products]. Swedish Environmental Protection Agency, Naturvårdsverket, Stockholm. [In Swedish] Accessed at: http://nvv005.naturvardsverket.se/pdf/91-620-5279-9.pdf

NAFDAC (2004). Act. Cap N1 Laws of the Federation of Nigeria (LFN) 2004, http://www.nlipw.com/ip-laws/nafdac-act/

Newhouse, D.W. (2003). There is mercury in those rubber floors. Newhouse, Prophater and Lechter LLC. Accessed at: http://www.npllawyers.com/source/profiles/Mercury%20Article.pdf

Philadelphia (2008). Thermoregulators. Philadelphia Instruments & Controls Inc. Accessed at: http://www.philadelphiainstrument.com/thermoregulators.asp

Raytheon (2008). Gyro Compass Standard 22. Raytheon Anschütz GmbH, Germany

Rankin (2008). Particle Data Elzone 180. Accessed at: http://websites.labx.com/rankin/detail.cfm?p=0&autonumber=47960

UNEP (2002). Global Mercury Assessment. United Nations Environment Programme, Chemicals Branch, Geneva, December 2002. Available in English, French and Spanish at http://www.chem.unep.ch/mercury/.

UNEP (2005). Toolkit for identification and quantification of mercury releases - pilot draft of November 2005. United Nations Environment Programme, Chemicals Branch, Geneva, 2005. Accessed at http://www.chem.unep.ch/mercury/Guidance-training-materials.htm.

Vertellus (2008c). Vertellus Performance Materials Inc. Accessed at: http://www.vertellus.com/

Watlow (2004). E-SAFETM Relay Provides Cost-effective Mercury-Free Power Switching. Accessed at: http://www.watlow.co.uk/literature/specsheets/files/controllers/winesr0704.pdf

World Customs Organisation (2012). Explanatory Notes of Harmonized Commodity Description and Coding System (fifth edition), volume 1-5.

Acknowledgements

For this survey, SRADev Nigeria highly acknowledged EEB/Zero Mercury Working Group (ZMWG), Belgium on behalf of Swedish Society for Nature Conservation (SSNC) for the financial support and understanding towards the success of this survey. The collaborative efforts of the Nigerian Customs Service, Ministry of Environment, Ministry of Health, Ministry of Science and Technology, NAFDAC, Standards Organisation of Nigeria, NESREA, Consumers Protection Council, and many other organisation too numerous to mention here and every other facilities used for the success of this project, you are appreciably acknowledged.

ANNEX A: Standard for environmental media, actions and regulations that control releases from environmental sources that contain mercury, actions and regulations on products that contain mercury and other standards, actions and programmes relevant to mercury.

Country	GMA Submission	Standards for environmental media maxi. Acceptable Hg conc. for different media	Actions of regulations that control releases from sources that mercury contains	Actions of regulations on product that contains mercury	Other standards, actions and programmes relevant to Hg
Nigeria	Yes	Mercury is not allowed in drinking water. The effluent limitation guidelines specifies limt for discharge into surface water at less than 40^0C within 15 meters of outfall for Hg is 0.05mg/l for all categories of industries: Alkyl mercury compounds must not be detectable in effluent both for discharge into surface water and for land application. The maximum concentration allowed for discharge into inland waters for specific industries as stated heron is: i. Metal working, Plating and finishing waste water. Hg = 0.01mg/l. ii. In plastic and synthetics industries, mercury was identified as one of the problem parameters in waste water along with plasticisers and PCBs. iii. The prescribed tolerant limit for safe levels of specific mercury as air pollutant tolerable to humans, aquatic organism and vegetation is 0.0003mg/m^3 for 24 hours (long term). iv. Any solid waste which exhibits the characteristics of extraction procedure (EP) toxicity assigned to mercury in the guideline and standards value of FD 009 with EHW maximum concentration in extract of >20mg/l and DW maximum conc. in extract of 0.2 – 20mg/l shall be listed as FEPA dangerous waste, (FD) Extremely Hazardous Waste (EHW) and Dangerous Waste (DW). v. The total metal contents of the waste in petroleum	Guidelines for emission limits from stationary sources represent maximum allowable levels of pollutants from a site, process, stack rents etc with the objective of achieving a desired air quality. Mercury is identified as mercaptans in petroleum operations, kraft pulp and in chlor-alkali vapour. The emission limits as stated in the guidelines for mercury substance is 1.0 – 230mg/m^3. The maximum concentration of mercury for ground water protection standard = 0.002mg/l. This guideline applies to owners and operators of facilities that treat, store or dispose of dangerous waste in surface impoundments, waste piles, land treatment units or landfills.	No mercury is allowed in Batteries. The allowed mercury in Dental amalgam capsule is 0.3g. Mercury Iodide is banned in cosmetics. This was also re-emphasized on 2nd of August 2002 by National Food and Drugs Administration Control (NAFDAC).	International instruments – Nigeria has ratified the Basel convention and Rotterdam convention.

Country	GMA Submission	Standards for environmental media maxi. Acceptable Hg conc. for different media	Actions of regulations that control releases from sources that mercury contains	Actions of regulations on product that contains mercury	Other standards, actions and programmes relevant to Hg
		shall not exceed the maximum concentration of contaminant for characteristics of EP toxicity of 0.2mg/l for mercury.			

