Minamata Convention On Mercury

INITIAL ASSESMENT REPORT FOR BANGLADESH

June 2019

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Secretary
Ministry of Environment, Forest and Climate Change
Government of the People's Republic of Bangladesh

Message

Mercury is a global threat to health and environment worldwide. Recognizing that Bangladesh could be affected in various ways due to use and disposal of mercury-containing products and mercury emissions and releases, Bangladesh signed the Minamata Convention on 10 October 2013. The Government of Bangladesh has the intention of actively proceeding towards the ratification of the Minamata Convention on Mercury and has undertaken the Minamata Initial Assessment (MIA). The Ministry of Environment, Forest and Climate Change (MOEFCC) is mandated to look after the environment issue in Bangladesh and take necessary actions to safeguard the environment against harmful and toxic substances. The Bangladesh Government will aim to protect human health and environment by adopting measures for the reduction of mercury emissions and releases.

I express my sincere thanks to the Department of Environment (DoE) for publishing the MIA report for the interest of all the stakeholders. I acknowledge the support of Bangladesh University of Engineering and Technology (BUET) for providing technical assistance in preparing the MIA report on behalf of DoE and MoEFCC. My thanks to the stakeholders of different ministries, NGOs, academia and research institutions for their contribution in the report.

I hope that that this document will aid in the ratification process.

(Abdullah Al Mohsin Chowdhury)

Director General
Department of Environment
Government of the People's Republic of Bangladesh

Foreword

I am delighted to present the Minamata Initial Assessment (MIA) report of Bangladesh which has been prepared to disseminate our current understanding and inventory of mercury use and emissions in the environment. The Department of Environment, as the environmental regulatory agency of Bangladesh, has a mandate to protect the environment from the adverse effects of hazardous substances to safeguard health and well-being of the people. The Minamata Initial Assessment (MIA) report contains the baseline account of mercury use in the society as well as a roadmap on mitigation, reduction or elimination of mercury use. All this information can feed into the national planning process and help us formulate strategies for definitive action.

A series of consultations with relevant stakeholders of various ministries, research institutions, regulatory authorities, civil societies, and NGOs have been undertaken to validate the findings of the report. A Mercury Coordination Committee (MCC) was set up in DoE to oversee the preparation of MIA and planning of awareness raising campaigns. Various awareness activities are already taking place in the form of dissemination workshops and seminars and these activities are being reported and highlighted in print and electronic media. The DoE is playing a central role in all these activities.

I highly appreciate the efforts taken by Dr. Masud Iqbal Md Shameem, the Project Director of the MIA project of DoE, for coordinating the process of the preparation of the document. I acknowledge the contribution of Professor Dr. Tanvir Ahmed for leading the BUET team in this study. My sincere thanks to UNITAR and UNDP for their generous support throughout the process of MIA document preparation.

I hope that this document will serve as a useful guide for regulating mercury emissions in the national context as well as paving the way for the ratification process of Minamata Convention.



(Dr. A.K.M. Rafique Ahammed)

EXECUTIVE SUMMARY

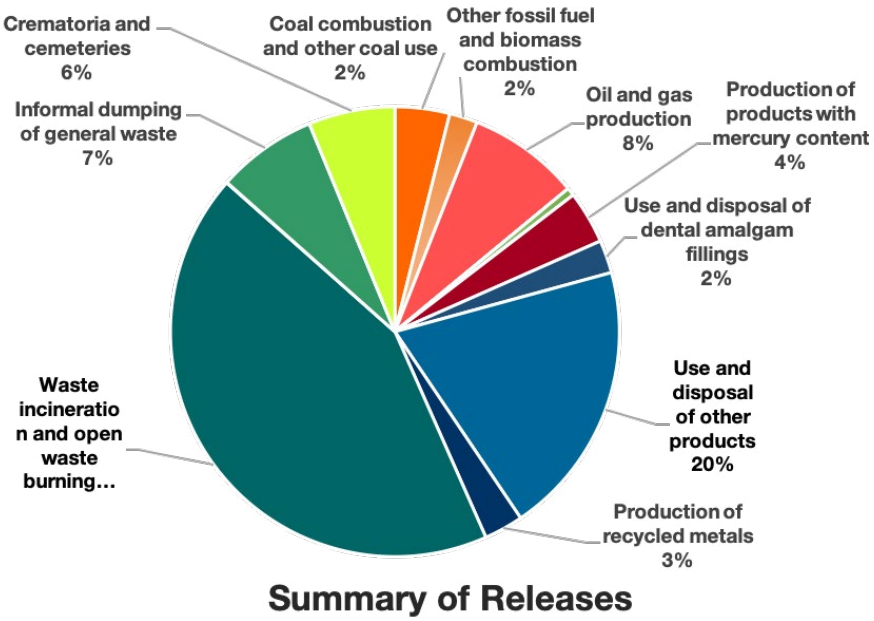
The Minamata Convention on Mercury is a global treaty designed to protect human health and the environment from the adverse effects of mercury, Bangladesh signed the Minamata Convention on 10 October 2013 and is actively proceeding towards ratification. The Bangladesh Government will aim to protect human health and environment by adopting measures for reduction of mercury emissions and releases. In this regard, the Global Environmental Facility (GEF) has developed a set of pre-ratification activities, called Minamata Initial Assessments (MIA), designed to prepare countries for treaty ratification and implementation. The MIA project in Bangladesh was developed with the support of the United Nations Development Programme (UNDP) as implementing Agency and the technical assistance and capacity-building provided by the United Nations Institute for Training and Research (UNITAR).

In Bangladesh, major mercury emission sources are use and disposal of products with mercury content, production of mercury-added products, open fire waste burning, informal dumping of general waste, production of oil and natural gas, and coal combustion. Bangladesh manufactures three consumer products (lamps, paint and cosmetic products) that potentially contain mercury, while all other consumer products are imported, such us dental amalgam, that remains the preferred restorative material in dental practice.
The national mercury inventory was prepared as a part of the Minamata Initial Assessment (MIA) project. This inventory analysis was performed using UN Environment's Toolkit for identification and quantification of mercury releases. Both levels 1 and 2 were utilized to prepare this inventory. From the inventory, the total mercury releases in Bangladesh are approximately 32,660 kg per year with major mercury emissions from the following sources (Figure ES-1(a)):

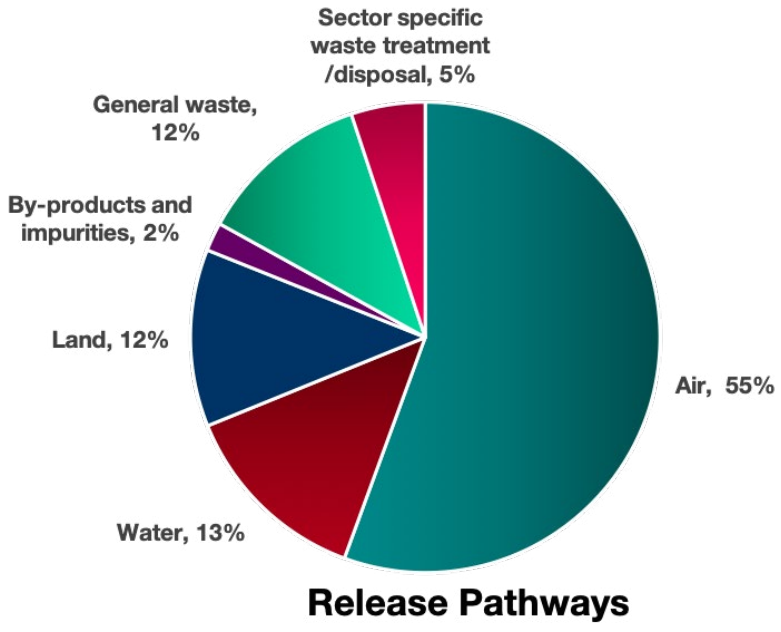
1. Waste incineration and open waste burning: 44 per cent (14,323 kg Hg/y),
2. Use and disposal of other products (including thermometers, paints with mercury preservatives (/pigments), other laboratory and medical equipment with mercury, polyurethane produced with mercury catalysts, and switches and relays): 20 per cent (6,564 kg Hg/y),
3. Oil and gas production: 8 per cent (2,675 kg Hg/y),
4. Informal dumping of general waste: 7 per cent (2,397 kg Hg/y),
5. Crematoria and cemeteries: 6 per cent (2,066 kg Hg/y),
6. Coal combustion and other coal use: 2 per cent (781 kg Hg/y), and
7. Production of products with mercury contents (thermometers, paints, cosmetics, light, battery): 4 per cent (1,258 kg Hg/y).

In Bangladesh, most of the mercury is released to air (55%) followed by water (13%). Figure ES-1(b) presents the summary of the main release pathways in Bangladesh.

Figure ES-1: (a) Summary of mercury releases in Bangladesh; (b) Release pathways in Bangladesh



(a)



(b)

With respect to the national policy and legislation on chemicals and waste management, there are different regulations on environment protection, conservation, waste management, among others; as well as institutions for testing and maintaining standards of products, yet more specific and detailed policies and institutional strengthening need to be developed to address the potential threat released by mercury to the environment and human health.

The existing rules do not state clearly the management strategy for mercury or do not directly limit the use of mercury in relevant processes. The descriptive review on existing policies and regulatory bodies of Bangladesh has been performed and an assessment has been made regarding the gaps that need to be filled to bring the national system into conformity with the articles of the Convention.

This report assessed and identified the legal instruments that can be utilized to regulate the sound management of mercury as well as the management strategies that need to be incorporated into the national legislations to ensure compliance of the Convention. A series of actions has been proposed to meet the obligations provided by the Minamata Convention in order to mitigate mercury emissions and releases from anthropogenic sources. Table ES-1 shows a summary of proposed actions, convention articles, lead institutions and prioritization of actions.

Table ES-1: Summary of proposed actions, convention articles, lead institutions and prioritization of actions

Plan	Title and Components	Articles Addressed	Lead Institutions	Priority
1	Legal and institutional arrangements to implement the convention at the national level	3, 4, 5, 8, 11, 14, 17, 18, 19, 21	DoE, MoI, NBR	High
2	Phasing down of dental amalgam	4, 11, 14, 18	DoE, DGHS, Bangladesh Dental Society, NBR	Moderate
3	Phasing out of mercury-added products	4, 11, 14, 17, 18	DoE, DGS, BSTI	High
4	Environmentally sound management of solid and hazardous wastes	11, 14	City Corporations and municipalities, DGHS, DoE	Moderate
5	Research and development, information dissemination and mass awareness	14, 16, 17, 18, 19	Technical and scientific institutions, DoE	High

The Mercury Coordination Committee (MCC) headed by the Director General of the Department of Environment (DoE) was formed to oversee the development of the MIA Project. The MCC includes members from Governmental and non-governmental entities such as the Ministry of Health, Bangladesh Dental Society, BSTI, private sector, academia and other NGOs.

The primary purpose of the MCC is to oversee the preparation of the MIA and coordinate progress on the MIA activities. When the Minamata Convention is ratified by Bangladesh, the Ministry of Environment, Forest and Climate Change will set up a Mercury Management and Co-ordination Cell (MMCC) at the Department of Environment (DoE). The MMCC will be headed by a Director of DoE who will also serve as the national focal point for the Minamata Convention. The MMCC will be staffed by relevant DoE officials and/or consultants to support the implementation of activities for mercury management. The activities and responsibilities of the MMCC focal point will be the following:

- Ensure that the obligations of the Minamata Convention are taken seriously at senior government levels of the concerned Ministries.

- Foster inter-ministerial collaboration and formulate joint strategies with other sectors involved in the Action Plan.

- Propose and undertake programmes associated with the activities under the Mercury Action Plan, monitor and track progress of the programmes that are being implemented.

- Keep track of the national development planning schedule and process (e.g. the 8th Five Year Plan, FYP), and seek the inclusion of the mercury priorities in Bangladesh into relevant sections of the FYP or other planning documents.

- Updating the national mercury inventory, whenever required, ensuring lessons are learnt from the inventory process of this MIA report and other, similar inventory processes that may be undertaken in the future.

- Report on the national status of programmes implemented with regard to mercury management in national and international meetings.

LIST OF ABBREVIATIONS

ADB	Asian Development Bank
BAEC	Bangladesh Atomic Energy Commission
BB	Bangladesh Bank
BBS	Bangladesh Bureau of Statistics
BCCRF	Bangladesh Climate Change Resilience Fund
BCCSAP	Climate Change Strategy and Acton Plan
BCSIR	Bangladesh Council for Science and Industrial Research
BDS	Bangladesh Standards
BDS	Bangladesh Dental Society
BMRC	Bangladesh Medical Research Council
BPC	Bangladesh Petroleum Corporation
BPDB	Bangladesh Power Development Board
BSTI	Bangladesh Standards and Testing Institute
BUET	Bangladesh University of Engineering and Technology
CCC	Chittagong City Corporation
CETP	Common Effluent Treatment Plant
CFL	Compact Fluorescent Lamp
CERM	Center for Environmental and Resource Management
Cl	Chlorine
CWASA	Chittagong Water Supply & Sewerage Authority
DCC	Dhaka City Corporation
DFID	U.K. Department for International Development
DG	Director General
DGHS	Directorate General of Health Services
DoE	Department of Environment
DPHE	Department of Public Health Engineering
DPRO	Designated Public Relations Officers
DWASA	Dhaka Water Supply & Sewerage Authority
ECA	Environment Conservation Act 1995
ECR	Environment Conservation Rules 1997

ELIB	Efficient Lighting Initiative of Bangladesh
EMP	Environmental Management Plan
ESDO	Environment and Social Development Organization
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FY	Fiscal Year
FYP	Five Year Plan
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHGs	Greenhouse Gases
GNI	Gross National Income
GoB	Government of Bangladesh
HCl	Hydrogen Chloride
HDI	Human Development Index
Hg	Mercury
HgO	Mercuric Oxide
HS	Harmonized System
IEA	International Energy Agency
IPP	Independent Power Producer
JICA	Japan International Cooperation Agency
LED	Light Emitting Diode
LFL	Linear Fluorescent Lamp
MCC	Mercury Coordination Committee
MDG	Millennium Development Goal
MIA	Minamata Convention Initial Assessment
MMCC	Mercury Management and Co-ordination Cell
MMSCFD	Million Standard Cubic Feet Per Day
MoEFCC	Ministry of Environment, Forest and Climate Change
MoI	Ministry of Information
MoPEMR	Ministry of Power, Energy and Mineral Resources
MT	Metric Ton

MW	Mega Watt
NaOH	Sodium Hydroxide
NBR	National Board of Revenue
NEP	National Environment Policy 1992
NGO	Non Governmental Organization
PM	Particulate Matter
POPs	Persistent Organic Pollutants
PPB	Parts Per Billion
PPM	Parts Per Million
PPP	Purchasing Power Parity
PSMP	Power Sector Master Plan 2016
PU	Polyurethane
SHS	Solar Home System
SLCPs	Short Lived climate pollutants
SWM	Solid Waste Management
UK	United Kingdom
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
UNITAR	United Nations Institute for Training and Research
US$	United States Dollar
VCM	Vinyl Chloride Monomer
WB	World Bank
WHO	World Health Organization

INTRODUCTION

Mercury is a naturally occurring element and is found throughout the world. Based on the Global Mercury Assessment, 2018 prepared by UN Environment, artisanal and small-scale gold mining and the burning of coal are estimated to be responsible for almost 60% of emissions to air in 2015. Human activity has increased the mobilization of mercury into the environment, raising the amounts in the atmosphere, soils, fresh waters, and oceans.

Mercury can exist in many forms in the natural environment and in our society, but the exposure pathways for mercury vary among countries depending on what type of activities are being carried out, what sort of products the population are exposed to, and existing and effective regulations. How someone's health may be affected by exposure to mercury depends on the form of mercury (for example, methylmercury, elemental (metallic) mercury or mercury-added products), the amount of mercury in the exposure, the age of the person exposed (the fetus is the most vulnerable), duration and modality of exposure (such as inhalation or ingestion) and the health of the person exposed[1].

According to the World Health Organization (WHO)[2], elemental mercury and methylmercury are toxic to the central and peripheral nervous systems. The inhalation of mercury vapour can produce harmful effects on the nervous, digestive and immune systems, lungs and kidneys, and may be fatal. The inorganic salts of mercury are corrosive to the skin, eyes and gastrointestinal tract, and may induce kidney toxicity if ingested. Neurological and behavioral disorders may be observed after inhalation, ingestion or dermal exposure of different mercury compounds. Symptoms include tremors, insomnia, memory loss, neuromuscular effects, headaches, and cognitive and motor dysfunction.

The Minamata Convention on Mercury is a global treaty to protect human health and the environment from the adverse effects of mercury. Major highlights of the Minamata Convention include a ban on new mercury mines, the phase-out of existing ones, the phase out and phase down of mercury use in a number of products and processes, control measures on emissions to air and on releases to land and water, and the regulation of the informal sector of artisanal and small-scale gold mining. The Convention also addresses interim storage of mercury and its disposal once it becomes waste, sites contaminated by mercury as well as health issues. Bangladesh is a signatory of the Minamata Convention and is actively considering ratification of the Convention. Ratification of the Convention will allow Bangladesh to have access to financial technical support provided by the Mechanisms of the Convention in order to implement mercury abatement measures. As a consequence of ratification, the Government will include mercury priorities in the national planning process and allocate budget accordingly which will bring about health and environmental benefits in the long run, as well as contributing to the Sustainable Development Goals (SDGs); specifically, 3, 4, 5, 6, 7, 10, 11, 12, 14 and 15.

[1]https://www.who.int/news-room/fact-sheets/detail/mercury-and-health
[2]https://www.who.int/news-room/fact-sheets/detail/mercury-and-health

Bangladesh is a deltaic plain crisscrossed by many rivers and remains extremely vulnerable to mercury contamination from uncontrolled dumping of mercury along with medical, industrial and electronic wastes into the waters and soil, the fish-dependent protein diet of the population, the cement and paint industries as well as medical applications of mercury (dental amalgam). Besides, the combustion of oil, gas and fossil fuels, and use and domestic production of mercury added products induce significant releases of mercury. All these anthropogenic activities increase the possibility of mercury releases to aquatic systems and subsequent environmental degradation.

With the financial support of the Global Environment Facility (GEF), the technical support of the United Nations Development Programme (UNDP) and the United Nations Institute for Training and Research (UNITAR), and under the project 'Strengthen National Decision Making Towards Ratification of the Minamata Convention and Build Capacity Towards Implementation of Future Provisions', Bangladesh, Guinea-Bissau, Mauritania, Mozambique and Samoa have developed their 'Minamata Initial Assessments' (MIA). The overall objective of the MIAs is to assist the countries in preparing for the implementation of the Minamata Convention to enable policy and strategic decision-making and to prioritize areas for future interventions.

This report is an outcome of the MIA in Bangladesh which was undertaken by the Department of Environment under the Ministry of Environment, Forest and Climate Change. The MIA consists of the following components which form the substance of the different chapters:

- Identification of sources of emissions and releases of mercury, development of mercury inventory and national mercury profile (Chapter 2);
- Assessment of the policy, regulatory and institutional framework available and needed for the implementation of the provisions included in the Convention text (Chapter 3)
- Preliminary review of potential populations at risk with an assessment of potential gender dimensions related to mercury in Bangladesh (Chapter 4)
- Efforts to disseminate understanding of mercury among the public and development of an awareness-raising plan and associated activities (Chapter 5);
- Development of a national action plan with proposals for key measures necessary to implement the convention (Chapter 6) and
- A roadmap of mainstreaming mercury priorities in national development planning process (Chapter 7).

CHAPTER 1:
NATIONAL BACKGROUND INFORMATION

1.1 Geography and population

Bangladesh covers an area of 147,570 square kilometers. It extends from 2034′ N to 26°38′ N latitude and from 88°01′ E to 92°41′ E longitude. India borders Bangladesh to the west, north and east. Myanmar (Burma on the map) forms the southern part of the eastern frontier. The total length of the land border is about 4,246 km, of which 93.9% is shared with India and about 6.1% with Myanmar.

The country is bounded in the south by the Bay of Bengal. Although Bangladesh is a small country, the length of the coastline is more than 580 km. Bangladesh is fringed on the southwest by the huge expanse of mangrove forest known as Sundarbans, and home to the famous Royal Bengal Tiger. Bangladesh has seven principal administrative units, known as divisions. These are Barisal, Chittagong, Khulna, Rajshahi, Sylhet, Rangpur and Dhaka, which functions as its capital.

Figure 1.1: Map of Bangladesh (CIA, 2018)



Bangladesh is the 8th most populous country in the world with 158.9 million (2015) inhabitants. The growth rate of the population is 1.37% per annum (up to 2015 census) and the literacy rate is 63.6% (2017) for the population of age seven years and above. The sex ratio of the population is approximately 107 males per 100 females. In respect to religion, about 88% of people in Bangladesh are Muslims, 11% Hindus, with the rest being Buddhists and Christians.

In terms of physiography, Bangladesh may be classified into three distinct regions: (A) floodplains, (B) terraces, and (C) hills, each having distinguishing characteristics of its own. The physiography and drainage pattern of the vast alluvial plains in the central, northern and western regions experienced considerable alterations in recent times. The Ganges-Padma, the Brahmaputra-Jamuna, and the Surma-Meghna and their numerous tributaries and distributaries are the arteries of the drainage system of Bangladesh.

The Karnafuli, the Sangu, the Matamuhuri, the Feni, and the Naf along with their feeding channels drain the water of the high hill ranges of the districts of Chittagong and Chittagong Hill Tracts directly to the Bay of Bengal. Many small streams that originate from the westernmost hill ranges also independently fall into the bay.

The climate is characterized by a tropical monsoon climate. Bangladesh has three distinct seasons: the pre-monsoon hot season (Summer) from March to May; the rainy monsoon season which lasts from June to October; and a cool, dry winter season from November to February.

Bangladesh has been ranked as 136 out of 189 countries in the Global Human Development Index (Human Development Statistical Update, 2018). Bangladesh's 2017 HDI is 0.608 which is below the average of 0.645 for countries in the medium human development group and below the average of 0.638 for countries in South Asia. From South Asia, countries which are close to Bangladesh in the 2017 HDI rank are India, Bhutan, Myanmar, Nepal and Pakistan, which have HDI rankings of 130, 134, 148 149 and 150 respectively (table 1.1).

Table 1.1: Bangladesh's HDI and component indicators for 2017 relative to selected countries and groups

	HDI value	HDI rank	Life expectancy at birth	Expected years of schooling	GNI per capita (PPP US$)
Bangladesh	0.608	136	72.8	11.4	3,677
Sri Lanka	0.770	76	75.5	13.9	11,326
Maldives	0.717	101	77.6	12.6	13,567
India	0.640	130	68.8	12.3	6,353
Bhutan	0.612	134	70.6	12.3	8,056
Myanmar	0.578	148	66.7	10.0	5,567
Nepal	0.574	149	70.6	12.2	2,471
Pakistan	0.562	150	66.6	8.6	5,311
South Asia	0.638		69.3	11.9	6,473
Medium HDI	0.645		69.1	12.0	6,849

Source: UNDP, *Human Development Indices and Indicators: 2018 Statistical Update - Bangladesh, 2018*

Bangladesh moved up three spots and ranked 136th out of 189 countries in the Global Human Development Index 2017 due to the remarkable progress it has made in many socio-economic areas, including life expectancy and per capita income[4]. Bangladesh maintained a higher average annual HDI growth rate (1.69 percent) from 1990 to 2017, compared to all other South Asian countries, including India (1.51 percent). Though India is a richer country with higher per capita economic output (6,353 PPP US$) compared to Bangladesh (3,677 PPP US$), Bangladesh came out ahead in terms of other measures of development such as life expectancy, child survival and the proportion of girls to boys in secondary education.

1.2 Economic and political profile

Bangladesh, in 2017, had an annual GDP growth of 7.284% (World Bank, 2017 data), largely driven by its exports of ready-made garments, remittances and the domestic agricultural sector. The country has pursued export-oriented industrialization, with its key export sectors include textiles, shipbuilding, fish and seafood, jute and leather goods. It has also developed self-sufficient industries in pharmaceuticals, steel and food processing. In 2018, per-capita income was estimated at US$4,561 (PPP) and US$1,754 (Nominal) and is ranked 144 out of 187 countries[5].

Bangladesh's economy has grown roughly 6% per year since 1996 despite prolonged periods of political instability, poor infrastructure, endemic corruption, insufficient power supplies, and slow implementation of economic reforms. Although more than half of GDP is generated through the services sector, almost half of Bangladeshis are employed in the agriculture sector, with rice as the single-most-important product.

Garment exports, the backbone of Bangladesh's industrial sector, accounted for more than 80% of total exports and were on track to again surpass $25 billion in 2017. The sector continues to grow, despite the need for improvements in factory working conditions to avert further high-profile accidents that have killed more than 1,000 workers in recent years. Steady export growth in the garment sector combined with remittances from overseas Bangladeshis - which totaled about $13 billion and 6% of GDP in 2016 - are key contributors to the sustained economic growth and rising foreign exchange reserves.

The Government of Bangladesh has three branches; the Executive branch, the Legislative branch and the Judicial branch. The Legislative Branch of Bangladesh is unicameral and known as Sangsad. The Speaker presides over meetings of the Sangsad and conducts its business in an orderly fashion.

The current Sangsad contains 350 seats, including 50 seats reserved for women, which are apportioned on elected party position in the parliament. The Executive Branch is led by the Prime Minister, who selects all the remaining Ministers. The Prime Minister and the other most senior Ministers belong to the supreme decision-making committee, known as the Cabinet.

The Judicial branch systematically contains an apex Supreme Court, composed of an Appellate Division and High Court Division. There are various levels of judiciary in Bangladesh: different types of courts that form a strict hierarchy of importance; District Courts, City Criminal Courts and Specialized Courts and Tribunals, all below the Supreme Court. The Chief Justice of Bangladesh is the head of the judiciary and the Supreme Court.

[4]UNDP. (2018). Human Development Indices and Indicators: Statistical Update 2018
[5]IMF. (2018). Bangladesh Economic and Financial Indicators, April 2018. Retrieved October, 2018 https://www.imf.org/~/media/Files/Countries/ResRep/BGD/2018/bangladesh-economic-and-financial-indicators-april-2018.ashx

1.3 Profiles of the energy sector

Natural gas is the main energy source of Bangladesh and the power generation sector is heavily dependent on it. The fossil fuel resources of Bangladesh are limited, though there are deposits of natural gas and coal. The mining sector does not play a significant role in Bangladesh. Being a developing country, the electric energy demand in Bangladesh has been increasing at a significantly high rate and the Bangladesh Government has undertaken various projects to meet this rapidly growing demand.

At present, energy demand for Bangladesh is currently met from three main sources: natural gas, fossil fuels and hydropower. Power plants using natural gas as fuel represent 58.89 % of the total generation capacity. The remaining generation capacity is derived from HFO (21.18%), HSD (9.95%), coal (3.09%), and hydropower (1.35%).

The 2016 Power Sector Master Plan (PSMP) is a key document detailing the roadmap of the power sector of Bangladesh, with five viewpoints which are in tandem with the country's economic growth. In this masterplan, focus has been given to issues related to i) enhancement of imported energy infrastructure, ii) efficient utilization of domestic natural resources, iii) construction of a high-quality power network, iv) promotion and maximization of green energy, and v) human resource development for the stable supply of energy.

Towards these objectives, the government has initiated several projects which are expected to be completed by 2020. These include the Ruppur nuclear power plant and the coal-fired power plants at Rampal and Payra. In the longer-term, the Power Division of government aims to generate a marked increase of 20,000 megawatts of coal-powered energy by 2030[6]. The installed capacity of electricity generation is shown in Table 1.2.

Table 1.2: Installed capacity of existing power stations in Bangladesh (as of May 2019)

Fuel Type	Capacity (unit)	Total (%)
Other	280MW	1.65%
Coal	545 MW	3.09%
Gas	10001 MW	58.89%
HFO (residual fuel oil)	3597 MW	21.18%
HSD (high speed diesel)	1690 MW	9.95%
Hydro	230 MW	1.35%
Imported	660 MW	3.89%
Total	**16982 MW**	**100%**

Source: Bangladesh Power Development Board. Retrieved May 30, 2019 from http://www.bpdb.gov.bd/bpdb/index.php?option=com_content&view=article&id=150&Itemid=16

[6] Bangladesh Power Sector Master Plan (2016)

1.4 Profiles of the agricultural and industry sector

Since its independence in 1971, Bangladesh has achieved tremendous growth in its industrial production. The economy comprises many small and medium enterprises that make up 25% of the nation's Gross Domestic Product (GDP). In 2018, the shares of the agricultural, industrial and service sectors in GDP terms were 14.23 percent, 33.66 percent and 52.11 percent respectively[7]. The contribution of the agriculture sector to GDP has been on a steady decline. In contrast, the average growth rate of industries is 6 to 10% with textiles and clothing, construction and pharmaceutical industries having major shares.

Agriculture is the largest employment sector in Bangladesh. The performance of this sector has an overwhelming impact on major macroeconomic objectives like employment generation, poverty alleviation, human resources development, and food security. The agriculture sector comprises crops, forests, fisheries and livestock. Of the agricultural GDP, the crop subsector contributes 71 percent, forest 10 percent, fisheries 10 percent and livestock 9 percent[8]. The sector generates 40.6% of total national employment, of which the crop sector share is just over half[9].

Exports of textiles and garments are the principal source of foreign exchange earnings. In 1972, the World Bank approximated the gross domestic product (GDP) of Bangladesh at US$6.29 billion[10], and it grew to $287.63 billion by 2018[11], with $41 billion of that generated by exports[12], 83.5% of which was ready-made garments (RMG)[13].

As of 2016, Bangladesh was second in terms of producing garments, after China[10]. In the financial year 2016-2017, the RMG industry generated US$28.14 billion, which was 80.7% of the total export earnings in exports and 12.36% of the GDP[14]. The construction industry is growing rapidly in Bangladesh, with annual employment growth of 13.5%, according to the Bangladesh Bureau of Statistics and GDP from construction in Bangladesh increased to 7359.50 BDT Million in 2018 (approximately 80 million US$ in 2019) from 6695.10 BDT Million in 2017[15].

Bangladesh is the only least developed country around the globe that meets up to 98% of its demand for pharmaceutical products, with a market size of nearly US $2 billion[16]. It is the 2nd highest contributor to the national exchequer and there are approximately 250 registered pharmaceutical companies[10]. All the top 10 companies are local and they have approximately 70% market share[10]. According to the Export Promotion Bureau, in 2017, the pharmaceutical exports generated US$89.17 million[17].

Other than these major sectors, there are chemical industries, steel and aluminum alloy manufacturing companies, cement and paper production factories, and paint, cosmetics and lamp manufacturing facilities. The chemical industry in Bangladesh is represented principally by 5 to 6 chlor alkali plants

[7]Gross Domestic Product (GDP) of Bangladesh (Final) 2017-18 (PDF) (Report) (Final ed.). Agargaon, Dhaka 1207: Bangladesh Bureau of Statistics (BBS). 18 September 2018. p. 5. Retrieved 21 September 2018.
[8]Contribution of agriculture in the economy of Bangladesh. (2017, May 19). Retrieved from https://studymoose.com/contribution-of-agriculture-in-the-economy-of-bangladesh-essay
[9]Report on Labour Force Survey (LFS) 2016-17 (PDF). BBS. January 2018. p. 173. ISBN 978-984-519-110-4. Retrieved 30 May 2019.
[10]Latifee, Enamul Hafiz. "RMG sector towards a thriving future". The Daily Star. Retrieved 30 May 2019.
[11]"World Economic Outlook Database, April 2019". International Monetary Fund. Retrieved 30 May 2019.
[12]"Bangladesh earned US$ 41b in 2017-18: Tofail". The Independent. Retrieved 30 May 2019.
[13]"Share of total exports of ready-made garments (RMG) in Bangladesh from 2010 to 2018". Statista. Retrieved 30 May 2019.
[14]Hossain, Latifee, Md. Sajib, Enamul Hafiz (6 August 2017). "Readymade garment industries going green". The Financial Express. International Publications Limited.
[15]"Bangladesh GDP from Construction". Trading Economics. Retrieved 30 May 2019
[16]"Overview". Bangladesh Association of Pharmaceutical Industries. Retrieved 30 May 2019 from http://www.bapi-bd.com/bangladesh-pharma-industry/overview
[17]"Bangladesh's burgeoning pharmaceutical sector: Ruling local market, stock business, and expanding abroad" (3 November 2018). Dhaka Tribune. Retrieved 30 May 2019 from https://www.dhakatribune.com/business/stock/2018/11/03/bangladesh-s-burgeoning-pharmaceutical-sector-ruling-local-market-stock-business-and-expanding-abroad

producing caustic soda (NaOH), chlorine (Cl_2) and hydrochloric Acid (HCl). Among the two current technologies - diaphragm and membrane cell technique - the chlor alkali plants in Bangladesh use diaphragm cell technique to produce NaOH. Manufacturing companies produce aluminum alloyed billets using fresh aluminum ingots: although these ingots are imported given no aluminum production in Bangladesh.

There are several cement factories in Bangladesh. However, except two, all the cement factories import clinker to produce cement[18]. Furthermore, there are few pulp and paper production facilities in Bangladesh, with most of them importing pulp to produce paper locally.

Other than lamps, paint and cosmetic products, Bangladesh does not manufacture consumer products that can potentially contain mercury, but relies on imports from other countries. Products such as cosmetics, soaps, batteries and electrical and lighting products that might all contain mercury are available on the open market.

1.5 Overall environmental status in Bangladesh and condition of waste management

The responsibility for collection, transport and disposal of municipal solid waste for Dhaka and Chittagong cities (the two largest in Bangladesh) is discharged upon Dhaka (DCC) and Chittagong City Corporation (CCC), respectively. DCC is divided into DCC (North) with 36 wards and DCC (South) with 56 wards and CCC is composed of 41 wards. In Dhaka all the waste is sent for open dumping in Matuail (Dhaka South) and Amin Bazar (Dhaka North) dumping grounds. The Matuail dump site is considered to be a sanitary landfill, though open dumping is practised there. In Chittagong, all the waste is currently dumped into Ananda Bazar, Kalurghat, and Arefin Nagar open dumping sites. The Roufabad open dumping site was closed in 2014. The Ananda Bazar dumping ground is the oldest open dumping site in Chittagong and is expected to close in 2020.The solid wastes of Dhaka and Chittagong consist of mainly organic and inorganic fractions like food waste, paper, textile, rubber, plastic, glass, metals and wood; the major fraction (75%) of Municipal Solid Waste (MSW) in Bangladesh is food waste[19].

The Department of Public Health Engineering (DPHE), a government agency, is responsible for water supply and sanitation for both urban and rural areas of the country, except for the capital city of Dhaka and the port city of Chittagong. In order to meet the growing demands for water supply and sanitation services of the two cities, two autonomous organizations, Dhaka Water Supply and Sewerage Authority (DWASA) and Chittagong Water Supply and Sewerage Authority (CWASA), were created in 1963 under the Water Supply and Sewerage Ordinance.

At present there are 237 municipalities in the country and the piped water supply system has been developed, partially or fully, in 101 of them. Water supply coverage is about 50% in the urban areas, except for Dhaka and Chittagong where the coverage is 72% and 45% respectively. Sanitation coverage in Dhaka city is around 70%, of which nearly 30% may be assigned to the water-borne piped sewerage[20]. The rest of the sewerage is handled through conventional septic tanks. Nearly one-third of the domestic effluents are released directly into the environment without any treatment, which is the major source of pollution of the surface water bodies located in and around the city[20].

[18]Mineral Yearbook of Bangladesh 2014. (August, 2017) Unites States Geological Survey: US Department of the Interior
[19]Islam, K. M. N. (2016). Municipal Solid Waste to Energy Generation in Bangladesh: Possible Scenarios to Generate Renewable Electricity in Dhaka and Chittagong City. Journal of Renewable Energy, 2016, 1-16. doi: 10.1155/2016/1712370
[20]Haq, K. A. (2006). Water Management in Dhaka. International Journal of Water Resources Development, 22(2), 291-311. doi: 10.1080/07900620600677810

Several rules have been approved in parliament regarding waste management, such as the Medical Waste Management Rules 2008, Bangladesh Standards and Guidelines for Sludge Management 2015, draft National Solid Waste Management Handling Rules, 2005. Two important One initiative was undertaken by Japan International Cooperation Agency (JICA) in 2005 with the objectives of formulating a master plan for Dhaka City and developing capabilities and management skills of the Dhaka City Corporation. Another initiative, the 3Rs Strategy (3Rs: Reduce, Reuse and Recycling of wastes), was undertaken in 2010 by the Department of Environment (DoE) of the Ministry of Environment and Forestry. Towards sustainable waste management, the 3Rs can play a vital role in protecting the environment from greenhouse gas emissions and convert waste into invaluable resources.

1.6 Environmental risk profile

Bangladesh is vulnerable to the adverse impacts of natural disasters and climate change. Climate change has huge impacts on human lives and livelihoods by increasing the frequency and intensity of various events or disasters. Due to the special geographical features and settings, the World Risk Report 2016 identified Bangladesh as the 6th most natural disaster-prone country in the world. The geography and climate have made the country vulnerable to different meteorological, hydrological and geological hazards. These hazards often lead to disasters and the major ones in the country are floods, cyclones, droughts, tidal surges, tornadoes, earthquakes, river erosion, infrastructure collapse, water logging, water and soil salinity, epidemic, and various forms of pollution.

Over the last 35 years, the Government of Bangladesh has invested over $10 billion in making the country less vulnerable to natural disasters[21]. These investments, in many cases supported by development partners, include flood management schemes, coastal polders, cyclone and flood shelters, and the raising of roads and highways above flood level.

