MINAMATA CONVENTION ON MERCURY
INITIAL ASSESSMENT REPORT FOR TURKEY

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FOREWORD (by Government Official)

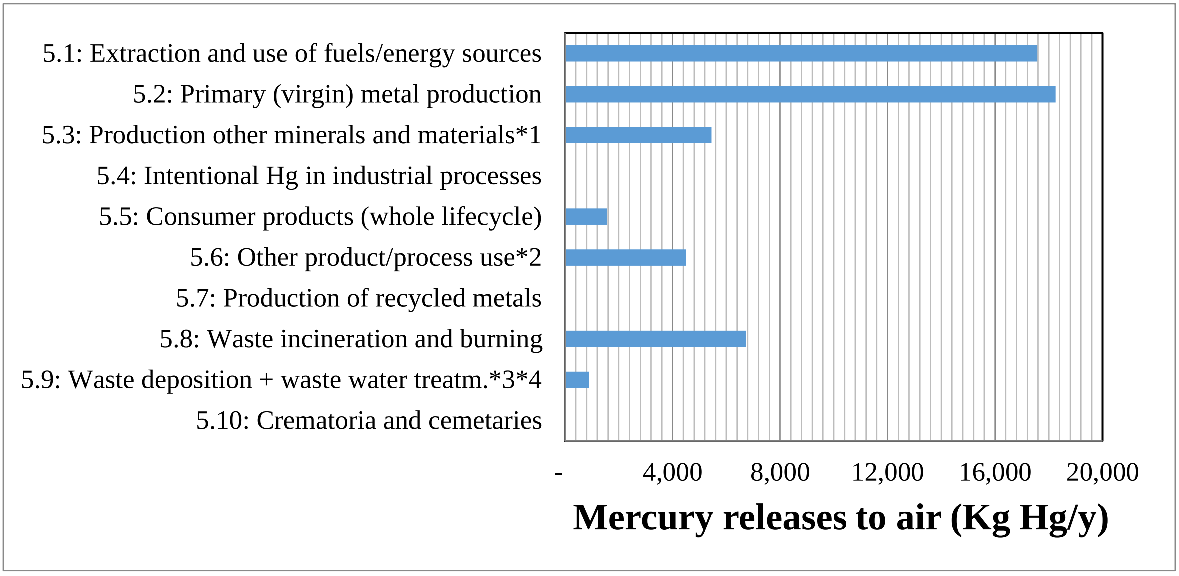
EXECUTIVE SUMMARY

Mercury is recognized as a substance, which is persistent in the environment and highly toxic to human health. Although mercury poses a particular threat to the development of the child in utero and early in life, depending on its form, it has toxic effects on the nervous, digestive, and immune systems and lungs, kidneys, skin, and eyes. It is emitted to the atmosphere and released to waters and land as a result of both anthropogenic activities and from natural sources and processes. The key reason for the implementation of a multilateral environmental agreement regarding mercury was the global transport of mercury and its compounds in the environment. To protect human health and the environment from anthropogenic emissions and releases of mercury and its compounds, the Minamata Convention, which addresses specific anthropogenic activities that are responsible for mercury pollution, was entered into force on 16 August 2017. At the time being, 128 countries, including Turkey, had signed the Convention.

To help parties determine the requirements specified under the Minamata Convention and to provide a basis for work towards its implementation, the Minamata Initial Assessment (MIA) was developed. This report was prepared within this scope. To this end, regulatory and institutional assessments were performed. When Turkish legislations were examined, it was seen that a limited number of adjustments and extensions to the Turkish legislations are required since Turkey already has a well-developed legislative framework for eliminating the risk posed by mercury.

In this context, a comprehensive national mercury inventory was developed to assist the country in setting priorities and reduction targets. This mercury release inventory was made with the use of the "Toolkit for identification and quantification of mercury releases" made available by the Chemicals Branch of the United Nations Environment Programme at United Nations Environment Chemicals' website. This inventory was developed on the Toolkits Inventory Level 2. The Toolkit methodology is based on mass balances for each mercury release source sub-category. This inventory was developed in 2019. Data between the years of 2013-2018 have been used in the inventory, when available. For some data types, data from these years have not been available. Then, the nearest available years' data were used. The default factors were used for performing mercury inventory and identification of emission sources. The calculations made indicate that the default input factors may overestimate or underestimate the mercury releases from source categories. This may be of priority in follow-up work, as feasible. Detailed presentation of mercury inputs and releases for all mercury release source types present in the country and major point sources of mercury releases identified in each of the relevant source sub-category sections are given in Chapter 2. The results for main groups of mercury release sources are presented in Table 2-3. The Toolkit spreadsheets used in the development of this inventory are provided in Annex 1.

The results of the inventory indicated that the following source sub-categories made the most substantial contributions to mercury releases to the atmosphere: incineration of hazardous waste, gold extraction and initial processing by other processes than mercury amalgamation and coal combustion in large power plants. Mercury releases to air, water, land, general waste, and sector-specific waste treatment/disposal and mercury outputs to by-products and impurities are provided in Figure 0-1. Figure 0-2 summarizes the percent of total mercury releases by the source category. On the other hand, percent of total mercury releases are shown in Figure 0-3.