ANNEX B:

SUMMARY OF RAW DATA OF IMPORT OF MERCURY RELATED PRODUCTS AND COMPONENTS FROM JAN.2010-APRIL.2014 IN NIGERIA

CATEGORY	HS CODE	DESCRIPTION	COUNTRY OF ORIGIN	TOTAL KG/MASS (IMPORT)
Electrical/Electronic Devices	**8535100000**	Fuses,for a voltage exceeding 1000 Volts	Australia	22
Switches	8535100000	Fuses,for a voltage exceeding 1000 Volts	Belgium	101990
	8535100000	Fuses,for a voltage exceeding 1000 Volts	Bulgaria	45
	8535100000	Fuses,for a voltage exceeding 1000 Volts	Cameroon	40000
	8535100000	Fuses,for a voltage exceeding 1000 Volts	Canada	353
	8535100000	Fuses,for a voltage exceeding 1000 Volts	China	6958207
	8535210000	Automatic circuit breakers for a voltage	China	2,962,373
	8535290000	Other automatic circuit breakers	China	6,394,523
	8535300000	Isolating switches and make-and-break	China	20,517,662
	8536100000	Fuses, for a voltage not exceeding 1000	Germany	185233
	8536100000	Fuses, for a voltage not exceeding 1000	China	12,599,744
	8536100000	Fuses, for a voltage not exceeding 1000	France	16355
	8536100000	Fuses, for a voltage not exceeding 1000	Republic of South Africa	14769
	8536100000	Fuses, for a voltage not exceeding 1000	Taiwan, Province of China	31030
	8536100000	Fuses, for a voltage not exceeding 1000	Hong Kong	30000
	8536100000	Fuses, for a voltage not exceeding 1000	India	2034824
	8536100000	Fuses, for a voltage not exceeding 1000	Egypt	905
	8536100000	Fuses, for a voltage not exceeding 1000	Italy	3102
	8536100000	Fuses, for a voltage not exceeding 1000	Belgium	1111454
	8536100000	Fuses, for a voltage not exceeding 1000	United Arab Emirates	212064

	8536100000	Fuses, for a voltage not exceeding 1000	Sweden	200
	8536100000	Fuses, for a voltage not exceeding 1000	Japan	500
	8536100000	Fuses, for a voltage not exceeding 1000	United States	677197
	8536100000	Fuses, for a voltage not exceeding 1000	Slovakia	10435
	8536100000	Fuses, for a voltage not exceeding 1000	Israel	1203
	8536100000	Fuses, for a voltage not exceeding 1000	United Kingdom	3314848
	8536100000	Fuses, for a voltage not exceeding 1000	Singapore	10,500
	8536100000	Fuses, for a voltage not exceeding 1000	Netherlands	8742
	8536100000	Fuses, for a voltage not exceeding 1000	Norway	746
	8536100000	Fuses, for a voltage not exceeding 1000	Australia	146
	8536100000	Fuses, for a voltage not exceeding 1000	Philippines	1,344
	8536100000	Fuses, for a voltage not exceeding 1000	Canada	3635
	8535400000	Lightning arresters, voltage	China	2,812,443
	8535400000	limiters and	Denmark	1,092
	8535400000	Lightning arresters, voltage limiters and	Egypt	433
	8535400000	Lightning arresters, voltage limiters and	Emirates	36,000
	8535400000	Lightning arresters, voltage limiters and	Ethiopia	10
	8535400000	Lightning arresters, voltage limiters and	France	127,007
	8535400000	Lightning arresters, voltage limiters and	Germany	3,104,691
	8535400000	Lightning arresters, voltage limiters and	Greece	4,862
	8535400000	Lightning arresters, voltage limiters and	Hong Kong	680,814
	8535400000	Lightning arresters, voltage limiters and	Hungary	134
	8535400000	Lightning arresters, voltage limiters and	India	14,889,638
	8535400000	Lightning arresters, voltage limiters and	Israel	48,390
	8535400000	Lightning arresters, voltage limiters and	Italy	133,844
	8535400000	Lightning arresters, voltage limiters and	Jamaica	24
	8535400000	Lightning arresters, voltage limiters and	Japan	25,331

	8535400000	Lightning arresters, voltage limiters and	Korea, Republic of	43,843
	8535400000	Lightning arresters, voltage limiters and	Latvia	1,500
	8535400000	Lightning arresters, voltage limiters and	Lebanon	100,724
	8535400000	Lightning arresters, voltage limiters and	Malaysia	20,950
	8535400000	Lightning arresters, voltage limiters and	Namibia	6,000
	8535400000	Lightning arresters, voltage limiters and	Nauru	3
	8535400000	Lightning arresters, voltage	Netherlands	191,473
	8535400000	limiters and	New Zealand	140
	8535400000	Lightning arresters, voltage limiters and	Norway	26
	8535400000	Lightning arresters, voltage limiters and	Poland	54
	8535400000	Lightning arresters, voltage	Republic of South Africa	135,918
	8535400000	Lightning arresters, voltage limiters and	Saudi Arabia	9,000
	8535400000	Lightning arresters, voltage limiters and	Singapore	991,101
	8535400000	Lightning arresters, voltage limiters and	Spain	14,198
	8535400000	Lightning arresters, voltage limiters and	Swaziland	4,038
	8535400000	Lightning arresters, voltage limiters and	Sweden	1731
	8535400000	Lightning arresters, voltage limiters and	Switzerland	16,958
	8535400000	Lightning arresters, voltage limiters and	Turkey	64,800
switches	**8535900000**	Other electrical apparatus for switching...	Turkey	365,136
	8535900000	Other electrical apparatus for switching...	Uganda	120
	8535900000	Other electrical apparatus for switching...	United Arab Emirates	2,347,676
	8535900000	Other electrical apparatus for switching...	United Kingdom	655,555
	8535900000	Other electrical apparatus for switching...	United States	2,821,628
	8536500000	Switches, nes, =<1000 V	United Kingdom	47766282
	8536500000	Switches, nes, =<1000 V	France	23758