In addition, the Government of Bangladesh has developed state-of-the-art warning systems for floods, cyclones and storm surges, and is expanding community-based disaster preparedness. Climate resilient varieties of rice and other crops have also been developed. In order to tackle climate change, Bangladesh launched its first Climate Change Strategy and Action Plan (BCCSAP) in 2008. To support its implementation, the Government of Bangladesh established the Bangladesh Climate Change Resilience Fund (BCCRF) with four development partners: Denmark, the European Union (EU), Sweden, and the U.K. Department for International Development (DFID).

For the Bangladesh government, pollution arising from the growing volume of solid and hazardous waste is considered a major threat to the human health and the environment. Bangladesh participates in regional efforts to improve waste management, including through the export of recyclable wastes in accordance with the Basel Convention. Over nearly a decade, the government of Bangladesh has invested over half a billion dollars of its own money on hundreds of activities to tackle climate change through the Climate Change Trust Fund.

[21]Bangladesh Climate Change Strategy and Action Plan 2008. (September 2008). Ministry of Environment and Forests. Government of The People's Republic of Bangladesh.

CHAPTER 2:
MERCURY INVENTORY AND IDENTIFICATION OF EMISSIONS AND RELEASES IN BANGLADESH

2.1 Summary of mercury releases, stockpiles, supply and trade

The purpose of the inventory is to identify the sources of emissions and releases in the country as well as to determine the amounts emitted/released by the various sources. UN Environment's (UNEP) 'Toolkit for Identification and Quantification of Mercury Releases' has been used to develop the mercury inventory in Bangladesh. The Toolkit exists in two versions: Inventory Level 1 and Inventory Level 2.

Inventory level 1 is the simpler tool requiring less data but is consequently more uncertain. Mercury releases are estimated in inventory level 1 through the insertion of production information from industries likely to contribute to mercury emissions and releases. Default emission factors are used for each of these specified sources to determine the likely emissions and releases. The pre-determined factors, used in the calculation of mercury inputs to society, are derived from data on mercury inputs and releases from relevant mercury source types from available literature and other data sources such as research and policy documents. Inventory level 2 is a more detailed and comprehensive tool that provides a more accurate analysis of the situation. Users can select emission factors based on their knowledge of the technologies used in different industry sectors that are likely to contribute to mercury emissions and releases. More detailed information is needed to perform inventory analyses in toolkit level 2. The mercury inventory for Bangladesh was prepared using a combination of level 1 and 2. Especially for significant emission sources, the approach taken was to collect detailed information and use them in the level 2 version.

2.1.1 Mercury release source types present

The key groups of mercury release sources in Bangladesh are presented in Table 2.1 below. Table 2.2 lists the miscellaneous mercury sources that are not included in the quantitative inventory with preliminary indication of possible presence. It should be noted that some of the minor mercury release source types might be present in Bangladesh (Table 2.2). However, due to lack of reliable data, the quantitative analysis for those sources was not included in this study.

Table 2.1: Mercury releases sources in Bangladesh

Source Category	Source Present (Y/N)	Toolkit Level
Energy Consumption		
Coal combustion in large power plant	Y	IL1
Coal combustion in brick kiln	Y	
Combustion/use of petroleum coke and heavy oil	Y	
Combustion of diesel, gasoline, petroleum, kerosene, LPG and other light to medium distillates	Y	
Use of raw or pre-cleaned natural gas	Y	
Use of pipeline gas (consumer quality)	Y	
Biomass fired power and heat production	Y	
Charcoal combustion	Y	
Fuel Production		
Oil extraction	Y	IL1
Oil refining	Y	
Extraction and processing of natural gas	Y	
Primary Metal Production		
Mercury (primary) extraction and initial processing	N	--
Production of zinc from concentrates	N	
Production of copper from concentrates	N	
Production of lead from concentrates	N	
Gold extraction by methods other than mercury amalgamation	N	
Alumina production from bauxite (aluminium production)	N	
Primary ferrous metal production (pig iron production)	N	
Gold extraction with mercury amalgamation from whole ore	N	
Gold extraction - mercury amalgamation from concentrate	N	

Production of Chemicals		
Chlor-alkali production with mercury-cells	N	--
VCM production with mercury catalyst	N	
Acetaldehyde production with mercury catalyst	N	
Production of Products with Mercury Content		
Light sources with mercury (fluorescent, compact, others: see guideline)	Y	IL2
Skin lightening creams and soaps with mercury chemicals	Y	IL2
Hg thermometers (medical, air, lab, industrial etc.)	N	--
Electrical switches and relays with mercury	N	
Batteries with mercury	N	
Manometers and gauges with mercury	N	
Biocides and pesticides with mercury	Y	IL2
Paints with mercury	Y	
Skin lightening creams and soaps with mercury chemicals	Y	
Production of Recycled of metals		
Production of recycled ferrous metals (iron and steel)	Y	IL1
Production of recycled mercury ("secondary production")	N	--
Waste Incineration		
Open fire waste burning (on landfills and informally)	Y	IL1
Incineration/burning of medical waste	Y	
Incineration of municipal/general waste	N	--
Incineration of hazardous waste	Y	IL2
Sewage sludge incineration	N	--
Waste Deposition/Landfilling and Waste Water Treatment		
Controlled landfills/deposits	Y	IL2
Informal dumping of general waste	Y	
Waste water system/treatment	Y	

Use and Disposal of Products with Mercury Content		
Dental amalgam		IL2
Dental amalgam fillings ("silver" fillings)	Y	
Preparations of fillings at dentist clinics	Y	
Use - from filling already in the mouth	Y	
Thermometers		IL2
Medical Hg thermometer	Y	
Other glass Hg thermometers (air, laboratory, dairy, etc.)	Y	
Engine control Hg thermometers and other large industrial/specialty Hg thermometers	N	
Light sources with mercury		IL2
Fluorescent tubes (double end)	Y	
Compact fluorescent lamp (CFL single end)	Y	
Other Hg containing light sources	Y	
Batteries with mercury		
Mercury oxide (button cells and other sizes); also called mercury-zinc cells	Y	
Other button cells (zinc-air, alkaline button cells, silver-oxide)	Y	
Other batteries with mercury (plain cylindrical alkaline, permanganate, etc.)	Y	
Laboratory chemicals	Y	IL1
Other laboratory and medical equipment with mercury	Y	
Polyurethane (PU, PUR) produced with mercury catalyst	Y	
Paints with mercury preservatives	Y	IL2
Medical blood pressure gauges (mercury sphygmomanometers)	Y	IL1
Other manometers and gauges with mercury	N	IL1
Crematoria and Cemeteries		
Crematoria	Y	IL1
Cemeteries	Y	

Table 2.2: Miscellaneous mercury sources not included in the quantitative inventory with preliminary indication of possible presence (Y = probable presence, ? = unknown)

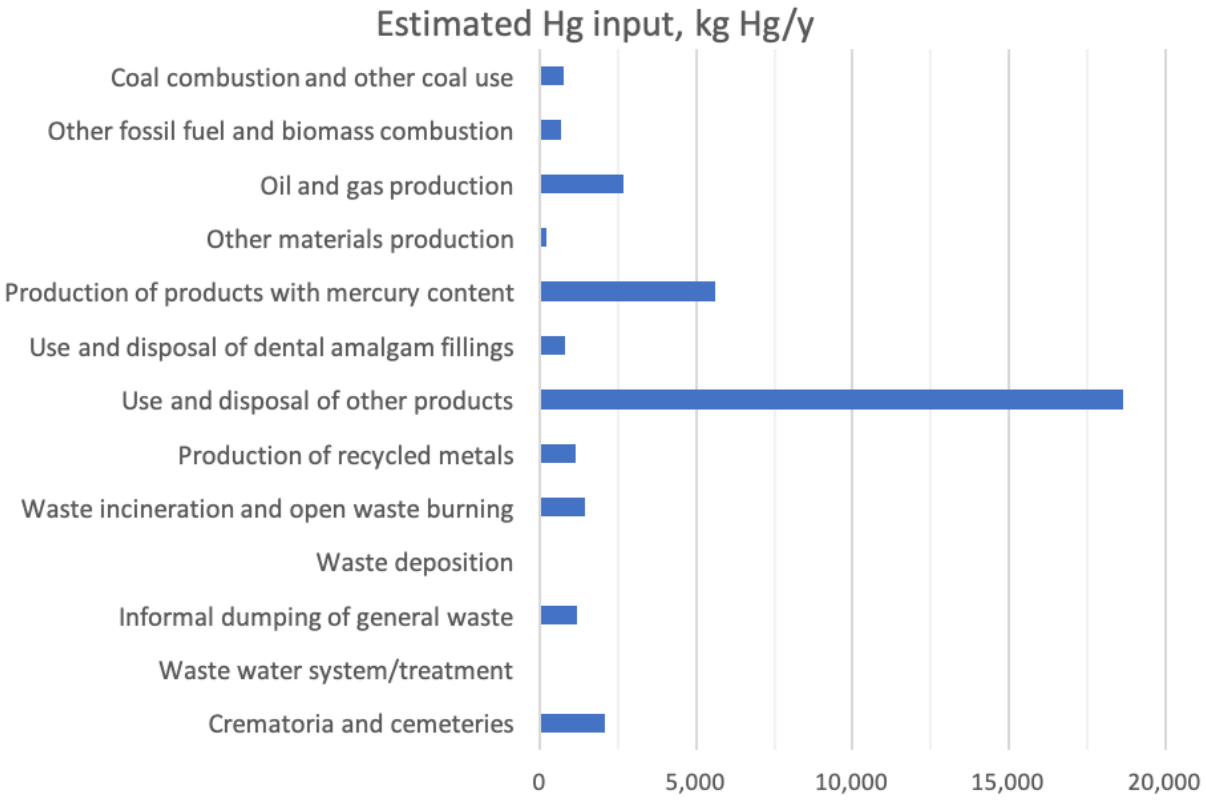
Source Category	Source Possibly Present Y/N/?
Combustion of oil shale	N
Combustion of peat	Y
Production of other recycled metals	?
Production of lime	Y
Bougie tubes and Cantor tubes (medical)	Y
Educational uses	Y
Gyroscopes with mercury	Y
Mercury used in traditional medicines (ayurvedic and others) and homeopathic medicine	Y
Light houses (levelling bearings in marine navigation lights)	?
Tanning	Y
Pigments	Y
Recoil softeners in rifles	?
Explosives (mercury-fulminate a.o.)	?

2.1.2 Summary of mercury inputs to society

Figure 2.1 shows the source categories and quantitative summary of mercury input to society. The source types positively identified at present are included in the quantitative assessment. Mercury inputs to society should be understood here as the mercury amounts made available for potential releases through economic activity in Bangladesh. This quantitative analysis estimated annual mercury inputs contributed by energy consumption, fuel production, primary metal production, production of cement, pulp and paper, lamps, paints, skin lightening creams and soaps, among others, and disposal of products with mercury contents, recycling metals, waste incineration and deposition, crematoria and cemeteries. Figure 2.1 shows that production of mercury-added products (lights, paints and skin-whitening creams), use and disposal of products with mercury content (including dental amalgam, thermometers, electrical switches, lights, batteries, paints blood pressure gauges) are the major sources of mercury inputs to society. The total mercury input to society is estimated as 30,850 kg Hg/y. The summary and breakdown of contributions from individual sources are shown in

Annex F. A detailed explanation of individual sources including the data and assumptions used in the estimation are provided in subsequent sections (Section 2.2 and beyond).

Figure 2.1: Mercury Inputs to Society



2.1.3 Summary of mercury releases

It is estimated that the total mercury releases are 32,660 kg per year and the major significant anthropogenic sources of mercury are:

1. Waste incineration and open waste burning: 44 per cent (14,323 kg Hg/y),

2. Use and disposal of other products: 20 per cent (6,564 kg Hg/y),

3. Oil and gas production: 8 per cent (2,675 kg Hg/y),

4. Informal dumping of general waste: 7 per cent (2,397 kg Hg/y),

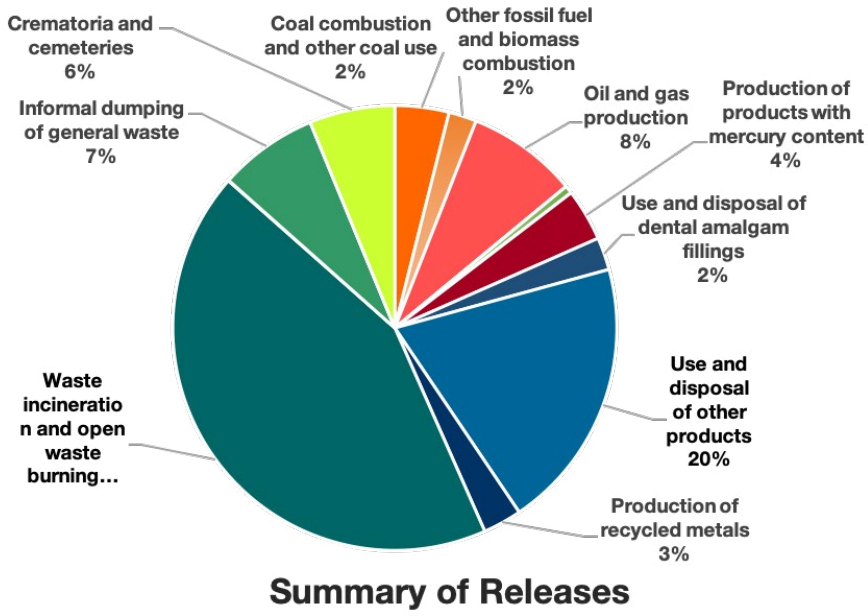
5. Crematoria and cemeteries: 6 per cent (2,066 kg Hg/y),

6. Coal combustion and other coal use: 2 per cent (781 kg Hg/y), and

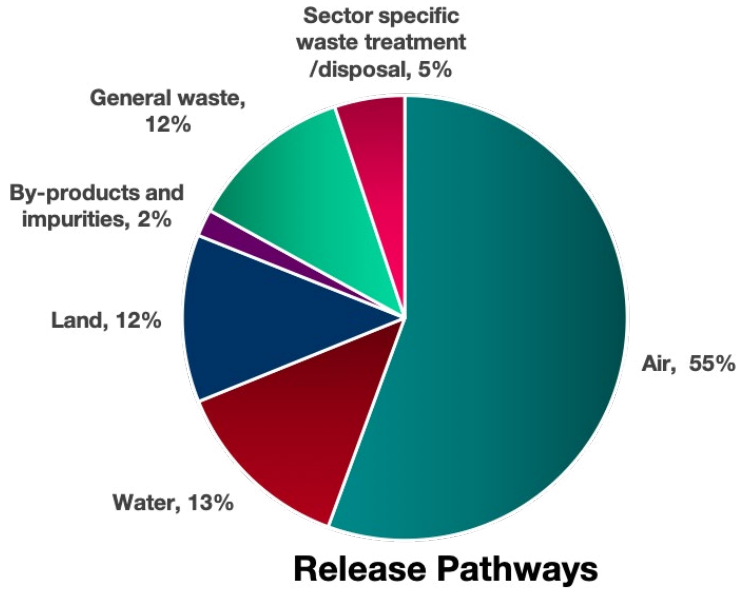
7. Production of products with mercury contents (thermometers, paints, cosmetics, light, battery): 4 per cent (1,258 kg Hg/y).

In Bangladesh, most of the mercury is released to air (55%) followed by water (13%). Figures 2.2(a) and 2.2(b), and Table 2.3 present the summary of the main release pathways in Bangladesh. The different pathways are air (the atmosphere), water (marine and freshwater bodies, including via waste water systems) and land (soil and ground water). A further breakdown of individual source contribution to mercury releases is shown in Annex E. A general description of output pathways to air, water, land, by-products and impurities, general waste and sector-specific waste treatment are given in Annex D. The subsequent sections (section 2.2 onwards) explains the basic assumptions in estimating mercury inputs and releases from different sectors. Figure 2.3 to 2.8 shows how much individual sectors contribute to mercury emissions to individual environmental compartments.

Figure 2.2: (a) Summary of mercury releases in Bangladesh; (b) Release pathways in Bangladesh



(a)



(b)

Table 2.3: Summary of mercury release pathways

Source category	Estimated Hg input, Kg Hg/y	Estimated Hg emissions and releases, standard estimates, Kg Hg/y							
	Standard estimate	Air	Water	Land	By-products and impurities	General waste	Sector specific waste treatment / disposal	Total releases *3*4*5	Percentage of total releases *3*4
Coal combustion and other coal use	781	751.5	0.0	0.0	0.0	0.0	29.6	781	2%
Other fossil fuel and biomass combustion	**673.2**	673.2	0.0	0.0	0.0	0.0	0.0	673	2%
Oil and gas production*1	**2,677.9**	402.1	534.7	0.0	801.9	0.0	936.2	2,675	8%
Primary metal production (excl. gold production by amalgamation)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0%
Gold extraction with mercury amalgamation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0%
Other materials production**6**	192.2	136.4	0.0	0.0	55.8	0.0	0.0	192	1%
Chlor-alkali production with mercury-cells	-	-	-	-	-	-	-	0	0%
Other production of chemicals and polymers	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0%
Production of products with mercury content*1	**5,589.0**	55.9	27.9	558.9	0.0	558.9	55.9	1,258	4%
Application, use and disposal of dental amalgam fillings	**785.4**	23.5	326.5	41.0	30.8	181.8	181.8	785	2%
Use and disposal of other products	**18,648.4**	6,563.7	3,924.4	2,742.8	0.0	4,309.8	1,107.5	6,564	20%
Production of recycled metals	1,135.9	309.0	0.5	317.9	0.0	308.6	0.0	936	3%

Waste incineration and open waste burning***2**	**14,322.1**	14,322.6	0.0	0.0	0.0	0.0	0.0	14,323	43%
Waste deposition***2**	**12.0**	11.7	0.1	0.0	0.0	0.0	0.0	12	0%
Informal dumping of general waste ***2*3**	**11,987.0**	1,198.7	1,198.7	9,589.6	-	-	-	2,397	7%
Waste water system/ treatment ***4**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0%
Crematoria and cemeteries	2,065.7	206.6	0.0	1,859.1	0.0	0.0	0.0	2,066	6%
TOTALS (rounded) *1*2*3*4*5*6	**30,850**	**24,650**	**6,010**	**5,520**	**890**	**5,360**	**2,310**	**32,660**	**100%**

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

*2: To avoid double counting of mercury inputs from waste and products in the input TOTAL, only 10% of the mercury input to waste incineration, waste deposition and informal dumping is included in the total for mercury inputs. These 10% represent approximately the mercury input to waste from materials which were not quantified individually in Inventory Level 1 of this Toolkit. See Appendix 1 to the Inventory Level1 Guideline for more explanation.

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

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

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

*6: To avoid double counting, fossil fuel mercury contributions to cement production was subtracted automatically in the TOTALS.

Figure 2.3 shows that fossil fuel and biomass combustion, use and disposal of various mercury-added products, and waste incineration and open waste burning are the major sources of mercury releases to air in Bangladesh. Among them, waste incineration and waste burning contributes 14,322 Kg Hg emission per year which is also 43% of the total mercury emissions from Bangladesh. Use and disposal of other products are also a major source of emissions to air (6,563 kg Hg/year). Altogether emissions to air constitute the largest mercury emissions among all environmental compartments.

On the other hand, oil and gas production (534 kg Hg/year), use and disposal of dental amalgam fillings (326 kg Hg/year), use and disposal of other products (3,924 kg Hg/year), informal dumping of general waste

(1,198 kg Hg/year) are the primary contributors of mercury releases to water (Figure 2.4). Emissions to water constitute the second largest mercury emissions among all environmental compartments.

The production of products with mercury content (559 kg Hg/year), use and disposal of other products (2,742 kg Hg/year), informal dumping of general waste (9,589 kg Hg/year) and crematoria and cemeteries (1,859 kg Hg/year) are the major sources of mercury releases to land in Bangladesh (Figure 2.5). Figure 2.6 shows that oil and gas production (802 kg Hg/year) contributes the most mercury as by-products and impurities. In the general waste category, use and disposal of mercury products has the highest contribution (4,310 kg Hg/year). (Figure 2.7)

Figure 2.3: Estimated mercury releases to air in Bangladesh

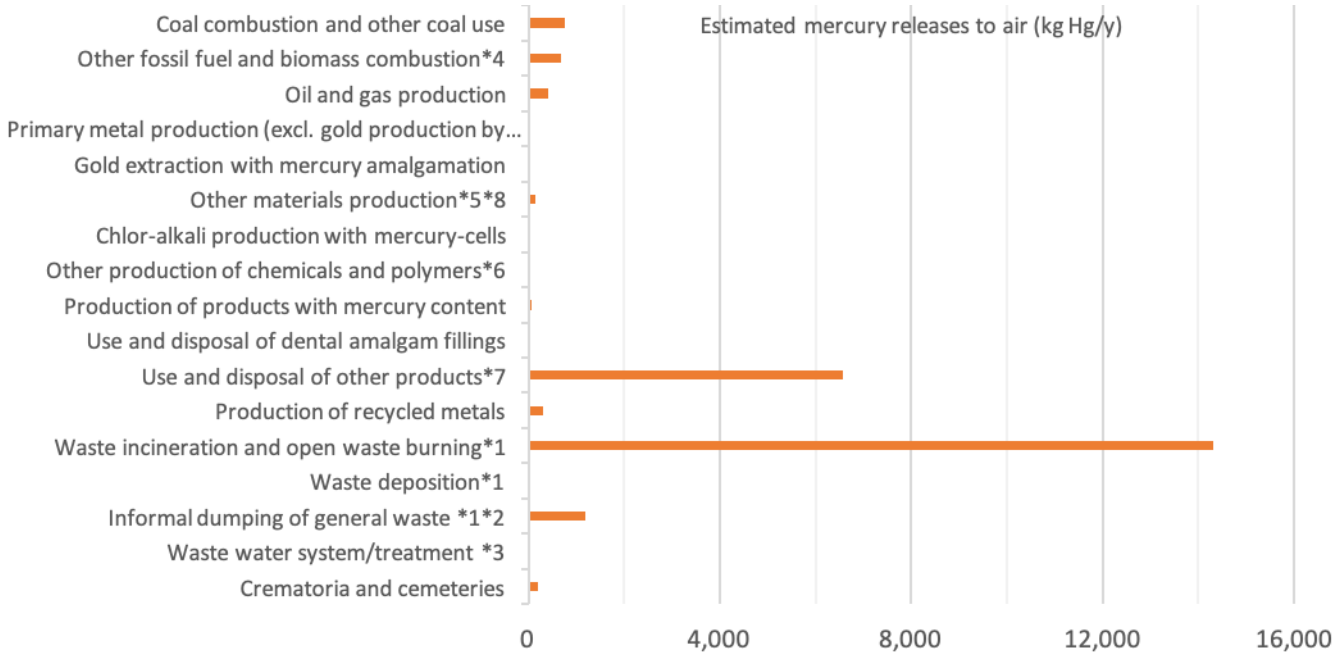


Figure 2.4: Estimated mercury releases to water in Bangladesh

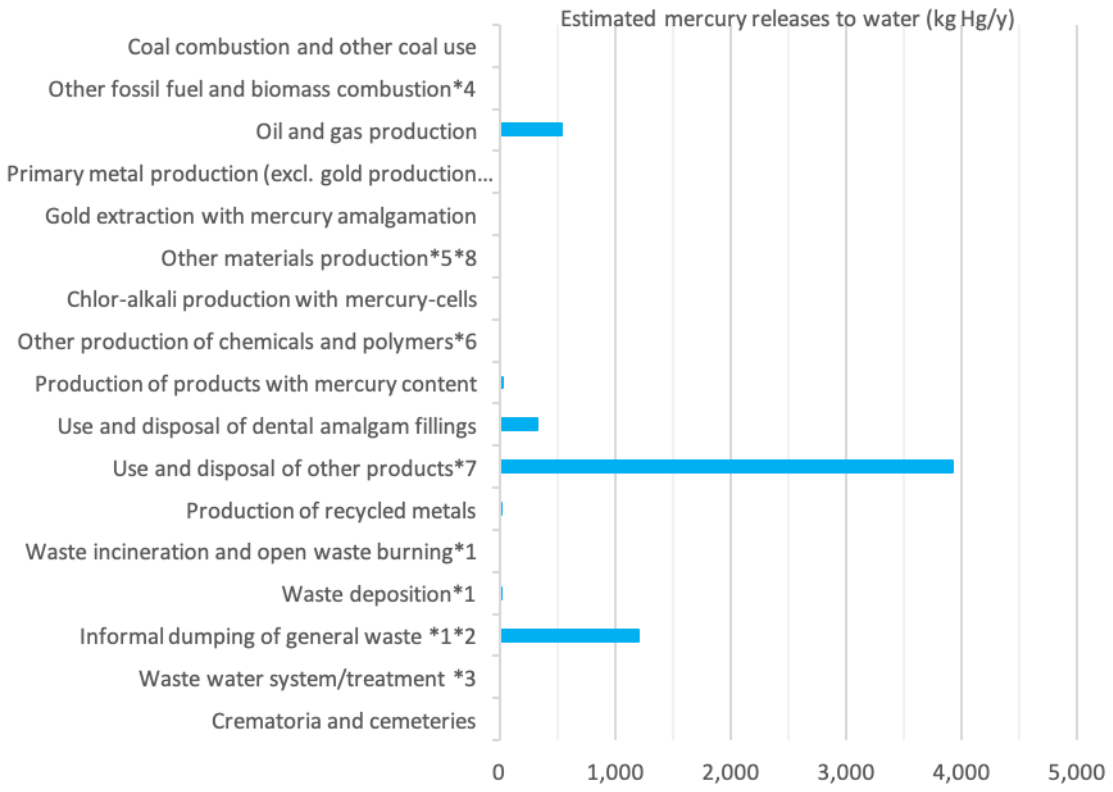


Figure 2.5: Estimated mercury releases to land in Bangladesh

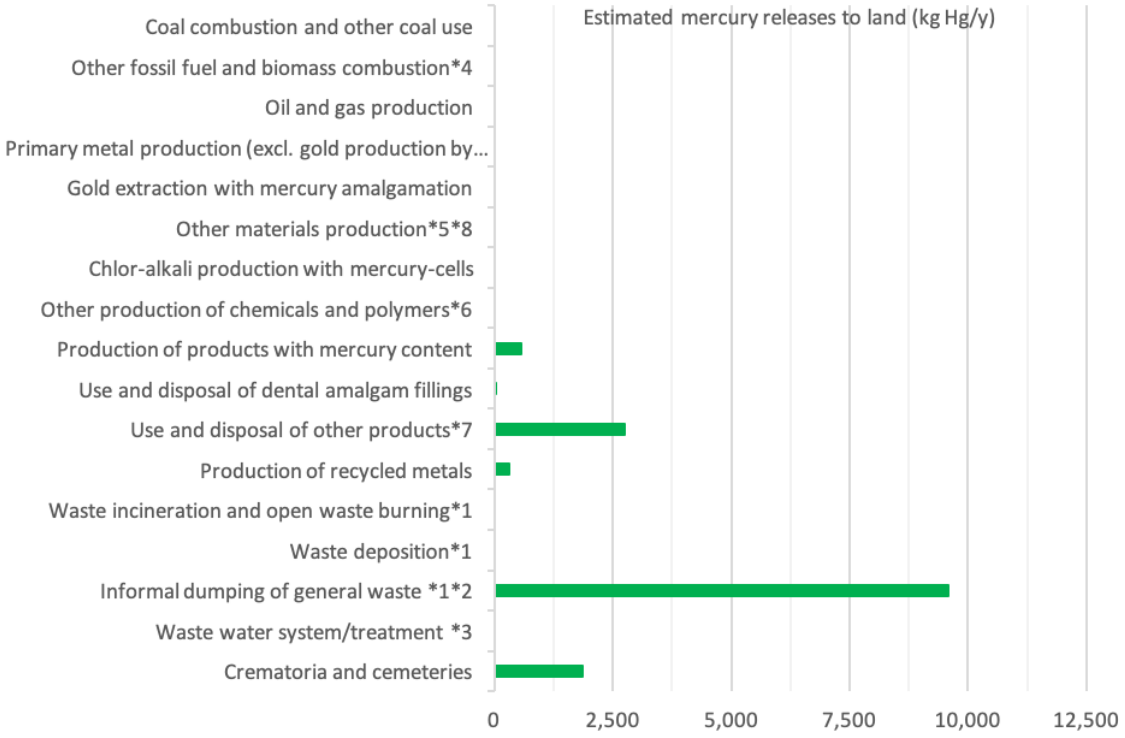


Figure 2.6: Estimated mercury releases to by-products and impurities in Bangladesh

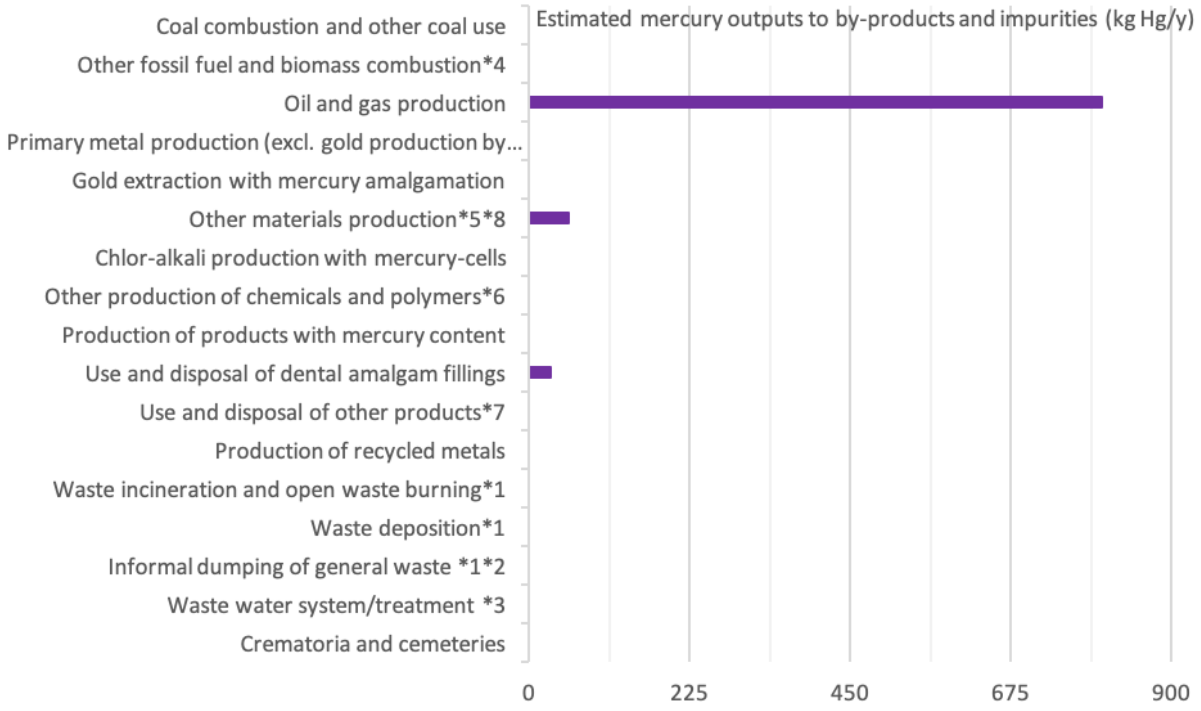


Figure 2.7: Estimated mercury releases to general waste in Bangladesh

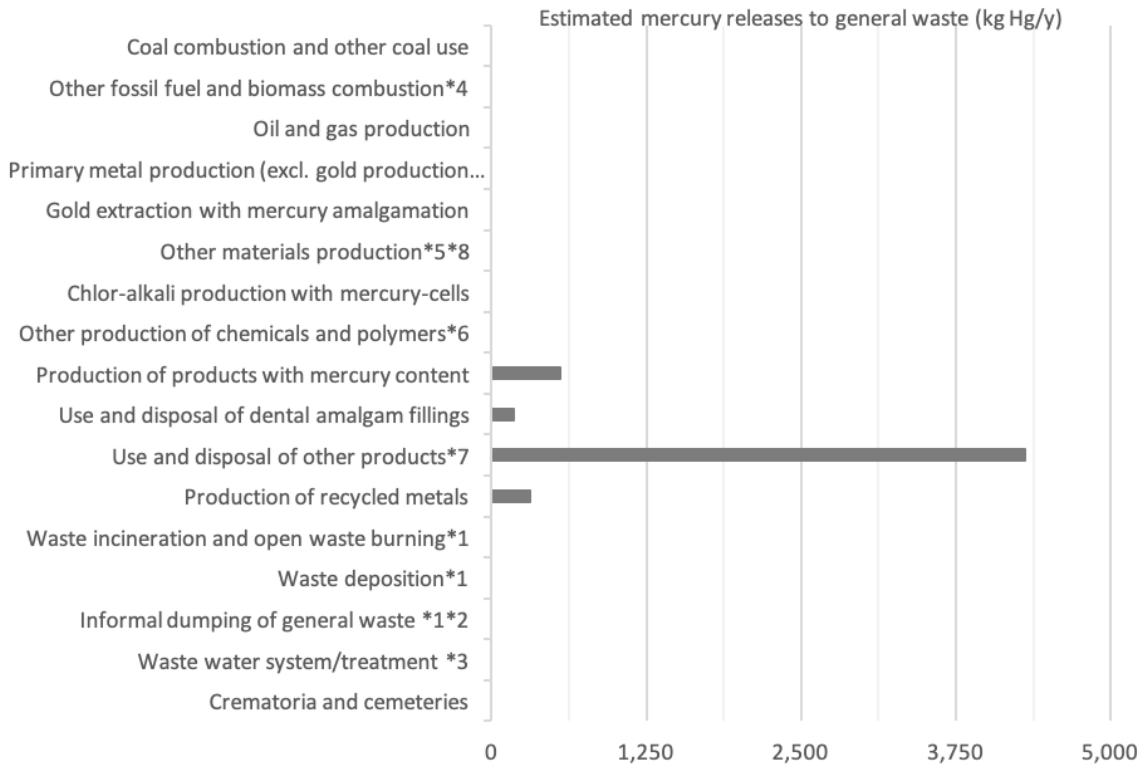
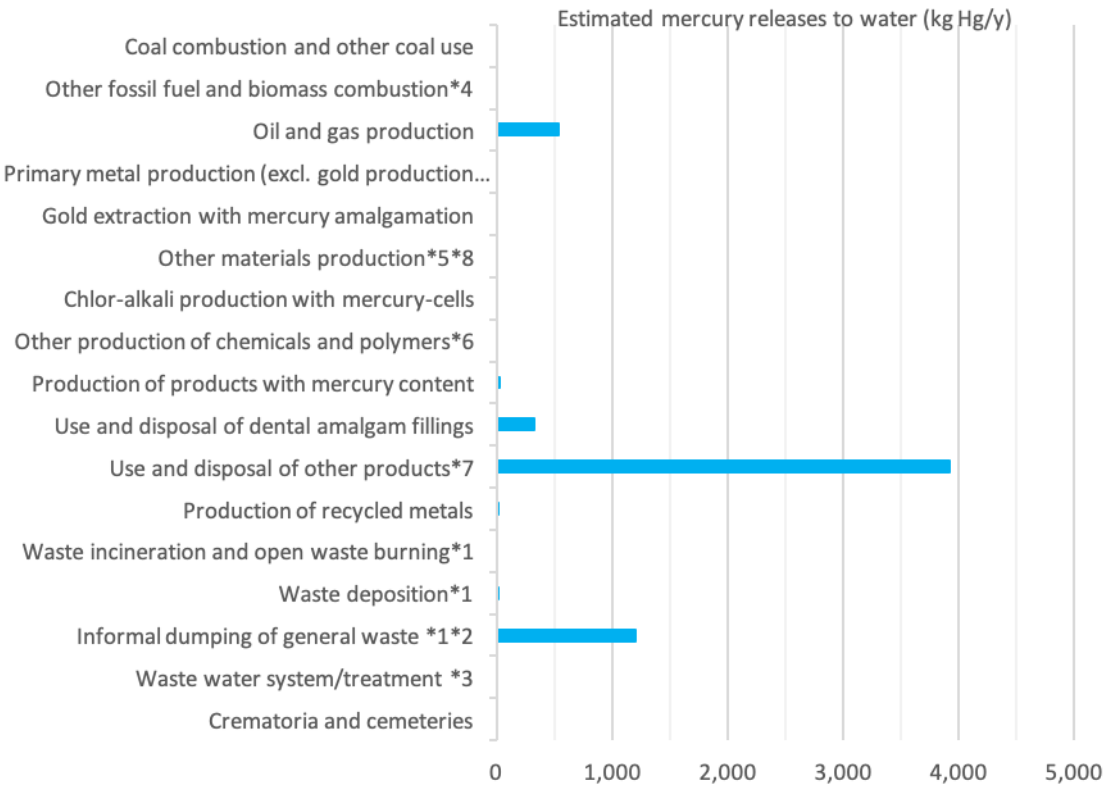


Figure 2.8: Estimated mercury releases to sector specific waste in Bangladesh



2.2 Inventory on energy consumption and fuel production

The growing demand for energy in Bangladesh is met with fossil fuels: coal, petroleum and natural gas, with natural gas being the largest energy source. Some biomass also contributes to energy supplies. Table 2.4 presents the energy consumption in Bangladesh and the subsequent mercury emissions calculated using default emission factors of the mercury toolkit. It can be seen that natural gas (extraction, processing and use) is the largest source of mercury emissions and releases among the energy consumption categories, contributing to 2,680 kg Hg/y. Coal and biomass are the second and third largest contributors, contributing about 781 kg/y and 596 kg/y mercury emissions and releases, respectively. Consequently, natural gas production and coal combustion account for 8% and 2% of the country's total mercury releases, respectively.