5.1: Extraction and use of fuels/energy sources
5.2: Primary (virgin) metal production
5.3: Production other minerals and materials*1
5.4: Intentional Hg in industrial processes
5.5: Consumer products (whole lifecycle)
5.6: Other product/process use*2
5.7: Production of recycled metals
5.8: Waste incineration and burning
5.9: Waste deposition + waste water treatm.*3*4
5.10: Crematoria and cemetaries
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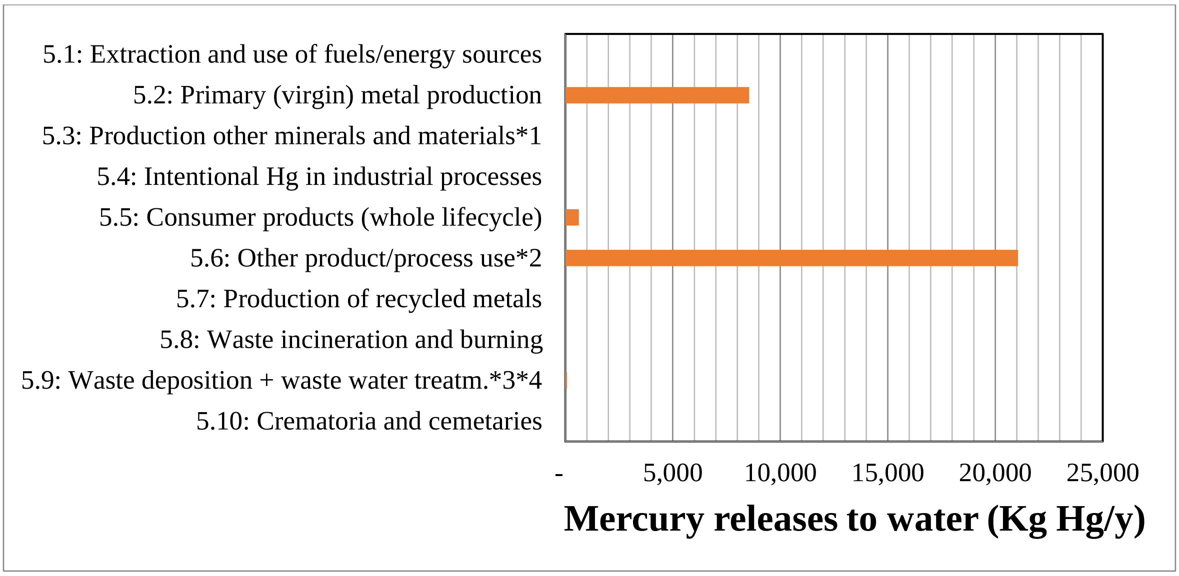
8,000
12,000
16,000
20,000
Mercury releases to air (Kg Hg/y)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5.7: Production of recycled metals
5.8: Waste incineration and burning
5.9: Waste deposition + waste water treatm.*3*4
5.10: Crematoria and cemetaries
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10,000
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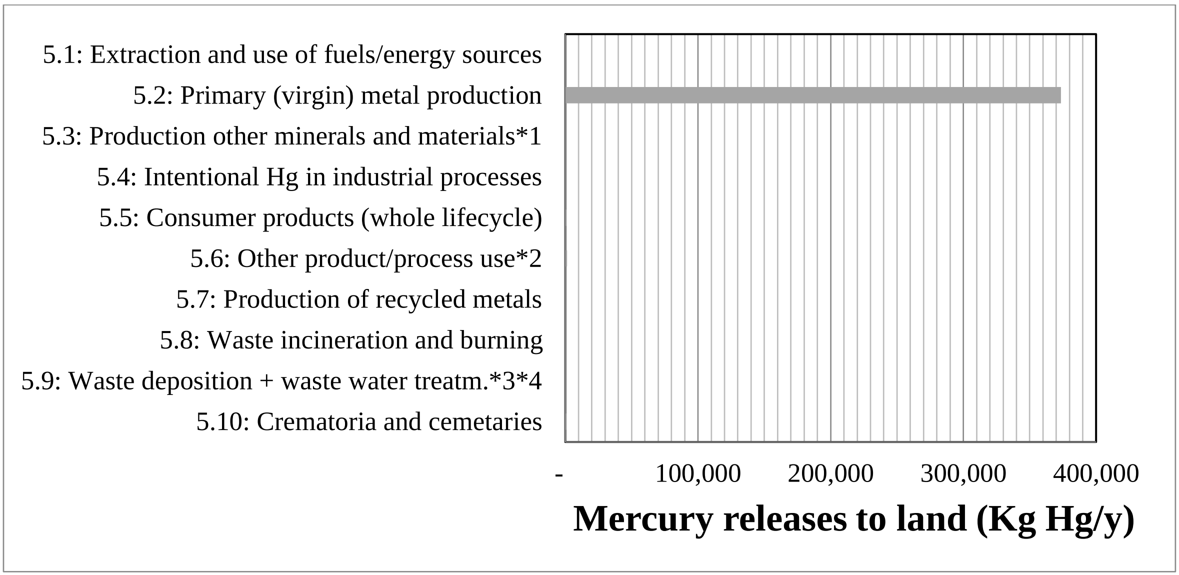
Mercury releases to water (Kg Hg/y)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5.7: Production of recycled metals
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Mercury releases to land (Kg Hg/y)