	8536500000	Switches, nes, =<1000 V	Spain	12601
	8536500000	Switches, nes, =<1000 V	Ukraine	100
	8536500000	Other Switches, for a voltage not exceeding	Brazil	12,920
	8536500000	Switches, nes, =<1000 V	Korea	13580
	8536500000	Other Switches, for a voltage not exceeding	Isle of Man	160
	8536500000	Switches, nes, =<1000 V	Switzerland	5811
	8536500000	Switches, nes, =<1000 V	Austria	2544473
	8536500000	Switches, nes, =<1000 V	Hong Kong	88824
	8536500000	Switches, nes, =<1000 V	Belgium	4645599
	8536500000	Switches, nes, =<1000 V	Israel	18952
	8536500000	Switches, nes, =<1000 V	Japan	8665
	8536500000	Switches, nes, =<1000 V	UAE	858592
	8536500000	Switches, nes, =<1000 V	South Africa	1655
	8536500000	Switches, nes, =<1000 V	Egypt	62674
	8536500000	Switches, nes, =<1000 V	Sweden	846
TOTAL SWITCHES				**142970930**
THERMOSTAT	8536500000	Switches, nes, =<1000 V	Hungary	1000
	8536500000	Switches, nes, =<1000 V	Swaziland	531
	8536500000	Switches, nes, =<1000 V	Lebanon	4660
	8536500000	Switches, nes, =<1000 V	Greece	45200
	8536500000	Switches, nes, =<1000 V	Indonesia	17796
	8536500000	Switches, nes, =<1000 V	Turkey	387028
	8536500000	Switches, nes, =<1000 V	Cameroun	1000
	8536500000	Switches, nes, =<1000 V	Canada	6
	8536500000	Switches, nes, =<1000 V	Equitorial Guinea	20000
	8536500000	Switches, nes, =<1000 V	Norway	260
	8536500000	Switches, nes, =<1000 V	china	18409768
	8536500000	Switches, nes, =<1000 V	India	3676797
	8536500000	Switches, nes, =<1000 V	Germany	1772053
	8536500000	Switches, nes, =<1000 V	Netherland	84721
	8536500000	Switches, nes, =<1000 V	Italy	40143

	8536500000	Switches, nes, =<1000 V	Singapore	40428
	8536500000	Switches, nes, =<1000 V	USA	122751
	8536500000	Switches, nes, =<1000 V	Germany	110790
	8536500000	Switches, nes, =<1000 V	Hong Kong	431761
	8536500000	Switches, nes, =<1000 V	India	29628
	8536500000	Switches, nes, =<1000 V	China	13301352
	8536500000	Switches, nes, =<1000 V	UK	78705
	8536500000	Switches, nes, =<1000 V	USA	113993
	8536500000	Switches, nes, =<1000 V	Singapore	690148
	8536500000	Switches, nes, =<1000 V	Spain	5931
	8536500000	Switches, nes, =<1000 V	Thailand	269756
	8536200000	Automatic circuit breakers, for a voltage of	Switzerland	133000
	8536200000	Automatic circuit breakers, for a voltage of	Israel	2310
	8536200000	Automatic circuit breakers, for a voltage of	UAE	26653
	8536200000	Automatic circuit breakers, for a voltage of	South Africa	121332
	8536200000	Automatic circuit breakers, for a voltage of	Greece	1250
	8536200000	Automatic circuit breakers, for a voltage of	Indonesia	7391
	8536200000	Automatic circuit breakers, for a voltage of	Turkey	15000
	8536200000	Automatic circuit breakers, for a voltage of	United Kingdom	50151964
	8536200000	Automatic circuit breakers, for a voltage of	France	28749
	8536200000	Automatic circuit breakers, for a voltage of	korea	22058
	8536200000	Automatic circuit breakers, for a voltage of	Hong Kong	45792
	8536200000	Automatic circuit breakers, for a voltage of	Belgium	885817
	8536200000	Automatic circuit breakers, for a voltage of	USA	63482
	8536200000	Automatic circuit breakers, for a voltage of	Netherland	1141
	8536200000	Automatic circuit breakers, for a voltage of	china	3141408
	8536200000	Automatic circuit breakers, for a voltage of	India	4063987
	8536200000	Automatic circuit breakers, for a voltage of	Germany	81180
	8536200000	Automatic circuit breakers, for a voltage of	Singapore	129045
	8536200000	Automatic circuit breakers, for a voltage of	Italy	1252
	8536200000	Automatic circuit breakers, for a voltage of	Malaysia	80000
	8536200000	Automatic circuit breakers, for a voltage of	Spain	20918
	8536200000	Automatic circuit breakers, for a voltage of	Honduras	835
	8536200000	Automatic circuit breakers, for a voltage of	Eritrea	76
	8536200000	Automatic circuit breakers, for a voltage of	Iran	62268
	8536200000	Automatic circuit breakers, for a voltage of	Croatia	100
	8536200000	Automatic circuit breakers, for a voltage of	Slovakia	932
	8536200000	Automatic circuit breakers, for a voltage of	Taiwan	45892
	8536200000	Automatic circuit breakers, for a voltage of	Thailand	345

	8536200000	Automatic circuit breakers, for a voltage of	Bulgaria	290
	8536200000	Automatic circuit breakers, for a voltage of	Morocco	1,000
	8536300000	Other apparatus for protecting electrical	UAE	252
	8536300000	Other apparatus for protecting electrical	South Africa	589
	8536300000	Other apparatus for protecting electrical	Turkey	27
	8536300000	Other apparatus for protecting electrical	Canada	1
	8536300000	Other apparatus for protecting electrical	Norway	640
	8536300000	Other apparatus for protecting electrical	Spain	3379
	8536300000	Other apparatus for protecting electrical	Malaysia	4555
	8536300000	Other apparatus for protecting electrical	Czech Republic	2,242
	8536300000	Other apparatus for protecting electrical	Luxembourg	5,040
	8536300000	Other apparatus for protecting electrical	Thailand	1000
	8536300000	Other apparatus for protecting electrical	Lativa	494
	8536300000	Other apparatus for protecting electrical	United Kingdom	4324
	8536300000	Other apparatus for protecting electrical	France	79619
	8536300000	Other apparatus for protecting electrical	Korea	138
	8536300000	Other apparatus for protecting electrical	Hong Kong	3752
	8536300000	Other apparatus for protecting electrical	Switzerland	11621
	8536300000	Other apparatus for protecting electrical	Israel	11000
	8536300000	Other apparatus for protecting electrical	Belgium	628
	8536300000	Other apparatus for protecting electrical	china	1079673
	8536300000	Other apparatus for protecting electrical	India	120230
	8536300000	Other apparatus for protecting electrical	Germany	24534
	8536300000	Other apparatus for protecting electrical	Netherland	50320
	8536300000	Other apparatus for protecting electrical	Singapore	1,690
	8536300000	Other apparatus for protecting electrical	USA	4449181
	8536300000	Other apparatus for protecting electrical	Italy	521
TOTAL THERMOSTAT				104647123
RELAYS	8536410000	Relays for a voltage =<60 V	china	274316
	8536410000	Relays for a voltage =<60 V	India	1152
	8536490000	Relays for a voltage 60-1000 V	Germany	15123
	8536410000	Relays for a voltage =<60 V	Netherland	4698
	8536410000	Relays for a voltage =<60 V	Italy	22456
	8536410000	Relays for a voltage =<60 V	Singapore	1517
	8536410000	Relays for a voltage =<60 V	USA	874
	8536410000	Relays for a voltage =<60 V	United Kingdom	44274
	8536410000	Relays for a voltage =<60 V	Canada	79