Bangladesh produces coal and petroleum; however, to fulfil domestic demand, Bangladesh also has to import coal and oil. Since mercury is a volatile element almost all the mercury can be estimated to be emitted to air. From the calculation, it is observed that the energy consumption sector contributes 7.4% of mercury emissions to air.

Table 2.4: Energy consumption in Bangladesh

Source category	Source present (Y/N/?)	Activity rate	Unit	Estimated Hg input, kg Hg/y
Energy consumption				
Coal combustion in large power plants	Y	1,642,500	Coal combusted, t/y	246
Coal combustion in coal fired industrial boilers	N	0	Coal combusted, t/y	-
Other coal uses	Y	4,010,000	Coal used, t/y	535
Combustion/use of petroleum coke and heavy oil	Y	884,000	Oil product combusted, t/y	49
Combustion/use of diesel, petroleum, kerosene, LPG & light to medium distillates	Y	3,916,000	Oil product combusted, t/y	22
Use of raw or pre-cleaned natural gas	?	0	Gas used, Nm^3/y	?
Use of pipeline gas (consumer quality)	Y	29,660,963,040	Gas used, Nm^3/y	7
Biomass fired power and heat production	**Y**	19,883,250	Biomass combusted, t/y	596
Charcoal combustion	**N**	0	Charcoal combusted, t/y	-
Fuel production				
Oil extraction	Y	91,000	Crude oil produced, t/y	0
Oil refining	Y	1,400,000	Crude oil refined, t/y	5
Extraction and processing of natural gas	Y	26,728,395,760	Gas produced, Nm^3/y	2,673

There is only one active large coal-fired power plant, at Barapukuriya. Therefore, combustion of coal from large power plants represents combustion from the Barapukuriya power plant i.e. 4,500 tons coal per day[22] resulting in 1,642,500-ton coal combustion per year. In addition, mercury emissions can come from other coal uses. While Bangladesh does not have coal-fired industrial boilers, it does have steel-rolling mills using coal. However, the total amount is considered negligible in comparison to the extensive use of coal by the brick industry in Bangladesh. Therefore, "other coal uses" mainly represents coal

[22] Tusher Mohanta, S. A., Chowdhury Quamruzzaman, Md. Lal mamud, Md Zonaed Hossain Sazal, & K.M. Imam Hossain. (July-2015). Case study on surrounding area of Barapukuria coal mine impeding soil fertility. International Journal of Scientific & Engineering Research, 6(7)

combustion in brick kilns. The rise in income levels has triggered rapid urbanization in rural areas and increased the use of bricks. Up to June 2016 a total of 6,637 brick kilns existed in the country; out of this, 2,602 were found with fixed chimneys, 4,045 were zigzag, 73 were Hybrid Hoffman and 41 kilns were using Automatic/tunnel technology[23]. Most kilns operate during the dry season, aggravating the already poor air quality. Total brick production in Bangladesh is estimated at 17.2 billion per year which consumes approximately 3.5 million tons of coal[24].

On the other hand, the guidelines for inventory level 1 instruct that, "other coal use" can be estimated using IEA Data which is the sum of consumption for heat plants, other transformation, industry, transport, residential, agriculture/forestry, fishing, other non-specified and non-energy use for the coal types: Anthracite, Coking coal, other bituminous coal, sub-bituminous coal, lignite, patent fuel, BKB (brown coal briquettes). For Bangladesh, according to the IEA database, 'other coal use' is 4,010,000 t/y[25]. This would account for the coal consumption in brick kilns and other industries. Although this coal consumption value is lower than the estimate above (5.68 million tons/year coal combusted by the brick industry), the IEA data was used in this case to represent coal combustion for "other purposes". This is because the rest of the energy sector data is sourced from the IEA database and it was deemed that having similar source of data for the same sector is a more logical approach.

Figure 2.9: Brick kiln operation during the dry season in Bangladesh (Dhaka Tribune, published November 9th, 2017)



In order to determine combustion/ use of petroleum coal and heavy oil, the guidelines for inventory level 1 instructs the use of IEA data of fuel oil for domestic supply. For Bangladesh, it is 884,000 tons coal combusted per year. Similarly, data of combustion/use of diesel, gas, oil, petroleum, kerosene, liquefied petroleum gas (LPG) and other light to medium distillates are derived from IEA's data of domestic supply for natural gas liquids, naphtha, liquefied petroleum gases, motor gasoline, aviation gasoline, jet kerosene, other kerosene, gas/diesel, which is 3,916,000 tons per year. Petrobangla (Bangladesh Oil, Gas & Mineral Corporation) is a government organization which performs natural

[23]DoE (2016) Barshik Protibedon (Annual Report) 2015-2016, Department of Environment, Ministry of Environment and Forest, Government of the People's Republic of Bangladesh.
[24] World Bank (2011) Introducing Energy-efficient Clean Technologies in the Brick Sector of Bangladesh; Environment, Climate Change, and Water Resources Unit South Asia Region (June 2011) P-17.
[25] IEA. (2018). Retrieved September, 2018, from International Energy Agency. http://www.iea.org/statistics/statisticssearch/report/?year=2015&country=Bangladesh&product

resources management in Bangladesh. The Petrobangla Annual report of 2016 states that total production of raw natural gas (i.e. extraction and processing of natural gas) is 2,734.3 MMSCFD i.e. 26,728,395,760 Nm^3/y . Besides, 300 MMSCFD LNG is imported per year according to information from interviews with Petrobangla officials. Therefore, the use of natural gas will be 3,034.3 MMSCFD i.e. 29,660,963,040 Nm^3/y[26]. This value conforms reasonably well to the pipeline gas flow for the year of 2016 which is 2,750 MMSCFD. It is assumed that the gas is of pipeline (cleaned) quality.

The Bangladesh Petroleum Corporation (BPC) is a government agency with the principal function to import, distribute and market oil and petroleum products. In Bangladesh, there are in total 7 companies who do oil refining. But among them, only Eastern Refinery imports and extracts crude oil. From 2010-11 annual report of BPC, oil extraction of Eastern Refinery is noted to be 5-8% of oil refining[27]. About 1.4 Million MT crude oil is refined per year according to information derived through conversations with Eastern Refinery officials. Therefore, per year crude oil refining is 1,400,000 MT and crude oil extraction is taken as 6.5% of refined crude oil which is 91,000 MT per year.

Data of biomass fired power and heat production are derived from FAO's Yearbook of Forest Product, 2015 under subsection "wood fuel including wood for charcoal" which is 26,511,000 m^3[28]. Multiplying the value with "hard wood density" of 0.75 t/m^3, the amount becomes 19,883,250 ton biomass combusted per year.

2.3 Inventory on domestic production of metals & raw materials

2.3.1 Primary metal production

Bangladesh does not have primary metal production nor extraction or processing of mercury, gold, zinc, copper and lead from concentrates or alumina production from bauxite. There is no known small-scale gold extraction using mercury amalgamation.

2.3.2 Other materials production

There are a number of cement factories in Bangladesh. However, all but two of the cement factories import clinkers to produce cement. Of the two plants producing cement clinker, Lafarge Surma Cement is estimated to produce 1,500,000 t/y of cement (equivalent to about 1,150,000 t/y of clinker representing about 10% of total clinker required for Bangladesh) while the Chhatak Cement Factory is estimated to product 190,000 t/y[29]. These facilities rely on natural gas for fuelling purposes.

One of them uses polyester needle-felt filter bags and the other one uses electrostatic precipitators and bag filters to control dust emissions[30]. Therefore, considering them as simple particle filters (according to options provided by inventory level 2 of the Toolkit), the analysis results in annual mercury emissions of 186 kg per year.

Similarly, there are a few pulp and paper production facilities in Bangladesh. However, most of the paper factories import pulp to produce paper. In 2015, the total amount of pulp production was 94,000 MT including wood, mechanical, semi chemical and chemical pulp[28]. Softwood contains 45-50% cellulose[31]. Since cellulose is the raw material of pulp, we can say that 45 MT cellulose/pulp is generated from 100 MT biomass/softwood. Assuming that the same conversion factor is applicable to the biomass used in pulp production in Bangladesh, it is estimated that, 208,889 MT of biomass is used per year.

[26] PETROBANGLA. (2016). Annual Report 2016: Bangladesh Gas, Oil and Mineral Corporation
[27] Annual Report 2010-2011. (2016): Bangladesh Petroleum Corporation (BPC)
[28] FAO's Yearbook of Forest Product. (2015). Rome: Food and Agriculture Organization of the United Nations
[29] 2014 Mineral Yearbook of Bangladesh. (August 2017) *Unites States Geological Survey:* US Department of the Interior
[30] Information collected from interviews with officials working at those clinker producing factories
[31] Biermann, C. J. (1996). *Handbook of Pulping and Papermaking* (2nd ed.): Elsevier

Table 2.5: Summary of mercury emissions from cement and pulp/paper sector

Source category	Default Input Factor (g Hg/t cement produced)	Entered Input Factor (g Hg/t cement produced)	Activity rate (cement produced, t/y)	Estimated Hg input, kg Hg/y
Energy consumption				
Use of natural gas in production	0.000002-0.00003	0.000002	1,690,000 cement produced, t/y	0.03
Contribution from raw materials	0.004 - 0.5	0.11	1,690,000 cement produced, t/y	186
Pulp and paper production				
Biomass used in production	--	--	208,889 biomass used, t/y	6

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

2.4.1 Production of chemicals

In Bangladesh there are several chlor-alkali production plants but none of these use mercury cells in the production process; in addition, there are no vinyl chloride monomer (VCM) and acetaldehyde production process using mercury as a catalyst.

2.4.2 Production of products with mercury content

2.4.2.1 Hg thermometer (medical, air, lab, industrial etc.)

Mercury thermometers are not manufactured, they are rather imported in Bangladesh, according to information obtained from JMI Syringes and Medical Devices Ltd., one of the leading thermometer importers in Bangladesh.

2.4.2.2 Electrical switches and relays with mercury

Previous studies stated that electrical switches and relays are manufactured in negligible quantities in Bangladesh and they are mostly imported[32]. We have not investigated this sector thoroughly. The source can be considered for further investigation in future inventories.

2.4.2.3 Production, use and disposal of light sources with mercury (LFL, CFL)

At present, the majority of demand of light source in Bangladesh is met by florescent tubes and compact fluorescent lamps. They have substituted the use of incandescent bulbs. Therefore, significant consumption of LFL and CFL exists in Bangladesh. The lamp consumption data for the year of 2015, has been collected from a study conducted by World Bank[33] which is shown in table 2.6.

[32] Nazneen Ahmed, Zaid Bakht. (2010). Light Engineering Industry in Bangladesh: A Case Study: Bangladesh Institute of Development Studies.
[33] *Bangladesh Energy Efficiency Opportunities: Roadmap for Implementation*. (2018). The World Bank. Unpublished Manuscript

Table 2.6: Consumption of different types of lights in the year of 2015

Name	Type and average size of unit	Number (2015)
Light	Incandescent (60W)	15.1 million
	Fluorescent T8 (60W)	14 million
	Fluorescent T5(40W)	3.5 million
	CFL (15W)	36.6 million
	LED (7W)	1.18 million

Source: World Bank Group. (2018). Bangladesh Energy Efficiency Opportunities: Roadmap for implementation. World Bank Publications. Unpublished manuscript.

It should be noted that high pressure mercury vapor lamps, ultra violet lamps and metal halide lamps are not produced in Bangladesh. Export-import data of these items are collected from UN Comtrade and have been used for analysis of the annual consumption. Collected data from UN Comtrade is shown in Table 2.7.

Table 2.7: Export-Import data of lights collected from UN Comtrade

Period	Commodity Code	Commodity Name	Import	Export	Imp-Exp	Average Imp-Exp
2010	853931	lamp- discharge, fluorescent, hot cathode (excluding ultra violet)	3,453,429	14,053	3,439,376	2,304,883
2011			2,428,612	6,008	2,422,604	
2012			1,792,823	420	1,792,403	
2013			1,576,177	11,030	1,565,147	

Period	Commodity Code	Commodity Name	Import	Export	Imp-Exp	Average Imp-Exp
2010	853949	lamps; ultra violet or infra red lamps	257,235	0	257,235	58,062
2011			17,271	0	17,271	
2012			7,292	0	7,292	
2013			3,290	0	3,290	
2015			5,220	0	5,220	
2010	853932	mercury or sodium vapor lamps, metal halide lamps	16,544	520	16,024	23,188
2011			18,265	0	18,265	
2012			18,060	0	18,060	
2013			51,341	800	50,541	
2015			13,164	112	13,052	

HS Code 853931 represents discharge lamps of both Fluorescent tubes (LFL) and Compact Fluorescent Lamps (CFL) and from the table it is noted that average "Import-Export" of HS Code: 853931 is 2,304,883 items per year. However, it should be noted that LFL and CFL are not distributed by types. Assuming they are imported at the ratio of their consumption characteristics (36,600,000 items CFL per year and 17,500,000 items Fluorescent tubes per year), the amount of annual "Import-Export" becomes 1,559,311[34] items per year for CFL and 745,572[35] items per year for LFL.

Similarly, HS Code 853932 represents mercury vapor lamps, sodium vapor lamps and metal halide lamps, without their distribution by types; the annual average "Import-Export" is calculated to be 23,188 items. Since, the consumption of these lights is negligible in Bangladesh, an assumption of their trading at an equal rate would not make a significant deviation from the reality. Therefore, assuming their trading at equal rate (i.e. dividing the total number equally into three), average "Import-Export" of sodium vapor lamps, mercury vapor lamps and metal halide lamps becomes 7,730 items (23188/3) per year each. Moreover, average "Import-Export" for ultra-violet lamps (HS Code:853949) is obtained to be 58,062 items per year[36]. Therefore, subtracting "import-export" from consumption data will give average annual production data. Table 2.8 below shows consumption, "import-export" and production data for each of the light types.

[34] 2304883*(36600000/ (36600000+17500000))
[35] 2304883*(17500000/ (36600000+17500000))
[36] UN Comtrade. Retrieved September, 2018, from United Nations Comtrade Database https://comtrade.un.org/data/

Table 2.8: Consumption, "import-export" and production data for each of the light types

Name	Annual "Import-Export" (items/yr) [a]	Annual consumption (items/yr) [b]	Annual production (items/yr) [b]~[a˙]
CFL	1,559,311	36,600,000	35,040,690
LFL	745,572	17,500,000	16,754,429
Ultra Violet Lamps	58,062	58,062	0
Metal Halide Lamps	7,730	7,730	0
Mercury Vapor Lamps	7,730	7,730	0
Sodium Vapor Lamps	7,730	7,730	0

Considering mercury content in CFL and LFL of 5 mg/item and 10 mg/item (as suggested by inventory level 2) respectively, mercury emissions for production in the light sector is found to be 343 kg per year. (Table 2.9)

Table 2.9: Summary of mercury input to society from production of lights

Source/category	Input factor (mg/item)	Activity rate (items/yr)	Hg input (kg Hg/y)
Production	--	--	343
CFL	5	35,040,690	175
LFL	10	16,754,429	168

2.4.2.4 Batteries with mercury

Most button cell batteries contain mercury, and these are mostly imported to Bangladesh. It has not been investigated if imported batteries of other shapes contain mercury; this could be a subject for follow-up work in future inventories.

2.4.2.5 Manometer and gauges with mercury

According to information obtained from JMI Syringes and Medical Devices Ltd., one of the leading thermometer importers in Bangladesh, manometers and gauges with mercury are not produced in Bangladesh.

2.4.2.6 Biocides and pesticides with mercury

In Bangladesh, production of biocides and pesticides is dominant. The production companies mainly mix active ingredients, fill and pack the pesticides, and do formulations of some insecticides. Officially, the companies do not declare the use of mercury. They do not take any extra precautions, which indicates that they may not use mercury-containing pesticides. No specific investigation for mercury contents in the biocides and pesticides (chemical analyses) have been performed for this study. The source can be considered for further investigation in future inventories.

2.4.2.7 Production of paints with mercury

Berger Bangladesh Ltd., Asian Paint Bangladesh Ltd., Elite Paint and Chemical Industries Ltd., and RAK Paints Ltd. are the major paint manufacturing companies in Bangladesh; at present, Berger Bangladesh Ltd. holds 60% market share. In this study, primary data was collected through interviews from different officials of different paint manufacturing companies. The information obtained from the interviews indicate that: i) most of the cheaper paint types (almost 90%) may contain mercury where mercury compounds are used as pigments and ii) mercury concentration for preservation or as pigments in paints (when present) ranges between 30 to 60 ppm.

So, total mercury containing paint production is approximately 112.5 million kg/y (i.e. 90% of total paint production which is 125 million kg/y, according to annual reports of the leading paint manufacturing companies). Assuming the average mercury concentration in paint to be 50 ppm (average of the range 30 – 60 ppm) or 50 mg of mercury per litre of paint and paint density of household latex paint to be10 lb/gal or 1.179 kg/L[37], the input factor for paint production can be determined as 0.042 kg Hg/t of paint[38]. Results from the inventory level 2 analysis are shown in Table 2.10.

It is assumed that that all the domestically produced mercury-containing paint is used in Bangladesh. Also, the above estimate is based on information of mercury concentration obtained solely from informal communication with industrial officials of leading paint manufacturing companies. A detailed investigation with laboratory experiments to determine mercury concentrations over a wide range of products should be carried out to obtain a more accurate estimate of mercury inputs to the society from this sector.

Table 2.10: Summary of mercury releases to society from the paint sector

	Input Factor	Unit	Activity rate	Unit	Estimated Hg Input	Unit
Production	0.042	kg Hg/t	112500	Hg used for production, t/y	4,725	kg Hg/y

2.4.2.8 Skin lightening creams and soaps with mercury chemicals

Unilever Bangladesh Ltd., Kohinoor Chemical Company Bangladesh Ltd., Square Toiletries Ltd. and Keya Cosmetics Ltd. are the major cream manufacturing companies in Bangladesh. Interviews with officials in Keya and Kohinoor revealed that: i) total national production of skin lightening creams is around 2.5 million items/month, ii) average weight per item is 50 gm and iii) less than 10% of

[37] http://www.paintcenter.org/rj/sep06d.php

[38] Input factor = $(50*10^{-6})/(1.179*10^{-3})$ = 0.042 kg Hg/t paint

creams available in the market could contain mercury.

However, a survey by Environment and Social Development Organization (ESDO) in 2015 stated that most of the creams of Bangladesh it tested contained mercury. Their results are shown in table 2.11[39]. The average concentration of mercury in these creams have been found to be 3,920 ppm. Assuming that this is the highest concentration of mercury present in mercury-containing creams (which is <10% of the market), the mercury emission (as well as input to the society) from skin lightening creams is calculated as 521 kg Hg/y. The details of the calculation is:

Table 2. 11: Summary of results of mercury concentration in skin creams performed in ESDO study

Sample No.	Name of product	Hg concentration (ppm)
1	Garnier	4,653
2	Fair and Lovely Ayurvedic	4,004
3	Fair and Lovely Max Fairness	4,174
4	Modern	4,152
5	Fair and Handsome	4,133
6	Botanic	3,929
7	Tibbat	3,752
8	PONDS	3,450
9	OLAY	3,603
10	Sumon's Aroma	3,361

<u>Calculations for mercury from use and disposal:</u>

Total production of cream = $25*10^5$ pc/month = $30*10^6$ pc/yr = $30*10^6*50*10^{-6}$ t/y = 1,500 t/y (assuming 1 pc of cream weighs 50 gm)
Total national production of Hg containing cream = 9%* 1500 t/y = 135 t/y (assuming <10% or 9% cream contains mercury)

Now, average Hg concentration in cream = 3,920 ppm (ESDO Study)
Cream density has been assumed for calculation due to the absence of more specific

[39] ESDO. (2015). Study Report on Mercury added products: Country situation analysis in Bangladesh. from Environment and Social Development Organization

data.

Input factor for Hg = (3,920*10^{-6}) kg Hg/ (1.0158*10^{-3}) t = 3.859 kg Hg/t of cream
(Cream density = 1.0158 gm/cc = 1.0158 kg/L [40])

Therefore, Hg consumption for use and disposal
=Input factor*national production of mercury containing cream
=(3.859 kg Hg/t of cream)*(135 t Cream/y)
= 521 kg Hg/y

2.5 Data and inventory on waste handling and recycling

2.5.1 Production of recycled metal mercury and ferrous metals

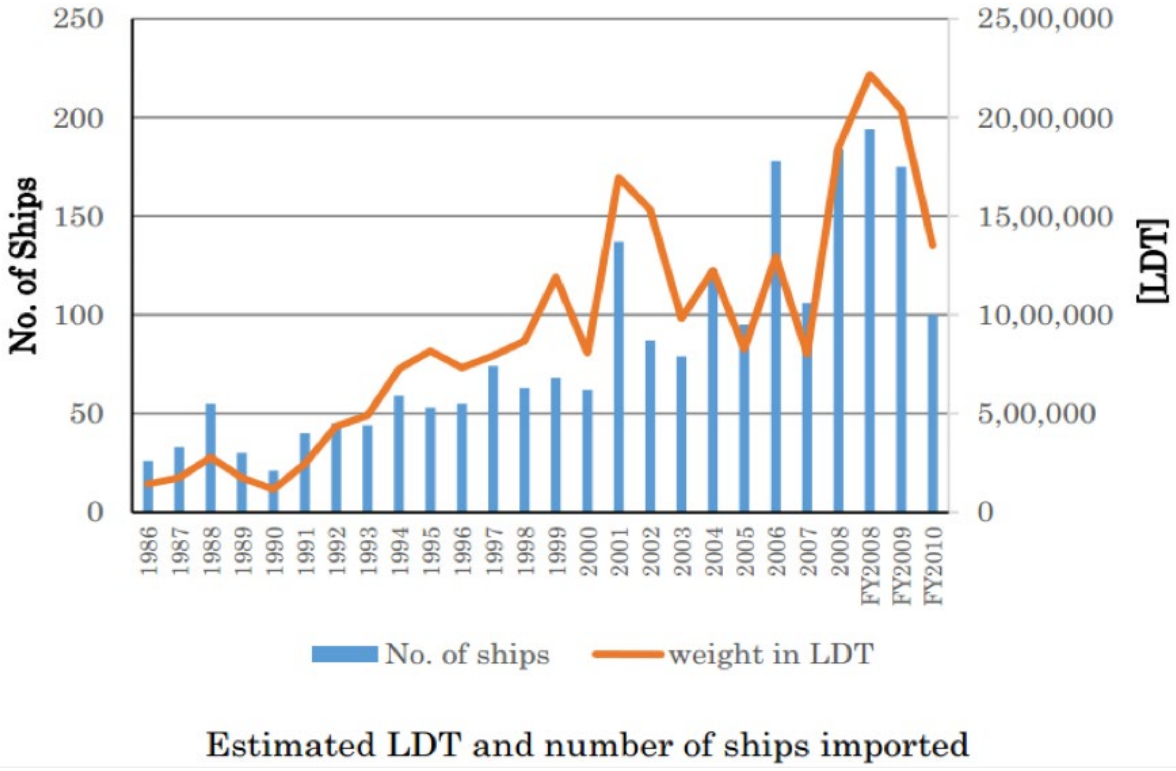
The Toolkit has default calculation factors for mercury inputs and emissions/releases for production of recycled ferrous metal from spent vehicles (e.g. cars, trucks, buses) but vehicle recycling is not practised. In Bangladesh, much of the recycled ferrous metal comes from the dismantling of old ships in Chittagong. The shipbreaking industries supply recovered ferrous metals to local steel mills.

Figure 2.10 presents the number of ships imported for shipbreaking in Bangladesh. Mercury concentrations in these old ships are not known, but possible mercury sources can be engine control thermometers (can contain several 100 grams of mercury per piece), light sources and compasses[41]. From Shitakunda Shipyard, Chittagong, workers collect compasses from the ships which contains almost 2 kg mercury per compass[42]. The shipyard workers sell it to the wholesalers and eventually to the retailers. In 2010, 100 ships were imported for recycling purposes[43].

The number of such compasses per ship on average is not known. Most likely, there are several compasses onboard each ship, but only some compasses would contain mercury. It was assumed that on average i) each ship had 1 such old-style compass onboard (perhaps for backup in case electronic instruments fail), ii) 100 ships are imported per year for recycling purpose and iii) all such mercury would be collected and recycled: the annual amount of mercury recycled would be around 200 kg per year. This quantity is used in the estimate of mercury emissions and releases from ferrous metal recycling. There may be other sources of mercury for recycling, but this has not been investigated in this study. More detailed analysis is needed for this sector.

[40] Paar, A. Application Report: Density Measurement of Viscous Pastes and Creams Using DMA 500. Retrieved October, 2018, from http://www.mep.net.au/foodlab/FL_43/FL43_DMA500_pastes_creams.pdf
[41] Information obtained from proprietors of the dental equipment stores in Shahbagh, Dhaka (in the condition of anonymity)
[42] Information obtained from proprietors of the dental equipment stores in Shahbagh, Dhaka (in the condition of anonymity)
[43] Mohammad Sujauddin, R. K., Takahiro Komatsu, Mohammad Mosharraf Hossain, Chiharu Tokoro, & Shinsuke Murakami. (2016). Ship Breaking and the Steel Industry in Bangladesh: A Material Flow Perspective. *Journal of Industrial Ecology*, 21(1). doi: 10.1111/jiec.12423

Figure 2.10: Number of ships imported [44]



2.5.2 Waste incineration

Inventory summary results show that, among all waste handling activities in Bangladesh, the open burning of waste results in the greatest emissions of mercury to air (14,231 kg per year) and informal dumping of general waste causes significant releases to land (9,590 kg/y) (Tables 2.1 and 2.3). The process of data collection is explained in the following subsections. It is recognized that depositing mercury waste or mercury containing waste in waste dumps or general engineered landfills, is not a sustainable way of treating such hazardous waste. The mercury waste and mercury containing waste should be segregated and treated in an environmentally sound manner.

2.5.2.1 Incineration of municipal/general waste

Incineration of municipal waste is not practised in Bangladesh. After collection, municipal waste is partly transported to the landfills, where open burning is practised[45] and the remainder goes to informal dumping sites. Seventy two per cent of the collected waste is landfilled and twenty eight per cent of collected waste is disposed of at open dumping site[46].

2.5.2.2 Incineration of hazardous waste

In this study, e-waste is considered as hazardous waste and the only information on hazardous waste available was the study by the Center for environmental and resource management (CERM). According to the study, in

[44] Sujauddin, M., Koide, R., Komatsu, T., Hossain, M. M., Tokoro, C., & Murakami, S. (2017). Ship breaking and the steel industry in Bangladesh: a material flow perspective. *Journal of Industrial Ecology*, 21(1), 191-203

[45] Islam, K. M. N. (2016). Municipal Solid Waste to Energy Generation in Bangladesh: Possible Scenarios to Generate Renewable Electricity in Dhaka and Chittagong City. *Journal of Renewable Energy, 2016,* 1-16. doi: 10.1155/2016/1712370

[46] R. B. Chowdhury, M. Sujauddin, S. Murakami, P. Chakraborty, and M. S. Alam, "Current status of municipal solid waste management system in Chittagong, Bangladesh," International Journal of Environment and Waste Management, vol. 12, no. 2, pp. 167–188, 2013

Bangladesh, the approximate total hazardous waste (e-waste) generation is 1.12 million metric tons per year of which 30-40% is generally recycled and only 10-15% is incinerated (assumed 12.5%)[47]. No other information on hazardous waste incineration/ burning is available.

Gold jewellery producers also collect e-waste (e.g. old mobile phones or tablets) in negligible amounts. They separate gold wires from electrical elements and integrate them. Then they mix it with lead and soda and burn the mixture to separate the gold out. Besides, from the research survey, it is observed that in the Tantibazar area where gold jewellery is sold, some sweepers collect waste from the gold shops, and take it to their community in Chargram, Savar. From communications with the gold makers, some dust collectors may use mercury to separate the gold out of dust, though the amount of gold obtained through this process is negligible. Approximate 45 gm mercury is needed to separate 1 gm of gold and this mercury is used again to remove more gold from dust through a recycling process. Since the process is very tedious with little gold obtained, this practice is rarely followed. Apart from this, no more specific data can be obtained in this sector. Further time and detailed survey at Chargram, Savar would be needed to get a good insight on this.

2.5.2.3 Incineration/burning of medical waste

In Dhaka and other major cities, medical waste is incinerated either in some major hospitals or at specialized facilities for medical waste management operated by private operators and supervised by the city corporations. The medical waste collection system overall is not adequate and poorly managed. For example, medical waste management by PRISM Bangladesh Foundation (a private operator specializing in medical waste management) covers almost 62.5% (875 health complexes out of 1,401) of health complexes in Dhaka city. The rest of the medical waste is either dumped with household solid waste or even pilfered from the facility, potentially causing a multitude of health risk problems. Regarding incineration of medical waste, the facilities are barely adequate. For example, in Dhaka, only the Dhaka Medical College Hospitals installed two manually operated incinerators supported by WHO, but these incinerators have been out of service for the last five years. The government of Japan donated an incinerator which is installed at the Matuail plant and operated by PRISM; however, it is not large enough to treat the huge amounts of Healthcare waste[48,49,50]. Outside of Dhaka, some government medical hospitals (Rajshahi and Chittagong Medical College Hospital) have small, locally-made incinerators but waste is not incinerated to appropriate standards or following proper regulations[51]. Furthermore, no data are available regarding the quantities incinerated.

PRISM Bangladesh maintains a record of waste collection and incineration in their facility in Matuail. According to them, they collect almost 8 tons of medical waste per day and incinerate almost 65%. Therefore, total waste incinerated by PRISM in Dhaka city is estimated as 0.65*8*365 = 1,898 t/y.

[47] CERM. (2018). Assessment of generation of E Waste, its impacts on environment and resource recovery potential in Bangladesh *Unpublished Manuscript:* Center for Environmental and Resource Management (CERM)
[48] Syed Emdadul, M. M., & Mosiur Rahman. (2012). Medical Waste Management (MWM) in Dhaka, Bangladesh. *Home Health Care Management & Practice*, 24(3), 140-145. doi: 10.1177/1084822311425235
[49] Nuralam, H. M., Xiao-lan, Z., Dubey, B. K., & Wen-Chuan, D. (2017). Healthcare Waste Management Practices in Bangladesh: A Case Study in Dhaka City, Bangladesh. *International Journal of Environmental, Chemical, Ecological, Geological and Geophysical Engineering,* 11(6), 524-529
[50] M Manzurul Hassan, S. A. A., K Anisur Rahman, & Tarit Kanti Biswas. (2008). Pattern of medical waste management: existing scenario in Dhaka City, Bangladesh. *BMC Public Health*, 8(1), 36. doi: 10.1186/1471-2458-8-36
[51] M.Z. Alam, M. S. I., & M.R. Islam. (2013). Medical Waste Management: A Case Study on Rajshahi City Corporation in Bangladesh. *Journal of Environmental Science and Natural Resources,* 6(1), 173-178. doi: 10.3329/jesnr.v6i1.22062

Since no data is available for incineration in DMCH or other district hospitals, it is assumed for this assessment that the total waste incineration in Bangladesh is almost double PRISM's coverage. Hence, medical waste incineration in Bangladesh can be estimated as 1,898*2 = 3,796 t/y and using the toolkit's level 1 methodology, resulting in 91 kg of mercury emissions per year. As indicated, this is most likely underestimating the actual emissions. This may be investigated further in future inventories.

2.5.2.4 Open fire municipal waste burning and dumping

Waste generation data are obtained from a black carbon study of 2010[52]. Using a municipal waste generation rate of 165 kg waste/y per capita and IPCC methodology for estimating openly burned waste (in dumps and residentially)[53],[54],the amount of municipal waste burned and dumped annually is estimated at 14,231,486 t/y and 11,987,014 t/y, respectively. The calculation is shown below:

Informal dumping= total waste generation – open fire waste burning
= waste generation rate*total population – open fire waste burning
= (0.165*158.9*10^6 - 14,231,486) waste dumped, t/y
= 11,987,014 waste dumped, t/y

Using the low end of level 2 default factor range (i.e. 1 g Hg/t of waste incinerated or dumped), estimated annual mercury emission from the sector of open fire waste burning and dumping are found to be 14,231 kg and 11,987 kg, respectively. The low end of the IL2 default factor range is used due to the nature of solid waste generation and burning in developing countries, as explained by a UNITAR submission to the second Conference of the Parties to the Minamata Convention.[55]

2.5.2.5 Waste deposition/landfilling and waste water treatment

There are dedicated land spaces for the formal dumping and landfilling of general and household wastes. Matuail landfill is considered as a sanitary landfill, but now open dumping is practised here. In addition, informal dumping grounds are also to be found. The amount of landfilled waste is found to be 1,168,000 t/y[45]. Using the low end of the level 2 default factor range (i.e. 1 g Hg/t of waste deposited), estimated annual mercury emissions from the sector of controlled landfills is found to be 1,168 kg.

An estimated 43,800,000 m^3 of waste water is treated in Dhaka each year[56]. Using the default factor of inventory level 1, annual mercury emissions from wastewater treatment is obtained as 230 kg/y.

2.6 Data and inventory on general consumption of mercury

2.6.1 Dental amalgam fillings

In Bangladesh, amalgam is the preferred restorative material; as such, the dental sector is a potentially significant source of mercury releases. Mercury emissions may occur from amalgam preparation for fillings, while mercury releases occur from excess materials during preparation and from when older fillings are drilled or extracted. Generally, dentists use a mixture of silver powder and mercury metal for the preparation of amalgam fillings. This silver powder contains silver and a lesser portion of copper and zinc.

[52] *National action plan for short-lived climate pollutants in Bangladesh.* (2014). Ministry of Environment, Forests and Climate change (MoEF), Government of Bangladesh
[53] Christine Wiedinmyer, R. J. Y., & Brian K. Gullett. (2014). Global emissions of trace gases, particulate matter, and hazardous air pollutants from open burning of domestic waste. *Environmental science & technology*, 48(16), 9523-9530
[54] G.H. Sabin Guendehou, M. K., Leif Hockstad, Riitta Pipatti, & Masato Yamada. (2006). Incineration and Open Burning of Waste *IPCC Guidelines for National Greenhouse Gas Inventories* (Vol. 5). IPCC = Inter-governmental Panel for Climate Change
[55] http://www.mercuryconvention.org/Portals/11/documents/meetings/COP2/Submissions/Open-burning-of-waste-UNITAR-submission-30Jun2018-corr.pdf
[56] Haq, K. A. (2006). Water Management in Dhaka. *International Journal of Water Resources Development*, 22(2), 291-311. doi: 10.1080/07900620600677810

The amalgam is prepared by mixing the silver powder with liquid mercury metal which is sold by wholesalers[57].

Amalgam materials are available in the local market in two forms:

(i) Firstly, the traditional form where mercury and alloy (silver powder) are bought separately. During the preparation of fillings, 30-40 mg of silver powder and approximately two drops of mercury are mixed manually to make a paste-like substance. Each drop of mercury weighs nearly 50-60 mg[58]. After making the paste, excess liquid mercury is squeezed out from the mixture and is disposed of. Nearly half a drop of mercury is removed from the mixture by this process. So, about 1.5 drop of mercury is needed to prepare the fillings and half a drop of mercury is disposed of after making the paste. Therefore, this process results in higher mercury wastage.

One of the sources of this liquid mercury could be the Shitakunda Shipyard, Chittagong, where workers collect mercury-containing compasses from the ships. Each compass can contain almost 2 kg of mercury. The shipyard workers sell the mercury to wholesalers who, in turn, sell it to the retailers. In Dhaka, both liquid mercury and silver powder are available at shops near Mitford Hospital and Aziz Super Market, Shahbagh.

(ii) Amalgam is also available in encapsulated form under the brand name "Ultracaps S", in a small can where the mercury and alloy are stored in certain proportions, separated by a membrane. At the time of mixing, doctors press a piston at the bottom of the can, as a result the membrane tears and the mercury-alloy mix proportionally with one another. This process of preparing amalgam mixture reduces direct exposure to mercury in the dental clinics and may also reduce releases to waste and waste water.

Alternatives to mercury amalgam are also available in the market, namely

1) Glasionomer Fillings
2) Light Cure Nano Composite

From the inventory level 2 analysis, it is estimated that 1,173 kg mercury is used currently per year for preparation of fillings at dental clinics[59], whereas 935 kg mercury per year was estimated to be used 5-15 years ago[60] that now contributes to releases from fillings in the mouth, and 513 kg Hg per year was estimated to be used 10-20 years ago[61] that now contributes to releases from drilling and extraction of fillings. *(Results derived using data of population and dentist per inhabitant)*

The calculation of mercury inputs and collection of basic data used for the analysis are explained below:

Assuming 1.2 gm mercury is needed per filling (high end of Danish observations referred to in the Toolkit Reference Report), including losses in the clinic, and assuming that one out of 10 inhabitants (10%) gets one amalgam filling per year, mercury use per year per inhabitant becomes 0.12 gm. Hence, the input factor for filling preparation is 0.12 g Hg/y*inhabitant. According to the Bangladesh Bureau of Statistics, 2017, the number of registered dental surgeons in 2016 is 8,130 and the total population is 158.9 million. Therefore, dentists per 1,000 inhabitants is 0.0511. Using these data, 1,173 kg mercury is found to be used currently per year for preparation of fillings at dental clinics. Statistics from 2012 and 2005 are used to derive mercury use in the dental sector 5-10

[57] From interviews with wholesalers of Aziz Super Market, Shahbagh, Dhaka
[58] McPherson, A. J. (1976). Methods of Biochemical Analysis. In D. Glick (Ed.), (Vol. 23, pp. 527-529): John Wiley & Sons, Inc., New York
[59] Bangladesh Bureau of Statistics, 2017. Statistics and Informatics Division, Ministry of Planning, Government of Bangladesh.
[60] Bangladesh Bureau of Statistics, 2012. Statistics and Informatics Division, Ministry of Planning, Government of Bangladesh

years ago and 10-20 years ago[61], respectively. In 2012 and 2005, the number of registered dental surgeons were 5,694 and 2,344, respectively[60,61]. Survey results state that 10-15 patients visit dentists per day of which approximately 5 patients need fillings. Therefore, total mercury use 5-10 years and 10-20 years ago will be mercury use per filling multiplied by the number of patients requiring fillings per year, multiplied by the number of registered dentists in 2012 and 2005, respectively. This results in mercury use of 935 kg/y and 513 kg/y in 2012 and 2005, respectively.