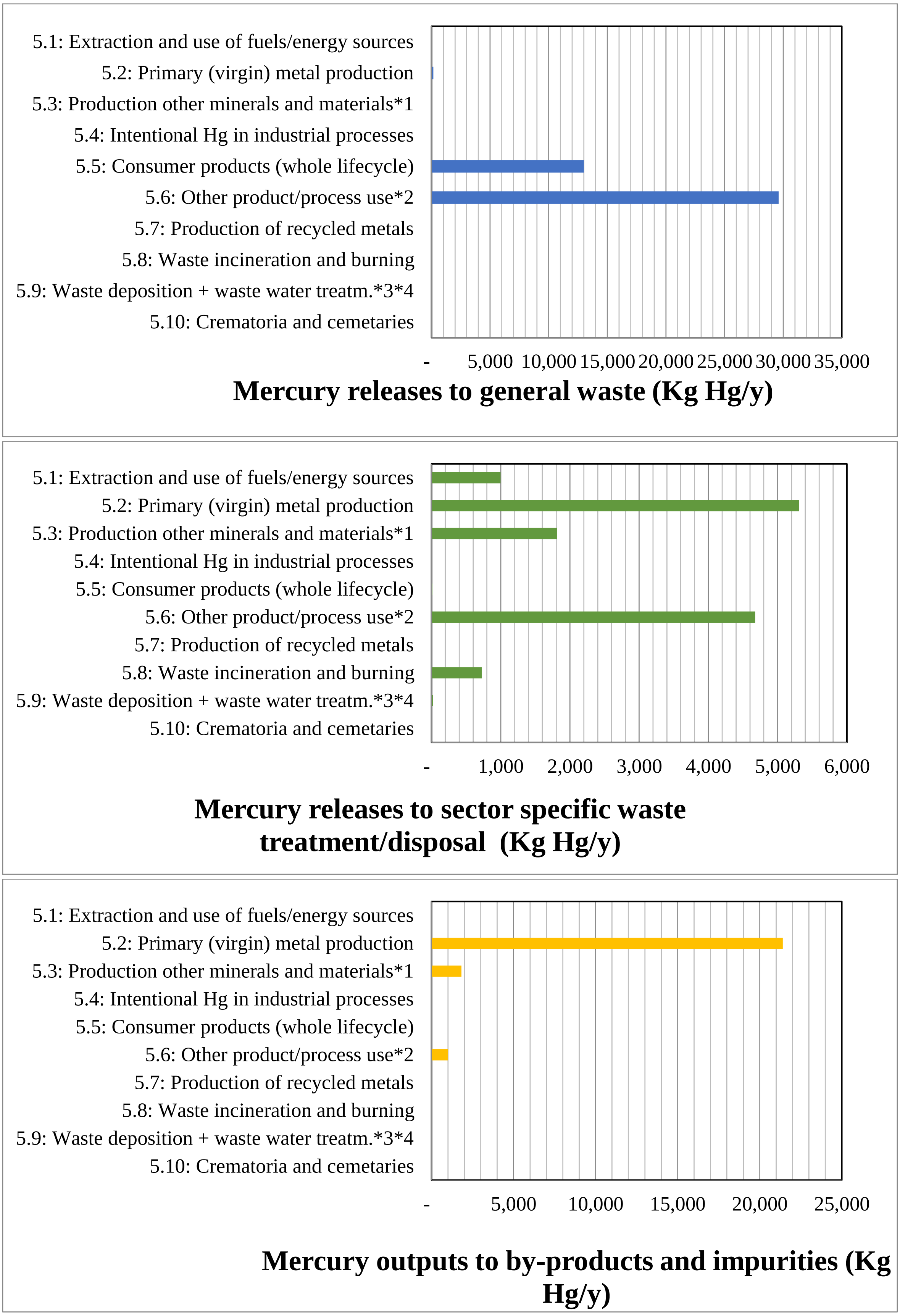

Figure 0-1. Mercury releases from each source sub-category

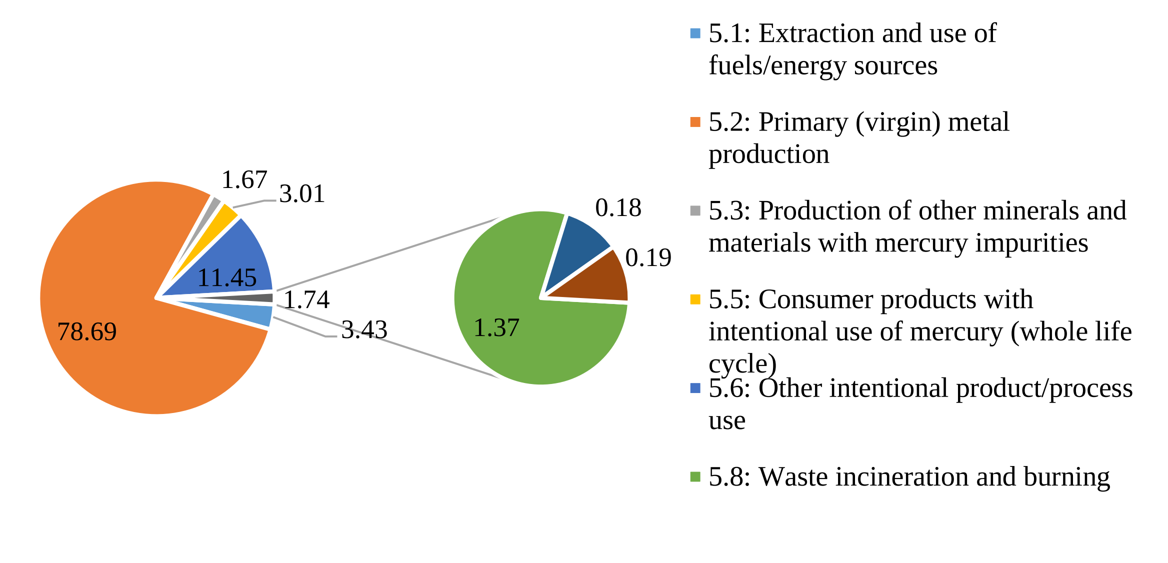

Figure 0-2. Percent of total mercury releases by source category

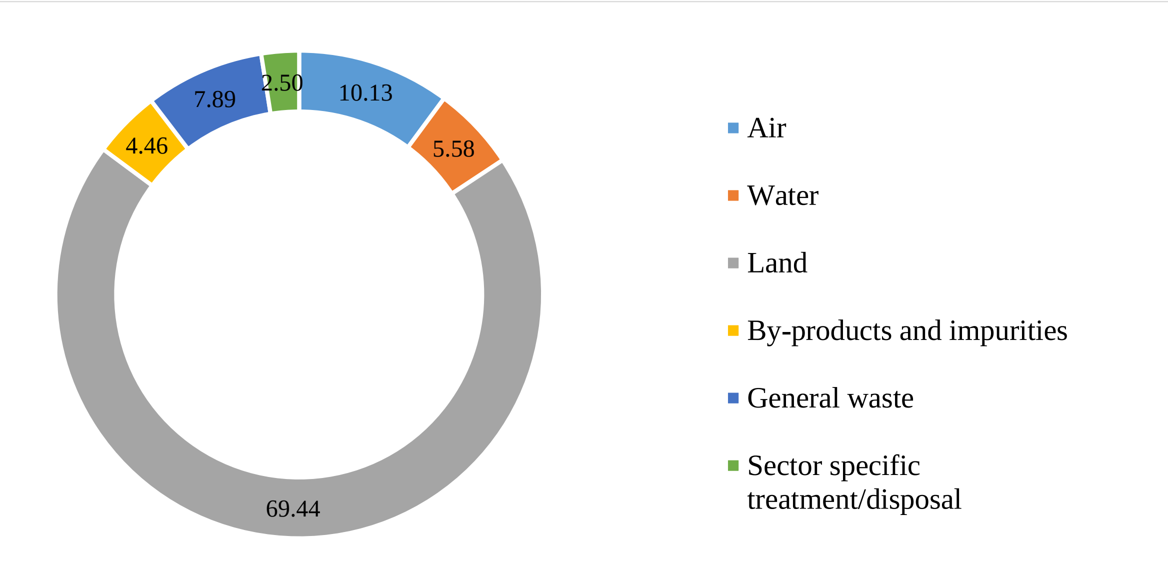

Figure 0-3. Percent of total mercury releases to different environmental compartments

As given in detail in Chapter 2, the following source sub-categories made the most significant contributions to mercury inputs to society: gold extraction and initial processing by other processes than mercury amalgamation, manometers, and gauges, and dental mercury-amalgam fillings.

On the other hand, the origin of mercury in waste and wastewater produced in the country is mercury in products and materials. Waste fractions and wastewater do, therefore, not represent original mercury inputs to society (except imported waste). Waste and wastewater may, however, represent substantial flows of mercury through the community. The following were found to be the significant flows of mercury with waste and wastewater: incineration of hazardous waste, controlled landfills/deposits and incineration of medical waste.

Major data gaps identified in source sections are the following;

- Site-specific data cannot be gathered for input and output factors,
- Activity rates for the recent years are not available,

- Measured data on emission reduction equipment applied on the source are not available,
- There is no information regarding emission reduction equipment used on the source,
- Long-term activity rate data are not available,
- Specifically, measured mercury amounts to all output streams are required.

The main priorities for further assessment are to perform studies in each source category that is present in the country to reveal the actual situation regarding mercury releases from each category.