	8536410000	Relays for a voltage =<60 V	Norway	1125
	8536410000	Relays for a voltage =<60 V	Portugal	346671
	8536410000	Relays for a voltage not exceeding 60 Volts	Romania	84,168
	8536410000	Relays for a voltage =<60 V	Germany	28816
	8536410000	Relays for a voltage not exceeding 60 Volts	Denmark	112
	8536410000	Relays for a voltage not exceeding 60 Volts	UAE	1000
	8536410000	Relays for a voltage =<60 V	Israel	20
	8536410000	Relays for a voltage =<60 V	Belgium	676067
	8536410000	Relays for a voltage not exceeding 60 Volts	South Africa	159
	8536410000	Relays for a voltage =<60 V	Canada	79
	8536490000	Relays for a voltage 60-1000 V	Czech Republic	50
	8536490000	Other Relays for a voltage not exceeding		106
	8536490000	Relays for a voltage 60-1000 V	Romania	454
	8536490000	Relays for a voltage 60-1000 V	Puerto Rico	103
	8536490000	Other Relays for a voltage not exceeding	Spain	34
	8536490000	Relays for a voltage 60-1000 V	Belgium	2862
	8536490000	Other Relays for a voltage not exceeding	Switzerland	899
	8536490000	Relays for a voltage 60-1000 V	Israel	134
	8536490000	Relays for a voltage 60-1000 V	UAE	20
	8536490000	Relays for a voltage 60-1000 V	South Africa	55765
	8536490000	Relays for a voltage 60-1000 V	Ireland	78
	8536490000	Other Relays for a voltage not exceeding	Sweden	50000
	8536490000	Relays for a voltage 60-1000 V	Canada	278
	8536490000	Other Relays for a voltage not exceeding	Taiwan, Province of China	1
	8536490000	Other Relays for a voltage not exceeding	Norway	1520
	8536490000	Relays for a voltage 60-1000 V	Indonesia	1800
	8536490000	Relays for a voltage 60-1000 V	USA	1000
	8536490000	Relays for a voltage 60-1000 V	United Kingdom	68435
	8536490000	Relays for a voltage 60-1000 V	France	8806
	8536490000	Relays for a voltage 60-1000 V	Australia	2507
	8536490000	Other Relays for a voltage not exceeding	Hong Kong	50
	8536490000	Relays for a voltage 60-1000 V	Austria	70346
	8536490000	Relays for a voltage 60-1000 V	Korea	65
	8536490000	Relays for a voltage 60-1000 V	Netherland	1364
	8536490000	Relays for a voltage 60-1000 V	Italy	5716
	8536490000	Relays for a voltage 60-1000 V	Singapore	840714
	8536490000	Relays for a voltage 60-1000 V	china	40470
	8536490000	Relays for a voltage 60-1000 V	India	1531111

	8536490000	Relays for a voltage 60-1000 V	Germany	41402
	8536490000	Relays for a voltage 60-1000 V		58465
TOTAL FOR RELAY				4287261
GRAND TOTAL FOR ELECTRICAL EQUIPMENT				251,905,314
LAMPS/ LIGHTING	**8539320000**	Mercury or sodium vapour lamps; metal halide	CHINA	178,520
HID	8539320000	Mercury or sodium vapour lamps; metal halide	FRANCE	3,403
	8539320000	Mercury or sodium vapour lamps; metal halide	GERMANY	682,641
	8539320000	Mercury or sodium vapour lamps; metal halide	U.K	4,590
	8539320000	Mercury or sodium vapour lamps; metal halide	USA	4,088
	8539320000	Mercury or sodium vapour lamps; metal halide	INDIA	11,000
	8539320000	Mercury or sodium vapour lamps; metal halide	HONGKONG	8,542
	8539100000	Sealed beam lamp units	China	1,421,369
	8539100000	Sealed beam lamp units	Spain	5,000
	8539100000	Sealed beam lamp units	Africa	210
	8539100000	Sealed beam lamp units	Belgium	10571
	8539100000	Sealed beam lamp units	UAE	28127
	8539100000	Sealed beam lamp units	japan	2,000
	8539100000	Sealed beam lamp units	USA	16020
	8539100000	Sealed beam lamp units	Germany	50
	8539100000	Sealed beam lamp units	France	60000
	8539210000	Sealed beam lamp units	China	2,190,387
	8539210000	Sealed beam lamp units	UAE	3000
	8539210000	Sealed beam lamp units	USA	237
	8539210000	Sealed beam lamp units	Germany	43151
	8539210000	Sealed beam lamp units	France	222
	8539210000	Sealed beam lamp units	South Africa	39,678
	8539210000	Sealed beam lamp units	Netherland	5000
	8539210000	Sealed beam lamp units	Indonesia	90,675
	8539210000	Sealed beam lamp units	Ukraine	80
	8539210000	Sealed beam lamp units	Lebanon	15306
	8539210000	Sealed beam lamp units	India	36798
	8539220000	Tungsten halogen filament lamps excluding	UAE	99028