Table 2. 12: Summary of mercury input to society from dental sector

Preparations of fillings at dentist clinics	Dentist/1000 inhabitant	Input factor (g Hg/ (y*inhabitant))	Number of inhabitants	Hg input (kg Hg/y)
	0.051	0.12	159,000,000	1,173
Use - from fillings in the mouth (releases from mercury supply for fillings 5-15 years ago)	No of patients needed filling	No of registered dental surgeon in 2012	Net weight of Hg amalgam used per filling (mg)	Hg emission (kg Hg/y)
	5	5,694	90	935
Disposal (releases from mercury supply for fillings 10-20 years ago)	No of patients needed filling	No of registered dental surgeon in 2005	Net weight of Hg amalgam for filling preparation (mg)	Hg emission (kg Hg/y)
	5	2,344	120	513

Besides, many unregistered and untrained dentists practice regularly, especially in remote areas of the country. No documentation or survey is available regarding the numbers of such dentists/ doctors in the country. Therefore, this estimate from the dental sector might be considered as conservative. Further research may need to be performed to obtain more accurate results.

2.6.2 Thermometers

Mercury thermometers are not manufactured in Bangladesh. According to information obtained through conversations with JMI Syringes and Medical Devices Ltd., one of the leading thermometer importers in Bangladesh, 25,000 laboratory thermometers are imported each month. Of these, 80% are mercury thermometers, making total imports of 240,000 laboratory mercury thermometers each year. In addition, 150,000 - 200,000 medical thermometers are imported per month, giving an estimated total of 2,400,000 medical thermometers imported per year which are all mercury thermometers. These medical thermometers are distributed to government and private hospitals and clinics. About 100,000 thermometers are supplied to government-owned hospitals and the rest of them to private clinics.

The total number of mercury thermometers (lab and medical) imported per year is thus approximately 2,640,000. Using default factors of the inventory level 1, about 5,280 kg of mercury is considered to be emitted/released per year for use and disposal of thermometers.

[61]Bangladesh Bureau of Statistics, 2005. Statistics and Informatics Division, Ministry of Planning, Government of Bangladesh

2.6.3 Electrical switches and relays with mercury

The research identified negligible industrial production of electrical switches and relays within Bangladesh and these electrical elements are mostly imported[62]. No specific investigation is performed in this study regarding production and disposal of electrical switches. The source can be considered for further investigation in future inventories.

For inventory Level 1, consumption of electrical switches and relays with mercury is calculated automatically. However, this results in very high mercury input estimates due to the high population. Therefore, the lowest default factor of inventory level 2 (0.02 g Hg/(y*inhabitant)) has been used to estimate the mercury inputs from use and disposal of switches. This calculation is based on the data on population and electrification rate as suggested by the methodology of this inventory. However, as suggested earlier, further investigation is needed for this sector in future inventories.

2.6.4 Light sources with mercury

In Bangladesh there has been a marked rise in the demand for compact fluorescent lamps (CFL) throughout the country, especially under the Efficient Lighting Initiative of Bangladesh (ELIB) and Solar Home System (SHS) programmes. The penetration of CFLs has increased rapidly with estimated annual sales of around 15-20 million items in 2013-2014. A survey conducted by the Environment and Social Development Organization (ESDO) suggests that the lifetime of a CFL light bulb is not more than 1 year to 18 months and an average consumer typically uses at least 3 CFL light bulbs per year (ESDO, 2015).

Table 2.8 in section 2.4.2.3 shows annual average production, import, export and consumption data for different light types. The collection process of the data has been explained in section 2.4.2.3. Using these data, mercury emissions from the use and disposal of mercury-containing lamps is estimated to be 359 kg per year. Table 2.13 shows the results.

Table 2.13: Summary of inventory results for use and disposal of the lighting sector

Source/category: Light sources with mercury	Input Factory	Unit	Activity Rate	Unit	Hg Input (kg Hg/y)
Fluorescent tubes (double end)	10	mg Hg/item	17,500,000	Items/y	175
Compact fluorescent lamp (CFL single end)	5	mg Hg/item	36,600,000	Items/y	183
High pressure mercury vapour	30	mg Hg/item	7,730	Items/y	0
High-pressure sodium lamps	20	mg Hg/item	7,730	Items/y	0
UV light for tanning	15	mg Hg/item	58,062	Items/y	1
Metal halide lamps	25	mg Hg/item	7,730	Items/y	0
Total Use + Disposal:					**359**

[62] Uddin, M.K., 2010. Bangladesh's Light Engineering Industry, baseline, profile, performance and plans for upgrading. SME Foundation, volume 7.

2.6.5 Batteries with mercury

Some button cell batteries contain mercury. Button cell batteries are not manufactured at an industrial scale in Bangladesh, but are mostly imported from China. Patuatuli and Chalk Bazar in Dhaka and Riazuddin Bazar in Chittagong are the major trading locations for button cell batteries in Bangladesh. In this study, approximately 50 battery shops were surveyed at Patuatuli Bazar. Information obtained from the study depicts that, Patuatuli, Riazuddin and Chalk Bazar holds respectively around 58%, 29% and 15% of the total market of button cell batteries. Of these, 95% are counterfeit and 5% of them are original. Batteries of Sony, Panasonic, Maxell, and Xnhung (original or copies) are sold in the market. Major button cell battery types are: alkaline, lithium and silver oxide batteries. 40% of the batteries contain "HgO 0%" labels, whereas 60% of the batteries are cheaper with no "HgO 0%" label, which are expected to have Hg contents in small amounts in order to prevent the formation of internal gases that can cause leakage.

According to the survey, 60% are lithium type, 20% are silver oxide type and the remaining 20% are alkaline button cells. The whole market is controlled by 3-6 importers, bringing in batteries through ships illegally, in an amount of 150-200 thousand pieces per invoice, at a rate of 5-6 invoices per year. They sell these batteries to wholesalers (approximate 10-12 persons) who buy the batteries at a rate of 25,000 piece per month. Then they sell these to retailers and eventually to customers. These button cell batteries are mainly used in products such as watches and toys. Using these data in combination with battery weights shown in table 2.16 below, an amount of 2.898 tons of silver oxide batteries, 3.024 tons of alkaline cell batteries and 10.962 tons of lithium batteries are found to be imported per year. No mercury oxide button cell batteries are found in the wholesale market. However, since these are imported illegally and there may be presence of copies of original batteries, these batteries may contain mercury in trace amounts. So, though lithium batteries do not contain mercury, they should not be kept out of analysis since they hold 60% of the market. Therefore, to avoid lower estimates, lithium button cell batteries have been considered as part of silver oxide batteries (since it contains comparatively low mercury content) and it should be noted that, in the inventory level 2 analysis, the amounts of both lithium and silver oxide batteries have been inserted in place of only silver oxide batteries.

Regarding plain cylindrical alkaline, permanganate batteries, approximately 90-120 shops are in Hazi Elias Market, Patuatuli Bazar which buy approximately 3,500 dry permanganate batteries per year. There are 3-4 other markets in Patuatuli, namely Hazi Rawshan Ara Market, Ali Ahmed Market, and R.S. Bhaban. Besides, there are 2-3 similar trading locations like Patuatuli Bazar, including Chalk Bazar and Riazuddin Market. Assuming 100 shops in each market, this hypothesis leads to total import of 116.55 tons of dry cylindrical batteries per year in Bangladesh. Table 2.14 shows the method of determination of total annual imports of button cell batteries in Bangladesh and table 2.15 shows numbers of types of batteries imported in Bangladesh.

Table 2.14: Determination of total annual import of button cell batteries in Bangladesh

Button cell batteries imported in Patuatuli Bazar	No of wholesalers	Annually imported in Patuatuli Bazar	Annually imported in Riazuddin Bazar	Annually imported in Chalk Bazar	Total annual import of button cell batteries in Bangladesh
25,000 items/month	10-12 (say 12)	3,600,000	50% of Patuatuli Bazar = 1,800,000	25% of Patuatuli Bazar = 900,000	6,300,000

Source: Field Survey conducted in this study

Table 2.15: Types of batteries imported in Bangladesh

Types of batteries	Silver Oxide batteries	Alkaline Cell batteries	Lithium batteries	Dry Permanganate batteries
Market share among button cells	20%	20%	60%	100 shops*3 markets*3 trading locations* 3,500 dry batteries imported per year = 3,150,000 items/year
No of batteries	1,260,000	1,260,000	3,780,000	

Source: Field Survey conducted in this study

Table 2.16: Summary of mercury releases from button cell battery sector

Battery Type	Items Imported/year	Approximate Weight		Total Weight (ton/year)	Total weight inserted in IL 2 Toolkit
		Unit (gm)	Source		
Silver Oxide	1,260,000	2.3	wikipedia.org/wiki/Button_cell	2.898	13.86
Lithium	3,780,000	2.9	wikipedia.org/wiki/-List_of_battery_sizes	10.962	
Alkaline Battery Cell	1,260,000	2.4	wikipedia.org/wiki/Button_cell	3.024	3.024
Dry Cell Batteries	3,150,000	37	wikipedia.org/wiki/-List_of_battery_sizes	116.55	116.55

Analysis using inventory level 2 of the toolkit shows that 100 kg of mercury per year is emitted/released from this sector due to use and disposal of button cell batteries. Table 2.17 depicts these releases.

Table 2.17: Summary of mercury releases from button cell battery sector

Source category /phase	Input factor (kg Hg/t batteries)	activity rate (Batteries, t/y)	Hg input (kg Hg/y)
Mercury oxide (all sizes); also called mercury-zinc cells	320	0	0
Zinc-air button cells	12	0	0
Alkaline button cells	5	3.024	15.12
Silver oxide button cells (including lithium button cells)	4	13.86	55.44
Alkaline, other than button cell shapes	0.25	116.55	29.1375
Total use + disposal			**100**

2.6.6 Polyurethane (PU, PUR) produced with mercury catalyst

Using level 1, the consumption of polyurethane produced with mercury catalyst is calculated automatically. This calculation is based on the data on population and electrification rate as suggested by the methodology of this inventory (population data: Bangladesh Bureau of Statistics, 2017; Electrification data: IEA). However, this results in very high mercury emission due to high population of our country. Therefore, the low end of the default factors of inventory level 2 (0.01 g Hg/(y*inhabitant)) is used to establish mercury emissions due to use and disposal of polyurethane. However, no specific investigation has been conducted in this study. Further investigation may be needed for this sector.

2.6.7 Paints with mercury preservatives

As mentioned in section 2.4.2.7, 112.5 million kg mercury containing paint is producted per year. Import/export data of UN Comtrade for paints has been collected to determine the annual consumption, shown in table 2.18.

Table 2.18: Summary of mercury releases from button cell battery sector

	Production per year (a) (ton)	HS Code	Code Name	Import data collected from UNComtrade for2013 (b) Net weight (ton)	Export data collected from UNComtrade for 2013 (c) Net weight (ton)	Annual consumption in 2013 (a)+(b)-(c) (ton)
		3209	paint and varnishes (including enamels and lacquers); dissolved in an aqueous medium	447.194	28.434	

	Production per year (a) (ton)	HS Code	Code Name	Import data collected from UNComtrade for2013 (b) Net weight (ton)	Export data collected from UNComtrade for 2013 (c) Net weight (ton)	Annual consumption in 2013 (a)+(b)-(c) (ton)
		3210	paint and varnishes (including enamels, lacquers and distempers)	135.118	0.191	
Total	112,500			582.312	28.625	113,053.687

The associated mercury emissions and releases were estimated using the level 2 inventory, using the calculated input factor of 0.042 kg Hg per ton of paint and annual consumption of 113,054 ton of paint. 4,748 kgs of mercury has been found to be emitted/released per year because of use and disposal of paint.

2.6.8 Skin lightening creams and soaps with mercury chemicals

This is explained in detail in Section 2.4.2.8.

2.6.9 Medical blood pressure gauges

According to JMI Syringes and Medical Devices Ltd, per month about 10,000 sphygmomanometers (i.e. per year about 120,000 sphygmomanometers) are imported, of which 70% is analog type (84,000 piece/year). Of these 84,000 analog sphygmomanometers, only 10,000 pieces are mercury sphygmomanometers and the rest of these are aneroid sphygmomanometers. So, total number of medical medical blood pressure gauges is 10,000 piece/year, resulting in a total input of 800 kgs of mercury per year.

2.6.10 Other manometers and gauges with mercury

Using level1, consumption of other manometer and gauges is calculated automatically (326 Kg Hg/year). This calculation is based on the data on population and electrification rate as suggested by the methodology of this inventory (population data: *Bangladesh Bureau of Statistics, 2017; Electrification data: IEA).*

2.6.11 Laboratory chemicals

From level 1, the consumption of laboratory chemicals is calculated automatically (651 Kg Hg/year). This calculation is based on the data on population and electrification rate as suggested by the methodology of this inventory (population data: *Bangladesh Bureau of Statistics, 2017; Electrification data: IEA).*

2.6.12 Other laboratory and medical equipment with mercury

At Level 1, consumption of other laboratory and medical equipment is calculated automatically (2606 Kg Hg/year). This calculation is based on the data on population and electrification rate as suggested by the methodology of this inventory (*population data: Bangladesh Bureau of Statistics, 2017; Electrification data: IEA*).

2.7 Data and inventory on crematoria and cemeteries

In 2017, the population of Bangladesh was about 158.9 million, of which 89% are Muslim or Christian, while Hindus comprise

10% of the population. Religious notions dictate that Hindu corpses should be cremated while Muslims and Christians are to be buried underground. In 2016, the death rate was 5.2/1000 capita[59]. Therefore, total number of corpses cremated is estimated at $158.9*10^6*(5.2/1000)*0.1$ per year i.e. 82,628 per year while total number of corpses buried will be $158.9*10^6*(5.2/1000)*0.89$ per year i.e. 743,652 per year. This translates into mercury emissions of 207 Kg Hg/year from crematoria and 1859 Kg Hg/year from cemeteries.

2.8 Implications of inventory findings with respect to the different provisions of the Minamata Convention

The findings from the inventory has implications to the following provisions of the Minamata Convention:

With regard to Article 4 (Mercury-added products), it can be seen that use and disposal of mercury-added products are responsible for 20% emissions in Bangladesh. This means that the country needs specific plans to address use and disposal of CFL bulbs, batteries and medical equipment. Restrictions should be imposed on the use of skin-whitening products and dental amalgam. Dental amalgam use and disposal constitutes 2% of the emissions.

With regards to Article 8 (Emissions), coal burning (power generation or other uses) is one of the major emissions to air and particularly important because, in the coming years, a large number of coal-fired thermal power plants will be in operation. Similarly, biomass-fired power generation is responsible for large emissions to the air. This indicates that industries need to adopt Best Available Technology and Best Engineering Practices to control emissions. Also, solid waste open burning contributes 44% of mercury emissions making it the largest contributor to the inventory. A plan to address solid waste management is necessary to arrest emissions from this sector.

With regard to Article 9 (mercury releases to land and water), poor solid waste management contributes the largest of mercury releases to land and water. This is because many of the mercury-added products are dumped into solid waste without segregation or recycling. Any plan to address solid and hazardous waste management would control the emission of mercury to land and water.

With regard to Article 19: (Research, Development and Monitoring), there is significant scope for research regarding determining the appropriate methods for mercury detection in mercury-added products, prevalence and use of mercury-added products in society. Mercury quantities in most products (e.g. skin creams and paints) are largely unknown and the inventory could be further refined if comprehensive studies can be done in this regard.

CHAPTER 3:
POLICY, REGULATORY AND INSTITUTIONAL FRAMEWORK ASSESSMENT

As ratification (or acceptance, approval or accession) by a country of the Minamata Convention on Mercury legally binds the country to the Convention's obligations, the ratification process should involve carrying out a national situation analysis, identifying existing relevant domestic legislation and identifying legal or administrative actions that may be needed. Bangladesh has a wide range of laws and regulations related to environmental protection, natural resources conservation, which will be relevant under this context.

Also, in order to ensure effective implementation of and compliance with the Minamata Convention through coordinated actions from institutions and stakeholders in the country, it is important to identify the relevant Government ministries, agencies and institutions as well as non-government institutions, private sector stakeholders and their respective roles and responsibilities.

This chapter provides a summary of existing policies and the regulatory framework, both in place and under development. It describes relevant institutions likely to be involved in mercury management in Bangladesh and gives a brief account of the existing gaps that would need to be addressed to ensure compliance with the Convention. A detailed mapping of the individual provisions of the Minamata Convention applied to the policy and regulatory framework of Bangladesh is provided in Annex A. A mapping of the institutional framework with the convention provisions is presented in Annex B. These annexes identify gaps in the current regulatory and institutional framework that need to be addressed to ensure the sound management of chemicals including mercury and, in particular, to meet the requirements of the Minamata Convention.

3.1 Legal instruments for managing and regulating hazardous chemicals (including mercury)

Bangladesh Environmental Conservation Act (ECA), 1995

This umbrella Act includes laws for conservation of the environment, improvement of environmental standards, and control and mitigation of environmental pollution. It is currently the main legislative framework document relating to environmental protection in Bangladesh. The main provisions of the Act are: (a) Declaration of ecologically critical areas, and restrictions on operations and processes which can be carried out or cannot be initiated in the ecologically critical area; (b) Regulation in respect of vehicles emitting smoke that is harmful for the environment, (c) Environmental Clearance, (d) Regulation of industries and other development activities with regards to discharge permits, (e) Promulgation of standards for quality of air, water, noises and soils for different areas for different purposes, (f) Promulgation of standard limits for discharging and emitting waste; and (g) Formulation and declaration of environmental guidelines. The first sets of rules to implement the provisions of the Act were promulgated in 1997 (see below: "Environmental Conservation Rules 1997").

The Department of Environment (DoE) implements the Act. A Director General (DG) heads DoE whose powers and functions are: (a) Identification of different types and causes of environmental degradation and pollution; (b) Instigating investigation and research regarding environmental conservation, development and pollution; (c) Power to close down the activities considered harmful to human life

or the environment; (d) Power to declare an area affected by pollution as an Ecologically Critical Area.

Under the Act, operators of industries/projects must inform the Director General of any pollution incident. In the event of accidental pollution, the DG may take control of an operation and the respective operator is obliged to help. The DG oversees the issuance of environmental clearance of facilities using hazardous raw materials, can fine/penalize emissions exceeding standards or causing harm to the ecosystem, can take steps to identify contaminated sites for the protection of public health, can conduct research, collect and publish/disseminate information for awareness and education. The operator is responsible for the costs incurred and possible payments for compensation. As such, the DG may have an important role in mercury management in Bangladesh. According to the Act, the DG can give advice or issue directions regarding the environmentally sound use, storage, transportation, export or import of hazardous substances (including mercury).

Environment Conservation Rules (ECR) 1997

The ECR are the first set of rules, promulgated under the Environment Conservation Act 1995. Among other things, these rules set (i) the National Environmental Quality Standards for ambient air, various types of water, industrial effluent, and emissions, among others, (ii) requirements for and procedures to obtain Environmental Clearance, and (iii) requirements for Environmental assessments according to categories of industrial and other development interventions. The rules provide the Director General a discretionary authority to grant '*Environmental Clearance*' to an applicant. Any proponent planning to set up or operate an industrial project is required to obtain an "*Environmental Clearance Certificate*" from the Department of Environment (DoE), under the Environment Conservation Act 1995.

The clearance process is important for all industries and processes using mercury as a raw material since their quantities need to be disclosed as a requirement for obtaining environmental clearance. In case of existing industries, the Environmental Management Plan (EMP) should include feasible mitigation measures to control mercury emissions to air, and releases to land and water. The ECR 1997 also sets standards for emissions of mercury for industrial projects. Compliance with these standards is critical for the renewal of an environmental clearance certificate.

Hazardous Waste and Ship-breaking Waste Management Rules, 2011

Issued under the ECA 1995, this rule contains detailed provisions relating to the management of hazardous wastes, safety provisions in handling and management of hazardous waste. Mercury and mercury compounds have been specifically categorized as hazardous waste in the rules. The rules also envisage the establishment of a national committee on hazardous waste management, which is responsible for determining the standard of the disposal of hazardous wastes and formulation of policies on safe management of hazardous waste.

The rules direct industries to maintain hazardous material safety datasheets and maintain records of imports of hazardous materials. In case of importing hazardous materials, before opening the letter of credit and before shipment, clearance from the Department of Environment has to be obtained and it also states several conditions and formalities for

obtaining clearance from the DoE. It states that hazardous waste generating industries (a) cannot dispose or sell their waste to anyone who does not have clearance, (b) cannot store waste more than 90 days and (c) must provide an annual report to the Director of the waste management cell of DoE.

Hazardous waste buyers are not permitted to store waste more than 90 days after the day of purchase. All hazardous waste generators, recyclers, re-refiners must use environmentally sound technology and processes, and submit annual reports to DoE. All these provisions are relevant for facilities using mercury as a raw material or emitting mercury as a waste product.

Bangladesh Labor Act, 2006

This Act pertains to the occupational rights and safety of factory workers and the provision of a comfortable work environment and reasonable working conditions. It addresses occupational hazard, exposure, training and hazard minimization options. Workers exposed to occupational mercury emissions in industries needs to be protected under this law.

Bangladesh Export Policy, 2015-2018 and Import Policy Order, 2015-2018

The export policy lists the type of allowable and prohibited export items in Bangladesh. The import policy order lists the type of allowable import items and the standards with which they should comply. Part A (List of controlled goods) states the types of banned and allowable insecticides/pesticides that can be imported and Part B (List of prohibited goods) states the chemical insecticides and industrial chemicals listed by the Stockholm Convention on Persistent Organic Pollutants (POPs).

The Bangladesh Standards and Testing Institution Ordinance,1985

The Ordinance has been promulgated for the adoption of standards related to materials, commodities and products in the market and provisions to secure their compliance. The BSTI sets out standards whether the product is suitable for local consumption, import and export. The BSTI seal is awarded to products conforming to such standards. The Government may, in consultation with the Institution, prohibit the sale and distribution of any article which does not conform to the Bangladesh Standard established by the Institution in relation to that article. Many of the Bangladesh Standards for Mercury-added products (e.g. face creams and paints) have set limits on the allowable concentration of mercury to be used.

Right to Information Act 2009

Under the Act, a citizen may request public information from any government agency, and the government agencies on the other hand, are required to appoint Designated Public Relations Officers (DO or PRO) to fulfil such requests within allotted time frames.

Bangladesh Consumers Right Protection Act 2009

This act has provisions for the protection of the rights of the consumers and prevention of anti-consumer right practices. Article 29 of this act states that If any goods are proved to be particularly harmful to human health, the Government, on recommendation of the Director General of the Directorate of Consumer Rights Protection, may issue direction for stopping the production, import, marketing, sale, display for sale, distribution, transportation for commercial purpose or commercial use of those goods completely all over the country or in any specific area.

3.2 Non-regulatory mechanisms for managing chemicals (including mercury)

National Environmental Policy 2013

The concept of environmental protection through national efforts was first recognized and declared in Bangladesh with the adoption of the Environment Policy, 1992 which was updated in 2013. The major objectives of Environmental policy are to 1) maintain ecological balance and overall development through protection and improvement of the environment; 2) protect the country against natural disasters; 3) identify and regulate activities which pollute and degrade the environment; 4) ensure environmentally sound development in all sectors; 5) ensure a sustainable, long term and environmentally sound base of natural resources; and 6) actively remain associated with all international environmental initiatives to the maximum possible extent.

The policy emphasizes public-private partnerships for implementing environmental protection strategies, encourages mass awareness for environmental protection and identifies scope for international and multilateral cooperation in environmental science and research, and clean technology transfer.

National 3R Strategy for Waste Management 2009

Emphasizes that industries are required to store hazardous waste for a period not exceeding 90 days and maintains a record of sale, transfer, storage, recycling and reprocessing of such wastes unless agreed by DoE. It emphasized the responsibility of industries to explore options/opportunities of reusing, recovery and recycling of hazardous waste in an environmentally sound manner. This strategy has been reflected now in the regulatory mechanism as Hazardous Waste and Shipbreaking Waste Management Rules 2011.

The 2009 strategy also suggests that there could be 'Waste Exchange Banks/ Centers', channeling wastes containing toxic metals for recovery (mercury from thermometers and fluorescent tube lights). It also states that DoE will develop an on-line tracking system for the movement of hazardous waste from generation to the disposal/ recovery/ recycle stage.

Bangladesh Standards and Guidelines for Sludge Management 2015

This document provides a classification of sludge based on hazard criteria and prescribes various management options for sludge with a primary focus on land application. According to this guideline, mercury-containing sludge may be categorized as "Category C" sludge (Sludge from industry including sludge from CETP belonging to the category of hazardous waste).

Two management options are prescribed for such sludge: controlled landfill and thermal incineration. A landfill class 3 is prescribed for disposing of hazardous waste. The document also prescribes the mercury limits of sludge for use as compost/fertilizer (8 mg/kg in sludge and 1 mg/kg in soil) and testing of mercury for all types of sludge prior to disposal so that they conform to the disposal limits. According to the guideline, the responsibility for sludge management lies with the producer and all industries generating it must prepare a sludge management plan and submit to the Department of Environment as a part of the environmental clearance process.

National Health Policy 2011

The main objective of this policy is ensuring

basic health care services to all levels of population in Bangladesh as per the constitution of Bangladesh. Prevention, treatment and care services for affected populations will be undertaken under this policy. The action plan under this policy highlights generating awareness for non-communicable diseases prevention and care. Awareness for mercury exposure, educational and prevention programmes can be conducted under this policy.

National Industrial Policy 2010

The policy states that the government will create awareness among the public on environment protection, pollution, and dumping of hazardous material (including mercury) on land and water. Also, the Government will develop mechanisms to track the impact of industrial projects on environment.

3.3 Institutional framework for managing chemicals (including mercury)

Department of Environment

The Department of Environment under the Ministry of Environment and Forest and Climate Change (MoEFCC), as per the Environment Conservation Act 1995, is widely mandated to undertake various measures including giving advice and issuing directions to concerned persons regarding the environmentally sound use, storage, transportation, import, and export of a hazardous substance or its components. As outlined in the National Environment Policy, the MoEFCC acts as the guide and custodian for the conservation and development of the environment and, in the pursuit of that goal, to ensure through appropriate laws and regulations that natural resources, including land, air, water and forests, are exploited and managed in an environmentally sustainable manner.

The Department of Environment (DoE) acts as the technical arm of the Ministry and is responsible for environmental planning, management, monitoring and enforcement. The mandate of the Department has expanded over time, evolving from an exclusive focus on pollution control to include natural resources and environmental management, now covering: (a) monitoring environmental quality, (b) promoting environmental awareness through public information programs, (c) controlling and monitoring industrial pollution, (d) reviewing environmental impact assessments and managing the environmental clearance process; and, (e) establishing regulations and guidelines for activities affecting the environment.

In the management of mercury and other hazardous materials, the DoE will play the key role through setting standards for emissions, enforcing the standards in industrial processes, controlling and stocktaking the use of hazardous materials (e.g. mercury) in industrial processes and devising schemes for generating mass awareness against mercury use with different forms of communication.

Bangladesh Standards and Testing Institution

Bangladesh Standards and Testing Institution (BSTI), the only National Standards body of Bangladesh, plays an important role in developing and promoting industrial standardization. Keeping in view that standardization, metrology, testing and quality control in the industrial spheres are the basic pre-requisites of the infrastructure necessary for sound economic development of the country, the Government of Bangladesh has established the BSTIunder the Ministry of Industries in 1985 through promulgating "The Bangladesh Standards and Testing Institution Ordinance, 1985 (Ordinance XXXVII of 1985)".

BSTI is entrusted with the responsibility of formulation of national Standards of industrial, food and chemical products keeping in view the regional and international standards. Its functions include the set-up of Bangladesh Standards of quality, and prepare and promote the general adoption of standards at the national level relating to materials, commodities, structures, practices and operations. The operation of BSTI has significant implications in mercury management as it sets standards of allowable mercury content (as well as testing protocols of mercury) in different mercury-added products in the market.

Import and Export Control Department

Under the Ministry of Commerce, this is the Government regulatory department of Bangladesh concerning export and import. It issues export and import certifications and advises the government on trade and tariffs. The Ministry of Commerce is responsible for regulation and implementation of policies applicable to domestic and foreign trade. Banning import and export of mercury-added products will fall under the purview of this Department and the Ministry's policies.

National Board of Revenue (NBR)

The National Board of Revenue (NBR) is the apex authority for tax administration in Bangladesh. NBR is responsible for formulation and continuous re-appraisal of tax-policies and tax-laws, and negotiating tax treaties with foreign governments. The main responsibility of NBR is to collect tax revenues (primarily, Value Added Tax, Customs Duty, Excise Duty and Income Tax). It is responsible for the inspection of all chemical imports, record keeping of volumes and quantities imported into Bangladesh. It keeps a database of all legally imported products including mercury and mercury compounds. Their database can be shared with relevant agencies to keep track of all the mercury/mercury compounds use within the country.

Directorate General of Health Services (DGHS)

Under the Ministry of Health and Family Welfare, the main functions of this agency are the implementation of different health programmes, health management, planning and execution of different policies through administration. It can promote the development and implementation of strategies to identify and protect populations at risk, such as developing fish consumption guidelines.

Directorate of National Consumer Rights Protection (DNCRP)

Under the Ministry of Commerce, the main functions of this agency are the implementation of the Bangladesh Consumers Right Act 2009. It is headed by a Director General and works through different councils established at the district and upazila levels. Raising awareness against harmful products (e.g. skin-whitening creams), conducting research on consumer feedback of products, enforcement and penalizing measures are some of the mandates of this agency. The vision and mission of the agency is to protect the rights of consumers in Bangladesh.

Bangladesh Medical Research Council (BMRC) and other Research Institutions

BMRC is the focal point for health research. The objectives of BMRC are to identify problems and issues relating to medical and health sciences and to determine priority areas in research on the basis of health care needs, goals, policies and objectives. The main activities of the Council include organization, promotion and coordination of scientific research

in various fields of health science, training of manpower in health research and dissemination of research results for proper utilization.

In addition to BMRC, the Bangladesh Council for Science and Industrial Research (BCSIR), the Bangladesh Atomic Energy Commission, and the University Grants Commission are some of the other (major) agencies financing health research.

Information Commission of Bangladesh

The Commission is entitled to provide information on any issues to the public upon request under the Right to Information Act and Rules, 2009. If the general public are interested to obtain any information on mercury (e.g. health and safety of humans and the environment, and mercury release quantities), the Commission would ensure that the information does not remain confidential and it would be relayed to them.

3.4 International Treaties

Basel Convention

The Basel Convention is an international legal instrument of regulation related to hazardous waste. It requires the state parties to minimize the transboundary movement of hazardous wastes, which inter alia provides for prior informed consent for all such shipments and environmentally sound management of recycling and prohibits the export of hazardous wastes from developed to developing countries. In most cases, ships exported for shipbreaking are a clear violation of these objectives. The Convention applies to the transboundary movement of mercury (A1010) and mercury compounds (A1030) as they are defined as hazardous wastes. Since Bangladesh is a Party to the Convention, it imposes substantive obligations on Bangladesh to prevent the movement and disposal of mercury in contravention of the Convention.

3.5 Summary of gaps identified with different provisions of the Minamata Convention

Bangladesh is a signatory to the Minamata Convention on Mercury. The goal of that treaty is to protect human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds. A detailed analysis of gaps in the legal and institutional framework corresponding to the different articles of the convention are presented in Annex A and B. To meet obligations upon a Party to the convention, a range of actions would need to be taken:

With regard to Article 3, (Mercury supply sources and trade) a country needs to obtain information on stocks of mercury or mercury compounds exceeding 50 metric tons (MT), and mercury supply generating stocks exceeding 10 MT/yr. Bangladesh currently does not have a mechanism of taking stocks of mercury or mercury compounds at a central level. Therefore, an institutional setup for taking stocks of mercury and mercury compounds need to be established.

With regard to Article 4 (Mercury-added products), Bangladesh needs to align the import policy order with the hazardous waste and ship-breaking Rules, 2011 to ban the import of prohibited items under the Basel Convention and Annex A part 1 products. This will prevent the entities to open Letter of Credit (LC) to import such items and NBR Customs Department to monitor and regulate imports. Bangladesh also needs to have national strategy, policy or action plans for phasing down the use of dental amalgam in the medical field.

With regard to Article 5 (Manufacturing pro-

cesses in which mercury or mercury compounds are used), Bangladesh has no manufacturing processes intentionally using mercury. Bangladesh may need to consider promoting a policy or regulatory measure which directly discourages new uses of mercury in industrial processes and preventing new facilities from using mercury in the processes.

With regards to Article 8 (Emissions), although generic mercury emission standards have been set in Bangladesh, it needs to be made industry-specific. A separate directive with respect to monitoring responsibilities and emission-control technology adoption for industry-owners need to be developed and be made legally binding.

With regard to Article 9 (mercury releases to land and water), although there are some guidelines to restrict the release of mercury from wastes in land and water, the guidelines are not legally binding.

With regard to Article 10 (environmentally sound interim storage of mercury), other than waste mercury, Bangladesh has to develop more specific guidelines for safe handling and storage of mercury.

With regard to Article 11 (Mercury wastes), Bangladesh will need to consider how best to reduce emissions and releases from the waste sector, in particular through the improved management of end-of-life mercury-added products. The existing regulations mention incineration, recycling and re-refining of hazardous waste in an environmentally sound manner but national guidelines for safe operation of these technology and processes need to be developed.

With regard to Article 17 (Information Exchange), a national focal point on mercury for exchange of information needs to be designated. No policy or act specifically addresses the facilitation of information exchange regarding mercury and regarding health and safety of humans and on the environment if it is not requested by the public. The national focal point can take on this role of information dissemination pursuant to this article, and 18 and 21.

CHAPTER 4:
IDENTIFICATION OF POPULATIONS AT RISK AND GENDER DIMENSIONS

4.1 Introduction

Mercury could exist in many forms in the natural environment and in our society, but the exposure pathways for mercury varies among countries depending on what type of activities are being carried out, what sort of products the population are exposed to, and existing and effective regulations. How someone's health may be affected by an exposure to mercury depends on the form of mercury (for example, methylmercury, elemental (metallic) mercury or mercury-added products), the amount of mercury in the exposure, the age of the person exposed (the fetus is the most vulnerable), duration and modality of exposure (such as inhalation or ingestion) and the health of the person exposed[63].

According to WHO[64], elemental mercury and methylmercury are toxic to the central and peripheral nervous systems. The inhalation of mercury vapour can produce harmful effects on the nervous, digestive and immune systems, lungs and kidneys, and may be fatal. The inorganic salts of mercury are corrosive to the skin, eyes and gastrointestinal tract, and may induce kidney toxicity if ingested. Neurological and behavioral disorders may be observed after inhalation, ingestion or dermal exposure of different mercury compounds. Symptoms include tremors, insomnia, memory loss, neuromuscular effects, headaches, and cognitive and motor dysfunction.

Bangladesh is a deltaic plain crisscrossed by many rivers and remains extremely vulnerable to mercury contamination from uncontrolled dumping of mercury along with medical, industrial, electronic wastes into the waters and soil, uncontrolled coal burning in brick kilns, the fish-dependent protein diet of the population, the cement and paint industries, and through the use of mercury-added products and medical applications of mercury (dental amalgam). The respective emissions from all of these areas have been estimated in Chapter 2 of this report. This chapter identifies and discusses the populations which might be at risk due to exposure of mercury in various forms, with potential gender dimensions.

4.2 Identification of populations at risk

4.2.1 Populations at risk from waste management activities

Bangladesh generates about 8,000 metric tons of solid waste each day from the six major cities (Dhaka, Chittagong, Khulna, Rajshahi, Barisal and Sylhet), of which Dhaka city alone contributes about 70%[65]. Since there are no municipal solid waste incineration facilities in Bangladesh, the huge fraction of the uncollected waste is burnt openly. There is no authentic data on waste incineration in Bangladesh. However, as per the Waste Atlas, the waste generation rate in Bangladesh is 149.7 kg per person per year and total municipal waste generation rate is nearly 22 million tons per year, of which only 20% of waste is under collection coverage, while the remaining waste is disposed of in an unsound manner[66].

A significant portion of the rural or village-based workforce has migrated to the cities in the last few years, which has resulted in increased waste generation in urban areas. Waste segregation at the source is practically non-existent and all forms of waste find their way towards municipal landfills and open-dumping sites. Since there are very lim-

[63] https://www.who.int/news-room/fact-sheets/detail/mercury-and-health
[64] https://www.who.int/news-room/fact-sheets/detail/mercury-and-health
[65] Md. Anwarul Abedin and M. Jahiruddin (2015); Waste generation and management in Bangladesh: An overview; Asian Journal of Medical and Biological Research, ISSN 2411-4472 www.ebupress.com/journal/ajmbr
[66] www.atlas.d-waste.com/index.php?view=country_report&country_id=4, las; BANGLADESH General Country Profile; last accessed 6th Feb, 2018

ited electronic waste recycling facilities, mercury-containing wastes (such as batteries) easily find their way towards these disposal sites. The medical waste management practice is also very poor, and it is very much possible that mercury containing medical wastes (broken thermometers and disused sphygmomanometers for example) will find its way to municipal dumpsites.