INTRODUCTION

Mercury is highly toxic to human health, occurs naturally in the environment, and it is found in air, water, and soil. World Health Organization (WHO) classifies mercury as one of the top ten chemicals or groups of chemicals of primary health concern (WHO, 2017). Commonly found forms in nature are elemental (or metallic), inorganic (mercury chloride), and organic (methyl- and ethylmercury). Their toxicities, health effects, and measures to be taken to prevent exposure vary depending on the mercury form.

Sources of exposure to mercury are widespread. Naturally occurring mercury is released into the environment from volcanic activity, weathering of rocks, water movements, and biological processes (WHO, n.d.). In addition to the natural processes, the leading cause of mercury detected in the environmental compartments is anthropogenic sources such as coal-fired power plants, mining activities, waste incinerators, residential heating, and cooling systems and industrial production processes. On the other hand, Hyman (2004) claimed that nearly all human exposures to methylmercury occur by eating fish and shellfish contaminated with methylmercury since once elemental mercury is introduced into the environment, it is naturally transformed into methylmercury which bioaccumulates in fish and shellfish. In addition to the abovementioned mercury sources, 5% of all mercury released in wastewater can be attributed to the use of thermometers, blood pressure monitors, and dental amalgam and to the incineration of medical waste (WHO, n.d.).

To protect human health and the environment from anthropogenic emissions and releases of mercury and its compounds, the Minamata Convention, a multilateral environmental agreement that points out specific anthropogenic activities that are responsible for mercury pollution, was entered into force on 16 August 2017. Like the Basel, Rotterdam, and Stockholm Conventions, the Minamata Convention aims to achieve sound management of chemicals and hazardous wastes. Therefore, it is expected that the implementation of the obligations of the Convention will contribute to the reduction in mercury levels in the environmental compartments (the United States Environmental Protection Agency, 2019). The Convention focuses on the following main topics;

- Mercury supply sources and trade (Article 3),
- Mercury-added products (Article 4),
- Manufacturing processes in which mercury or mercury compounds are used (Article 5),
- Artisanal and small-scale gold mining (ASGM) (Article 7),
- Emissions (to air) (Article 8),
- Releases (to land and water) (Article 9),
- Environmentally sound interim storage of mercury, other than mercury waste (Article 10),
- Mercury wastes (Article 11),
- Contaminated sites (Article 12),
- Health aspects (Article 16).

In addition to the afore-mentioned significant areas, the Convention covers particular processes to help parties comply with its obligations. These processes include the following items;

- Financial resources and mechanism (Article 13),
- Capacity-building, technical assistance, and technology transfer (Article 14),
- Implementation and Compliance Committee (Article 15),
- Information exchange (Article 17),
- Public information, awareness, and education (Article 18),

- Research, development, and monitoring (Article 19),
- Implementation plans (Article 20),
- Reporting (Article 21),
- Effectiveness evaluation (Article 22).

Per the listed articles, the Convention requires states;

- To reduce and where feasible eliminate the use and release of mercury from ASGM,
- To control mercury air emissions from coal-fired power plants, coal-fired industrial boilers, certain non-ferrous metals production operations, waste incineration, and cement production,
- To phase-out or take measures to reduce mercury use in certain products such as batteries, switches, lights, cosmetics, pesticides, and measuring devices, and create initiatives to reduce the use of mercury in dental amalgam.
- To phase out or reduce the use of mercury in manufacturing processes such as Chlor-alkali production, vinyl chloride monomer production, and acetaldehyde production (the United States Environmental Protection Agency, 2019).

This report covers six chapters. The first chapter gives national background information regarding the country profile. In Chapter 2, emission sources and mercury inventory of the country are provided. Policy, regulatory, and institutional assessment are presented in the third chapter. In Chapter 4, a preliminary review of potential populations at risk and evaluation of possible gender dimensions related to the management of mercury are shared. Public information, awareness, and education-related activities are given in Chapter 5. Finally, Chapter 6 summarizes the implementation plan and priorities for action.

1 CHAPTER 1. NATIONAL BACKGROUND INFORMATION

This chapter provides a brief country profile to place the Minamata Initial Assessments (MIAs) strategies and action plans in a country-specific context. It includes information regarding geography and population, membership in regional and sub-regional organizations, the country's political, institutional, legal and economic profile, profiles of potentially critical economic sectors in the context of mercury issues, and overall environmental conditions and priorities in the country.

1.1 Country Profile

1.1.1 Geography and population

The Republic of Turkey is located between 36°-42° north latitude and 26°-45° east longitude in the Northern Hemisphere. It occupies a unique geographic position, lying partly in Asia and Europe. It can be considered as a larger country when compared to other countries of the region based on its territory and population. In addition, its land area is higher than that of any European state. The total surface area of the country is 785,347 $km^{2,}$ while 1.3% of the total area comprises of water and agricultural lands account for 31.1% of the country's land use (World Bank Group - Climate Change Knowledge Portal, 2019). Turkey is surrounded by the Black Sea on the north, by Georgia and Armenia on the northeast, by Azerbaijan and Iran on the east, by Iraq and Syria on the southeast, by the Mediterranean Sea and the Aegean Sea on the southwest and west and by Greece and Bulgaria on the northwest. The political map of Turkey is given in Figure 1-1.

The country's population is estimated at 82 million, with a population density of 102/km^2 (Turkish Statistical Institute, 2018). When the population distribution by gender was examined, it was seen that female and male populations are approximately equal (Turkish Statistical Institute, 2018). About 75% of the population lives in urban areas.

As a result of Turkey's distinctive topography, it experiences different climatic conditions. The climatic zones observed in Turkey are the followings;

- the Mediterranean Climate where summers are hot and dry and the winters are mild and rainy,
- the Black Sea Climate where summers are cool and winters are warm in the coastal area and snowy and cold at the higher parts,
- the Terrestrial Climate where temperature differences between summer and winter and day and night are substantial,
- the Marmara Climate showing the characteristics of a climate transition between the Terrestrial, Black Sea and Mediterranean climates (World Bank Group-Climate Change Knowledge Portal, 2019).

Figure 1-1. Political map of Turkey (Nations Online Project, 2019)

1.1.2 Political, legal and economic profile

1.1.2.1 Political Profile

Turkey is divided into 81 provinces, which in turn are divided into districts and sub-districts. Provinces have an average of eight districts each. Thirty metropolitan municipalities, about 900 district municipalities, 390 smaller towns, and about 50,000 villages have their local governments.

In Turkey, the provinces are administered by governors, who are appointed by the president. The governors function as the principal agents of the central government and report to the Ministry of Interior. Sub-governors administer districts. Provinces and districts also have directly elected councils. The national government oversees elected local councils to ensure the effective provision of local services and to safeguard the public interest. Several ministries have offices at the provincial level.

Suffrage is universal for citizens 18 years of age and older. The president is elected by popular vote for a term of five years. Direct parliamentary and local elections are held (separately) every four years.