	8539220000	Tungsten halogen filament lamps excluding	China	194,116,084
	8539220000	Tungsten halogen filament lamps excluding	Spain	4000
	8539220000	Tungsten halogen filament lamps excluding	USA	411940
	8539220000	Tungsten halogen filament lamps excluding	Germany	1282351
	8539220000	Other filament lamps of a power not	Indonesia	232886
	8539220000	Other filament lamps of a power not	Netherlands	147,097
	8539220000	Tungsten halogen filament lamps excluding	France	32
	8539220000	Tungsten halogen filament lamps excluding	South Africa	2204
	8539220000	Other filament lamps of a power not	Hungary	79,230
	8539220000	Other filament lamps of a power not	Russian Federation	299,750
	8539220000	Tungsten halogen filament lamps excluding	Hong kong	390164
	8539220000	Other filament lamps of a power not	Thailand	986
	8539220000	Tungsten halogen filament lamps excluding	Korea	5129
	8539220000	Tungsten halogen filament lamps excluding	Singapore	100
	8539220000	Tungsten halogen filament lamps excluding	Italy	8821
	8539290000	Other filament lamps of a power not	China	12,448,180
	8539290000	Other filament lamps of a power not	Belgium	1000
	8539290000	Other filament lamps of a power not	UAE	2210
	8539290000	Other filament lamps of a power not	USA	10864
	8539290000	Other filament lamps of a power not	Germany	610923
	8539290000	Other filament lamps of a power not	France	3023
	8539290000	Other filament lamps of a power not	South Africa	14586
	8539290000	Other filament lamps of a power not	Netherlands	1732
	8539290000	Other filament lamps of a power not	Lebanon	26820
	8539290000	Other filament lamps of a power not	Hong Kong	104
	8539290000	Other filament lamps of a power not	UK	28335
	8539290000	Other filament lamps of a power not	Singapore	30
	8539290000	Other filament lamps of a power not	Turkey	284
	8539290000	Other filament lamps of a power not	Sweden	160
	8539290000	Other filament lamps of a power not	Denmark	1500
	8539290000	Other filament lamps of a power not	Brazil	1700
	8539290000	Other filament lamps of a power not	Taiwan	18678
	8539310000	Discharge lamps, other than ultra-violet	Belgium	495
	8539310000	Other filament lamps excluding ultra-violet	China	17,038,655
	8539310000	Discharge lamps, other than ultra-violet	Emirates	343811
	8539310000	Other filament lamps excluding ultra-violet	Germany	804012
	8539310000	Other filament lamps excluding ultra-violet	France	12680

	8539310000	Discharge lamps, other than ultra-violet	Republic of South Africa	5,000
	8539310000	Discharge lamps, other than ultra-violet	Netherlands	19,790
	8539310000	Discharge lamps, other than ultra-violet	Indonesia	
	8539310000	Other filament lamps excluding ultra-violet	India	4296
	8539310000	Discharge lamps, other than ultra-violet	Singapore	365
	8539310000	Discharge lamps, other than ultra-violet	Italy	2253
	8539310000	Discharge lamps, other than ultra-violet	United Kingdom	18559
	8539310000	Discharge lamps, other than ultra-violet	Switzerland	5,800
	8539310000	Discharge lamps, other than ultra-violet	Romania	84,168
	8539310000	Discharge lamps, other than ultra-violet	Vetnamese	6329
	8539310000	Discharge lamps, other than ultra-violet	Poland	2253
	8539310000	Discharge lamps, other than ultra-violet	Turkey	8000
	8539390000	Other discharge lamps(exc.ultra	United Arab Emirates	592,679
	8539390000	Other discharge lamps(exc.ultra	Spain	12812
	8539390000	Mercury or sodium vapour lamps; metal halide	China	1,837,558
	8539390000	Other discharge lamps(exc.ultra	japan	5224
	8539390000	Discharge lamps, other than ultra-violet	USA	4209
	8539390000	Mercury or sodium vapour lamps; metal halide	Germany	11,169,705
	8539390000	Other discharge lamps(exc.ultra	France	692
	8539390000	Other discharge lamps(exc.ultra	Netherlands	8072
	8539390000	Other discharge lamps(exc.ultra	Republic of South Africa	54,719
	8539390000	Other discharge lamps(exc.ultra	Indonesia	15884570
	8539390000	Mercury or sodium vapour lamps; metal halide	Lebanon	11400
	8539390000	Other discharge lamps(exc.ultra	India	633709
	8539390000	Other discharge lamps(exc.ultra	Hungary	548089
	8539390000	Other discharge lamps(exc.ultra	hong Kong	125247
	8539390000	Other discharge lamps(exc.ultra	Swaziland	300
	8539390000	Other discharge lamps(exc.ultra	Jamaica	424
	8539390000	Other discharge lamps(exc.ultra	Poland	54,357
	8539390000	Mercury or sodium vapour lamps; metal halide	Sweden	15
	8539390000	Other discharge lamps(exc.	Turkey	27,411
	8539390000	Mercury or sodium vapour lamps; metal halide	Thailand	363
	8539390000	Other discharge lamps(exc.ultra	Korea, Republic of	4323