The mercury inventory presented in Chapter 2 shows that Bangladesh annually generates 9.5 tons of mercury waste which is disposed to land (batteries, medical equipment and use and disposal of other products; waste incineration and open waste burning; waste deposition and informal dumping of general waste) and a large part of it may find its way to municipal landfills and open dumping sites.

In Bangladesh, since there is no formal recycling industry, the recycling of municipal waste is being carried out by informal sectors such as the rag-pickers. Due to lack of adequate medical waste management facilities, many healthcare facilities dump their waste along with municipal waste. The rag-pickers are less likely to be wearing any sort of personal protective equipment and there is every chance of infection as well as exposure to mercury. Studies have shown that in some healthcare facilities there are unauthorised persons collecting waste from the wards (e.g. blood bags, tubes and other sets pilfered out and washed to be sold to recyclers)[67],[68]. This exposes the pilferers to infection as well as exposure to mercury poisoning.

The lack of a functional system to ensure the environmentally sound disposal of waste CFL bulbs indicates that these will find their way to dumpsites along with domestic waste. The mercury content in CFLs generally range between 2 mg to 5 mg, while for a small segment of manufacturers, mercury content goes up to 8 mg. When broken, compacted, crushed, or disposed of improperly, fluorescent bulbs may release mercury into the air, water, and land, posing significant threats to people and the environment. The waste-pickers and their communities, who often retrieve waste lamps from mixed trash disposed in dump sites or landfills in an attempt to recycle them, are directly exposed to mercury compounds in

Figure 4.1: (left) Uncontrolled urban waste dumped on Dhaka-Aricha highway (source: The Daily Star published June 12, 2017) and (right) recycling by informal sectors in Bangladesh (image source: The Daily Mail UK published on January 20, 2015)





[67] World Bank (2017) Environmental and Social Systems Assessment, Health Population and Nutrition Support Program, Government of People's Republic of Bangladesh. (http://documents.worldbank.org/curated/en/273581485771019664/Environmental-and-social-system-assessment-ESSA)

[68] Mullen, P. M. (2017). Bangladesh - Health, Nutrition and Population Sector Support Program : environmental assessment : Environmental and social system assessment (ESSA) (English) (Vol. 1)

uncontrolled conditions.

4.2.2 Populations at risk from dental amalgam use in dentistry

Mercury is used in a variety of devices and measuring instruments in the healthcare sector. However, the most prevalent use is the application of teeth fillings as "Silver Amalgam". As mentioned in section 2.6.1, due to the unavailability of better alternatives for the purpose, dental amalgam is still being used in a widespread manner. It has been estimated that 1,173 kg mercury is used currently per year for preparation of fillings at dentist clinics. Mercury vapour may be released to air during the preparation phase. It is often found that the mercury mixing area is adjacent to the patient and the mixing is done without the use of personal protective equipment (ESDO, 2015). Professional dentists, students and health workers are exposed to mercury vapors through accidental mercury spills, malfunctioning amalgamators, leaky amalgam capsules, polishing and removal of amalgam and vaporization of mercury from contaminated instruments.

A survey conducted by ESDO found that 91% of dentists do not use personal protective equipment during amalgam mixing and almost 50% of dentists conduct the mixing of amalgam within the vicinity of the patients (ESDO, 2015). Mercury discarded during the filling process can find its way into the waste water stream. Also, the prolonged existence of mercury in the mouth which is directly a route of food ingestion of human beings is also a perpetual risk. The ESDO report (2015) mentions that 1.09- 6.22 tons of mercury vapor is emitted annually from dental amalgam and a person breathes in 3 to 17 micrograms of mercury vapor during dental amalgam filling (ESDO, 2015).

It has been observed that the efficiency of the mixing procedure using accurately proportioned ingredients can potentially reduce the amount of mercury wasted, though this technique requires sophisticated instruments which are not available in most dental clinics in Bangladesh. Especially in clinics in peri-urban areas, dental amalgam is prepared by manually mixing the ingredients and the risk of mercury wastage and entering into streams and dumpsites are higher. There is also the potential for amalgam to be discarded when fillings are replaced or removed. Even the clinics in major cities are not fitted with special traps to capture mercury from being washed into drains, disused amalgam (extracted from patients) from the clinics are disposed as general wastes and are likely to enter dumpsites and landfills. The waste-pickers scavenging through the dumpsites and landfills for recyclable materials, can become vulnerable to mercury poisoning in such a scenario.

Figure 4.2: (a) Individual units of mercury bottles (containing one ounce of mercury) sold in a dental equipment shop in Dhaka city for the purpose of preparing dental amalgam, (b) A set of mercury and metal alloy mixture capsules, also used by dentists where mercury and metal alloy powder is properly proportioned, (c) Nanocomposites and glass ionomer fillings which are used as alternatives to dental amalgam (Photo credit: Tanvir Ahmed)

(a)



(b)



(c)



4.2.3 Populations at risk from mercury-added products

Skin lightening creams are popular cosmetic agents typically used to undo sun damage to the skin, even-out skin tones and remove age spots. Mercury is commonly used in skin products as it blocks the formation of melanin. Mercury contamination in face whitening cream is a dangerous issue of increasing importance, considering the widespread and growing popularity of skin-whitening products in countries like Bangladesh, neighboring India and many other Asian countries, where there is a strong cultural preference for fairer skin.

A study[69] conducted by surveying a large sample of university students of different countries found a very high prevalence of skin lightener use among both males and females. However, females were more likely to engage in skin bleaching which could possibly be attributed to complex social dynamics, particularly among single woman. The study reports that in the case of Bangladesh, where a survey was conducted among 791 university-going students, the prevalence of skin bleaching cream use was 29.5% and the prevalence among females and males were 33.4% and 26.7% respectively. According to the World Health Organization, the main adverse effect of the inorganic mercury contained in skin-lightening soaps and creams is kidney damage. It may also cause skin rashes, skin discolouration and scarring.

[69] Karl Peltzer, Supa Pengpid and Caryl James. "The globalization of whitening: prevalence of skin lighteners (or bleachers) use and its social correlates among university students in 26 countries" International Journal of Dermatology 2016, 55, 165–172

Figure 4.3: Common types of skin whitening creams available in local market which have been found to be high in mercury reported in a national daily on January 6, 2019 (Source: https://www.thedailystar.net/frontpage/news/beauty-s-care-1683580)



The Daily Star

Sunday, "January 6, 2019"

12:00 AM, January 06, 2019 / LAST MODIFIED: 12:06 AM, January 06, 2019

Beauty s-care

Mercury found way beyond limit in almost half of skin lightening creams available in market

The market is flooded with skin lightening products by often obscure manufacturers. But there is not any effective monitoring of the level of mercury present in the seemingly innocuous products. Photo: Star

A survey conducted by ESDO reveals that almost 70% of consumers of skin creams have no idea about the use of mercury used in manufacturing. On the same topic, some retailers (15%) said that they knew about mercury used in production while 40% were not bothered about it and 35% said they were not aware of the use of mercury in cosmetics. (ESDO, 2015). The same study found 3,361 to 4,653 ppm of mercury being used in various beauty and skincare products.

The inventory analysis in Chapter 2 of this report estimates that 521 kg of mercury is used in skin creams per year in Bangladesh. There is a huge variety of skin creams (both local and imported) used in Bangladesh. A comprehensive study on the Mercury content of these creams in Bangladesh is yet to be done. However, there is growing evidence (based on police raids and shutdowns in cream manufacturing factories using harmful ingredients) that local brands of creams could have high contents of mercury. In addition, due to their cheaper price, they may have high penetration in the market, especially in the rural areas.

The people using these creams could be at risk of adverse physiological reactions due to mercury poisoning. It is highly unlikely that foreign reputed brands will have mercury in excess of permissible limit of 1 ppm indicated in the BSTI Standards. This is evidenced in a recent study which found that mercury ranging between 0.14–0.36 ppm in skin lightening creams available in India which included Emami Fair and Handsome, Pond's White Beauty Daily Anti-Spot Fairness Cream, Garnier Skin Natural White and Fair and Lovely[70]. These brands of creams are also available in the markets of Bangladesh.

Although 1 ppm is considered as a standard limit for mercury in creams, scientific research suggests that even low mercury content creams could be harmful to kidneys and livers[71], as evidenced from laboratory studies which put forward the notion that there is no safe limit of mercury in such creams.

Studies should be designed to assess the quantity of mercury present in different skin creams and the pervasiveness of their usage among Bangladeshi people.

The research on university students indicates that this may have important gender components, with both women and men using the products. For women, the use of mercury-containing skin-lightening creams is a well-known issue, for which specific interventions may be needed, such as raising awareness of the issue with consumers, retailers and wholesalers, and seeking NGO and media support to change perceptions. It may also be the case that those in charge of finances in a household may need to be convinced of the health and environmental benefits of more expensive or more reputable brands, so that the cheap versions of the creams can be avoided. Moreover, for men, it must not be forgotten that they too may use such creams and products, and should not be excluded from such messaging and awareness-raising campaigns. Both men and women may also be in a position to help change the perceptions of what constitutes attractiveness, and shift the perceived demand for those with fairer skin.

4.2.4 Mercury ingestion from fish-dependent diet

Bangladesh is crisscrossed by many rivers and fish is a major source of protein for a significant section of the population. Fish consumption – both freshwater and marine fish - is relatively high and covers about 80% of the daily animal protein intake[72]. More than 11 percent of the total population of Bangladesh is engaged with this sector on a full time or part time basis for their livelihoods[73].

Several studies have been conducted on the prevalence of trace metals in inland freshwater fish in Bangladesh and the concentration of mercury has been found to be very low[74], [75]. Holsbeek et al. reported that this value can be as low as 2 to 430 ng Hg /g fresh weight of the fish and although having a high fish consumption rate, there is no significant accumulation of mercury in the human body as evidenced by analyzing the mercury concentration in human hair[76],[77].

Marine fisheries are 16.28% of the national fish production[78] and the species that are found are Hilsha, shrimp, sardine, Bombay duck, indian salmon, pom fret, jew fish, catfish, shark/skate/ray and others[79]. The mer-

[70] Agrawal, S. S., & Sharma, P. (2017). Current status of mercury level in skin whitening creams. Current Medicine Research and Practice, 7(2), 47-50.
[71] Al-Saleh, I., El-Doush, I., Shinwari, N., Al-Baradei, R., Khogali, F., & Al-Amodi, M. (2005). Does low mercury containing skin-lightening cream (fair & lovely) affect the kidney, liver, and brain of female mice?. Cutaneous and ocular toxicology, 24(1), 11-29.
[72] Sharif, A.K.M., M. Alamgir, A.I. Mustafa, M.A. Hossain and M.N. Amin, 1993. Trace element concentrations in ten species of freshwater fish of Bangladesh. Sci. Total Environ., 138: 117-126.
[73] Yearbook of Fisheries Statistics of Bangladesh, 2016-17
[74] Khan, A.H., M. Ali, SK. Biswas and D.A. Hadi, 1987. Trace elements in marine fish from the Bay of Bengal. Sci. Total Environ., 61: 121-130.
[75] Sharif, A.K.M., M. Alamgir, A.I. Mustafa, M.A. Hossain and M.N. Amin, 1993. Trace element concentrations in ten species of freshwater fish of Bangladesh. Sci. Total Environ., 138: 117-126.
[76] Holsbeek, L., Das, H. K., & Joiris, C. R. (1997). Mercury speciation and accumulation in Bangladesh freshwater and andromogous fish. Sci. Total. Environ. 198, 201
[77] Holsbeek, L., Das, H. K., & Joiris, C. R. (1996). Mercury in human hair and relation to fish consumption in Bangladesh. Science of the total environment, 186(3), 181-188.
[78] FRSS. (2016). Fisheries resources survey system (FRSS), fisheries statistical report of Bangladesh (vol. 32, pp. 1e57). Bangladesh: Department of Fisheries.
[79] Annual Report, 2017, Department of Fisheries, GoB

cury content in these marine fish species captured in the Bay of Bengal are largely unknown. Among the marine species that are captured in the Bay of Bengal, some of them are exclusively sold in supermarkets with a high price tag compared to inland freshwater fishes and cater to upper-middle to high-income groups of people in Bangladesh. These species include Tuna, Salmon, Koral, Datina fish, Sardine, Beauty Queen, herrings, Trouts, red snapper. The mercury content in these species is unknown as well.

Besides the fishes from inland and marine capture and aquaculture, it is estimated that about 88,593 tonnes of fish are imported; just 1.6% of the total current fish demand of Bangladesh. The total imported fishery products in Bangladesh consist of approximately 69.4% frozen marine fish followed by 25.3% chilled or iced fish.

Bangladesh mainly imports carps, sea fish and hilsha from Myanmar, Oman, India and Thailand[80]. The Bangladesh Food Safety Authority (BSFA), the food safety watchdog of Bangladesh, has recently become increasingly concerned about heavy metal contamination in imported fishes and has instructed testing of all imported fish for heavy metal after finding hazardous levels of lead, chromium and mercury in almost all the fishes brought in from abroad[81]. Published quantitative evidence on the presence of mercury in imported fishes are unavailable, but it is possible that if imported fishes continue to penetrate the markets, more people may be exposed to mercury contamination. In these cases, the population at risk will be both urban and rural people.

A comprehensive study to assess the current situation of the level of contamination in marine and imported fishes needs to be done.

4.2.5 Mercury exposure in urban areas

Open burning of waste at both the residential level and dumping sites produces many atmospheric pollutants, including greenhouse gases (GHGs), reactive trace gases, particulate matter (PM), and toxic compounds including mercury. Since there are no municipal solid waste incineration facilities in Bangladesh, the huge fraction of the uncollected waste is burnt openly contributing to particulate and mercury emissions. There is no authentic data on waste incineration in Bangladesh in general, though it practised in some healthcare facilities.

The inventory analysis presented in chapter 2 shows that mercury emissions from open burning of municipal waste could be 17,683 kg Hg per year. Besides open burning of municipal solid waste, brick kilns are also a major source of particulate and mercury emissions in the country.

Estimated yearly mercury emissions from brick kilns is around 535 kg per year. Most of the brick kilns are clustered around major urban centers such as Dhaka city and they are considered to be responsible for much of the air quality degradation during the dry season. The open burning of municipal solid waste takes place in and around major urban centres where population density is high. This makes the people residing in major urban centres vulnerable to mercury contamination. However, measurements of ambient mercury levels in the air are not available to support this statement and further studies need to be carried out in this regard.

4.2.6 Mercury exposure in shipbreaking industry

Shipbreaking activities in Bangladesh is concentrated in Sitakund (Bhatiary to Barwalia), just north of Chittagong city on the Bay of Bengal. As mentioned in section 2.5.1,

[80] Shamsuzzaman, M. M., Islam, M. M., Tania, N. J., Al-Mamun, M. A., Barman, P. P., & Xu, X. (2017). Fisheries resources of Bangladesh: Present status and future direction. Aquaculture and Fisheries, 2(4), 145-156

[81] https://www.thedailystar.net/business/economy/imported-fish-be-tested-heavy-metals-1518652

Figure 4.4: solid waste open burning in Dhaka city, the capital of Bangladesh (UK Daily Mail, published 21 Jan, 2015)



around 100 ships are imported per year for recycling purposes and the annual amount of mercury recycled from different components of these ships would be around 200 kg per year. Ship breaking activities is a threat to both the terrestrial and marine environment, as well as to public health. Most of the ship breaking workers come from the poverty-stricken northern region of Bangladesh where there are limited employment opportunities. The majority of the labour is between the ages of 18-22 years old and there is practice of child labour as well[82]. There is usually lack of provision of safety equipment and environmentally sound management practices. This leads the workers to be exposed to many toxic chemicals and gases, including mercury.

The following table summarizes the population risk and potential gender dimensions.

Table 4.1: Population risk and potential gender dimensions

Mercury exposure pathway	Significance	Populations at risk	Potential gender dimensions
Waste management	Significant	Waste-pickers, people involved in waste collection, transportation and recycling	Females and young children
Dental Amalgam	Significant	Patients, Dentists, associates in dental institutions and clinics	female and children patients
Mercury-added products (skin creams)	Potentially significant (scarce data available)	All people using the product. People of lower to middle income group are more vulnerable.	Mostly females (un-married or single), though men's use is not to be discarded
Fish consumption (marine and imported fishes)	Could be significant in future if not regulated (data not available)	For some marine species, the middle to high income group in urban areas. For imported fishes, both urban and rural areas	No
Burning of solid waste in open dumps and coal-burning in brick kilns	Potentially significant (data not available)	Urban population, Waste-pickers	Female and children waste-pickers
Ship-breaking industry	Potentially significant (data not available)	Workers engaged in ship metal recycling and separating mercury from ship equipment in shipyards	Young children (child labour)

[82] https://www.shipbreakingbd.info/overview.html

4.3 Implications of the assessment results for Bangladesh as a future party to the Minamata Convention

With regard to Article 4: Mercury-added products, the removal of mercury-added products from the marketplace after the phase out date of 2020, combined with the promotion of mercury-free alternative products, is likely to be the most effective measure to prevent exposure to the mercury such products contain. Where products remain in use, in particular within the healthcare sector, training in handling breakages and spillages of mercury, information on exposure risks, and implementing a plan to replace mercury instruments with mercury-free alternatives are likely to be important. With regard to dental amalgam, it can be assumed that dental professionals working in dental clinics are at particular risk of mercury exposure through the processing of dental amalgams and the measures set out in Part II of Annex A form the basis of a phase-down initiative.

With regard to Article 11: Mercury wastes, more comprehensive and effective measures and further efforts are needed in the national waste management sector. The solid waste management rules (draft) need to be finalized and endorsed. Bangladesh would need to develop and implement strategies to ensure institutional support and the effectiveness of the hazardous waste management rules.

With regard to Article 16: Health aspects, the inventory highlights the potential exposure to mercury of a number of population groups including those engaged in waste management activities, those handling mercury-containing products (e.g. amalgam and mercury-containing thermometers) in the health and dental sector, and a greater segment of the urban population. Bangladesh will wish to consider strategies and programmes to identify and protect these and other populations at risk pursuant to paragraph 1.

With regard to Article 18 Public information, informing the public, creating awareness and education are all critical to the management of hazardous chemicals including mercury. An understanding of how chemicals can be harmful to humans and the environment will pave the way towards a better public response and participation in chemicals management initiatives. The Department of Environment under the Ministry of Environment Forest and Climate Change and Directorate General of Health Services under the Ministry of Health and Family Welfare have an active role to play in creating awareness, dissemination of up-to-date information, and communicating public health issues through internal and external meetings, and national and local-level workshops. The Information Commission of Bangladesh has the role of ensuring that any information in the public domain (in this case, it can be information related to mercury contamination) is relayed to the public if requested.

With regard to Article 19: Research, Development and Monitoring, Bangladesh will be willing to receive technical assistance and support in capacity building and enabling activities in hazardous chemical management. It has received technical and grant assistance from UN organizations such as UNITAR, UNEP and UNDP and multilateral and bilateral organizations in the past. Bangladesh needs to involve local expertise (researchers in scientific and technical institutions), and explore local financial mechanisms for monitoring activities, research and development.

CHAPTER 5:
AWARENESS RAISING PLAN AND ACTIVITIES

The overall objective of the Minamata Initial Assessment Project is to assist Bangladesh in preparing for the ratification and implementation of the Minamata Convention in order to enable policy and strategic decision-making and to prioritize areas for future interventions. The Department of Environment under the Ministry of Environment, Forest and Climate Change (MoEFCC) will be the organization spearheading the efforts to engage key stakeholders from other ministries and organizations in the process of the implementation of Convention obligations.

The DoE has initiated awareness raising activities related to mercury with the stakeholders. An inception workshop titled 'Strengthening National Decision Making towards Ratification of the Minamata Convention and Build Capacity towards Implementation of Future Provisions of the People's Republic of Bangladesh' was organized by DoE in July 2018. The Secretary, Additional Secretary of MoEFCC, DG of DoE, and the senior mercury expert from UNITAR were among the key discussants of the workshop. The workshop was attended by a wide range of stakeholders including DoE officials, city corporation officials, faculty members of academic institutions, NGOs, bulb manufacturers, energy sector officials, among others.

This was the first workshop organized by DoE to introduce the hazards of mercury to humans, potential sectors contributing to the mercury inventory in Bangladesh and the requirements of Bangladesh as a signatory of the Minamata Convention. Government ministries, NGOs, waste management organizations recognized that awareness regarding different sectors contributing to mercury in the environment is very low and comprehensive sensitization activities are required to address this issue.

Figure 5.1: Speech given by Secretary, MoEFCC in the MIA inception workshop



A three-day training workshop on "UNEP's Toolkit for Identification and Quantification of Mercury Releases" was organized by the Department of Civil Engineering, BUET in July 2018. UNITAR's senior mercury expert conducted the training programme and the BUET inventory team as well as DoE officials were present among the trainees of the workshop. The objectives of the training programme were to introduce this toolkit to the first-time users, to provide technical information as well as to give overall instruction regarding preparation of the national mercury profile. It is important for DoE to learn the toolkit to institutionalize the process of continuously updating the national mercury profile. Similarly, the process can learn from and inform other, similar inventory processes.

Figure 5.2: Senior mercury expert of UNITAR with participants at inauguration of the training program at BUET



DoE has engaged the NGO Environment and Social Development Organization (ESDO) with the objective of developing and implementing awareness-raising strategies in order to sensitize decision makers, vulnerable populations and other relevant groups towards the health and environmental risks posed by mercury. The specific objectives include:

- Raising awareness among health sector professionals, about the health risks posed by the improper handling of products containing mercury.
- Improving understanding of relevant Minamata Convention provisions among government institutions responsible for priority sectors.
- Ensuring that decision-makers in the private sector engaged in activities with intentional uses or unintentional releases of mercury, particularly the fluorescent lighting industry, understand relevant obligations under the Minamata Convention.
- Raising awareness about negative effects on health that can be caused by mercury containing lightening creams.

For the awareness raising, the following activities in close cooperation with the focal person for Minamata Convention at DoE will be undertaken:

1. Screen existing information, most importantly from the national mercury profile and the legal, policy and institutional review.

2. Identify target audiences for an awareness raising programme which includes dentists and health sector professionals (nurses, doctors), pregnant women and other vulnerable groups, retailers selling mercury-added products, government officials, representatives of the light manufacturing industry.

3. Draft key messages targeted and adapted to identified audiences.

4. Prepare materials and identify means for communication, for example:
- Brochures distributed in hospitals
- Workshops, meetings, roundtables with industry representatives, talk shows on TV and radio
- Articles in newspapers, press release in print media, short clips in TV, advertisement on the radio etc.
- Participation in fairs and exhibitions, e.g. via a booth with banners
- Power point presentations and posters at an inter-ministerial meeting
- Awareness campaign in social media

The priority areas of intervention and activities to implement the obligations of Bangladesh under the Minamata Convention along with key institutions involved are highlighted in Chapter 6. The plans to address different stakeholders so the awareness campaigns can be targeted to these different audiences. The awareness raising campaigns to provide information and engage key sectors with regard to the replacement of mercury-containing products and processes and to the reduction of mercury emissions and releases will use these directions provided in Chapter 6. The DoE will also align its awareness raising programme with existing sectoral guidelines.

For example, the Power Cell under the Power Division of the Ministry of Power, Energy and Mineral Resources Bangladesh has prepared a 'Guideline for Environmentally Sound Disposal and Recycling of CFLs' which describes strategies for reducing the risk of mercury exposure from handling CFL bulbs along with the roles and responsibilities of different stakeholders associated with it. It is evident that DoE has a critical role to play in order to implement these guidelines[83].

The following figure shows a sample of the communication materials developed for preventing the hazards associated with the handling of CFL bulbs.

[83] The guidelines can be downloaded from the Power Cell, Bangladesh website in the following link: https://drive.google.com/drive/folders/1ik5VOFjNs1YYzFKDGSu8-rz3inM0KlKk

Figure 5.3: Communication materials developed under the 'Guidelines for environmentally sound Disposal and Recycling of CFLs'

কেন সিএফএল ম্যানেজমেন্ট গুরুত্বপূর্ণ?

সিএফএল এর সীল্ড কাঁচের পাইপ এর মধ্যে পাঁচ মিলিগ্রাম পারদ থাকে যা পরিবেশে মুক্তি পেলে মানব স্বাস্থ্যের বিপত্তি বা পরিবেশের ক্ষতি করতে পারে. অক্ষত বাল্ব থেকে কোন পারদ পরিবেশে মুক্তি পায় না যার দরুন সিএফএল এর সঠিক ব্যাবহার এবং নিস্পত্তি অত্যন্ত আবশ্যক. একটি ভাঙা সিএফএল পরিষ্কার করতে নিম্নলিখিত পদক্ষেপ গুলি গ্রহণ করা উচিত:

1. ঘরের জানালা এবং কোন বহি দরজা খুলে অন্তত পনের মিনিটের জন্য মুক্ত বায়ুর চলাচল করতে হবে
2. সব উপকরণ সরিয়ে ফেলুন আর ভ্যাকুয়াম করবেননা
   a. নিষ্পত্তিযোগ্য গ্লাভস পরে. সাবধানে কাঁচের টুকরগুলি এবং অবশিষ্টাংশ একটি শক্ত কাগজ বা কর্ডবোর্ড এ তুলে পরিষ্কার করবেন.
   b. কোনো অবশিষ্ট ছোট টুকরা তুলে নিতে, সল্লা বা ডাক্ট টেপ ব্যাবহার করবেন
   c. একটি স্যাঁতসেঁতে কাপড় দিয়ে এলাকাটি পরিষ্কার করে মুছে নেবেন
3. সব পরিষ্করণ উপকরণ (পিচবোর্ড, গ্লাভস, টেপ, ইত্যাদি) একটি হওয়া বন্ধ কাঁচের কন্টেইনারে রাখুন. এই কন্টেনারটি পরিবারের বিপজ্জনক বর্জ্য অবস্থানে বাচ্চাদের অপ্রাপ্য একটি এলাকায় বাড়ির বাইরে রাখুন
4. আপনার হাত ভালো করে ধুয়ে নেবেন



The plans and associated activities in order to raise awareness among people are described in Table 5.1 which shows key messages to make people aware regarding mercury emissions.

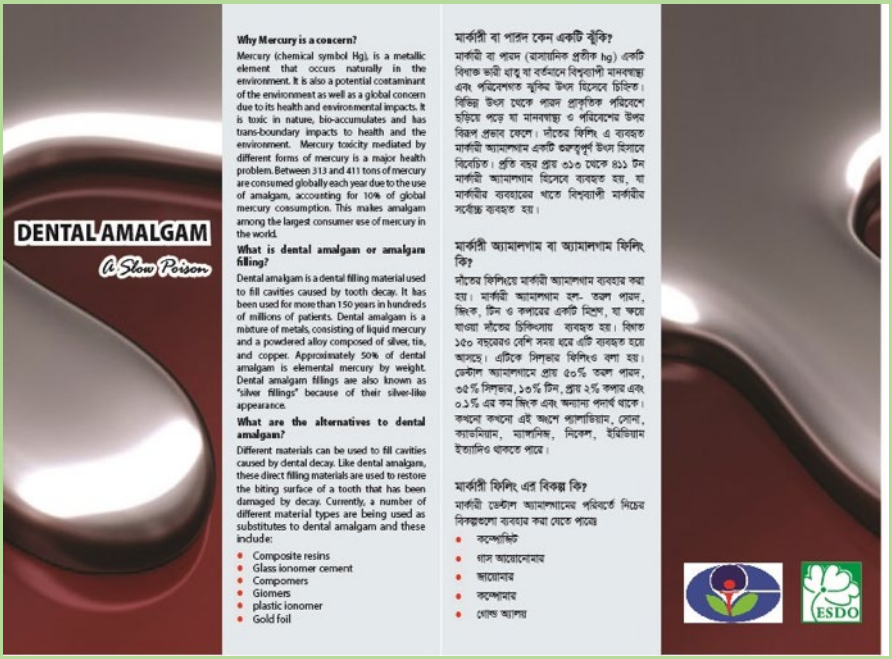
Table 5.1: Messages for the target audiences

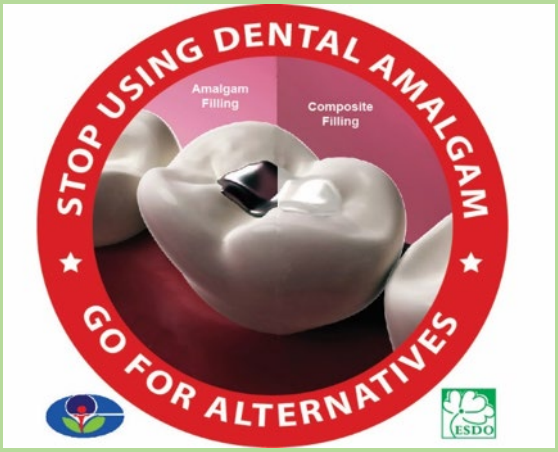
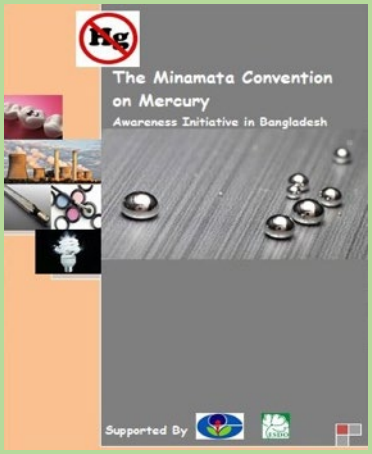
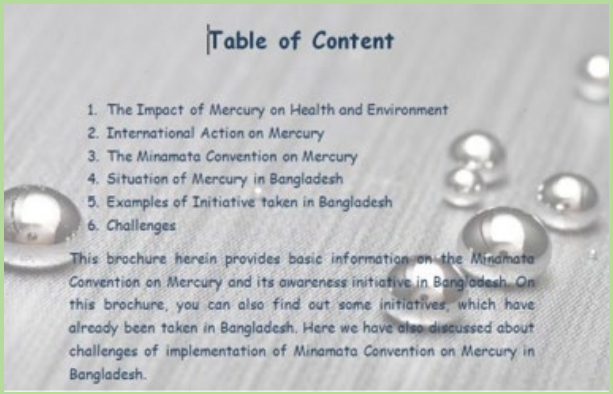
Target audience	Information/Message	Facts
Health sector professionals (working in dental clinics)	Education for safe handling, use and disposal of mercury-containing products and waste.	Because health sector professionals are mostly affected by mercury exposures when improperly handled or breakdown of any mercury containing medical devices such as thermometers can create pollution in the environments.
Dental college students	Knowledge sharing among the dental students about the harmful health effects of mercury from mercury-containing dental fillings.	Creates awareness among the future dentist for not using mercury-based products, and pushing for alternatives to dental amalgam or other innovative techniques
Target audience	**Information/Message**	**Facts**
Dentists	Knowledge sharing regarding the harmful health effects of mercury from mercury-containing dental fillings.	Creates awareness among the practising dentists for phasing down the use of dental amalgam
Retailers and consumers (general public) mercury added products	The retailers as well as the consumers need to be made aware of the harmful effects of mercury-added products (e.g. skin whitening creams, CFL bulbs).	Along with effective regulations to ban the use or import of these products, the awareness among retailers and consumers are required to control the supply and demand of these products or choosing alternatives. Some key messages could be: - Mercury-free bulbs consume less power than CFLs - Harmful effects of skin-whitening creams, etc
Light manufacturers	Use the alternatives of CFL lights available on the market and disposal of existing CFL.	They can motivate other retailers and manufacturers about its negative effects on health and environment. Also LED alternatives use much less power than CFLs.
Government officials (especially from environment and health sectors)	To prepare regulation and monitor/ enforce phasing out of mercury added products and dental amalgam, update procurement policies in their institutions to promote mercury-free bulbs.	Because government is the only entity which can make laws and implement them.
Academics	Spreading scientific knowledge on impacts of mercury .	Because academics are key to perform research. They also have the capability to spread the knowledge in a wide network.

Print Media

Different information, education and communication (IEC) materials such as stickers, leaflets, brochures and newspaper adverts can be used for dissemination of information about the harmful effects of mercury on human health and the environment. Leaflets and brochures can be targeted among dentists, retailers selling mercury-added products, Government officials and representatives of the light manufacturing industries.

Table 5.2: Prepared IEC materials for awareness raising

Types	Description	Features
Leaflets	Leaflets on mercury containing CFL lamp and its alternatives	
	Leaflets on mercury dental amalgam and its alternatives	

Types	Description	Features
Stickers	Stickers on dental amalgam	
	Sticker on mercury containing light	
Brochures	Brochure on Minamata Convention	 

Types	Description	Features
Newspaper Ad	Bangla Newspaper Ad on Health and Environmental impact of Mercury	
	English Newspaper Ad on Health and Environmental impact of Mercury	

Electronic Media Activities

Electronic media, for example radio and television, can play a large role for creating awareness among all people throughout the country. In this aspect, radio and TV talk shows could be arranged that would cover the sources, impacts and mitigations of mercury pollution, emphasizing the role of the Minamata Convention.

Social Media Campaign

Advancements in technology have made information dissemination to numerous people easy through the use of social media and YouTube. Social media such as Facebook and Twitter could be used to reach youth and middle-aged groups of the population as they are the ones who are more knowledgeable on the use of technology. Young people in particular can be influenced early in their lives, particularly as they start to become consumers and workers, and thus be informed of the risks of mercury.

Workshop and Print Media Roundtable Meeting

Workshops can serve as platforms to educate groups or individuals with common ground. For instance, they can be aimed at health sector professionals, industry, government, academics, consumers and other main users of mercury. Health and environmental impacts of Mercury as well as potential alternatives to mercury can be discussed in such platforms.

CHAPTER 6:
PRIORITY AREAS FOR IMPLEMENTATION

Bangladesh is a signatory of the Minamata Convention on Mercury. The goal of that treaty, is to protect human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds. For Bangladesh to meet its future obligations under the treaty, a number of actions need to be undertaken.

The outline plans set out below form a set of priority actions that arise from the initial assessment described in previous chapters. As work to implement the Minamata Convention progresses and as further information about mercury issues in Bangladesh becomes available, there will be a need to review and, if necessary, modify the actions proposed here or to add new initiatives. The actions that it will need to take will require careful coordination and cooperation between government institutions, between government and the private sector, and between government, communities and the public. Table 6.1 below provides a summary of proposed actions, the Convention articles they address and the likely lead institution within Bangladesh. Each plan is described more fully in the following section.

Table 6.1: Summary of proposed actions, convention articles, lead institutions and prioritization of actions

Plan	Titles and Components	Articles Addressed	Lead Institutions	Priority
1	Legal and institutional arrangements to implement the convention at the national level	3, 4, 5, 8, 11, 14, 17, 18, 19, 21	DoE, MoI, NBR	High
2	Phasing down of dental amalgam	4, 11, 14, 18	DoE, DGHS, Bangladesh Dental Society, NBR	Moderate
3	Phasing out of mercury-added products	4, 11, 14, 17, 18	DoE, DGS, BSTI	High
4	Environmentally sound management of solid and hazardous wastes	11, 14	City Corporations and municipalities, DGHS, DoE	Moderate
5	Research and Development, information dissemination and mass awareness	14, 16, 17, 18, 19	Technical and scientific institutions, DoE	High

Details of the plans

Plan: **1**
Priority: **High**

Legal and institutional arrangements to implement the convention at the national level	
Objective(s) of the plan	
The objective of this plan is to incorporate the obligations of the Minamata Convention into national legislation in order to ensure the effective management of the Convention at the national level. The plan will utilize, wherever possible, existing acts and regulations and relevant institutions, instead of promoting the development of a separate legislation. After assessment of the gaps in the existing regulatory framework, the plan will seek amendments or annexation of certain provisions in order to comply with the requirements of the Minamata convention. Regarding institutions, the plan will address potential capacity constraints and provide recommendations to improve their respective functions.	
Baseline findings from the initial assessment	
It has been assessed that the policy, regulatory and institutional framework of Bangladesh is broadly aligned with the provisions of the Minamata Convention. However, several gaps have been identified in the initial assessment and the proposed plan aims towards filling those gaps.	
Convention articles addressed and their requirements	
Article 3	Obtain information of stocks of mercury and mercury compounds, and mercury supply in facilities using mercury.
Article 4	Mercury-added products, Annex A Part I; Import of products to be prohibited by the end of 2020.
Article 5	Not to allow new facilities from using mercury in the processes listed in Annex B and for existing processes, to obtain information of mercury compound use and control measures.
Article 8	Amend existing regulations or formulate new regulations to propose strict mercury emission standards to control or reduce mercury emissions from existing sources and ensure best environmental practices are followed for new sources listed in Annex D.
Article 11	To manage mercury waste in an environmentally sound manner and to take measures to restrict mercury derived from the treatment or re-use of mercury waste to allowed uses under the convention or environmentally sound disposal.
Article 14	Capacity building, technical assistance and technology transfer; parties to seek cooperation among themselves and external organizations for capacity building and environmentally sound technology.
Article 17	Information exchange to be facilitated between Parties regarding health effects of mercury through a designated national focal point.
Article 18	Public information, awareness and education to be provided to the public to boost understanding of effects of exposure to mercury and to promote alternatives.
Article 19	Research, development and monitoring: Parties to cooperate to conduct research on mercury inventories and releases, modelling and assessing impacts and fate of mercury in the environment and build on existing monitoring networks and existing programmes to undertake the above activities.
Article 21	Parties to report to the COP on measures to implement the Convention.