1.1.2.2 Legal Profile

Turkey has a written, codified constitution, contained in a single document, the Constitution, enacted in 1982. It is a unitary constitution, with power mainly located in the central government, which has supreme authority. The constitution was significantly changed on 27 April 2017 as a result of a referendum (on 16 April 2017) on substantial reforms of the governance system. All the changes to the Constitution became effective on 9 July 2018.

Turkey has a civil law system based on laws. Higher court decisions have influence over the lower courts to ensure uniformity in judicial practice. International law duly approved and put into the legislature is also considered to be part of the legal system. Further, international agreements prevail against domestic codes and regulations.

The primary domestic sources of law in hierarchical order can be listed as follows: The Constitution, Codes and statutes, International treaties (once ratified by the Grand National Assembly of Turkey), Presidential decrees, Regulations, By-laws.

1.1.2.3 Economical Profile

Turkey's economic and social development performance since 2000 led to increased employment and incomes and made Turkey an upper-middle-income country with a GDP of approximately $851 billion[1]. The country was the 17th largest economy in the World in 2018[2].

Its industry drives Turkey's largely free-market economy and, increasingly, service sectors, although its traditional agriculture sector still accounts for about 25% of employment. The automotive, petrochemical and electronics industries have risen in importance and surpassed the traditional textiles and clothing sectors within Turkey's export mix[3].

1.1.3 Profiles of economic sectors

This section covers the key sectors where mercury use, trade, disposal, emissions, or releases are relevant; industries using mercury, mercury-added products, or manufacturing processes in which mercury and its compounds are used; waste treatment/recycling; sectors which use mercury-containing products. (Table 2-1 shows which mercury release sources were identified as present or absent in the country).

Primary extraction and processing of mercury, gold and silver extraction with the mercury-amalgamation process, zinc extraction and initial processing, lead extraction and initial processing, pulp and paper production, chlor-alkali production with mercury-technology, VCM (vinyl-chloride-monomer) production with mercury-dichloride ($HgCl_2$) as catalyst, acetaldehyde production with mercury-sulphate ($HgSO_4$) as catalyst, other production of chemicals and polymers with mercury compounds as catalysts are not applied in Turkey. Besides, consumer products with intentional use of mercury including biocides and pesticides, paints, and cosmetics and the related products, are not used in the country. Mercury is not also used in religious rituals and folklore medicine. As indicated in detail in Chapter 2, the following source sub-categories made the largest contributions to mercury inputs to society: gold extraction and initial processing by other processes than mercury amalgamation, manometers, and gauges, and dental mercury-amalgam fillings. Moreover, the origin of mercury in waste and wastewater produced in the country is mercury in products and materials. Waste fractions and wastewater do, therefore not represent original mercury inputs to society (except imported waste). Waste and wastewater may, however, represent substantial flows of mercury through society. The following were found to be the major flows of mercury with waste and wastewater: incineration of hazardous waste, controlled landfills/deposits and incineration of medical waste.

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[1] https://www.worldbank.org/en/country/turkey/overview
[2] https://www.wikiwand.com/en/List_of_countries_by_GDP_(nominal)
[3] https://www.indexmundi.com/turkey/economy_profile.html

1.1.3.1 Mining and Minerals

Starting from the early 2000s, major mining companies were increasingly privatized in, and aluminum, chrome, copper, and silver mines moved into the private sector from the public sector. Based on foreign investment in the early 2000s, the output of gold and soda ash has increased significantly. Turkey's gold reserves are estimated at 450 tons. By far, the most crucial mineral product is lignite coal, with an estimated reserve of 10.6 billion tons in 2008. Turkey's lignite is of low-quality and burned mainly in power stations. On the other side, the output of hard coal has declined in Turkey, decreasing to 3.3 million tons in 2002. Hard coal reserves are estimated at 1.2 billion tons. Marble remains to be the most crucial mineral export of the Country[4].

1.1.3.2 Industry and Manufacturing

Turkey has a diverse manufacturing sector that can satisfy domestic demand for a wide variety of products. The main manufactured exports are consumer goods. Textiles and clothing account for 15 percent of all manufacturing and about one-third of manufactured exports. Besides textiles, the most crucial consumer items produced are televisions, automobiles, refrigerators, washing machines, and vacuum cleaners. The most prominent heavy industrial products are processed fuels, steel, cement, tractors, and fertilizers.

Turkey's annual cement production was 80.55 million tonnes in 2017 and 72.5 million tonnes in 2018[5]. Currently, the installed capacity of cement production in Turkey is 141.9 million tonnes, with a capacity utilization rate of 53.397%[6].

Gold reserves in Turkey are estimated at 450 tons[7]. As of 2018, there are currently 15 operating gold mines in Turkey[8] , with a total production of 27.1 tonnes per year[9]. The first gold mine (Ovacık in Western Turkey) has begun commercial production in 2001, and the number has increased to 15 by the year 2018.

1.1.3.3 Energy

Turkey possesses coal in abundance as the only fossil fuel and imports large amounts of oil and natural gas. Since the 1990s, Turkey has attempted to substitute cleaner natural gas for highly polluting domestic coal. In 2017, Turkey's domestic oil output was about 17,9 million barrels per year[10]. Turkey imported 550 000 barrels per day in 2017[11].

Because the demand for electric power increase continuously, in 2018, Turkey's generating capacity has increased to 303.9 billion kWh. As of the end of 2018, 67.1% of the electricity production was from thermal power plants, 19.8% was from hydroelectric power plants, and 13.1% from other renewable

[4] https://www.loc.gov/rr/frd/cs/profiles/Turkey-new.pdf
[5] https://www.tcma.org.tr/tr/istatistikler/aylik-veriler
[6] https://www.tcma.org.tr/tr/istatistikler/kapasite
[7] https://www.loc.gov/rr/frd/cs/profiles/Turkey-new.pdf
[8] http://altinmadencileri.org.tr/wp-content/uploads/2019/02/T%C3%BCrkiyedeki-alt%C4%B1n-madenler.png
[9] http://altinmadencileri.org.tr/wp-content/uploads/2019/02/Slayt3.jpg
[10] http://www.tpao.gov.tr/?mod=sektore-dair&contID=37
[11] http://www.tpao.gov.tr/?mod=sektore-dair&contID=38

energy sources[12]. By the end of 2018, the total number of thermoelectric and hydroelectric plants has increased to 362 and 653, respectively.

1.1.4 Environmental overview

In recent years, there has been serious progress in Turkey, mainly in increasing capacity in waste management and wastewater treatment. But still, the main environmental problems appear as water pollution from the discharge of untreated or partially treated urban and industrial wastewaters, air pollution due to industrial emissions, and deforestation. Industrial air pollution comes mainly from power plants and the metallurgy, cement, sugar, and fertilizer industries, a large percentage of which lack filtration equipment[13]. Another critical problem is land degradation, caused by inappropriate use of agricultural land, overgrazing, over-fertilization, and deforestation. Therefore, the most significant needs are for water and wastewater treatment plants, solid waste management, and the conservation of biodiversity.