	8539390000	Other discharge lamps(exc.ultra	Singapore	15300
	8539390000	Other discharge lamps(exc.ultra	Italy	2377
	8539390000	Other discharge lamps(exc.ultra	United Kingdom	31,499
	8539410000	Arc-lamps	China	21,000
	8539410000	Arc-lamps	France	45
	8539410000	Other discharge lamps(exc.ultra	United Kingdom	1629
	8539490000	Other ultra-violet or infra-red lamps;arc	Netherlands	301
	8539490000	Other ultra-violet or infra-red lamps;arc	Japan	12,520
	8539490000	Ultra-violet or infra-red lamps	China	6,000
	8539490000	Other ultra-violet or infra-red lamps;arc	Switzerland	600
	8539490000	Other ultra-violet or infra-red lamps;arc	United Arab Emirates	3,000
	8539490000	Other ultra-violet or infra-red lamps;arc	Germany	197,030
	8539490000	Other ultra-violet or infra-red lamps;arc	France	1,026
	8539490000	Other ultra-violet or infra-red lamps;arc	Lebanon	4,500
	8539490000	Other ultra-violet or infra-red lamps;arc	Ghana	4,000
	8539490000	Other ultra-violet or infra-red lamps;arc	India	29
	8539490000	Other ultra-violet or infra-red lamps;arc	Singapore	861
	8539490000	Other ultra-violet or infra-red lamps;arc	Italy	3
	8539490000	Other ultra-violet or infra-red lamps;arc	Turkey	221
	8539490000	Other ultra-violet or infra-red lamps;arc	Austria	2
	8539490000	Other ultra-violet or infra-red lamps;arc	Egypt	1605
TOTAL LIGHT AND LAMP				264,746,488
Batteries	**8506101100**	Manganese dioxide flashlight and radio	Africa	2,112
Alkaline manganese oxide	8506101100	Manganese dioxide flashlight	Armenia	1300
	8506101100	Manganese dioxide flashlight and radio	Belgium	4,476,619
	8506101100	and radio	Canada	20
	8506101100	Manganese dioxide flashlight and radio	China	1665556
	8506101100	Manganese dioxide flashlight and radio	China	7,727,412

Others	**8506101911**	CKD or R20 blank type batteries	China	516366
	8506101911	CKD or R20 blank type batteries	China	2,378,000
	8506101912	Complete or finished R20 type batteries	China	62,343,142
	8506101919	R6 primary cells and primary batteries	China	7,526,397
Mercuric oxide	**8506300000**	Primary cells and primary batteries,	China	1,497,572
Silver oxide	**8506400000**	Primary cells and primary batteries, silver	China	292,984
	8506400000	Primary cells and primary batteries, silver	Congo	150
Lithium	**8506500000**	Primary cells and primary batteries, silver	Czech Republic	1
	8506500000	Primary cells and primary batteries, lithium	Denmark	139
	8506500000	Primary cells and primary batteries, lithium	Egypt	1,451,430
	8506500000	batteries, lithium	France	333,432
	8506500000	Primary cells and primary batteries, lithium	Germany	51,485
	8506500000	Primary cells and primary batteries, lithium	Ghana	50
	8506500000	Primary cells and primary batteries, lithium	Haiti	1
	8506500000	Primary cells and primary batteries, lithium	Hong Kong	195,525
	8506500000	Primary cells and primary batteries, lithium	India	251,091
	8506500000	Primary cells and primary batteries, lithium	Indonesia	4,639
	8506500000	Primary cells and primary batteries, lithium	Israel	385
	8506500000	Primary cells and primary batteries, lithium	Italy	11,204
	8506500000	Primary cells and primary batteries, lithium	Japan	21,830

	8506500000	Primary cells and primary batteries, lithium	Korea, Republic of	94100
	8506500000	Primary cells and primary batteries, lithium	Netherlands	3,449
	8506500000	Primary cells and primary batteries, lithium	Norway	685
	8506500000	Primary cells and primary batteries, lithium	Republic of South Africa	32,801
Air-zinc	**8506600000**	Primary cells and primary batteries, lithium	Republic of South Africa	2
	8506600000	Primary cells and primary batteries,	Republic of South Africa	234
	8506600000	Primary cells and primary batteries,	Singapore	230,400
Others	**8506800000**	Other primary cells and primary batteries	Singapore	230,400
	8506800000	Other primary cells and primary batteries	Slovakia	13,126
	8506800000	Other primary cells and primary batteries	Spain	530
	8506800000	Other primary cells and	Sweden	460
	8506800000	Other primary cells and primary batteries	Switzerland	2858
	8506800000	Other primary cells and primary batteries	Taiwan, Province of China	135,519
	8506800000	Other primary cells and primary batteries	Thailand	42,512
	8506800000	primary batteries	Turkey	172,157
	8506800000	Other primary cells and primary batteries	United Arab Emirates	30,953
	8506800000	Other primary cells and primary batteries	United Kingdom	10,072
	8506800000	Other primary cells and primary batteries	United States	63,265
Parts	**8506900000**	Parts of primary cells and primary batteries	United States	20,544
TOTAL				91,832,909

Measuring device	9025190000	Other thermometers and pyrometers not	Austria	581,875
	9025190000	Other thermometers and pyrometers not	Belgium	721,459
	9025800000	Other instruments; Hydrometers, pyrometers,	Belgium	165367
	9025800000	Other instruments; Hydrometers, pyrometers,	Congo	10,947
	9025800000	Other instruments; Hydrometers, pyrometers,	Cameroon	45
	9025800000	Hydrometers, pyrometers,	China	259380
	9025800000	Other instruments; Hydrometers, pyrometers,	Denmark	46
	9025800000	Other instruments; Hydrometers, pyrometers,	Gabon	5,040
	9025800000	Hydrometers, pyrometers,	Germany	10676
	9025800000	Hydrometers, pyrometers,	France	2714
	9025800000	Other instruments; Hydrometers, pyrometers,	Greece	38
	9025800000	Hydrometers, pyrometers,	India	342,599
	9025800000	Hydrometers, pyrometers, hygrometers, etc,	Indonesia	6,060
	9025800000	Other instruments; Hydrometers, pyrometers,	Ireland	235
	9025800000	Other instruments; Hydrometers, pyrometers,	Israel	12500
	9025800000	Hydrometers, pyrometers, hygrometers, etc,	Italy	44316
	9025800000	Other instruments; Hydrometers, pyrometers,	Korea, Republic of	732
	9025800000	Other instruments; Hydrometers, pyrometers,	Lebanon	70
	9025800000	Other instruments; Hydrometers, pyrometers,	Malaysia	14
	9025800000	Other instruments; Hydrometers, pyrometers,	Netherlands	2,303
	9025800000	Other instruments; Hydrometers, pyrometers,	Republic of South Africa	1789
	9025800000	Other instruments; Hydrometers, pyrometers,	Saudi Arabia	500