Activities/Actions	Responsible agencies/stakeholders
Incorporate obligations of the Minamata Convention into existing national legislation through amendments, particularly: (a) Incorporate the provision to keep records of current stocks of mercury in industries in the Hazardous Waste and Ship-breaking Waste Management Rules, 2011 (b) Include the products listed in Part I of Annex A as banned items for import in the Import Policy Order (c) In the Environmental Clearance Application process as per ECR 1997, ensure that processes listed in Annex B do not use mercury (d) Amend ECR 1997 to set industry-specific gaseous emission standards for mercury including standards for brick kilns, coal plants and applicable sources of emissions of mercury and mercury compounds to the atmosphere listed in Annex D (e) Separate directive with respect to monitoring and emission control technology of coal-based power plants need to be developed	MoI (for the import policy order and export policy), DoE to coordinate
Establish a protocol for obtaining environmental clearance before importing mercury.	DoE, NBR, Bangladesh Bank
DoE to enforce "environmental audits" in the industries using the compliance of mercury use policies as a condition for renewal of the license to operate.	DoE
Establishing a monitoring cell at the national level for mercury management in line with the provisions of Minamata Convention including but not limited to: designating an information focal point, assigning staff and allocating resources for the development and implementation of action plans, reporting, information dissemination to public, identifying development assistance programmes, national strategies.	DoE
Establish and maintain a data management system (online) for current stocks of mercury, mercury usage, and emissions of mercury (as waste product). This will aid the reporting of Bangladesh regarding emissions and releases of mercury as well as the reporting on the progress made on the implementation of the Minamata Convention to the Conference of the Parties, as required.	DoE to enforce it in all facilities using mercury and facilities generating and treating hazardous waste as per Hazardous Waste and Ship-breaking Waste Management Rules, 2011
Developing guidelines for environmentally safe operation of incinerators, hazardous waste (e-waste) recycling and re-refining.	DoE
Inclusion of the provision of "Extended Producer Responsibility principle" in the Hazardous Waste and Ship-breaking Waste Management Rules, 2011 in order to foster active industry involvement of the industry to manage hazardous waste.	DoE
Developing a portal for inter-agency database sharing regarding import and export of mercury and mercury compounds.	DoE, NBR, Bangladesh Bank
Formulate mechanisms for implementation of existing guidelines for mercury management in different sectors, amend or modify existing standards if necessary.	DoE
Time Frame of Plan	Short to medium term
Priority of the plan	High

Plan: **2**
Priority: **Moderate**

Phasing down Dental Amalgam	
Objective(s) of the plan	
The objective of the plan is to reduce the use of amalgam as a dental restorative material and to prevent the emission and release to the environment of mercury through dental amalgam waste as much as practicable. The Minamata Convention requires Parties to take measures to reduce the use of dental amalgam and to avoid its emission or release when it becomes waste. Now, absolute elimination of the use of dental amalgam in Bangladesh may not be possible for various reasons, therefore several measures need to be devised which would eventually result in reduced exposure to dental amalgam.	
Baseline findings from the initial assessment	
Dental amalgam remains the preferred dental restorative material in Bangladesh. While dental amalgam mixture is also imported in encapsulated form which generates less waste and is less risky to handle, it requires specialized mixing devices which are not widely available in most dental clinics, particularly in the rural areas. Therefore, purchasing liquid mercury and mixing it with powdered metal alloy mixture remains the most widely used method in Bangladesh. The mercury-free alternatives to dental amalgam are less effective as a restorative material in certain cases, expensive and not widely available. Moreover, dental clinics are not equipped to manage amalgam wastes in an environmentally sound manner resulting in mercury waste being released with waste water or entering landfill through municipal solid waste, much of which may be burnt openly generating mercury emissions.	
Convention articles addressed and their requirements	
Article 4	Mercury-added products, Annex A Part II: Articles to be phased down by taking measures set out in the annex;
Article 11	Wastes to be managed and disposed of in an environmentally sound manner.
Article 14	Capacity building, technical assistance and technology transfer; Parties to cooperate to deliver capacity building and technical assistance, and to promote diffusion of and access to environmentally sound alternative technologies.
Article 18	Public information, awareness and education to be provided to the public to boost understanding of effects of exposure to mercury and to promote alternatives.

Activities/Actions	**Responsible agencies/stakeholders**
Issue directives to dental chambers to prohibit the use of dental amalgam to populations at risk (young children and pregnant women) and to minimize the use in other population groups.	DoE, DGHS, Bangladesh Dental Society
Promote the use of alternative dental restorative materials by capacity building and awareness among dental practitioners (training of dental staff by national dental institutions), providing tax incentives for import of mercury-free restoration materials (increase affordability).	DoE, DGHS, Bangladesh Dental Society, NBR
Develop and implement public awareness campaigns to promote dental health and the prevention of dental caries.	DoE, DGHS, Bangladesh Dental Society
In case of amalgam use, encourage the use in its encapsulated form with automatic mixing device by making it more affordable (tax incentives) and thereby reducing the probability of mercury wastage and exposure by dental practitioners	DoE, NBR, Bangladesh Dental Society
Establish and promote a system for the separate interim storage and collection of amalgam waste from dental clinics, providing occupational health and safety training to workers engaged in such systems.	DoE, DGHS, Dhaka City Corporation, Bangladesh Dental Society
Prepare a national policy and roadmap for phasing out and reducing the use of dental amalgam and managing mercury waste from dental clinics	DoE, DGHS, Bangladesh Dental Society

Time Frame of Plan	Short to medium term
Priority of the plan	Moderate

Plan: **3**
Priority: **High**

Phasing out of mercury-added products	
Objective(s) of the plan	
To encourage the phase out of mercury-added products in domestic use and to avoid the emissions and releases to the environment of mercury contained in phased-out mercury-added products through better solid waste management. Restricting import of certain mercury-added products is addressed in plan 1 through regulatory options. However, there are a range of products which are already in use in Bangladesh which need to be carefully disposed of. At the same time, a certain class of products could be manufactured locally (e.g. skin creams) which may contain mercury as ingredients. This plan addresses these issues specifically.	
Baseline findings from the initial assessment	
A range of mercury-added products are imported and used in Bangladesh. The prohibition on the import of products listed in Annex-A Part I might preclude new products from entering Bangladesh. However, a huge number of these products are currently in use (e.g. CFL bulbs, mercury thermometers and manometers). Efforts to improve energy efficiency have seen some less efficient mercury vapour lamps being replaced with LED lamps, but the old bulbs need to be disposed in an environmentally sound manner. On the other hand, though manufacturing of skin creams is controlled by BSTI standards which limits the concentration of mercury in these products, several products in the market have been found to contain mercury in excess of the standard limit. Also, several brands of skin-creams are produced locally without adhering to the standards and which potentially has a huge consumer base, particularly in rural areas. Lack of enforcement from the regulators and lack of awareness from the consumers are responsible for unabated use of these products. It is also true that information on these mercury-added products is very scarce; extensive surveys and research studies are required to get a realistic idea of the magnitude of the problem. As Bangladesh is not yet a party, the 2020 deadline does not apply but Bangladesh may need to consider the implications of the date. This can be done by controlling imports (as stated in plan 1) to restrict access of these products to the local market. Local manufacturers may need time to adjust manufacturing processes and consumers may need persuasion to change their buying habits. However, as an interim measure, since the public sector is a major procurer of many of these products (particularly medical instruments, batteries and lighting), updating the procurement rules to exclude mercury containing products could be a useful measure.	
Convention articles addressed and their requirements	
Article 4	Mercury-added products, Annex A Part I; Import of products to be prohibited by the end of 2020.
Article 11	Wastes to be managed and disposed of in an environmentally sound manner.
Article 14	Capacity building, technical assistance and technology transfer; Parties to cooperate to deliver capacity building and technical assistance, and to promote diffusion of and access to environmentally sound alternative technologies.
Article 17	Information exchange to be facilitated between Parties regarding viable alternatives to mercury-added products.
Article 18	Public information, awareness and education to be provided to the public to boost understanding of effects of exposure to mercury-added products and seek for mercury-free alternatives.

Activities/Actions	Responsible agencies/stakeholders
Creation of interim environmentally-sound storage of mercury-containing waste products such as batteries, lamps, and medical equipment, training of medical waste and domestic waste handlers and recyclers.	DoE, DGHS, City Corporations and municipalities
Raising public awareness to encourage regulation at individual household level and medical facilities regarding use and disposal of mercury-added products.	DoE, NGOs, Consumers Association of Bangladesh (CAB)
Raising awareness on the dangers of using mercury-added skin cream products and restricting market access to skin-whitening creams containing mercury.	DoE, BSTI, NGOs, DNCRP
Undertaking research and study on the pervasiveness of mercury in beauty products and making information available to public.	DoE, DNCRP, academic and research institutions
Increasing enforcement activities (e.g. penalty, seizure of products) against unsafe skin cream and beauty products manufacturing.	DoE, BSTI, DNCRP
Advocating the change of public procurement policies of government institutions to exclude mercury-containing products (CFLs, thermometer, sphygmomanometer, batteries).	DoE
Time Frame of Plan	Medium to long-term
Priority of the plan	High

Plan: **4**
Priority: **Moderate**

Environmentally Sound Management of Solid and Hazardous Wastes	
Objective(s) of the plan	
To seek environmentally sound management (interim storage, other precautionary measures before disposal) of solid and hazardous wastes containing mercury. The plan addresses mercury-containing waste generated from discarded batteries, broken medical equipment, fluorescent lamps which typically gets mixed with domestic solid waste and disposed in a landfill, burnt openly or incinerated.	
Baseline findings from the initial assessment	
The current waste management practice for mercury-added products are not environmentally sound. Since there is no system of waste segregation in practice, mercury-containing batteries and lamps may be disposed along with domestic solid waste which finds their way to landfills and may take various exposure routes from there. A huge fraction of the solid waste collected is burnt openly causing severe air pollution. Medical equipment containing mercury may also be disposed of in similar way. Some healthcare facilities equipped with incinerators may burn hazardous wastes with mercury and cause mercury emissions. Plans 2 and 3 address segregation and collection of mercury wastes to dispose of them in specialized facilities. However, open burning/incineration of solid waste/medical waste containing mercury needs to be stopped and the segregated mercury waste needs to be stored in an environmentally sound manner before disposal. The current practice is not compatible with environmentally sound disposal as established by the Basel Convention, to which Bangladesh is Party.	
Convention articles addressed and their requirements	
Article 11	Wastes to be managed and disposed of in an environmentally sound manner.
Article 14	Capacity building, technical assistance and technology transfer; Parties to cooperate to deliver capacity building and technical assistance, and to promote diffusion of and access to environmentally sound alternative technologies.

Activities/Actions	Responsible agencies/stakeholders
Eliminate open burning of solid and hazardous waste in dump sites, formulate and endorse solid waste management rules.	City Corporations and municipalities, DoE to formulate guidelines/rules
Construct centralized facilities for their safe storage and management of E-waste and medical waste and follow the best available techniques to segregate and dispose mercury waste.	City Corporations and municipalities, DoE to formulate guidelines/rules
Provide Occupational Health and Safety training for workers engaged in hazardous waste management including mercury in centralized facilities.	City Corporations and municipalities, DoE
Prevent incineration of mercury waste in healthcare facilities, segregating mercury waste from medical waste and sending them to specialized facilities.	DGHS, DoE, Waste collection companies
Time Frame of Plan	Medium to long-term
Priority of the plan	Moderate

Plan: **5**
Priority: **High**

Research and Development, information dissemination and mass awareness	
Objective(s) of the plan	
To initiate comprehensive research studies to assess the prevalence of mercury in mercury-added products, to identify populations at risk of mercury contamination, health risk assessments, fate and cycling of mercury in the environment, socio-economic and cultural impacts and occupational exposure burden on people working in waste management. The results of these studies also need to be communicated to the people and develop awareness. The outcome from this plan will help improve local health services by assisting them in the identification and treatment of populations vulnerable to mercury.	
Baseline findings from the initial assessment	
There is not enough evidence to suggest that mercury intoxication has become a threat to human health in the Bangladesh context. This is mainly because very limited research has been conducted in this field and the available data on mercury from the industries and manufacturers are relatively scarce. In order to make the mercury inventory more accurate, detailed survey and analysis in mercury-added products (paints, skin creams and beauty products in particular) need to be conducted. Research needs to be conducted on probable exposure from imported fish as consumption of these are on the rise in Bangladesh and the mercury content in them are unknown. At the same time, the capacity of local institutions and government organizations to reliably analyze mercury needs to be increased and this includes purchase of equipment and developing protocols for analysis etc.	
Convention articles addressed and their requirements	
Article 14	Capacity building, technical assistance and technology transfer; Parties to cooperate to deliver capacity building and technical assistance, research and development, strategies for mass awareness.
Article 16	Health aspects – promote research and development and implement strategies to identify and protect populations at risk and to conduct mass awareness programs.
Article 17	Information exchange - information on the health and safety of humans and the environment to be exchanged within Parties
Article 18	Public information and awareness building related to the effects of exposure to mercury and mercury compounds on human health and the environment, available alternatives of mercury-added products
Article 19	Research, development and monitoring: Parties to cooperate to develop and improve inventories, modeling and geographically representative monitoring, impacts on human health and the environment, social, economic and cultural impacts, information on mercury cycling, transport, transformation and fate in the environment.

Activities/Actions	Responsible agencies/stakeholders
Funding local research to conduct studies on the extent of contamination of mercury on various mercury-added products (e.g. skin-whitening creams, paints) and imported fishes in Bangladesh by laboratory testing.	DoE to arrange funding, research organizations in Bangladesh to carry out research, BSTI to develop protocols for testing and lending technical expertise and lab facilities
Design and conduct surveys of the mercury burden on vulnerable groups, including those subject to occupational exposure.	DoE, DGHS
Build expertise for research on mercury at the local level, increase capacity for better detection and analysis (equipment and technical manpower) of mercury in local institutions and participate in international networks conducting research on mercury.	DoE, DGHS, BSTI, BCSIR
Develop capacity (people and equipment) for monitoring gaseous emissions of mercury from power plants, brick kilns, incinerators.	DoE, BSTI, BCSIR
Time Frame of Plan	Short to medium term
Priority of the plan	High

CHAPTER 7:
MAINSTREAMING NATIONAL MERCURY PRIORITIES

The action plan framed in Chapter 6 can be mainstreamed if the proposed actions are incorporated in the national development planning process. The national five-year plan (FYP) serves as the primary development blueprint for Bangladesh which provides a series of social and economic development initiatives. It is prepared by the Planning Commission of the Bangladesh Government, feeding in programmes and activities proposed by different ministries which seek budgetary allocations from the Annual Development Program. Incorporating mercury priorities in the list of programmes proposed by the Ministry of Environment, Forest and Climate Change is a way of mainstreaming national mercury priorities. However, external funding (Development Partners, multilateral donors) can be sought for programmes and activities not incorporated in the FYP.

7.1 Linkage with the 7th five year plan

Since the mainstreaming would happen after the action plan is endorsed by the Ministry, it is difficult to provide mainstreaming related information at the time of the preparation of the MIA report. At the time of the preparation of the MIA report, the 7th Five Year Plan[84] (time frame: FY2016-FY2020) was being implemented. In this section, a discussion is included of how different provisions in the existing 7th Five Year Plan[84] can be directly or indirectly linked to some of the national action plan activities proposed in this report. The subsequent section highlights how mercury priorities can be addressed under the current context and future development planning processes.

Key aspects of the 7th FYP are to provide environmentally sustainable growth, maintain environment friendly development and mitigate the impacts of climate change. Implementation of these sectors requires proper management of toxic and hazardous chemicals and wastes, improving air quality, reducing water pollution and enhancing the environment and human health in general.

Disposal of used products such as compact fluorescent lamps and button cell batteries leads to the release of mercury compounds into the ground, water and air resulting in serious environmental pollution. Keeping this in view, it is specifically mentioned in the 7th FYP that "Bangladesh has signed Minamata Convention on Mercury and an initial assessment will be performed in order to understand the magnitude of mercury pollution in the country and then will develop an Action Plan". Therefore, the current undertaking of preparation of national mercury profile and action plan is already aligned with the 7th FYP.

Some programmes and activities in the 7th FYP can be linked to the mercury priority action areas though those programmes may not have been formulated with the purpose of mainstreaming mercury management measures. The Table below presents some of the related activities mentioned in 7FYP.

[84] 7th Five Year Plan: FY2016-FY2020: Accelerating Growth, Empowering Citizens. Bangladesh Planning Commission, Government of the People's Republic of Bangladesh

Table 7.1 Link between the 7th Five Year Plan activities and the mercury action plan

Mercury Management Activities	Actual text included in the 7th Five Year Plan (2016-2020)
Keeping records of current stocks of mercury in industries in the Hazardous Waste Management Rules, 2011 (Plan 1 Activity 1)	**Section 8.6: Activity – *Natural Resource Management:*** Issue 3: For effective monitoring and environmental compliance, a comprehensive public database will be developed for all firms. DOE will take up the responsibility for setting up a more comprehensive public database on industry environmental compliance. **Section 8.6: Activity – *Governance (Environment):*** Issue 6: Strengthening ambient environment monitoring network and establishing a strong environmental data base.
Amend ECR 1997 to set industry-specific gaseous emission standards for mercury including standards for brick kilns, coal plants and applicable processes listed in Annex B of the Minamata Convention (Plan 1 Activity 1)	**Section 8.6: Activity – *Governance (Environment):*** Issue 2: Revision of standards and development of protocol for sampling & monitoring. **Section 8.6: Activity – *Governance (Environment):*** Issue 5: i) Updating the Environment Policy 1992 taking care of all emerging issues (national, regional & international) with an aim to guide the country's development, economic growth with environmental sustainability involving all relevant stakeholders. ii) Updating National Environmental Management Action Plan (NEMAP) through participatory planning process and devising as new Action Plan taking care of all the emerging issues. **Section 8.6: Activity – *Pollution Control:*** Issue 6: ii) Strict enforcement of Brick Kiln Act 2013 for phasing out of traditional brick kiln. **Section 8.3:** One of the Key Objectives under the 7th FYP is - To meet national air and water quality standards, i) Implementation of emission, effluent and waste management strategy. ii) Introduce energy efficient affordable technology.
Separate directive with respect to monitoring and emission control technology of coal-based power plants need to be developed (Plan 1 Activity 1)	**Section 8.3:** One of the Key Objectives under the 7th FYP is to meet national air and water quality standards, monitor, control and prevent environmental pollution and degradation related to air, water and soil. **Section 8.7.2(3):** Since the Government intends to generate more than 20,000 MW from coal by 2030, it accepts that greater attention must be provided to the choice of technology by ensuring that high efficiency options are adopted for energy generation.

Mercury Management Activities	Actual text included in the 7th Five Year Plan (2016-2020)
Developing guidelines for environmentally safe operation of incinerators, hazardous waste recycling and re-refining (Plan 1 Activity 5)	**Section 8.6: Activity – *Pollution Control:*** Issue 4: Design and implement plans on solid waste management in accordance with the 4R policy (reduce, reuse, recycle, reclaim). **Section 8.6: Activity – *Governance (Environment):*** Issue 2: Strengthening of all sectoral ministries and agencies to integrate environmental management and issues into their core operations.
Financing local research to gain more understanding on the prevalence of mercury in various mercury-added products in Bangladesh and their potential health effects (Plan 1 Activity 6)	**Section 8.6: Article - *Addressing Knowledge Gap for Better Environmental Management:*** The Government will facilitate research that looks into effective management of wastes in landfills, which can be used by concerned authorities for policymaking. **Section 8.6: Activity – *Governance (Environment):*** Issue 2: Establishing criteria / methodology for assessment of loss & damage of the environment by various factors including effluent discharge and / or air pollution.
Separation, collection and environmentally sound storage of mercury-added products such as batteries, lamps or medical equipment, by electronic waste, medical waste and domestic waste handlers and recyclers, preparation and adoption of guidelines for safe use and disposal (Plan 3 Activity 1)	**Section 8.6: Activity – *Pollution Control:*** Issue 4: i) Design and implement plans on solid waste management in accordance with the 4R policy (reduce, reuse, recycle, reclaim). ii)Removal of neighbourhood dumping sites and introducing of private/community waste collectors to carry segregated waste to central dumping sites or transfer stations. **Section 8.6: Activity – *Pollution Control:*** Issue 2: Strict compliance to ensure that all ships imported for breaking are decontaminated prior to entering Bangladesh waters and that breaking only takes place in authorized zones after passing environmental checks. **Section 8.3:** One of the Key Objectives under the 7th FYP is to ensure cities are sustainable and more efficient, with development following appropriately structured plans, strengthening the capability of public and private sectors to manage environmental concerns.
Increasing enforcement activities (e.g. penalty, seizure of products) against unsafe skin cream and beauty products manufacturing (Plan 3 Activity 5)	**Section 8.6: Activity – *Governance (Environment):*** Issue 2: Strengthening enforcement and monitoring capacity of DoE.
Eliminate open burning of solid and hazardous waste in dump sites, formulate and endorse solid waste management rules (Plan 4 Activity 1)	**Section 8.3:** One of the Key Objectives under the 7th FYP is - To address environmental health, ensure proper waste management system in place for good environmental health. **Section 8.6: Activity – *Governance (Environment):*** Issue 2: Strengthening of all sectoral ministries and agencies to integrate environmental management and issues into their core operations. **Section 8.6:** ***Article - Addressing Knowledge Gap for Better Environmental Management:*** GoB will facilitate research that looks into effective management of wastes in landfills, which can be used by concerned authorities for policymaking.

Mercury Management Activities	Actual text included in the 7th Five Year Plan (2016-2020)
Provide OHS training for workers engaged in hazardous waste management including mercury in centralized facilities (Plan 4 Activity 3)	**Section 8.6: Activity – *Pollution Control:*** Issue 3: The Government will take measures to improve medical waste management in the country by delivering specific disposal training and with strict enforcement of separate collection & disposal systems.
Prevent incineration of mercury waste in healthcare facilities, segregating mercury waste from medical waste and sending them to specialized facilities (Plan 4 Activity 4)	**Section 8.6: Activity – *Pollution Control:*** Issue 3: i) The Government will take measures to improve medical waste management in the country by delivering specific disposal training and with strict enforcement of separate collection & disposal systems. ii) The Government will establish environmentally acceptable treatment centers for infectious wastes in each divisional city. iii) Strict compliance of Medical Waste Rules along with in-house and off-the-house management should be established.

Activity-based budget allocations and monitoring indicators are not available in the 7th FYP. However, it is stated that the fund provided by the Annual Development Programme for the entire sector of Environment and Climate Change during 7th FYP for the years 2016, 2017, 2018, 2019 and 2020 were 4.8, 6.8, 7.7, 8.6 and 9.6 billion Taka respectively (100 Taka is about USD1.19). Information on the status of all the activities proposed in the 7th FYP related to environmental management that are directly or indirectly related to mercury management is not available at this moment, however, the following initiatives led by the DoE are in congruence with the activities proposed in the 7th FYP:

- DoE had undertaken the 'Minamata Initial Assessment' in line with the obligations as a signatory of the Minamata Convention as well as one of the activities proposed in the 7th FYP. The MIA project has developed a national mercury profile and an action plan for mercury management.

- DoE has updated the National Environmental Policy 1992 (currently termed as 'National Environmental Policy 2017') which sets out national environmental sustainability goals in key development sectors and considers emerging issues (national, regional & international) with an aim to guide the country's development and economic growth.

- DoE has drafted the Environmental Conservation Rules 1997 (currently termed as 'Environmental Conservation Rules 2017') with a set of revised standards on air, water and land emissions of pollutants and it is pending approval in the Ministry.

- DoE has developed an Action Plan for Short-lived climate pollutants (SLCPs) which addresses among many sectors, activities to reduce/eliminate open burning of municipal solid waste and replacing traditional coal-based brick kilns with improved kilns. Both of these activities have impact on reduction of mercury releases. The SLCP Action Plan is pending approval from the Ministry.

7.2 The way forward

In order to oversee the preparation of the mercury initial assessment, a Mercury Co-ordination Committee (MCC) headed by DG, DoE was formed. The MCC includes members from Governmental and non-governmental entities such as the Ministry of Health, Bangladesh Dental Society, BSTI, the private sector, academia and NGOs. The primary purpose of the MCC was to validate all individual reports and the final MIA report. When the Minamata Convention is ratified by Bangladesh, the Ministry of Environment, Forest and Climate Change will set up a Mercury Management and Co-ordination Cell (MMCC) at the Department of Environment (DoE), which will be able to continue and learn from the work of the MCC. The MMCC will be headed by a Director of DoE who will also serve as the national focal point for the Minamata Convention. The MMCC will be staffed by relevant DoE officials and/or consultants to support the activities of the Director. The activities and responsibilities of the MMCC focal point will be the following:

- Ensure that the obligations of the Minamata Convention are taken seriously at senior government levels of concerned Ministries.

- Foster inter-ministerial collaboration and formulate joint strategies with other sectors involved in the Action Plan.

- Propose and undertake programmes associated with the activities under the Mercury Action Plan, monitor and track progress of programmes being implemented.

- Keep track of the national development planning schedule and process, identify when the critical times are to inform development of national development plans (e.g. the 8th FYP), and prepare specific text for inclusion of the mercury priorities in Bangladesh into relevant sections of the FYP or other planning documents.

- Updating of the national mercury inventory, whenever required, ensuring lessons are learnt from the inventory process for this initial assessment report and other, similar inventory processes.

- Report the national status of programmes implemented and the national mercury profile in national and international meetings.

Chapter VI identifies five priority areas for implementation for the management of mercury in Bangladesh. It also states what specific activities would be associated in each of these areas and the responsible agencies/ministries and other parties. Table 7.2 highlights how the different mercury priority areas in this action plan can be addressed for mainstreaming in future by the MMCC.

Table 7.2 Mainstreaming national priorities for mercury management

Plan	Priority Areas for Action	Priority	Initiatives to be taken for mainstreaming
1	Legal and institutional arrangements to implement the convention at the national level	High	Some of the activities are a part of on-going processes in DoE. The Mercury Management and Coordination Cell (MMCC) at DoE needs to monitor the status of specific activities proposed under the plan.
2	Phasing down of dental amalgam	Moderate	Not addressed in any other national plans and policies. The MMCC at DoE will take actions to generate awareness and formulate strategies with relevant stakeholders by engaging with Ministry of Health and Bangladesh Dental Society. GEF is currently providing support through the MIA project for the development of an overall assessment and awareness raising activities. However, continued external support (multilateral donor agencies, development banks, among others) will be required to carry out the activities proposed in the action plan (Ref: Action plan 2 of Chapter VI). Some activities may be incorporated in the next cycle of development planning (e.g. the 8th FYP)
3	Phasing out of mercury-added products	High	The DoE has to engage with BSTI in order to find effective means of enforcement against the sale and distribution of mercury-added skin creams. Regarding disposal and recycling of CFL bulbs, the guideline published by Power Cell needs to be mainstreamed by DoE.
4	Environmentally sound management of solid and hazardous wastes	Moderate	Some activities proposed in the 7th FYP partially addresses the measures under this plan (Section 8.6: Activity – Pollution Control: management of domestic and hazardous waste). However, the MMCC of DoE need to initiate programmes addressing the activities under this plan and liaise with other ministries so that their activities are in line with the requirements of this action plan. Some activities may be incorporated in the next cycle of development planning and budgetary allocations need to be made. GEF is currently providing some support for awareness raising, however, external support (in the form of grants from international agencies) will be required to carry out activities under the action plan.
5	Research and Development, information dissemination and mass awareness	High	GEF is currently providing some support for awareness raising under the MIA project. However, national allocation on Research and Development overall in the budget is very low. In order to carry out R&D under the proposed plan, external funding will be required, in addition to use of international and regional research so that duplication is not always necessary.

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BDS 1382:2015 Bangladesh Standard Specification for Skin creams (Second revision)

Legislation

Environment Conservation Rules 1997

Hazardous Waste and Ship-breaking Waste Management Rules, 2011

Biomedical Waste Management Rules 2008,

Bangladesh Standards and Guidelines for Sludge Management 2015

Bangladesh Labor Act, 2006

Bangladesh Export Policy, 2015-2018 and Import Policy Order, 2015-2018

The Bangladesh Standards and Testing Institution Ordinance,1985
National Environmental Policy 2013

National 3R Strategy for Waste Management 2009

National Health Policy 2011

National Industrial Policy 2010

ANNEXES

Annex A: Policy and regulatory framework mapping with the provisions of the Minamata Convention

The policy and regulatory framework assessment is presented in a tabular form below which shows a summary assessment of existing national policies and regulatory measures (in place and under development), their scope and to what extent they already meet the requirements as stipulated in the provisions of the Minamata Convention. In addition, these tables also provide an analysis of existing gaps that would need to be addressed to ensure compliance with the Convention.

Article 3: Mercury supply sources and trade		
Description of the Article and applicability in the context of Bangladesh		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
3.3	Not allow new primary mercury mining.	Not applicable as Bangladesh has no mercury mines and there is no artisanal and small-scale gold mining
3.4	Phase out existing primary mercury mining within 15 years.	
	Prevent the import and use of mercury from primary mercury mining for artisanal and small-scale gold mining (ASGM).	
3.5(b)	Restrict the use of excess mercury from decommissioning chlor-alkali plants, and require environmentally sound disposal.	Not Applicable (Chlor alkali plants in Bangladesh do not use mercury in its reactor)
3.5(a)	Obtain information on stocks of mercury or mercury compounds exceeding 50 metric tons (MT), and mercury supply generating stocks exceeding 10 MT/yr.	Applicable
3.6	Not allow the export of mercury unless the importing country provides written Consent and the mercury is for an allowed use under the convention or environmentally sound storage, and all other conditions of Article 3.6 are met.	Not applicable as Bangladesh do not export mercury

Policy and regulatory measures in place that enable Bangladesh to comply with the above listed provisions:	
Title, ref. no. and date of relevant Policy and Regulatory Measure	What aspects of the above provisions are being addressed by policy/regulatory measure
Bangladesh Environment Conservation Act, 1995	Article 12 states that no industrial unit or project shall be established or undertaken without obtaining an Environmental Clearance Certificate (ECC).
Environment Conservation Rules, 1997	Sets out procedures for obtaining ECC. Obtaining clearance would require exact description and probable quantities of raw materials and their supply including mercury.
Hazardous waste and ship-breaking Waste Management Rules, 2011	Schedule-4: Identifies certain mercury compounds as 'hazardous chemicals' (Mercuric chloride, Mercuric Oxide, Mercury Acetate, Mercury fulminate, Mercury methyl chloride) Article 12: directs the industries to maintain hazardous material safety data sheet

Hazardous waste and ship-breaking Waste Management Rules, 2011	Article 14(7): if hazardous materials are imported, the industry is directed the maintain records of its amount according to schedule-9 of the Rules
National 3R strategy for Waste Management, 2009	Section 5.22 states that Industries will be required to store hazardous waste for a period not exceeding 90 days and shall maintain a record of sale, transfer, storage, recycling and reprocessing of such wastes unless agreed by DoE. It emphasized the responsibility of industries to explore options/opportunities of reusing, recovery and recycling of hazardous waste in an environmentally sound manner. This could be Establishment of 'Waste Exchange Banks/ Centers', channeling of wastes containing toxic metals for recovery, (mercury from thermometers and fluorescent tube lights). It also states that DoE will develop on-line tracking system for movement of hazardous waste from generation to the disposal/ recovery/ recycle stage.
Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions	
Although ECR 1997 necessitates stating the raw material and fuel requirement for the industry during the process of environmental clearance, it does not explicitly prescribe stocktaking of hazardous contaminants (e.g. Mercury) used in the process as a requirement for ECC application or renewal. Also ECR 1997 does not state clearly the management strategy for excess hazardous substances (e.g. Mercury) from industry. Also ECR 1997 does not provide any directive for decommissioning plants. The hazardous waste and ship-breaking waste Management Rules, 2011 directs industries to keep records of hazardous materials imported but not current stocks of mercury. The national 3R strategy, however, indicates that the DoE may be involved in online monitoring of hazardous chemicals and keep track of the hazardous materials inventory managed by the industries. However, no such mechanism is yet in place in DoE.	

Article 4: Mercury-added products		
Description of the Article and applicability in the context of Bangladesh		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
4.1	Not allow the manufacture, import, and export of products listed in Part I of Annex A not otherwise excluded following the phase out date listed in the Annex	Applicable
4.3	Phase down the use of dental amalgam through two or more measures listed in Part II of Annex A	Applicable
4.5	Take measures to prevent the incorporation of products listed in Part I of Annex A (i.e., switches and relays, batteries) into larger, assembled products	Applicable
4.6	Discourage the manufacture and distribution of new mercury product types	Applicable
Policy and regulatory measures in place that enable Bangladesh to comply with the above listed provisions:		
Title, ref. no. and date of relevant Policy and Regulatory Measure	What aspects of the above provisions are being addressed by policy/regulatory measure	
Bangladesh Environment Conservation Act, 1995	Article 4 states that The Director General can give advice or issue directions to the concerned person regarding the environmentally sound use, storage, transportation, import and export of a hazardous substance or its components.	
Bangladesh Export Policy, 2015-2018 (Ministry of Commerce)	Lists the type of allowable and prohibited export items in Bangladesh.	

Bangladesh Import Policy Order, 2015-2018 (Ministry of Commerce)	Lists the type of allowable import items and the standards they should comply with. Such as: • Batteries pursuant to BDS IEC 60086 (Part-1 to Part-5):2005 Switches for household and similar fixed electrical (pursuant to BDS IEC 60669-1:2007) • Double- capped Fluorescent Lamps (pursuant to BDS-IEC 60081 :2006) • Skin Creams (pursuant to BDS 1382: 2011) Part A (List of controlled goods) states the types of banned and allowable insecticides/pesticides that can be imported Part B (List of prohibited goods) states the chemical insecticides and industrial chemicals under the Stockholm Convention on Persistent Organic Pollutants (POPs)
The Bangladesh Standards and Testing Institution Ordinance,1985	Adoption of standards related to materials, commodities and products in the market and provisions to secure their compliance. Sets out standards whether the product is suitable for local consumption, import and export. The BSTI seal is awarded to products conforming to such standards. The Government may, in consultation with the Institution, prohibit the sale and distribution of any article specified therein which does not conform to the Bangladesh Standard established by the Institution in relation to that article.
Hazardous waste and ship-breaking Waste Management Rules, 2011	Schedule-10 (Hazardous wastes prohibited for import and export) lists Mercury (A1010 Basel convention) and wastes having mercury: Mercury compounds as constituents or contaminants (A1030 Basel Convention) Schedule-14 states that in case of importing hazardous materials, before opening the letter of credit and before shipment, clearance from the Department of Environment has to be obtained. The schedule also states several conditions and formalities for obtaining clearance from the DoE. Schedule-4 lists some hazardous wastes applicable for imports and exports in line with Basel convention which has the following wastes which specifically mentions mercury: - Part 1, list A, item A1180: waste electrical and electronic assembles or scrap containing compounds such as accumulators and other batteries included in list A, mercury switches, glass from cathode-ray tubes and other activated glass and PCB capacitors, or contaminated with schedule-2 constituents (e.g. mercury) to an extent that they exhibit hazard characteristics indicated in part B of this schedule. - Part 1, list B, item B1090: used batteries conforming to specification, excluding those made with mercury) - Part 1,List B, item B1110: waste electrical and electronic assemblies scrap (including printed circuit boards) not containing components such as accumulators and other batteries on list A, mercury switches, glass from cathode-ray tubes and other activated glass and PCB-capacitors, or not contaminated with constituents (e.g. Mercury) or from which these have been removed, to an extent that they do not possess any of the constituents mentioned in schedule 2 to the extent of concentration limits specified therein. Schedule 3 lists mercury and mercury compounds as hazardous (Class A) if the concentration exceeds 50 mg/kg

Consumers' Right Act 2009	Article 29 of this act prohibits manufacturing, selling etc. of consumer goods injurious to human health. This Act also advocates making consumers aware of such harmful products. Mercury containing skin whitening creams can be a candidate for banning sale and manufacture under this Act.
Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions	
The items listed in Part I of Annex A are not specifically banned except insecticides. (i.e. not listed in the List 'A' of Bangladesh Import Policy Order, 2015-2018). Items such as batteries, fluorescent lamps, skin cream import are allowable pursuant to BDS standards. For the rest of the items, no standards are available or not specifically mentioned in the banned list. The items listed in Part I of Annex A are not specifically banned for export (i.e. not listed in the Annex-1 of Bangladesh Export Policy, 2015-2018). Mechanism for Phasing down the use of dental amalgam in the medical field is not mentioned in any national strategy, policy or action plans. There are also no policies or plans to prevent the incorporation of products listed in Part I of Annex A into larger, assembled products.	

Article 5: Manufacturing processes in which mercury or mercury compounds are used		
Description of the Article and applicability in the context of Bangladesh		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
5.2	Not allow the use of mercury or mercury compounds in the manufacturing processes listed in Part I of Annex B.	Not Applicable (Bangladesh only has chlor-alkali plants but they do not use mercury in their reactors)
5.3	Restrict (as specified in the Annex) the use of mercury in the processes listed in Part II of Annex B.	Not applicable as there are no such plants listed in part II of Annex in Bangladesh
5.4	Not allow new facilities from using mercury in the processes listed in Annex B, except facilities using mercury catalysts to produce polyurethane.	Applicable
5.5	For facilities with processes listed in Annex B, identify and obtain information on mercury or mercury compound use; and control mercury emissions to air, and releases to land and water.	Applicable
5.7	Discourage new uses of mercury in industrial processes.	Applicable
Policy and regulatory measures in place that enable Bangladesh to comply with the above listed provisions:		
Title, ref. no. and date of relevant Policy and Regulatory Measure	What aspects of the above provisions are being addressed by policy/regulatory measure	
Bangladesh Environment Conservation Act, 1995	Article 4 states that The Director General can examine any equipment, manufacturing or other processes, ingredients, or substance for the purpose of improvement of the environment, control and mitigation of pollution. Any facility using mercury in their process has to disclose the relevant information. Article 12 states that all industries have to obtain an Environmental Clearance Certificate (ECC).	