There is relatively limited literature available that address environmental contamination by mercury in Turkey. In a recent study, Cengiz et al. (2017) analyzed 25 river water samples collected from the Bogacayi River in Antalya and found no mercury in the samples. Odabasi et al. (2018) investigated the spatial and temporal distributions of mercury in seawater at the mid-Black Sea coast of Samsun during the year 2013 and obtained values ranging from 0.57 to 12.6 µg/L with an average of 5.24 µg/L, which are below the relevant environmental quality standard. Matin et al. (2016) found no mercury in the samples of honey bees, propolis, and pine tree leaves collected from the industrial İzmir Area. On the other side, in 2006, Kontas (2006) indicated that inactive mining sites were the most critical inputs of mercury to the bay suspended. Hg concentrations ranged from 0.70 to 28.7 nmol g^{-1}(dry weight) in suspended particulate, from 0.60 to 3.19 nmol g^{-1}(dry weight) in plankton, from 0.20 to 3.14 nmol g^{-1} (dry weight) in sediment and from 0.05 to 4.54 nmol g^{-1}(wet weight) in organisms. In an evaluations of heavy metal pollution in sediment and Mullus barbatus from the Izmir Bay during 1997–2009, Kucuksezgin et al. (2011) found that all the mean Hg levels were below the guideline (500 µg/kg) and therefore the consumption of the fish from the Bay should not be a problem. In a study done for Beysehir Lake in Southern Turkey, the average lake water Hg concentration was measured as 86 µg/L (Altındag and Yigit, 2005). All the above-mentioned studies indicate that mercury contamination in the environmental samples in Turkey is not severe. Moreover, even the latest samples collected are not high in mercury.

The Ministry of Environment and Urbanization prepares Environmental Indicator and Provincial State of the Environment Reports specified under the Decree-Law No 644. (European Environment Agency, 2017). These reports are published annually and constitute the main component of the National State of the Environment Reports. The data required for these reports are commonly provided by the Ministry of Environment and Urbanization and the Turkish Statistical Institute. According to the key finding of this report, the above-mentioned major environmental challenges facing Turkey result from population growth, industrialization, and rapid urbanization.

Turkey is a party to main international environmental agreements and has adopted new institutional practices to overcome some of the environmental challenges. Table 1-1 presents the key environmental agreements for which Turkey is a party. On the other hand, Turkey has made progress in waste

[12] https://enerji.gov.tr/tr-TR/Sayfalar/Elektrik
[13] https://ec.europa.eu/neighbourhood-enlargement/sites/near/files/20190529-turkey-report.pdf

management, noise control, industrial pollution control, and risk management, forestry, erosion control, and the quality of its water and air (European Environment Agency, 2017).

Table 1-1. Main Environmental Agreements for Which Turkey is a Party (Ministry of Foreign Affairs, n.d.)

Title of Treaty or Convention	**Date Signed**
Convention for the Protection of the Ozone Layer (Vienna Convention)	1991
Amendment to the Montreal Protocol on Substances that deplete the Ozone Layer	1991
Framework Convention on Climate Change	2004
Kyoto Protocol	2009
Convention on Biological Diversity (Rio Conference)	1996
Cartagena Protocol	2004
International Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa	1998
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES Convention)	1996
Ramsar Convention	1994
Barcelona Convention	2002
Protocol on the Prevention of Pollution of the Mediterranean Sea by Transboundary Movements of Hazardous Wastes and their Disposal	2004
Protocol for the Protection of the Mediterranean Sea against Pollution from Land-Based Sources	2002
Protocol Concerning Specially Protected Areas and Biological Diversity in the Mediterranean	2002
The Bucharest Convention on the Protection of the Black Sea against Pollution	1994
Protocols to the Convention on the Protection of the Black Sea Against Pollution	1994
Emergency Protocol	1994
Protocols to the Convention on the Protection of the Black Sea Against Pollution	1994
Basel Convention	1994
Rotterdam Convention	1998
Stockholm Convention	2009
Convention on Long-range Transboundary Air Pollution	1983
Protocol on Long-term Financing of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP)	1985
Convention on the Conservation of European Wildlife and Natural Habitats - Bern Convention	1984
Convention on the Conservation of Atlantic Tunas (ICCAT)	2003
The Protocol on Environmental Protection to the Antarctic Treaty	2017
Minamata Convention	2014

As can be seen in Table 1-1, Turkey signed the Minamata Convention in 2014, which is the first global agreement on health and the environment. The objective of the Convention is “to protect human health and the environment from anthropogenic emissions and releases of mercury and its compounds by addressing mercury through its life cycle from its mining to its management as waste.” As explained in detail in Section 3.1, the legal structure and status of Turkey for implementation of the Minamata Convention on Mercury were assessed by considering the existing structures, policies, strategies, laws, and regulations, and the responsible parties and their roles. The main conclusion that can be drawn from this assessment is that a limited number of adjustments and extensions to the Turkish legislations are required since Turkey already has a well-developed legislative framework for eliminating the risk posed by mercury.

2 CHAPTER 2. MERCURY INVENTORY AND IDENTIFICATION OF EMISSION RESOURCES

2.1 Summary of Mercury Releases, Stockpiles, and Supply and Trade

2.1.1 Mercury release source types present

Table 2-1 shows the mercury release sources that were identified as present or absent in the country. Only source types positively identified as current were included in the quantitative assessment.

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

Cat. no.	Source category	Source presence (y/n/?)
5.1	**Main category - Extraction, and use of fuels/energy sources**	
5.1.1	Coal combustion in large power plants	y
5.1.2	Other coal combustion	y
5.1.3	Extraction, refining and use of mineral oil	y
5.1.4	Extraction, refining and use of natural gas	y
5.1.5	Extraction and use of other fossil fuels	n
5.1.6	Biomass fired power and heat production	y
5.1.7	Geothermal power production	y
5.2	**Main category - Primary (virgin) metal production**	
5.2.1	Primary extraction and processing of mercury	n
5.2.2	Gold and silver extraction with the mercury-amalgamation process	n
5.2.3	Zinc extraction and initial processing	n
5.2.4	Copper extraction and initial processing	y
5.2.5	Lead extraction and initial processing	n
5.2.6	Gold extraction and initial processing by other processes than mercury amalgamation	y
5.2.7	Aluminum extraction and initial processing	y
5.2.8	Extraction and processing of other non-ferrous metals	?
5.2.9	Primary ferrous metal production	y
5.3	**Main category - Production of other minerals and materials with mercury impurities**	
5.3.1	Cement production	y
5.3.2	Pulp and paper production	n
5.3.3	Lime production and lightweight aggregate kilns	?
5.3.4	Others minerals and materials	?
5.4	**Main category – Intentional use of mercury as auxiliary material in industrial processes**	
5.4.1	Chlor-alkali production with mercury-technology	n
5.4.2	VCM (vinyl-chloride-monomer) production with mercury-dichloride ($HgCl_2$) as catalyst	n
5.4.3	Acetaldehyde production with mercury-sulfate ($HgSO_4$) as the catalyst	n
5.4.4	Other production of chemicals and polymers with mercury compounds as catalysts	n
5.5	**Main category - Consumer products with intentional use of mercury**	
5.5.1	Thermometers with mercury	y
5.5.2	Electrical and electronic switches, contacts and relays with mercury	y
5.5.3	Light sources with mercury	y