	9025800000	Other instruments; Hydrometers, pyrometers,	Singapore	400
	9025800000	Other instruments; Hydrometers, pyrometers,	Sweden	23
	9025800000	Other instruments; Hydrometers, pyrometers,	Switzerland	20
	9025800000	Other instruments; Hydrometers, pyrometers,	Taiwan, Province of China	27,531
	9025800000	Other instruments; Hydrometers, pyrometers,	United Arab Emirates	2910
	9025800000	Hydrometers, pyrometers,	United Kingdom	1043377
	9025800000	Hydrometers, pyrometers,	United States	45867
	9025190000	Other thermometers and pyrometers not	Italy	56176
	9025190000	Other thermometers and pyrometers not	France	7815
	9025190000	Other thermometers and pyrometers not	China	486275
	9025190000	Other thermometers and pyrometers not	Canada	2,749
	9025190000	Other thermometers and pyrometers not	Czech Republic	200
	9025190000	Other thermometers and pyrometers not	Denmark	619
	9025190000	Other thermometers and pyrometers not	Emirates	13,838
	9025190000	Other thermometers and pyrometers not	Egypt	2,935
	9025190000	Other thermometers and pyrometers not	Eritrea	6
	9025190000	Other thermometers and pyrometers not	Germany	1539747
	9025190000	Other thermometers and pyrometers not	Honduras	1,000
	9025190000	Other thermometers and pyrometers not	Hong Kong	38,644
	9025190000	Other thermometers and pyrometers not	India	118,195
	9025190000	Other thermometers and pyrometers not	Indonesia	14,860
	9025190000	Other thermometers and pyrometers not	Israel	29117
	9025190000	Other thermometers and pyrometers not	Korea, Democratic People's Rep. of	8
	9025190000	Other thermometers and pyrometers not	Korea, Republic of	10,043
	9025190000	Other thermometers and pyrometers not	Lebanon	19675
	9025190000	Other thermometers and pyrometers not	Malaysia	90
	9025190000	Other thermometers and pyrometers not	Netherlands	17,166
	9025190000	Other thermometers and pyrometers not	Norway	354
	9025190000	Other thermometers and pyrometers not	Republic of South Africa	14408
	9025190000	Other thermometers and pyrometers not	Saudi Arabia	604
	9025190000	Other thermometers and pyrometers not	Singapore	418
	9025190000	Other thermometers and pyrometers not	Sweden	9
	9025190000	Other thermometers and pyrometers not	Switzerland	1,128
	9025190000	Other thermometers and pyrometers not	Taiwan, Province of	39256

			China	
	9025190000	Other thermometers and pyrometers not	Thailand	2
	9025190000	Other thermometers and pyrometers not	Turkey	3,092
	9025190000	Other thermometers and pyrometers not	United Arab Emirates	9396
	9025190000	Other thermometers and pyrometers not	United Kingdom	55405
	9025190000	Other thermometers and pyrometers not	United States	135896
	9025150000	Liquid filled thermometers and pyrometers,	France	108
	9025150000	-- Liquid filled, for direct reading	China	52024
	9025150000	Liquid filled thermometers and pyrometers,	Germany	2
	9025150000	Liquid filled thermometers and pyrometers,	India	7000
	9025150000	Liquid filled thermometers and pyrometers,	United Kingdom	1463
	9025150000	Liquid filled thermometers and pyrometers,	United States	701
TOTAL OF MEASURING DEVICE				5,969,257
Chemicals	**2805400000**	Mercury	Republic of South Africa	1,948
	2805400000	Mercury	India	789
	2805400000	Mercury	United States	92,896
TOTAL				95,633
GRAND TOTAL OF ALL MERCURY IN PRODUCT				614,549,601

LED (Mercury Alternatives)			
HS CODE	**HS DESCRIPTION**	**MASS/KG**	**COUNTRY OF ORIGIN**
8541400000	Photosensitive semiconductor devices; light	304	Australia
8541400000	Photosensitive semiconductor devices; light	204	Austria
8541400000	Photosensitive semiconductor	223469	Belgium
8541400000	Photosensitive semiconductor devices; light	242	Brazil
8541400000	Photosensitive semiconductor devices; light	5,045	Canada
8541400000	Photosensitive semiconductor devices; light	60441457	China
8541400000	Photosensitive semiconductor devices; light	66220	Croatia
8541400000	Photosensitive semiconductor devices; light	6509	Cyprus