Environment Conservation Rules, 1997	Since all new industries will have to obtain ECC, it will have to disclose details of all raw materials used (including mercury). That can be a checkpoint on not using mercury in new industries and processes. In case of existing industries, the EMP should consist feasible mitigation measures to control mercury emissions to air, and releases to land and water
Bangladesh Standards and Testing Institution (Management System Certification) Rules 2009	Provisions for providing management system licenses to entities, rules for application and requirements to obtain such license. The application requires the proponent to furnish details on hazardous materials management (quantity generated, type of material, removal/minimization measures). If mercury is used in the process and the proponent wants to apply for certification, he would have to furnish the details of such.
Hazardous waste and ship-breaking Waste Management Rules, 2011	Article 5 states that one of the responsibilities of the director of the hazardous waste and shipbreaking waste management cell of DoE is to maintain detailed quantitative information on products and wastes generated from facilities using hazardous materials and waste which is pursuant with Article 5.5 of the Minamata convention.
Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions	
No policy or regulatory measure in Bangladesh directly discourages new uses of mercury in industrial processes or Not allowing new facilities from using mercury in the processes. BSTI is in a position to obtain such information only when the proponent applies for the management system certification. However, if the proponent does not wish to apply for such license, BSTI will not have that information. In that case, it needs to be ensured that the necessary information on mercury is furnished in the environmental clearance application, obtaining of which is mandatory for all industries in Bangladesh.	

Article 6: Exemptions available to a party upon request		
Description of the Article and applicability in the context of Bangladesh		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
6.1	May register for one or more exemptions from the phase-out dates listed in Annex A and Annex B.	Applicable
Policy and regulatory measures in place that enable Bangladesh to comply with the above listed provisions:		
Title, ref. no. and date of relevant Policy and Regulatory Measure	What aspects of the above provisions are being addressed by policy/regulatory measure	
No specific policies or regulatory measures related to the article	N/A	
Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions		
No specific policies or regulatory measures related to the article.		

Article 7: Artisanal and Small-scale Gold Mining (ASGM)		
Description of the Article and applicability in the context of Bangladesh		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
7.2	Take measures to reduce, and where feasible, eliminate mercury and mercury compound use, emissions (to air), and releases (to land and water) associated with ASGM	Not Applicable (there are no ASGM in Bangladesh)
Policy and regulatory measures in place that enable Bangladesh to comply with the above listed provisions:		
Title, ref. no. and date of relevant Policy and Regulatory Measure	What aspects of the above provisions are being addressed by policy/regulatory measure	
N/A	N/A	
Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions		
N/A		

Article 8: Emissions		
Description of the Article and applicability in the context of Bangladesh		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
8.4	Require best available techniques/best environmental practices (BAT/BEP) or associated emission limit values (ELVs) for new (as defined in Article 8.2(c)) sources listed in Annex D (coal-fired power plants, coal-fired industrial boilers, non-ferrous metal smelting and roasting processes, waste incineration, and cement production).	Applicable
8.5	Require one or more measures identified in Article 8.5 to control/reduce mercury emissions from existing sources listed in Annex D, which shall be operational at the source within 10 years.	Applicable
8.7	Require monitoring/reporting and otherwise establish a mercury emissions inventory for sources listed in Annex D.	Applicable
Policy and regulatory measures in place that enable Bangladesh to comply with the above listed provisions:		
Title, ref. no. and date of relevant Policy and Regulatory Measure	What aspects of the above provisions are being addressed by policy/regulatory measure	
Bangladesh Environment Conservation Act, 1995	Provisions for enforcement measures (fines/penalties etc) for entities causing harm to the ecosystem, provisions for seeking compensation of affected parties, provision to formulate Rules under which emission standards are prescribed.	

Environment Conservation Rules (ECR), 1997	Sets out standards for emission limit values of gaseous contaminants for industrial projects including - Coal power plants (Schedule 11) - Industrial boilers (Schedule 12) - Cement Industry (Schedule 12) ECR 1997 does not have any gaseous emission limit values for non-ferrous metal smelting and roasting processes, waste incineration. Schedule-11 specifies Mercury Standards for Gaseous Emission from Industries or Projects. A mercury emission limit of 0.2 mg/m3 is allowed for gaseous emissions. Regarding liquid emissions from industrial projects, schedule-10 (Standards for Waste From Industrial Units or Projects Waste) provides allowable concentrations of Mercury. It is prescribed that 0.01 mg/L of Hg is allowed in project waste which are discharged in inland waters, public sewers and irrigated land. Industries are responsible for applying best available techniques/best environmental practices (BAT/BEP) in order to achieve the emission standards
Brick Kiln Act 2013	Relevant in this case because coal is the primary fuel in brick kilns and there may be mercury emissions from burning coal. This act requires the proponent to apply best available techniques/best environmental practices (BAT/BEP) (e.g improved kilns as opposed to traditional kilns) to reduce emissions. Reducing emissions from brick kilns will also reduce the emissions of mercury.
Hazardous waste and ship-breaking waste management Rules, 2011	Schedule-20 states that hazardous waste generating industries - Cannot dispose or sell their waste to anyone who does not have clearance - Cannot store waste more than 90 days - Must provide annual report to the Director of the waste management cell of DoE - All recyclers, re-refiners and incinerators also submit their annual reports to the Director - All hazardous waste generators, recyclers, re-refiners must use environment-friendly technology and processes
National Action Plan for Short-lived Climate Pollutants, 2017 (draft)	One of the mitigation measures to reduce black carbon is to convert all traditional brick kilns (coal-based) to improved brick kilns. This will reduce black carbon, particulate matter which shows huge co-benefits in terms of deaths avoided and reduce of GHG affecting climate change. Since improved kilns will also reduce mercury emissions from coal-burning, the action plan shows that huge co-benefits can be obtained (requirement 8.5 of Minamata Convention).
Bangladesh Power Sector Master Plan	The future energy demand, to a large extent, will be met by coal-fired power plants. Coal-burning will generate mercury emissions and these plants will have to be equipped with the most efficient burning technology as well as emission-control measures.

Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions
Although emission limit values are set out in the standards in ECR 1997, these are generic and not industry-specific. Separate emission standards may be developed for industrial projects listed in Annex D. Under the brick kiln act 2013, no standards have yet been set on any gaseous emissions. There are no specific directives for emission control in coal-based power plants in ECR 1997. Separate directive with respect to monitoring responsibilities and emission-control technology adoption for industry-owners need to be developed and be made legally binding. Emission standards for Mercury also need to be set out for such power plants.

Article 9: Releases to land and water		
Description of the Article and applicability in the context of Bangladesh		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
9.3, 9.6	Require reporting or otherwise obtain information as needed to identify significant sources of mercury/mercury compound releases to land or water, and to maintain an inventory of releases from the sources identified.	Applicable
9.5	Take one or more measures specified in Article 9.5 to control/reduce mercury and mercury compound releases to land and water from significant sources it identifies.	Applicable
Policy and regulatory measures in place that enable Bangladesh to comply with the above listed provisions:		
Title, ref. no. and date of relevant Policy and Regulatory Measure	What aspects of the above provisions are being addressed by policy/regulatory measure	
National Industrial Policy, 2010 (Ministry of Industries)	For that Government will track the impact of industrial projects on environment	
Bangladesh Environment Conservation Act, 1995	Provisions for enforcement measures (fines/penalties etc) for entities causing harm to the ecosystem, provisions for seeking compensation of affected parties, provision to formulate Rules under which emission standards are prescribed.	
Environment Conservation Rules (ECR), 1997	Sets Standards for liquid emissions from industrial projects. Schedule-10 (Standards for Waste from Industrial Units or Projects Waste) provides allowable concentrations of Mercury in liquid emissions. It is prescribed that 0.01 mg/L of Hg is allowed in project waste which are discharged in inland waters, public sewers and irrigated land. Industries are responsible for applying best available techniques/ best environmental practices (BAT/BEP) in order to control/reduce mercury and mercury compound releases to water so that it satisfies the standards in Schedule-10	

Bangladesh Standards and Guidelines for Sludge Management, 2015	This document provides classification of sludge based on hazard criteria and prescribes various management options for sludge with a primary focus on land application. Mercury-containing sludge may be categorized as "Category C" sludge (Sludge from industry including sludge from CETP belonging to the category of hazardous waste). Two management options are prescribed for such sludge: controlled landfill and thermal incineration. A landfill class 3 is prescribed for disposing hazardous waste (Ref Table 3 of the guideline). Also prescribes: - Mercury limits of sludge for use as compost/fertilizer (8 mg/kg in sludge and 1 mg/kg in soil) [Ref: Table 2 of the guideline] - Testing of Mercury for all types of sludge prior to disposal so that they conform to the disposal limits According to the guideline, the responsibility for sludge management lies with the producer of the sludge. The holder of the sludge must also comply with the requirements in this guideline. All industries generating sludge must prepare a sludge management plan and submit to the Department of Environment as a part of the environmental clearance process. The sludge management plan must contain the following necessary information which is relevant to the reporting Article of the Minamata convention: - The amount of sludge that is to be expected per year - The class of sludge (hazardous if it contains mercury) - Planned option for safe disposal or use and Documentation on fulfilment of requirements relevant for this option - Company and address of further parties involved in sludge management including collection, transport, recovery and disposal of sludge, including the supervision of such operations and after-care of disposal sites
Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions	
Adopting the sludge management guideline is currently not legally binding as it is not linked to the ECR 1997. During the clearance process, the ECR 1997 needs to specifically address the requirement of submitting the sludge management plan and subsequent monitoring. (e.g. ECR needs to have a clear reference to this guideline).	

Article 10: Environmentally sound interim storage of mercury, other than waste mercury		
Description of the Article and applicability in the context of Bangladesh		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
10.2	Take measures to ensure interim mercury storage is conducted in an environmentally sound manner, taking into account guidelines to be developed by the Conference of the Parties (COP).	Applicable
Policy and regulatory measures in place that enable Bangladesh to comply with the above listed provisions:		
Title, ref. no. and date of relevant Policy and Regulatory Measure	What aspects of the above provisions are being addressed by policy/regulatory measure	
Bangladesh Environment Conservation Act, 1995	Article 4 states that The Director General can give advice or issue directions to the concerned person regarding the environmentally sound use, storage, transportation, import and export of a hazardous substance or its components.	

Bangladesh Environment Conservation Act, Environment Conservation Rules 1997	An Environmental Management Plan is required to obtain environmental clearance for a particular industry. Typically in environmental management plans, storage and handling of hazardous materials (if used) are addressed.
Hazardous waste and ship-breaking waste management Rules, 2011	Schedule-20 states that hazardous waste generating industries cannot store waste more than 90 days from the time of generation. All hazardous waste buyers also cannot store hazardous waste more than 90 days after the day of purchase.
Bangladesh Standards and Testing Institution (Management System Certification) Rules 2009	The application for management system certification from BSTI requires the proponent to furnish details on hazardous materials management (quantity generated, type of material, removal/minimization measures). If mercury is used in the process and the proponent wants to apply for certification, he would have to furnish the details of such.
Policy and regulatory measures in place that enable Bangladesh to comply with the above listed provisions:	
The Rules are very generic and not specific to mercury. No mercury-specific guidelines are available for safe handling and storage.	

Article 11: Mercury wastes		
Description of the Article and applicability in the context of Bangladesh		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
11.3 (a)	Take measures to manage mercury wastes in an environmentally sound manner, taking into account guidelines developed under the Basel Convention and in accordance with COP requirements to be developed.	Applicable
11.3 (b)	Take measures to restrict mercury derived from the treatment or re-use of mercury waste to allowed uses under the Convention or environmentally sound disposal.	Applicable
11.3 (c)	Require transport across international boundaries in accordance with the Basel Convention, or if the Basel Convention does not apply, consistent with international rules, standards, and guidelines.	Not applicable. No known hazardous wastes are transported across international boundaries
Policy and regulatory measures in place that enable Bangladesh to comply with the above listed provisions:		
Title, ref. no. and date of relevant Policy and Regulatory Measure	What aspects of the above provisions are being addressed by policy/regulatory measure	
Bangladesh Environment Conservation Act, 1995	Provisions for enforcement measures (fines/penalties etc) for entities causing harm to the ecosystem, provisions for seeking compensation of affected parties, provision to formulate Rules under which emission standards are prescribed. Mercury wastes are hazardous wastes and therefore ECA 1995 enforcement measures can be applied.	

Bangladesh Environment Conservation Act, Environment Conservation Rules 1997	Industries are responsible for applying best available techniques/ best environmental practices (BAT/BEP) in order to control/reduce mercury and mercury compound releases to water so that it satisfies the standards in Schedule-10. The Environmental management Plan, which is a prerequisite for environmental clearance, usually addresses waste management issues.
Hazardous waste and ship-breaking waste management Rules, 2011	Schedule-20 states that hazardous waste generating industries - Cannot dispose or sell their waste to anyone who does not have clearance - Cannot store waste more than 90 days - All hazardous waste generators, recyclers, re-refiners must use environment-friendly technology and processes
Bangladesh Standards and Guidelines for Sludge Management, 2015	This guideline has been developed taking into account guidelines developed under the Basel Convention. For example, Annex 4 of the Guideline lists the disposal and recovery options of the Basel Convention (Operations which do not lead to the possibility of resource recovery, recycling, reclamation, direct re-use or alternative uses) for hazardous wastes. According to the guideline, the responsibility for sludge management lies with the producer of the sludge. The holder of the sludge must also comply with the requirements in this guideline. All industries generating sludge must prepare a sludge management plan and submit to the Department of Environment as a part of the environmental clearance process.
Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provisions	
Adopting the sludge management guideline is currently not legally binding as it is not linked to the ECR 1997. During the clearance process, the ECR 1997 needs to specifically address the requirement of submitting the mercury waste management plan. (e.g. ECR needs to have a clear reference to this guideline specifically regarding the requirements of the Basel convention) The Hazardous Waste and Ship-breaking Waste Management Rules, 2011 mentions incineration, recycling and re-refining of hazardous waste in an environment friendly manner. However, there are no national guidelines for safe operation of these technology and processes.	

Article 12: Contaminated sites		
Description of the Article and applicability in the context of Bangladesh		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
12.1	Develop strategies for identifying and assessing mercury/ mercury compound contaminated sites.	May be applicable if contaminated sites are found. Currently there are no known mercury contaminated sites in Bangladesh
12.2	If risk reduction activities are taken at contaminated sites, they are taken in an environmentally sound manner, incorporating risk assessment where appropriate.	Same as above

Policy and regulatory measures in place that enable Bangladesh to comply with the above listed provisions:	
Title, ref. no. and date of relevant Policy and Regulatory Measure	What aspects of the above provisions are being addressed by policy/regulatory measure
Bangladesh Environment Conservation Act, 1995	Identification and assessment of contaminated sites and formulation of risk assessment guidelines can be done under the following Articles of ECA 1995: - Article 5: can declare an area as "Ecologically Critical Area" if it is in an environmentally critical situation or is threatened to be in such situation - Article 8: any person affected by environmental degradation may seek remedy to DG, DoE - Article 10: use the Power to Entry to get access to any sites where contamination is suspected - Article 11: use Power to Collect Samples of air, water, soil or other substance for analysis from any factory, premises or other place. - Article 13: formulate and publish environmental guidelines relating to the control and mitigation of environmental pollution, conservation and improvement of the environment.
Policy and regulatory measures in place that enable Bangladesh to comply with the above listed provisions:	
No outstanding aspects since ECA 1995 encompasses the basic requirement of the articles. ECA 1995 can be exercised to make Rules in future if necessary.	

Article 13: Financial resources and mechanism		
Description of the Article and applicability in the context of Bangladesh		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
13.1	Access domestic resources as may be needed to implement Convention obligations.	Applicable
13.2	Access financial resources available under the Convention financial mechanism and other resources available from multilateral, regional, and bilateral funding sources.	Applicable
Policy and regulatory measures in place that enable Bangladesh to comply with the above listed provisions:		
Title, ref. no. and date of relevant Policy and Regulatory Measure	What aspects of the above provisions are being addressed by policy/regulatory measure	
N/A	N/A	
Policy and regulatory measures in place that enable Bangladesh to comply with the above listed provisions:		
There are no regulatory measures that precludes accessing financial resources for implementing convention obligations		

Article 14: Capacity-building, technical assistance and technology transfer		
Description of the Article and applicability in the context of Bangladesh		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
14.2	Capacity-building and technical assistance pursuant to article 14.1 and Article 13 may be delivered through regional, subregional and national arrangements, including existing regional and subregional centres, through other multilateral and bilateral means, and through partnerships, including partnerships involving the private sector.	Applicable
Policy and regulatory measures in place that enable Bangladesh to comply with the above listed provisions:		
Title, ref. no. and date of relevant Policy and Regulatory Measure	What aspects of the above provisions are being addressed by policy/regulatory measure	
National Environmental Policy,2013	Emphasizes public private partnership for implementing environmental protection strategies and encourages identifying scope for international and multilateral cooperation in environmental science and research, clean technology transfer etc.	
Policy and regulatory measures in place that enable Bangladesh to comply with the above listed provisions:		
There are no policies or regulatory measures that precludes implementing provisions of the convention article		

Article 16: Health aspects		
Description of the Article and applicability in the context of Bangladesh		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
16.1(a)	Promote the development and implementation of strategies to identify and protect populations at risk, such as developing fish consumption guidelines.	Applicable
16.1(b)	Promote occupational exposure educational and prevention programs.	Applicable
16.1(c)	Promote prevention, treatment, and care services for affected populations.	Applicable
Policy and regulatory measures in place that enable Bangladesh to comply with the above listed provisions:		
Title, ref. no. and date of relevant Policy and Regulatory Measure	What aspects of the above provisions are being addressed by policy/regulatory measure	
Constitution of Bangladesh	The fundamental right to life enshrined in the Constitution of Bangladesh, includes the fundamental role of health as an integral component.	
Bangladesh Environment Conservation Act, 1995	DG of DoE can take measures for the control and mitigation of environmental pollution for the protection of public health.	
National Health Policy, 2011	Main objective is ensuring basic health care services to all levels of population in Bangladesh as per the constitution of Bangladesh. Prevention, treatment and care services for affected population will be done under this policy.	

National Health Research Strategy 2008	Highlights the needs, mechanisms and coordination of health-based research in Bangladesh. Any research to identify and protect populations at risk of mercury contamination could be coordinated following this strategy.
Bangladesh Labour Act 2006 (Amended 2013)	Addresses occupational hazard, exposure, training and hazard minimization options
Policy and regulatory measures in place that enable Bangladesh to comply with the above listed provisions:	
There are no policies or regulatory measure gaps that preclude implementing provisions of the convention article	

Article 17: Information exchange		
Description of the Article and applicability in the context of Bangladesh		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
17.1, 17.3 and 17.5	Each party shall facilitate the exchange of information referred to in paragraph 17.1. Each Party shall designate a national focal point for the exchange of information under this Convention. Share information on the health and safety of humans and the environment as non-confidential, in accordance with Article 17.5	Applicable
Policy and regulatory measures in place that enable Bangladesh to comply with the above listed provisions:		
Title, ref. no. and date of relevant Policy and Regulatory Measure	What aspects of the above provisions are being addressed by policy/regulatory measure	
Right to Information Act, 2009	Under the Act, a citizen may request public information from any government agency, and the government agencies on the other hand, are required to appoint Designated Public Relations Officers (DO or PRO,) To full fill such requests within allotted time frames.	
Policy and regulatory measures in place that enable Bangladesh to comply with the above listed provisions:		
A national focal point on Mercury for exchange of information needs to be designated. No policy or act specifically addresses the facilitation of information exchange regarding mercury and regarding health and safety of humans and on the environment if it is not requested by the public. The national focal point either from the health or environment ministry can take on this role of information dissemination pursuant to 18.2.		

Article 18: Public information, awareness and education		
Description of the Article and applicability in the context of Bangladesh		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
18.1	Shall promote and facilitate provision to the public of available information referred to in paragraph 18.1 and education, training and public awareness related to the effects of exposure to mercury and mercury compounds on human health and the environment.	Applicable
18.2	Shall use existing mechanisms or give consideration to the development of mechanisms, such as pollutant release and transfer registers where applicable, for the collection and dissemination of information on estimates of its annual quantities of mercury and mercury compounds that are emitted, released or disposed of through human activities.	Applicable

Policy and regulatory measures in place that enable Bangladesh to comply with the above listed provisions:	
Title, ref. no. and date of relevant Policy and Regulatory Measure	What aspects of the above provisions are being addressed by policy/regulatory measure
National Environmental Policy, 2013	Encourages mass awareness for environmental protection.
Bangladesh Environment Conservation Act, 1995	Article 4 states that one of the functions of the Director General is the collection and publication of information about environmental pollution. Article 18.1 may fall under this role of DG, DoE.
National Industrial Policy, 2010 (Ministry of Industries)	The government will create awareness among the public on environment protection, pollution, dumping of hazardous material on land and water. Mercury not specifically mentioned but may fall under the purview of hazardous materials.
BSTI Ordinance 1985	establish and publish, in such manner as may be prescribed, the Bangladesh Standard Specifications in relation to any article or process or code of practice.
Right to Information Act, 2009	Under the Act, a citizen may request public information from any government agency, and the government agencies on the other hand, are required to appoint Designated Public Relations Officers (DO or PRO,) To fulfill such requests within allotted time frames.
Consumers Right Protection Act 2009	This Act has provisions for raising awareness regarding goods injurious to human health.
Policy and regulatory measures in place that enable Bangladesh to comply with the above listed provisions:	
Mercury not specifically mentioned in the awareness building and information dissemination roles of DG, DoE. Also it needs to be ensured that the information mentioned in article 18.2 are prioritized in any dissemination activities of DoE	

Article 19: Research, Development and Monitoring		
Description of the Article and applicability in the context of Bangladesh		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
19.1	shall endeavor to cooperate to develop and improve, (a) Inventories of use, consumption, and anthropogenic emissions to air and releases to water and land of mercury and mercury compounds; (b) Modelling and geographically representative monitoring of levels of mercury and mercury compounds in vulnerable populations and ecosystems, (c) Assessments of the impact of mercury and mercury compounds on human health and the environment;(d) Harmonized methodologies for the activities undertaken under subparagraphs (a), (b) and (c);(e) Information on the environmental cycle, transport, transformation and fate of mercury and mercury compounds in a range of ecosystems.	Applicable
19.2	build on existing monitoring networks and research programmes in undertaking the activities identified in paragraph 19.1.	Applicable

Policy and regulatory measures in place that enable Bangladesh to comply with the above listed provisions:	
Title, ref. no. and date of relevant Policy and Regulatory Measure	What aspects of the above provisions are being addressed by policy/regulatory measure
Bangladesh Environment Conservation Act, 1995	Article 4 states that one of the functions of the DG, DoE is conducting inquiries and undertaking research on conservation, improvement and pollution of the environment and rendering assistance to any other authority or organization regarding those matters. In this case, under this article the DG, DoE can spearhead any research, development and monitoring activity regarding mercury contamination and its mobilization as required by the convention.
Bangladesh Labour Act 2006 (Amended 2013)	Addresses occupational hazard, exposure, training and hazard minimization options.
Policy and regulatory measures in place that enable Bangladesh to comply with the above listed provisions:	
There are no policies or regulatory measures that preclude implementing provisions of the convention article.	

Article 21: Reporting		
Description of the Article and applicability in the context of Bangladesh		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
21.1	shall report to the Conference of the Parties, through the Secretariat, on the measures it has taken to implement the provisions of this Convention and on the effectiveness of such measures and the possible challenges in meeting the objectives of the Convention.	Applicable
21.2	shall include in its reporting the information as called for in Articles 3, 5, 7, 8 and 9 of this Convention.	Applicable
Policy and regulatory measures in place that enable Bangladesh to comply with the above listed provisions:		
Title, ref. no. and date of relevant Policy and Regulatory Measure	What aspects of the above provisions are being addressed by policy/regulatory measure	
N/A	N/A	
Policy and regulatory measures in place that enable Bangladesh to comply with the above listed provisions:		
There are no regulatory measures that precludes implementing provisions of the convention article.		

Annex B: Institutional framework mapping with the provisions of the Minamata Convention

The institutional assessment is presented in a tabular form below which shows a summary assessment of existing national institutions and stakeholders, their roles and an analysis of possible gaps, such as capacities and institutions needed for the implementation of the Minamata Convention and ensure the sound management of mercury in Bangladesh.

Article 3: Mercury Supply Sources and Trade		
Description of the Article and applicability in the context of Bangladesh		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
3.3	Not allow new primary mercury mining.	Not applicable as Bangladesh has no mercury mines and there are no artisanal and small-scale gold mining
3.4	Phase out existing primary mercury mining within 15 years.	
	Prevent the import and use of mercury from primary mercury mining for artisanal and small-scale gold mining (ASGM).	
3.5(b)	restrict the import and use of excess mercury from decommissioning chlor-alkali plants, and require environmentally sound disposal.	Not applicable (since chlor-alkali plants in Bangladesh do not use mercury in their reactors)
3.5(a)	Obtain information on stocks of mercury or mercury compounds exceeding 50 metric tons (MT), and mercury supply generating stocks exceeding 10 MT/yr.	Applicable
3.6	Not allow the export of mercury unless the importing country provides written Consent and the mercury is for an allowed use under the convention or environmentally sound storage, and all other conditions of Article 3.6 are met.	Not applicable as Bangladesh do not export mercury
Policy and regulatory measures in place that enable Bangladesh to comply with the above listed provisions:		
Title, ref. no. and date of relevant Policy and Regulatory Measure	What aspects of the above provisions are being addressed by policy/regulatory measure	
Department of Environment, Ministry of Environment, Forest and Climate Change: issuance of environmental clearance certificate for industries and hazardous materials clearance before import	Provide clearance before opening L/C and before shipping for import as per Hazardous and Shipbreaking Waste Management Rules, 2011. Mercury and mercury products are banned from import. Issues environmental clearance certificate for industries in order to commence operation. The application for clearance necessitates submission of raw material information and environmental management plant. The hazardous waste management cell under DoE can keep track of mercury stocks in all industries in Bangladesh.	

Remaining Capacity Gaps at National Level that need to be addressed before provisions can be met
The current directive in the Rules states that material safety datasheet of industries should be shared with the hazardous waste management cell of DoE. However, there is no requirement of taking stocks of mercury or mercury compounds of specific amount stated in the convention article. The current directive in the ECR 1997 do not require any decommissioning plan to be submitted for environmental clearance and environmentally sound disposal of hazardous material generated thereof.

Article 4: Mercury-Added Products		
Description of the Article and applicability in the context of Bangladesh		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
4.1	Not allow the manufacture, import, and export of products listed in Part I of Annex A not otherwise excluded following the phase out date listed in the Annex	Applicable
4.3	Phase down the use of dental amalgam through two or more measures listed in Part II of Annex A	Applicable
4.5	Take measures to prevent the incorporation of products listed in Part I of Annex A (i.e., switches and relays, batteries) into larger, assembled products	Applicable
4.6	Discourage the manufacture and distribution of new mercury product types	Applicable

Relevant National Stakeholder:	
Name of the Institution/stakeholder and its role with respect to the above-listed provisions	Relevant institutional capacity in place to comply with the above listed provisions
Import and Export Control Department, Ministry of Commerce: The Government regulatory department of Bangladesh concerning export and import.	It issues export and import certifications and advises the government on trade and tariff. The Ministry of Commerce is responsible for regulation and implementation of policies applicable to domestic and foreign trade. Banning import and export of mercury-added products will fall under the purview of this Department and the Ministry's policies.
National Board of Revenue (NBR): It is the apex authority for tax collection of Bangladesh. It is the responsibility of NBR to collect the customs duty from imports of items as per Import Policy Order. It also keeps records of all the imports in its database (imported item, quantities, importer information, price, tax etc.)	It keeps database of all legally imported products including mercury, mercury compounds. Their database can be shared with relevant agencies to keep track of all the mercury/mercury compounds use within the country.
Bangladesh Standards and Testing Institute (BSTI), Ministry of Industries: The function of BSTI is to set up Bangladesh Standards of quality and dimensions and prepare and promote the general adoption of standards on national and international basis relating to materials, commodities, structures, practices and operations and, from time to time, to withdraw, revise, alter and amend the same.	Not allowing mercury-containing products in the market, to make new standards and revise existing standards (if necessary) to discourage the use of any product in the market is within the jurisdiction of this institute.

Remaining Capacity Gaps at National Level that need to be addressed before provisions can be met
Formulating new standards, revising existing standards often takes a long time because BSTI is understaffed and there is lack of resources. Often phasing out a product requires enforcement, but the legal jurisdiction of BSTI is very limited.

Article 5: Manufacturing processes in which mercury or mercury compounds are used		
Description of the Article and applicability in the context of Bangladesh		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
5.2	Not allow the use of mercury or mercury compounds in the manufacturing processes listed in Part I of Annex B	Not applicable (Bangladesh only has chlor alkali plants but mercury is not used in its reactor)
5.3	Restrict (as specified in the Annex) the use of mercury in the processes listed in Part II of Annex B	Not applicable as there are no such plants listed in part II of Annex in Bangladesh
5.4	Not allow new facilities from using mercury in the processes listed in Annex B, except facilities using mercury catalysts to produce polyurethane	Applicable
5.5	For facilities with processes listed in Annex B, identify and obtain information on mercury or mercury compound use; and control mercury emissions to air, and releases to land and water	Applicable
5.7	Discourage new uses of mercury in industrial processes	Applicable
Relevant National Stakeholder:		
Name of the Institution/stakeholder and its role with respect to the above-listed provisions	Relevant institutional capacity in place to comply with the above listed provisions	
Department of Environment, Ministry of Environment, Forest and Climate Change: taking stock of hazardous wastes and issuance of environmental clearance certificate to industries	The director of the hazardous waste management cell of DoE is under the hazardous waste Rules, 2011 is to maintain detailed quantitative information on products and wastes generated from facilities using hazardous materials and waste. The DG of DoE issues environmental clearance certificates to industries which has to disclose its raw materials usage and quantities. It can discourage new uses of mercury, new facilities to use mercury while giving clearance to the industry.	
Bangladesh Standards and Testing Institute (BSTI), Ministry of Industries: issuance of management system certificates	Under the provisions of the BSTI (Management Systems Certification) rules 2009, BSTI can issue certificates to management systems of an entity. If mercury is used in the process and the proponent wants to apply for certification, he would have to furnish the details of such.	
Remaining Capacity Gaps at National Level that need to be addressed before provisions can be met		
The BSTI rules 2009 will apply if the industry is interested in management system certification therefore it is voluntary and not mandatory.		

Article 6: Exemptions available to a Party upon request		
Description of the Article and applicability in the context of Bangladesh		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
6.1	may register for one or more exemptions from the phase-out dates listed in Annex A and Annex B.	Applicable

Relevant National Stakeholder:	
Name of the Institution/stakeholder and its role with respect to the above-listed provisions	Relevant institutional capacity in place to comply with the above listed provisions
Department of Environment: will act through the national focal point for such requests	If required, will provide justification for exemption and plans for a delayed phasing out
Remaining Capacity Gaps at National Level that need to be addressed before provisions can be met	
N/A	

Article 7: Artisanal and Small-scale Gold Mining (ASGM)		
Description of the Article and applicability in the context of Bangladesh		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
7.2	Take measures to reduce, and where feasible, eliminate mercury and mercury compound use, emissions (to air), and releases (to land and water) associated with ASGM.	Not applicable
Relevant National Stakeholder:		
Name of the Institution/stakeholder and its role with respect to the above-listed provisions	Relevant institutional capacity in place to comply with the above listed provisions	
N/A	N/A	
Remaining Capacity Gaps at National Level that need to be addressed before provisions can be met		
N/A		

Article 8: Emissions		
Description of the Article and applicability in the context of Bangladesh		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
8.4	Require best available techniques/best environmental practices (BAT/BEP) or associated emission limit values (ELVs) for new (as defined in Article 8.2(c)) sources listed in Annex D (coal-fired power plants, coal-fired industrial boilers, non-ferrous metal smelting and roasting processes, waste incineration, and cement production).	Applicable
8.5	Require one or more measures identified in Article 8.5 to control/ reduce mercury emissions from existing sources listed in Annex D, which shall be operational at the source within 10 years.	Applicable
8.7	Require monitoring/reporting and otherwise establish a mercury emissions inventory for sources listed in Annex D.	Applicable

Relevant National Stakeholder:	
Name of the Institution/stakeholder and its role with respect to the above-listed provisions	*Relevant institutional capacity in place to comply with the above listed provisions*
Department of Environment, Ministry of Environment, Forest and Climate Change: Enforcement, setting emission limit values, promote new pollution abatement technologies, monitoring activities	DoE is considered seriously understaffed to carry out activities under its various mandates specially enforcement and monitoring. Mercury monitoring equipment in flue gases are not available at DoE. Technical capacity to carry out monitoring is also lacking.
Remaining Capacity Gaps at National Level that need to be addressed before provisions can be met	
Lack of technical capacity, resource constraints (monitoring equipment) and lack of manpower at DoE must be overcome if the relevant provisions of the convention are to be met.	

Article 9: Releases to Land and Water		
Description of the Article and applicability in the context of Bangladesh		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
9.3, 9.6	Require reporting or otherwise obtain information as needed to identify significant sources of mercury/mercury compound releases to land or water, and to maintain an inventory of releases from the sources identified.	Applicable
9.5	Take one or more measures specified in Article 9.5 to control/reduce mercury and mercury compound releases to land and water from significant sources It identifies.	Applicable
Relevant National Stakeholder:		
Name of the Institution/stakeholder and its role with respect to the above-listed provisions	Relevant institutional capacity in place to comply with the above listed provisions	
Department of Environment, Ministry of Environment, Forest and Climate Change: setting emission limit values for land and water, enforcement and monitoring activities, maintaining information on hazardous wastes through its hazardous waste management cell	DoE through its hazardous waste management cell and national focal point on mercury, can carry out the required reporting and inventory work. DoE is considered seriously understaffed to carry out activities under its various mandates specially enforcement and monitoring. Lack of technical capacity is also an issue. DoE has central laboratory which is equipped to analyze mercury concentration in water and sludge samples. Apart from DoE, there are many other institutions in Bangladesh such as BUET, BCSIR, BSTI etc. which are equipped to analyze mercury in liquid and solid samples.	
Remaining Capacity Gaps at National Level that need to be addressed before provisions can be met		
DoE has to designate a national focal point on mercury management who will work with the hazardous waste management cell to update and report the mercury inventory. Lack of technical capacity, and lack of manpower at DoE must be addressed if the relevant provisions of the convention are to be met. The technology for reducing mercury releases in waste streams as per Article 9.5 may be cost-prohibitive for the entity. Also in Bangladesh, waste streams are often not separated and therefore the generated sludge or wastewater can be a complex composition of chemicals. Devising treatment strategies for such wastewater can be a complex exercise. Again, analysis of mercury is also very expensive. All these can pose difficulties in guaranteeing the compliance with limit values for certain disposal routes.		

Article 10: Environmentally sound interim storage of mercury, other than waste mercury		
Description of the Article and applicability in the context of Bangladesh		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
10.2	Take measures to ensure interim mercury storage is conducted in an environmentally sound manner, taking into account guidelines to be developed by the Conference of the Parties (COP).	Applicable
Relevant National Stakeholder:		
Name of the Institution/stakeholder and its role with respect to the above-listed provisions	*Relevant institutional capacity in place to comply with the above listed provisions*	
Department of Environment: one of the tasks of the hazardous waste management cell is to take account of hazardous waste imported	There is no provision to monitor the storage of hazardous chemical inside the facility and the manner of storage (whether or not environmentally sound) by the entity as per the Rules.	
Remaining Capacity Gaps at National Level that need to be addressed before provisions can be met		
National guidelines for environmentally sound storage of mercury need to be developed and implemented. Capacity of DoE (manpower, resources, technical capacity) to monitor the nature of storage is inadequate which needs to be overcome.		

Article 11: Mercury Wastes		
Description of the Article and applicability in the context of Bangladesh		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
11.3 (a)	Take measures to manage mercury wastes in an environmentally sound manner, taking into account guidelines developed under the Basel Convention and in accordance with COP requirements to be developed.	Applicable
11.3 (b)	Take measures to restrict mercury derived from the treatment or re-use of mercury waste to allowed uses under the Convention or environmentally sound disposal.	Applicable
11.3 (c)	Require transport across international boundaries in accordance with the Basel Convention, or if the Basel Convention does not apply, consistent withinternational rules, standards and guidelines.	Not applicable. No known hazardous wastes are transported across international boundaries
Relevant National Stakeholder:		
Name of the Institution/stakeholder and its role with respect to the above-listed provisions	*Relevant institutional capacity in place to comply with the above listed provisions*	
Department of Environment: one of the tasks of the hazardous waste management cell is to monitor the storage of hazardous waste before it is disposed to an authorized vendor and certifying the vendor (recycler, re-refiner or incinerator).	Currently it is the responsibility of the industry to dispose the hazardous waste in an environment-friendly manner. The industry generating the waste or the vendor buying and disposing the waste are to report their activities to the waste management cell. There is no provision to monitor the storage of hazardous chemical inside the facility and the manner of disposal by the vendor (whether or not environmentally sound) by the DoE directly.	