Cat. no.	Source category	Source presence (y/n/?)
5.5.4	Batteries containing mercury	y
5.5.5	Polyurethane with mercury catalysts	y
5.5.6	Biocides and pesticides	n
5.5.7	Paints	n
5.5.8	Pharmaceuticals for human and veterinary uses	?
5.5.9	Cosmetics and related products	n
5.6	**The main category - Other intentional products/process uses**	
5.6.1	Dental mercury-amalgam fillings	y
5.6.2	Manometers and gauges	y
5.6.3	Laboratory chemicals and equipment	y
5.6.4	Mercury metal use in religious rituals and folklore medicine	n
5.6.5	The miscellaneous product uses, mercury metal uses and other sources	?
5.7	**Main category - Production of recycled metals**	
5.7.1	Production of recycled mercury ("secondary production)	y
5.7.2	Production of recycled ferrous metals (iron and steel)	y
5.7.3	Production of other recycled metals	?
5.8	**Main category – Waste incineration**	
5.8.1	Incineration of municipal/general waste	y
5.8.2	Incineration of hazardous waste	y
5.8.3	Incineration of medical waste	y
5.8.4	Sewage sludge incineration	y
5.8.5	Informal waste burning	y
5.9	**Main category - Waste deposition/landfilling and wastewater treatment**	
5.9.1	Controlled landfills/deposits	y
5.9.2	Diffuse deposition under some control	?
5.9.3	Informal local deposition of industrial production waste	?
5.9.4	Informal dumping of general waste	y
5.9.5	Wastewater system/treatment	y
5.10	**Main category - Cremation and cemeteries**	
5.10.1	Crematoria	n
5.10.2	Cemeteries	y

2.1.2 Summary of mercury inputs to society

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

For waste categories, the “inputs” are calculated to show the distribution of mercury in waste through the different waste treatment activities and calculate releases from these activities, through waste is not a source of input mercury into society (except in case of waste import). Waste “inputs” are marked in *italics.*

Table 2-2 provides a summary of mercury inputs to society. The sub-category lines for sub-categories marked as not present in Table 2-1 were erased. However, the lines with question marks were not erased since it is vital to note missing results here.

Table 2-2. Summary of mercury inputs to society

Cat. no.	Source category	Estimated Hg input, Kg Hg/y, by life cycle phase (as relevant)		
		Production phase*1	Use phase	Disposal phase
5.1	**Main category - Extraction, and use of fuels/energy sources**			
5.1.1	Coal combustion in large power plants		10,595	
5.1.2	Other coal combustion		2059	
5.1.3	Extraction, refining and use of mineral oil	98	141	
5.1.4	Extraction, refining and use of natural gas	40	4697	
5.1.6	Biomass fired power and heat production		269	
5.1.7	Geothermal power production		761	
5.2	**Main category - Primary (virgin) metal production**			
5.2.4	Copper extraction and initial processing	11,436		
5.2.6	Gold extraction and initial processing by other processes than mercury amalgamation	414,915		
5.2.7	Aluminum extraction and initial processing	247		
5.2.8	Extraction and processing of other non-ferrous metals			
5.2.9	Primary ferrous metal production	501		
5.3	**Main category - Production of other minerals and materials with mercury impurities**			
5.3.1	Cement production	9081		
5.3.3	Lime production and lightweight aggregate kilns			
5.3.4	Others minerals and materials			
5.4	**Main category – Intentional use of mercury as auxiliary material in industrial processes**			
5.5	**Main category - Consumer products with intentional use of mercury**			
5.5.1	Thermometers with mercury		1,674	
5.5.2	Electrical and electronic switches, contacts and relays with mercury		11,481	
5.5.3	Light sources with mercury		80	
5.5.4	Batteries containing mercury		653	
5.5.5	Polyurethane with mercury catalysts		2,460	
5.5.8	Pharmaceuticals for human and veterinary uses			
5.6	**The main category - Other intentional products/process uses**			
5.6.1	Dental mercury-amalgam fillings	16,401	16,401	16,401
5.6.2	Manometers and gauges		41,222	
5.6.3	Laboratory chemicals and equipment		4,100	

Cat. no.	Source category	Estimated Hg input, Kg Hg/y, by life cycle phase (as relevant)		
		Production phase*1	Use phase	Disposal phase
5.6.5	The miscellaneous product uses, mercury metal uses and other sources			
5.7	**Main category - Production of recycled metals**			
5.7.1	Production of recycled mercury ("secondary production)	90		
5.7.2	Production of recycled ferrous metals (iron and steel)	16		
5.7.3	Production of other recycled metals			
5.8	**Main category – Waste incineration**			
5.8.1	Incineration of municipal/general waste			36
5.8.2	Incineration of hazardous waste			6,885
5.8.3	Incineration of medical waste			278
5.8.4	Sewage sludge incineration			61
5.8.5	Informal waste burning			199
5.9	**Main category - Waste deposition/landfilling and wastewater treatment**			
5.9.1	Controlled landfills/deposits			87,716
5.9.2	Diffuse deposition under some control			
5.9.3	Informal local deposition of industrial production waste			
5.9.4	Informal dumping of general waste			*263*
5.9.5	Wastewater system/treatment			*96*
5.10	**Main category - Cremation and cemeteries**			
5.10.2	Cemeteries			1,008

Notes: *1: Production phase includes raw material production

Note that the following source sub-categories made the most significant contributions to mercury inputs to society: gold extraction and initial processing by other processes than mercury amalgamation, manometers and gauges, and dental mercury-amalgam fillings.

The origin of mercury in waste and wastewater produced in the country is mercury in products and materials. Waste fractions and wastewater do, therefore, not represent original mercury inputs to society (except imported waste). Waste and wastewater may, however, represent substantial flows of mercury through society. The following were found to be the major flows of mercury with waste and wastewater: incineration of hazardous waste, controlled landfills/deposits, and incineration of medical waste.