8541400000	Photosensitive semiconductor devices; light	702	Denmark
8541400000	Photosensitive semiconductor devices; light	16344	Egypt
8541400000	devices; light	5,000	Emirates
8541400000	Photosensitive semiconductor devices; light	200	Finland
8541400000	Photosensitive semiconductor devices; light	757774	France
8541400000	Photosensitive semiconductor devices; light	1321676	Germany
8541400000	Photosensitive semiconductor devices; light	98	Greece
8541400000	devices; light	760558	Hong Kong
8541400000	Photosensitive semiconductor devices; light	844204	India
8541400000	Photosensitive semiconductor devices; light	4,000	Indonesia
8541400000	devices; light	4000	Ireland
8541400000	Photosensitive semiconductor devices; light	4550	Israel
8541400000	Photosensitive semiconductor devices; light	87724	Italy
8541400000	Photosensitive semiconductor devices; light	171857	Jordan
8541400000	Photosensitive semiconductor devices; light	690	Jordan
8541400000	Photosensitive semiconductor devices; light	1009591	Korea, Republic of
8541400000	Photosensitive semiconductor devices; light	1049	Lebanon
8541400000	Photosensitive semiconductor devices; light	273028	Malaysia
8541400000	Photosensitive semiconductor devices; light	50338	Netherlands
8541400000	Photosensitive semiconductor devices; light	5,000	New Caledonia
8541400000	Photosensitive semiconductor devices; light	187	Norway
8541400000	Photosensitive semiconductor devices; light	8,160	Philippines
8541400000	Photosensitive semiconductor devices; light	16240	Poland
8541400000	Photosensitive semiconductor devices; light	38157	Portugal
8541400000	Photosensitive semiconductor devices; light	63915	Republic of South Africa
8541400000	Photosensitive semiconductor devices; light	37520	Saudi Arabia
8541400000	Photosensitive semiconductor devices; light	4,418	Senegal
8541400000	Photosensitive semiconductor devices; light	172399	Singapore
8541400000	Photosensitive semiconductor devices; light	841	Slovenia
8541400000	Photosensitive semiconductor devices; light	1727	Slovakia
8541400000	Photosensitive semiconductor devices; light	24882	Spain
8541400000	Photosensitive semiconductor devices; light	254745	Sweden
8541400000	Photosensitive semiconductor devices; light	32388	Switzerland
8541400000	Photosensitive semiconductor devices; light	653315	Taiwan, Province of China
8541400000	Photosensitive semiconductor devices; light	2217	Thailand
8541400000	Photosensitive semiconductor devices; light	79978	Turkey
8541400000	Photosensitive semiconductor devices; light	848898	United Arab Emirates
8541400000	Photosensitive semiconductor devices; light	2852414	United Kingdom
8541400000	Photosensitive semiconductor devices; light	1236163	United States
Grand Total		72,390,397	

ANNEX C:

APPLICATIONS OF MERCURY AND ALTERNATIVES

S/N	Product category/ components	Amount of Mercury in Individual Component or Product (grams)	Mercury-free alternatives
1	**Measuring Devices:**		
	Barometers	400 – 620	Aneroid, Digital
	Sphygmomanometers	50 – 140	Aneroid, Oscillometric
	Manometers	30 – 75	Aneroid, Digital, Needle/Bourdon
	Fever and Non Fever Thermometers	0.5 – 54	Digital, Liquid-in-Glass Bi-Metal, Digital, Infrared, Liquid-in-Glass
	Hygrometer/Psychrometer	5 – 6	Digital, Spirit-Filled
	Flow Meter		Ball-Actuated, Digital
	Pyrometer		Digital, Optical
	Hydrometer		Spirit-Filled
2	**Dental Amalgam**		
	Dental cements and fillings *Pre-measured capsules Liquid mercury*	>0.1 – 1	Composite, Glass Ionomer, Resin Ionomer
3	**Lamps/Lighting**		
	Linear fluorescent	<0.10	Linear LED
	Compact fluorescent	<0.01	LED, LED Downlight
	High intensity discharge	<1	Halogen, LED, Mercury-Free Units
	Backlight units for LCD displays		LED
	Neon		No known mercury-free alternatives
4	**Electrical/Electronic Devices**		
	Flame sensors	>1	Electronic Ignition System
	Thermostat		Digital, Snap-Switch
	Tilt/vibration switch	0.05 – 5	Capacitive, Electrolytic, Mechanical, Metallic Ball, Potentiometer, Solid-State
	Float switch	0.1 – 70	Alloy, Capacitance, Conductivity, Magnetic Dry Reed, Mechanical, Metallic Ball, Optical, Pressure Transmitter, Sonic/Ultrasonic, Thermal
	Pressure switch		Mechanical, Solid-State
	Temperature switch		Mechanical, Solid-State

	Displacement relay	0.005 - >1	Dry Magnetic Reed, Electromechanical, Hybrid (Electromechanical& Solid-State), Silicon Controlled Rectifier, Solid-State
	Wetted reed relay	0.005 - >1	
	Contact relay	0.005 - >1	
5	**Batteries**		
	Button cell, silver oxide	<0.05	Mercury-Free Units
	Button cell, zinc air		
	Alkaline manganese (manganese dioxide)		
	Button cell, alkaline manganese (manganese dioxide)		
	Mercuric oxide batteries		
	Button cell, mercuric oxide batteries		
	Button cell, zinc carbon		
	Product category/ components	**Amount of Mercury in Individual Component or Product (mg or ppm)**	**Mercury-free alternatives**
6	**Cosmetics**		
	Skin Care Products (creams, soaps, lotions)	>0 - >250	Non-Mercury Preservative/Microbial
7	**Paints**		
	Interior/exterior paints (phenylmercuric acetate, biocide)	>0 - >250	Non-Mercury Preservative/Microbial
8	**Pesticides**		
	Agricultural applications (organomercurial compounds, biocide)	>0 - >250	Non-Mercury-Based Pesticides
9	**Chemicals**		
	Chemical intermediate and catalyst (excl PU) *1	>0 - >250	
	Laboratories and pharmaceutical industry	>0 - >250	
	Preservatives in vaccines and cosmetics	>0 - >250	
	Disinfectant	>0 - >250	
10	**Miscellaneous uses**		
	Porosimetry and pycnometry		
	Gold production (illegal)	**varies**	
	Other applications		
	Pressure Transducers	>100 mg up to 1000 mg	
	Film	>0 – 10 ppm; >0 – 5 mg	
	Piston-pak Sensors	>1000 mg	
	Analyzers	>0 – 5 mg	
	Bicycle Computers	>0 – 5 mg	
	Fire Arm Accessories	>1000 mg	
	Imaging Devices	>0 – 5 mg	
	Electric Heat Contactors	>1000 mg	
	Electrical Connectors	500 mg to >1000 mg	

	Permeation Tubes/Mercury Probe Systems	>50 mg – >1000 mg	
	Scanning Electrodes	>0 – 5 mg	