Remaining Capacity Gaps at National Level that need to be addressed before provisions can be met
Capacity of DoE (manpower, resources, technical capacity) to monitor the nature of storage and disposal is inadequate which needs to be overcome to meet the convention requirements. Although the Hazardous Waste management Rules prescribe that disposal of hazardous waste must be done with licensed or certified vendors (recyclers, re-refiners or incineration facilities), there is no mechanism to guarantee that disposal is done in those facilities in an environment-friendly manner. Especially in Bangladesh, the sophisticated re-use and recycling technology for mercury may not be available. Such facilities or other disposal routes guaranteeing a safe disposal need to be planned and built first.

Article 12: Contaminated Sites		
Description of the Article and applicability in the context of Bangladesh		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
12.1	Develop strategies for identifying and assessing mercury/mercury compound contaminated sites.	May be applicable if contaminated sites are found. Currently there are no known mercury contaminated sites in Bangladesh
12.2	If risk reduction activities are taken at contaminated sites, they are taken in an environmentally sound manner, incorporating risk assessment where appropriate.	Same as above
Relevant National Stakeholder:		
Name of the Institution/stakeholder and its role with respect to the above-listed provisions		*Relevant institutional capacity in place to comply with the above listed provisions*
Department of Environment: can identify and designate contaminated site and restrict development activities in the area		After identification is done (e.g. 'Ecologically Critical Area'), DoE can declare restriction of certain activities in the area.
Remaining Capacity Gaps at National Level that need to be addressed before provisions can be met		
Capacity of DoE (manpower, resources, technical capacity) to monitor the activities at contaminated sites is inadequate which needs to be overcome to meet the convention requirements.		

Article 13: Financial Resources and Mechanism		
Description of the Article and applicability in the context of Bangladesh		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
13.1	Access domestic resources as may be needed to implement Convention obligations.	Applicable
13.2	Access financial resources available under the Convention financial mechanism and other resources available from multilateral, regional, and bilateral funding sources.	Applicable

Relevant National Stakeholder:	
Name of the Institution/stakeholder and its role with respect to the above-listed provisions	*Relevant institutional capacity in place to comply with the above listed provisions*
The industry owners need to seek their own funding for environment-friendly technology adoption. Often multilateral, regional and bilateral funding agencies are interested to finance the ventures. DoE can seek resources for capacity building or undertaking research studies.	There are many commercial banks in Bangladesh. Often multilateral donor agencies channelize their funds through commercial banks and other financial institutions.
Remaining Capacity Gaps at National Level that need to be addressed before provisions can be met	
N/A	

Article 14: Capacity-building, technical assistance and technology transfer		
Description of the Article and applicability in the context of Bangladesh		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
14.2	Capacity-building and technical assistance pursuant to article 14.1 and Article 13 may be delivered through regional, subregional and national arrangements, including existing regional and subregional centres, through other multilateral and bilateral means, and through partnerships, including partnerships involving the private sector.	Applicable
Relevant National Stakeholder:		
Name of the Institution/stakeholder and its role with respect to the above-listed provisions	*Relevant institutional capacity in place to comply with the above listed provisions*	
Department of Environment can play a co-ordinating role in capacity building, technical assistance and technology transfer	Department of Environment has a vast experience of working with various international organizations and multilateral donor agencies, development partners in various aspects of environmental management. DoE has also partnered with private sectors in various ventures.	
Remaining Capacity Gaps at National Level that need to be addressed before provisions can be met		
N/A		

Article 16: Health Aspects		
Description of the Article and applicability in the context of Bangladesh		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
16.1(a)	Promote the development and implementation of strategies to identify and protect populations at risk, such as developing fish consumption guidelines.	Applicable

16.1(b)	Promote occupational exposure educational and prevention programs	Applicable
16.1(c)	Promote prevention, treatment, and care services for affected populations	Applicable

Relevant National Stakeholder:	
Name of the Institution/stakeholder and its role with respect to the above-listed provisions	*Relevant institutional capacity in place to comply with the above listed provisions*
Department of Environment: can take any measures for the protection of public health.	Can initiate studies for identification of risk and assessment of current situation.
Directorate General of Health Services, Ministry of Health and Family Welfare:The main functions of this agency are the implementation of different health programs, health management, planning & execution of different policies through administration.	Can undertake activities associated with Article 16.1 of the Convention.
Bangladesh Medical Research Council: BMRC is the focal point for health research. The objectives of BMRC are to identify problems and issues relating to medical and health sciences and to determine priority areas in research on the basis of health care needs ,goals, policies and objectives.	The main activities of the Council include: organization, promotion and coordination of scientific research in various fields of Health Science, training of manpower in health research and dissemination of research results for proper utilization. In addition to BMRC, the Bangladesh Council for Science and Industrial Research (BCSIR), Bangladesh Atomic Energy Commission, and the University Grants Commission are some of the other (major) agencies financing health research.
Remaining Capacity Gaps at National Level that need to be addressed before provisions can be met	
No apparent gaps in terms of objectives of the agencies/stakeholders in order to meet the Convention requirements.	

Article 17: Information Exchange		
Description of the Article and applicability in the context of Bangladesh		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
17.1, 17.3 and 17.5	Each party shall facilitate the exchange of information referred to in paragraph 17.1. Each Party shall designate a national focal point for the exchange of information under this Convention. Share information on the health and safety of humans and the environment as non-confidential, in accordance with Article 17.5	Applicable

Relevant National Stakeholder:	
Name of the Institution/stakeholder and its role with respect to the above-listed provisions	*Relevant institutional capacity in place to comply with the above listed provisions*
Department of Environment: Collection and publication of information related to environmental contamination.	DoE disseminates findings of studies through seminars, public consultation workshops, annual reports, publications (hardcopy and online) and also through printed media and television. There are no policies in Bangladesh that preclude the sharing of information on the health and safety of humans and the environment.
Information Commission of Bangladesh: entitled to provide information on any issues to the public upon request under the RTI Act and Rules, 2009.	Required to appoint Designated Public Relations Officers (DO or PRO,) To fulfill such requests within allotted time frames.
Remaining Capacity Gaps at National Level that need to be addressed before provisions can be met	
DoE will have to designate a national focal point for the dissemination and exchange of information as required by Article 17	

Article 18: Public information, awareness and education		
Description of the Article and applicability in the context of Bangladesh		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
18.1	shall promote and facilitate provision to the public of available information referred to in paragraph 18.1 and education, training and public awareness related to the effects of exposure to mercury and mercury compounds on human health and the environment	Applicable
18.2	shall use existing mechanisms or give consideration to the development of mechanisms, such as pollutant release and transfer registers where applicable, for the collection and dissemination of information on estimates of its annual quantities of mercury and mercury compounds that are emitted, released or disposed of through human activities.	Applicable
Relevant National Stakeholder:		
Name of the Institution/stakeholder and its role with respect to the above-listed provisions	*Relevant institutional capacity in place to comply with the above listed provisions*	
Department of Environment: Collection and publication of information related to environmental contamination.	DoE disseminates findings of studies through seminars, public consultation workshops, annual reports, publications (hardcopy and online) and also through printed media and television. Hazardous waste generators, recyclers, re-refiners and entities carrying out its incineration are directed to maintain records of the waste and share it with DoE.	
BSTI: formulation and publication of standards for products.	BSTI forms committees including local experts through its different divisions to formulate a standard	
Information Commission of Bangladesh: entitled to provide information on any issues to the public upon request under the RTI Act and Rules, 2009.	Required to appoint Designated Public Relations Officers (DO or PRO,) To fulfill such requests within allotted time frames.	
Remaining Capacity Gaps at National Level that need to be addressed before provisions can be met		
No apparent capacity gaps.		

Article 19: Research, Development and Monitoring		
Description of the Article and applicability in the context of Bangladesh		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
19.1	shall endeavour to cooperate to develop and improve, (a) Inventories of use, consumption, and anthropogenic emissions to air and releases to water and land of mercury and mercury compounds; (b) Modelling and geographically representative monitoring of levels of mercury and mercury compounds in vulnerable populations and ecosystems, (c) Assessments of the impact of mercury and mercury compounds on human health and the environment;(d) Harmonized methodologies for the activities undertaken under subparagraphs (a), (b) and (c);(e) Information on the environmental cycle, transport, transformation and fate of mercury and mercury compounds in a range of ecosystems	Applicable

19.2	build on existing monitoring networks and research programmes in undertaking the activities identified in paragraph 19.1.	Applicable
Relevant National Stakeholder:		
Name of the Institution/stakeholder and its role with respect to the above-listed provisions	*Relevant institutional capacity in place to comply with the above listed provisions*	
Department of Environment: one of the responsibilities of DG, DoE is to undertake research on conservation, improvement and pollution of the environment and rendering assistance to any other authority or organization regarding those matters.	The DoE can engage universities and other research organizations in the country to carry out research and development regarding mercury contamination and human health effects in Bangladesh.	
Remaining Capacity Gaps at National Level that need to be addressed before provisions can be met		
Scarcity of funds for carrying out research is an issue. Often the expertise to carry out health effect research may not be available; so capacity building may be required.		

Article 21: Reporting		
Description of the Article and applicability in the context of Bangladesh		
Article No	***Succinct summary of provisions of the Article***	***Applicability***
21.1	shall report to the Conference of the Parties, through the Secretariat, on the measures it has taken to implement the provisions of this Convention and on the effectiveness of such measures and the possible challenges in meeting the objectives of the Convention.	Applicable
21.2	shall include in its reporting the information as called for in Articles 3, 5, 7, 8 and 9 of this Convention.	Applicable
Relevant National Stakeholder:		
Name of the Institution/stakeholder and its role with respect to the above-listed provisions	*Relevant institutional capacity in place to comply with the above listed provisions*	
Department of Environment, Ministry of Environment, Forest and Climate Change: DG, DoE can set up a focal point in the Department for reporting to the Conference of Parties.	The Department of Environment has qualified officers to carry out the responsibility of reporting.	
Remaining Capacity Gaps at National Level that need to be addressed before provisions can be met		
N/A		

Annex C: Data sources used for preparing the Minamata Initial Assessment report

Source category	Activity rate	Unit	Reference
Energy consumption			
Coal combustion in large power plants	1,642,500	Coal combusted, t/y	Hossain, K. I. Case study on surrounding area of Barapukuria coal mine impeding soil fertility.
Coal combustion in coal fired industrial boilers	0	Coal combusted, t/y	
Other coal uses	4,010,000	Coal used, t/y	International Energy Agency (IEA) National Strategy for Sustainable Brick Production in Bangladesh, 2017 Shuchi Verma and Jai Uppal (2013). Use of Biomass in Brick Kilns: A View of Biomass Fired Brick Kiln in Uttar Pradesh. Volume 6, Issue 4
Combustion/use of petroleum coke and heavy oil	884,000	Oil product combusted, t/y	International Energy Agency (IEA)
Combustion/use of diesel, gasoil, petroleum, kerosene, LPG and other light to medium distillates	3,916,000	Oil product combusted, t/y	International Energy Agency (IEA)
Use of raw or pre-cleaned natural gas	0	Gas used, Nm^3/y	
Use of pipeline gas (consumer quality)	29,660,963,040	Gas used, Nm^3/y	PETROBANGLA, Bangladesh Gas, Oil and Mineral Corporation (2016) annual report
Biomass fired power and heat production	19,883,250	Biomass combusted, t/y	FAO's Yearbook of Forest Product, 2015
Charcoal combustion	0	Charcoal combusted, t/y	
Fuel production			
Oil extraction	91,000	Crude oil produced, t/y	Bangladesh Petroleum Corporation (BPC). (2016). 2010-2011 annual report Internal Communication with Eastern Refinery Limited, owned by BPC.

Source category	Activity rate	Unit	Reference
Oil refining	1,400,000	Crude oil refined, t/y	Bangladesh Petroleum Corporation (BPC). (2016). 2010-2011 annual report Internal Communication with Eastern Refinery Limited, owned by BPC.
Extraction and processing of natural gas	26,728,395,760	Gas produced, Nm^3/y	PETROBANGLA, Bangladesh Gas, Oil and Mineral Corporation (2016) annual report
Primary metal production			
Mercury (primary) extraction and initial processing	0	Mercury produced, t/y	Survey conducted in this study
Production of zinc from concentrates	0	Concentrate used, t/y	Survey conducted in this study
Production of copper from concentrates	0	Concentrate used, t/y	Survey conducted in this study
Production of lead from concentrates	0	Concentrate used, t/y	Survey conducted in this study
Gold extraction by methods other than mercury amalgamation	0	Gold ore used, t/y	Survey conducted in this study
Alumina production from bauxite (aluminium production)	0	Bauxit processed, t/y	Survey conducted in this study
Primary ferrous metal production (pig iron production)	0	Pig iron produced, t/y	Survey conducted in this study
Gold extraction with mercury amalgamation - from whole ore	0	Gold produced, kg/y	Survey conducted in this study
Gold extraction with mercury amalgamation - from concentrate	0	Gold produced, kg/y	Survey conducted in this study
Other materials production			
Cement production*4	1,690,000	Cement produced, t/y	United States Geological Survey. (2014). 2014 The Mineral Industry of Bangladesh. The Daily Star. (2015). Cement: The Basic Building Material. Retrieved November 11, 2018 from https://www.thedailystar.net/cement-the-basic-building-material-50127
Pulp and paper production	208,889	Biomass used for production, t/y	Global Yearbook of Forest Product 2015 Biermann, C. J. (1996). Handbook of pulping and papermaking. Elsevier.
Production of chemicals			
Chlor-alkali prod. with mercury-cells	0	Cl2 produced, t/y	Survey conducted in this study

Source category	Activity rate	Unit	Reference
VCM production with mercury catalyst	0	VCM produced, t/y	Survey conducted in this study
Acetaldehyde production with mercury catalyst	0	Acetaldehyde produced, t/y	Survey conducted in this study
Production and use-disposal of products with mercury content			
Hg thermometers (medical, air, lab, industrial etc.)	0	Mercury used for production, kg/y	Survey conducted in this study
Electrical switches and relays with mercury	0	Mercury used for production, kg/y	Survey conducted in this study
Light sources with mercury (fluorescent, compact, others: see guideline)	343	Mercury used for production, kg/y	*World Bank Group. (2018). Bangladesh Energy Efficiency Opportunities: Roadmap for implementation. World Bank Publications. Unpublished manuscript* *An ongoing study conducted by Waste Concern Consultants under the assignment entitled 'Preparation for Environmentally Sound Management of Mercury Containing Lighting Sources with a Life-Cycle Approach' for the Department of Environment (DoE), GoB and UNIDO* United Nations Comtrade Database, UN Comtrade
Batteries with mercury	0	Mercury used for production, kg/y	Survey conducted in this study Wikipedia. Button Cell. Retrieved September 20, 2018 from https://en.wikipedia.org/wiki/Button_cell Wikipedia. List of battery sizes. Retrieved September 20, 2018 from https://en.wikipedia.org/wiki/List_of_battery_sizes
Manometers and gauges with mercury	0	Mercury used for production, kg/y	Survey conducted in this study
Biocides and pesticides with mercury	0	Mercury used for production, kg/y	Survey conducted in this study
Paints with mercury	4,725	Mercury used for production, kg/y	Survey conducted in this study United Nations Comtrade Database, UN Comtrade Paints and Coatings Resource Center. Retrieved September 30, 2018 from_http://www.paintcenter.org/rj/sep06d.php

Source category	Activity rate	Unit	Reference
Skin lightening creams and soaps with mercury chemicals	521	Mercury used for production, kg/y	Survey conducted in this study United Nations Comtrade Database, UN Comtrade Anton Paar. Application Report: Density Measurement of *Viscous Pastes and Creams Using DMA 500*. Retrieved September 30, 2018 from http://www.mep.net.au/foodlab/FL_43/FL43_DMA500_pastes_creams.pdf Environment and Social Development Organization (ESDO). (2015). *Study Report on Mercury added products: Country situation analysis in Bangladesh*
Dental amalgam fillings ("silver" fillings)	158,900,000	Number of inhabitants	Survey conducted in this study STATISTICS, B. B. O. (2012). Bangladesh Statistics, 2012. Statistics and Informatics Division, Ministry of Planning, Bangladesh. STATISTICS, B. B. O. (2017). Bangladesh Statistics, 2017. Statistics and Informatics Division, Ministry of Planning, Bangladesh. McPherson, A. (1976). In Methods of Biochemical Analysis (Glick, D., ed.), vol. 23, pp. 527-529, John Wiley & Sons, Inc., New York.
Thermometers	2,640,000	Items sold/y	Survey conducted in this study
Electrical switches-relays with mercury	158,900,000	Number of inhabitants	STATISTICS, B. B. O. (2017). Bangladesh Statistics, 2017. *Statistics and Informatics Division, Ministry of Planning, Bangladesh*
Polyurethane (PU, PUR) produced with mercury catalyst	158,900,000	Number of inhabitants	
Medical blood pressure gauges (mercury sphygmomanometers)	10,000	Items sold/y	Survey conducted in this study
Other manometers and gauges with mercury	158,900,000	Number of inhabitants	STATISTICS, B. B. O. (2017). Bangladesh Statistics, 2017. Statistics and Informatics Division, Ministry of Planning, Bangladesh
Laboratory chemicals	158,900,000	Number of inhabitants	
Laboratory-medical equipment with Hg	158,900,000	Number of inhabitants	

Source category	Activity rate	Unit	Reference
Production of recycled of metals			
Production of recycled mercury ("secondary production")	200	Mercury produced, kg/y	Sujauddin, M., Koide, R., Komatsu, T., Hossain, M. M., Tokoro, C., & Murakami, S. (2017). Ship breaking and the steel industry in Bangladesh: a material flow perspective. *Journal of Industrial Ecology*, 21(1), 191-203. Supporting information retrieved September 12, 2018 from https://onlinelibrary.wiley.com/action/downloadSupplement?doi=10.1111%2Fjiec.12423&file=jiec12423-sup-0001-text.pdf The New York Times. (2012). *Around the World With 5,500 Cars.* Retrieved September 30, 2018 from https://www.nytimes.com/2012/07/15/automobiles/around-the-world-with-5500-cars.html
Production of recycled ferrous metals (iron and steel)	850,000	Number of vehicles recycled/y	
Waste incineration			
Incineration of municipal/ general waste	0	Waste incinerated, t/y	Survey conducted in this study
Incineration of hazardous waste	0	Waste incinerated, t/y	Survey conducted in this study Center for environmental and resource management (CERM). (2018). *Assessment of generation of E Waste, its impacts on environment and resource recovery potential in Bangladesh. Unpublished Manuscript.*

Source category	Activity rate	Unit	Reference
Waste incineration			
Incineration of municipal / general waste	0	Waste incinerated, t/y	Survey conducted in this study
Incineration / burning of medical waste	3,796	Waste incinerated, t/y	PRISM Bangladesh Foundation. (2005). *Survey Report on Hospital Waste Management in Dhaka City. Unpublished Manuscript.* Hassan, M. M., Ahmed, S. A., Rahman, K. A., & Biswas, T. K. (2008). Pattern of medical waste management: existing scenario in Dhaka City, Bangladesh. *BMC Public Health, 8*(1), 36. Nuralam, H. M., Xiao-lan, Z., Dubey, B. K., & Wen-Chuan, D. (2017). Healthcare Waste Management Practices in Bangladesh: A Case Study in Dhaka City, Bangladesh. *World Academy of Science, Engineering and Technology, International Journal of Environmental, Chemical, Ecological, Geological and Geophysical Engineering, 11*(6), 524-529. Syed, E. H., Mutahara, M., & Rahman, M. (2012). Medical waste management (MWM) in Dhaka, Bangladesh: it'sa review. *Home Health Care Management & Practice, 24*(3), 140-145. Alam, M. Z., Islam, M. S., & Islam, M. R. (2013). Medical Waste Management: A Case Study on Rajshahi City Corporation in Bangladesh. *Journal of Environmental Science and Natural Resources, 6*(1), 173-178. Bangladesh Ministry of Health and Family Welfare (2011). 2011-2016 *Environmental Assessment and Action Plan for Health, Population and Nutrition Sector Development Program.*
Sewage sludge incineration	0	Waste incinerated, t/y	Survey conducted in this study

Source category	Activity rate	Unit	Reference
Open fire waste burning (landfills and informally)	14,231,486	Waste burned, t/y	Wiedinmyer, C., Yokelson, R. J., & Gullett, B. K. (2014). Global emissions of trace gases, particulate matter, and hazardous air pollutants from open burning of domestic waste. Environmental science & technology, 48(16), 9523-9530. Guendehou, G. H. S., Koch, M., Hockstad, L., Pipatti, R., &Yamada, M. (2006). Incineration and Open Burning of Waste. (Chapter 5 of IPCC Guidelines for National Greenhouse Gas Inventories). Retrieved September 30, 2018 from https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/5_Volume5/V5_5_Ch5_IOB.pdf
Waste deposition/landfilling and waste water treatment			
Controlled landfills/deposits	1,168,000	Waste landfilled, t/y	K. M. Nazmul Islam, "Municipal Solid Waste to Energy Generation in Bangladesh: Possible Scenarios to Generate Renewable Electricity in Dhaka and Chittagong City," Journal of Renewable Energy, vol. 2016, Article ID 1712370, 16 pages, 2016. https://doi.org/10.1155/2016/1712370
Informal dumping of general waste *1	11,987,014	Waste dumped, t/y	Wiedinmyer, C., Yokelson, R. J., & Gullett, B. K. (2014). Global emissions of trace gases, particulate matter, and hazardous air pollutants from open burning of domestic waste. *Environmental science & technology, 48(16), 9523-9530.*
Waste water system/treatment	0	Waste water, m3/y	KhondakerAzharulHaq (2006) Water Management in Dhaka, International Journal of Water Resources Development, 22:2, 291311, DOI: 10.1080/07900620600677810
Crematoria and cemeteries			
Crematoria	82,628	Corpses cremated/y	
Cemeteries	743,652	Corpses buried/y	STATISTICS, B. B. O. (2017). Bangladesh Statistics, 2017. *Statistics and Informatics Division, Ministry of Planning, Bangladesh.* Index_mundi. Bangladesh Demographic Profile 2018. Retrieved September 20, 2018 from https://www.indexmundi.com/bangladesh/demographics_profile.html

Annex D: Mercury output pathways

Calculation Result Type	Description
Estimated Hg input, kg Hg/y	The standard estimate of the amount of mercury entering this source category with input materials, for example calculated mercury amount in coal used annually in the country for combustion in large power plants.
Air	Mercury emissions to the atmosphere from point sources and diffuse sources from which mercury may be spread locally or over long distances with air masses. For example, from: • Point sources such as coal fired power plants, metal smelter, waste incineration; • Diffuse sources such as small-scale gold mining, informal burning of waste with fluorescent lamps, batteries, thermometers.
Water	Mercury releases to aquatic environments and to waste water systems; point sources and diffuse sources from which mercury will be spread to marine environments (oceans), and freshwaters (rivers, lakes, etc.). For example, releases from: • Wet flue gas cleaning systems on coal fired power plants; • Industry, households, etc. to aquatic environments; • Surface run-off and leachate from mercury contaminated soil and waste dumps.
Land	Mercury releases to the terrestrial environment: General soil and ground water. For example, releases from: • Solid residues from flue gas cleaning on coal fired power plants used for gravel road construction. • Uncollected waste products dumped or buried informally. • Local un-confined releases from industry such as on site hazardous waste storage/burial. • Spreading of sewage sludge with mercury content on agricultural land (sludge used as fertilizer). • Application on land, seeds or seedlings of pesticides with mercury compounds.
By-products and impurities	By-products that contain mercury, which are sent back into the market and cannot be directly allocated to environmental releases, for example: • Gypsum wallboard produced from solid residues from flue gas cleaning on coal fired power plants. • Sulphuric acid produced from desulphurization of flue gas (flue gas cleaning) in non-ferrous metal plants with mercury trace concentrations. • Chlorine and sodium hydroxide produced with mercury-based chlor-alkali technology; with mercury trace concentrations. • Metal mercury or calomel as by-product from non-ferrous metal mining (high mercury concentrations).

Calculation Result Type	Description
General waste	General waste: Also called municipal waste in some countries. Typically, household and institutional waste where the waste undergoes a general treatment, such as incineration, landfilling or informal dumping. The mercury sources to waste are consumer products with intentional mercury content (batteries, thermometers, fluorescent tubes) as well as high volume waste like printed paper and plastic with small trace concentrations of mercury.
Sector specific waste treatment /disposal	Waste from industry and consumers which is collected and treated in separate systems, and in some cases recycled; for example: • Confined deposition of solid residues from flue gas cleaning on coal fired power plants on dedicated sites. • Hazardous industrial waste with high mercury content which is deposited in dedicated, safe sites. • Hazardous consumer waste with mercury content, mainly separately collected and safely treated such as batteries, thermometers, mercury switches, lost teeth with amalgam fillings. • Confined deposition of tailings and high-volume rock/ waste from extraction of non-ferrous metals.

Annex E: Summary of mercury releases

Source category	Estimated Hg releases, kg Hg/y					
	Air	Water	Land	By-products and impurities	General waste	Sector specific waste treatment / disposal
Energy consumption						
Coal combustion in large power plants	216.8	0.0	0.0	0.0	0.0	29.6
Coal combustion in coal fired industrial boilers	-	-	-	-	-	-
Other coal uses	534.7	0.0	0.0	0.0	0.0	0.0
Combustion/use of petroleum coke and heavy oil	48.6	0.0	0.0	0.0	0.0	0.0
Combustion/use of diesel, gasoil, petroleum, kerosene, LPG and other light to medium distillates	21.5	0.0	0.0	0.0	0.0	0.0
Use of raw or pre-cleaned natural gas	?	?	?	?	?	?
Use of pipeline gas (consumer quality)	6.5	0.0	0.0	0.0	0.0	0.0
Biomass fired power and heat production	596.5	0.0	0.0	0.0	0.0	0.0
Charcoal combustion	-	-	-	-	-	-
Fuel production						
Oil extraction	0.0	0.1	0.0	0.0	0.0	0.0
Oil refining	1.2	0.0	0.0	0.0	0.0	0.7
Extraction and processing of natural gas	400.9	534.6	0.0	801.9	0.0	935.5
Primary metal production						
Mercury (primary) extraction and initial processing	-	-	-	-	-	-
Production of zinc from concentrates	-	-	-	-	-	-
Production of copper from concentrates	-	-	-	-	-	-
Production of lead from concentrates	-	-	-	-	-	-

Source category	Estimated Hg releases, kg Hg/y					
	Air	Water	Land	By-products and impurities	General waste	Sector specific waste treatment / disposal
Gold extraction by methods other than mercury amalgamation	-	-	-	-	-	-
Alumina production from bauxite (aluminium production)	-	-	-	-	-	-
Primary ferrous metal production (pig iron production)	-	-	-	-	-	-
Gold extraction with mercury amalgamation - from whole ore	-	-	-	-	-	-
Gold extraction with mercury amalgamation - from concentrate	-	-	-	-	-	-
Other materials production						
Cement production*3	130.2	0.0	0.0	55.8	0.0	0.0
Pulp and paper production	6.3	0.0	0.0	0.0	0.0	0.0
Production of chemicals						
Chlor-alkali production with mercury-cells	-	-	-	-	-	-
VCM production with mercury catalyst	-	-	-	-	-	-
Acetaldehyde production with mercury catalyst	-	-	-	-	-	-
Production of products with mercury content						
Hg thermometers (medical, air, lab, industrial etc.)	-	-	-	-	-	-
Electrical switches and relays with mercury	-	-	-	-	-	-
Light sources with mercury (fluorescent, compact, others: see guideline)	3.4	1.7	34.3	0.0	34.3	3.4
Batteries with mercury	-	-	-	-	-	-
Manometers and gauges with mercury	-	-	-	-	-	-
Biocides and pesticides with mercury	-	-	-	-	-	-
Paints with mercury	47.3	23.6	472.5	0.0	472.5	47.3

Source category	Estimated Hg releases, kg Hg/y					
	Air	Water	Land	By-products and impurities	General waste	Sector specific waste treatment / disposal
Skin lightening creams and soaps with mercury chemicals	5.2	2.6	52.1	0.0	52.1	5.2
Use and disposal of products with mercury content						
Dental amalgam fillings ("silver" fillings)	23.5	326.5	41.0	30.8	181.8	181.8
Thermometers	1,056.0	1,584.0	1,056.0	0.0	1,584.0	0.0
Electrical switches and relays with mercury	390.9	0.0	521.2	0.0	390.9	0.0
Light sources with mercury	107.7	0.0	107.7	0.0	143.5	0.0
Batteries with mercury	24.9	0.0	24.9	-	49.8	0.0
Polyurethane (PU, PUR) produced with mercury catalyst	390.9	195.4	781.8	0.0	586.3	0.0
Paints with mercury preservatives	4,368.2	237.4	0.0	0.0	142.4	0.0
Skin lightening creams and soaps with mercury chemicals	0.0	494.9	26.0	0.0	0.0	0.0
Medical blood pressure gauges (mercury sphygmomanometers)	160.0	240.0	160.0	0.0	240.0	0.0
Other manometers and gauges with mercury	65.1	97.7	65.1	0.0	97.7	0.0
Laboratory chemicals	0.0	215.0	0.0	0.0	215.0	221.5
Other laboratory and medical equipment with mercury	0.0	860.0	0.0	0.0	860.0	886.0
Production of recycled of metals						
Production of recycled mercury ("secondary production")	0.4	0.5	0.0	-	0.0	0.0
Production of recycled ferrous metals (iron and steel)	308.6	0.0	317.9	0.0	308.6	0.0
Waste incineration						
Incineration of municipal/ general waste	-	-	-	-	-	-
Incineration of hazardous waste	?	?	?	?	?	?

Source category	Estimated Hg releases, kg Hg/y					
	Air	Water	Land	By-products and impurities	General waste	Sector specific waste treatment / disposal
Incineration / burning of medical waste	91.1	0.0	0.0	0.0	0.0	0.0
Sewage sludge incineration	-	-	-	-	-	-
Open fire waste burning (on landfills and informally)	14,231.5	0.0	0.0	0.0	0.0	0.0
Waste deposition / landfilling and waste water treatment						
Controlled landfills/deposits	11.7	0.1	0.0	0.0	0.0	0.0
Informal dumping of general waste *1	1,198.7	1,198.7	9,589.6	-	-	-
Waste water system/ treatment *2	0.0	0.0	0.0	0.0	0.0	0.0
Crematoria and cemeteries						
Crematoria	206.6	0.0	0.0	-	0.0	0.0
Cemeteries	0.0	0.0	1,859.1	-	0.0	0.0
TOTAL of quantified releases*1*2*3	**24,650.0**	**6,010.0**	**5,520.0**	**890.0**	**5,360.0**	**2,310.0**

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

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

*3: To avoid double counting, fossil fuel mercury contributions to cement production was subtracted automatically in the TOTALS

Annex F: Present source categories and summary of mercury input to society

Source category	Source present? (Y/N/?)	Activity Rate	Unit	Estimated Hg input, kg Hg/y
Energy consumption				
Coal combustion in large power plants	Y	1,642,500	Coal combusted, t/y	246
Coal combustion in coal fired industrial boilers	N	0	Coal combusted, t/y	-
Other coal uses	Y	4,010,000	Coal used, t/y	535
Combustion/use of petroleum coke and heavy oil	Y	884,000	Oil product combusted, t/y	49
Combustion/use of diesel, gasoil, petroleum, kerosene, LPG and other light to medium distillates	Y	3,916,000	Oil product combusted, t/y	22
Use of raw or pre-cleaned natural gas	?	0	Gas used, Nm^3/y	?
Use of pipeline gas (consumer quality)	Y	29,660,963,040	Gas used, Nm^3/y	7
Biomass fired power and heat production	Y	19,883,250	Biomass combusted, t/y	596
Charcoal combustion	N	0	Charcoal combusted, t/y	-
Fuel production				
Oil extraction	Y	91,000	Crude oil produced, t/y	0
Oil refining	Y	1,400,000	Crude oil refined, t/y	5
Extraction and processing of natural gas	Y	26,728,395,760	Gas produced, Nm^3/y	2,673
Primary metal production				
Mercury (primary) extraction and initial processing	N	0	Mercury produced, t/y	-
Production of zinc from concentrates	N	0	Concentrate used, t/y	-
Production of copper from concentrates	N	0	Concentrate used, t/y	-

Source category	Source present? (Y/N/?)	Activity Rate	Unit	Estimated Hg input, kg Hg/y
Production of lead from concentrates	N	0	Concentrate used, t/y	-
Gold extraction by methods other than mercury amalgamation	N	0	Gold ore used, t/y	-
Alumina production from bauxite (aluminium production)	N	0	Bauxit processed, t/y	-
Primary ferrous metal production (pig iron production)	N	0	Pig iron produced, t/y	-
Gold extraction with mercury amalgamation - from whole ore	N	0	Gold produced, kg/y	-
Gold extraction with mercury amalgamation - from concentrate	N	0	Gold produced, kg/y	-
Other materials production				
Cement production*4	Y	1,690,000	Cement produced, t/y	186
Pulp and paper production	Y	208,889	Biomass used for production, t/y	6
Production of chemicals				
Chlor-alkali prod. with mercury-cells	N	0	Cl2 produced, t/y	-
VCM production with mercury catalyst	N	0	VCM produced, t/y	-
Acetaldehyde production with mercury catalyst	N	0	Acetaldehyde produced, t/y	-
Production of products with mercury content				
Hg thermometers (medical, air, lab, industrial etc.)	N	0	Mercury used for production, kg/y	-
Electrical switches and relays with mercury	N	0	Mercury used for production, kg/y	-
Light sources with mercury (fluorescent, compact, others: see guideline)	Y	343	Mercury used for production, kg/y	343
Batteries with mercury	N	0	Mercury used for production, kg/y	-
Manometers and gauges with mercury	N	0	Mercury used for production, kg/y	-

Source category	Source present? (Y/N/?)	Activity Rate	Unit	Estimated Hg input, kg Hg/y
Biocides and pesticides with mercury	N	0	Mercury used for production, kg/y	-
Paints with mercury	Y	4,725	Mercury used for production, kg/y	4,725
Skin lightening creams and soaps with mercury chemicals	Y	521	Mercury used for production, kg/y	521
Use and disposal of products with mercury content				
Dental amalgam fillings ("silver" fillings)	Y	158,900,000	Number of inhabitants	785
Thermometers	Y	2,640,000	Items sold/y	5,280
Electrical switches-relays with mercury	Y	158,900,000	Number of inhabitants	1,303
Light sources with mercury	Y	28,204,000	Items sold/y	359
Batteries with mercury	Y	100	t batteries sold/y	100
Polyurethane (PU, PUR) produced with mercury catalyst	Y	158,900,000	Number of inhabitants	1,954
Paints with mercury preservatives	Y	113,054	Paint sold, t/y	4,748
Skin lightening creams and soaps with mercury chemicals	Y	135	Cream or soap sold, t/y	521
Medical blood pressure gauges (mercury sphyg-momanometers)	Y	10,000	Items sold/y	800
Other manometers and gauges with mercury	Y	158,900,000	Number of inhabitants	326
Laboratory chemicals	Y	158,900,000	Number of inhabitants	651
Laboratory-medical equipment with Hg	Y	158,900,000	Number of inhabitants	2,606
Production of recycled of metals				
Production of recycled mercury ("secondary production")	Y	200	Mercury produced, kg/y	201
Production of recycled ferrous metals (iron and steel)	Y	850,000	Number of vehicles recycled/y	935

Source category	Source present? (Y/N/?)	Activity Rate	Unit	Estimated Hg input, kg Hg/y
Waste incineration				
Incineration of municipal/general waste	N	0	Waste incinerated, t/y	-
Incineration of hazardous waste	?	0	Waste incinerated, t/y	?
Incineration / burning of medical waste	Y	3,796	Waste incinerated, t/y	91
Sewage sludge incineration	N	0	Waste incinerated, t/y	-
Open fire waste burning (landfills and informally)	Y	14,231,486	Waste burned, t/y	14,231
Waste deposition / landfilling and waste water treatment				
Controlled landfills/ deposits	Y	1,168,000	Waste landfilled, t/y	12
Informal dumping of general waste *1	Y	11,987,014	Waste dumped, t/y	11,987
Waste water system/ treatment*3	Y	0	Waste water, m^3/y	0
Crematoria and cemeteries				
Crematoria	Y	82,628	Corpses cremated/y	207
Cemeteries	Y	743,652	Corpses buried/y	1,859
TOTAL of quantified inputs*1*2*3*4				**30,850**

Notes:*1: Waste is not an original source to mercury input to society. To avoid double counting of mercury inputs from waste and products in the graphs, only 10% of the mercury input to waste incineration, waste deposition and informal dumping is included in the chart for mercury inputs. These 10% represent approximately the mercury input to waste from materials which were not quantified individually in Inventory Level 1 of the toolkit. This correction may cause minor discrepancies between total inputs and total releases.

*2: Waste is not an original source to mercury input to society. The estimated quantities include mercury in products which has also been accounted for under each product category. To signal the importance of this release pathway, the release to land from informal dumping of general waste has NOT been subtracted in the charts.

*3: Wastewater is not an original source to mercury input to society. The estimated input and release to water include mercury amounts which have also been accounted for under each source category. To avoid double counting, input to waste water system/treatment have been subtracted automatically in the charts. To signal the importance of this release pathway, releases to water via waste water system/ treatment has NOT been adjusted in the charts in spite of double counting.

*4: To avoid double counting, fossil fuel mercury contributions to cement production was subtracted automatically in the TOTALS.