2.1.3 Summary of mercury releases

In Table 2-3 below, a summary of mercury releases from all source categories present is given. The key mercury releases here are releases to air (the atmosphere) to water (marine and freshwater bodies, including via wastewater systems), to land, to general waste, and sectors specific waste. An additional output pathway is "by-products and impurities," which designate mercury flows back into the market with by-products and products. See Table 2-4 below for a more detailed description and definition of the output pathways.

Table 2-3 provides a summary of mercury inputs to society. The sub-category lines for sub-categories marked as not present in Table 2-1 were erased. However, the lines with question marks were not erased since it is essential to note missing results here.

Table 2-3. Summary of mercury releases

C	Sub-C	Source category	Exists? (y/n/?)	Calculated Hg output, kg/y					
				Air	Water	Land	By-prod. +impurities	General waste	Sector specific treatment/disposal
5.1		**Source category: Extraction and use of fuels/energy sources**							
	5.1.1	Coal combustion in large power plants	y	9836					759
	5.1.2	Other coal use	y	1838					221
	5.1.3	Mineral oils - extraction, refining, and use	y	164	3				14
	5.1.4	Natural gas - extraction, refining, and use	y	4705	8		20		4
	5.1.6	Biomass fired power and heat production	y	269					
	5.1.7	Geothermal power production	y	761					
5.2		**Source category: Primary (virgin) metal production**							
	5.2.4	Copper extraction and initial processing	y	1144	229		4803		5261
	5.2.6	Gold extraction and initial processing by methods other than mercury amalgamation	y	16597	8298	373424	16597		
	5.2.7	Aluminum extraction and initial processing	y	37	25			161	25
	5.2.8	Other non-ferrous metals - extraction and processing	?						
	5.2.9	Primary ferrous metal production	y	476					25
5.3		**Source category: Production of other minerals and materials with mercury impurities**							
	5.3.1	Cement production	y	5449			1816		1816
	5.3.3	Production of lime and lightweight aggregates	?						
	5.3.4	Others minerals and materials	?						
5.4		**Source category: Intentional use of mercury in industrial processes**							
5.5		**Source category: Consumer products with intentional use of mercury**							
	5.5.1	Thermometers with mercury	y	167	502			1004	
	5.5.2	Electrical switches and relays with mercury	y	1148		1148		9185	
	5.5.3	Light sources with mercury	y	4				64	12
	5.5.4	Batteries with mercury	y					653	
	5.5.5	Polyurethane with mercury catalysts	y	246	123			2091	
5.6		**Source category: Other intentional product/process use**							

C	Sub-C	Source category	Exists? (y/n/?)	Calculated Hg output, kg/y					
				Air	**Water**	**Land**	**By-prod. +impurities**	**General waste**	**Sector specific treatment/disposal**
	5.6.1	Dental mercury-amalgam fillings (b	y	328	7216	1312	984	3280	3280
	5.6.2	Manometers and gauges with mercury	y	4163	12490			24979	
	5.6.3	Laboratory chemicals and equipment with mercury	y		1353			1353	1394
	5.6.5	Miscellaneous product uses, mercury metal uses, and other sources	?						
5.7		**Source category: Production of recycled metals ("secondary" metal production)**							
	5.7.1	Production of recycled mercury ("secondary production")	y	0.18	0.22				0.01
	5.7.2	Production of recycled ferrous metals (iron and steel)	y	5		5		5	
	5.7.3	Production of other recycled metals	?						
5.8		**Source category: Waste incineration**							
	5.8.1	Incineration of municipal/general waste*1	y	32					4
	5.8.2	Incineration of hazardous waste*1	y	6196.5					688.5
	5.8.3	Incineration of medical waste*1	y	250					28
	5.8.4	Sewage sludge incineration*1	y	55					6
	5.8.5	Informal waste burning*1	y	199					
5.9		**Source category: Waste deposition/landfilling and wastewater treatment**							
	5.9.1	Controlled landfills/deposits*1	y	877	9				
	5.9.2	Diffuse disposal under some control	?						
	5.9.3	Informal local disposal of industrial production waste	?						
	5.9.4	Informal dumping of general waste*1*2	y	26	26	211			
	5.9.5	Wastewater system/treatment*3	y		48			29	19
5.10		**Source category: Crematoria and cemeteries**							
	5.10.2	Cemeteries	y			1008			
SUM OF QUANTIFIED RELEASES:				**54974**	**30282**	**376897**	**24220**	**42804**	**13555**

Notes: *2: The estimated quantities include mercury in products which has also been accounted for under each product category. To avoid double-counting, the release to land from informal dumping of general waste has been subtracted automatically in the TOTALS. *3: The estimated release to water includes mercury amounts, which have also been accounted for under each source category. To avoid double-counting, release to water from wastewater system/treatment have been subtracted automatically in the TOTALS

Note that the following source sub-categories made the largest contributions to mercury releases to the atmosphere: incineration of hazardous waste, gold extraction and initial processing by other processes than mercury amalgamation and coal combustion in large power plants.

Table 2-4 deep below provides general descriptions and definitions of the output pathways.

Table 2-4. Description of the types of results

Calculation result type	**Description**
Estimated Hg input, kg Hg/y	The standard estimate of the amount of mercury entering this source category with input materials, for example, calculated mercury amount in the amount of coal used annually in the country for combustion in large power plants.
Air	Mercury emissions to the atmosphere from point sources and diffuse sources from which mercury may be spread locally or over long distances with air masses; for example from: • Point sources such as coal-fired power plants, metal smelter, waste incineration; • Diffuse sources as small-scale gold mining informally burned waste with fluorescent lamps, batteries, thermometers.
Water	Mercury releases to aquatic environments and to wastewater systems: Point sources and diffuse sources from which mercury will be spread to marine ecosystems (oceans), and freshwaters (rivers, lakes, etc.). for example releases from: • Wet flue cleaning systems from coal-fired power plants; • Industry, households, etc. to aquatic environments; • Surface run-off and leachate from mercury-contaminated soil and waste dumps

Land	Mercury releases to soil, the terrestrial environment: General soil and groundwater. 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 is 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 a by-product from non-ferrous metal mining (high mercury concentrations)
General waste	General waste: Also called municipal waste in some countries. Typically household and institution waste where the waste undergoes a general treatment, such as incineration, landfilling, or informal dumping or burning. The mercury sources to waste are consumer products with intentional mercury content (batteries, thermometers, fluorescent tubes, etc.) as well as high volume waste like printed paper, plastic, etc., with small trace concentrations of mercury.

Calculation result type	Description
Sector-specific waste treatment /disposal	Waste from industry and consumers which is collected and treated in separate systems, and in some cases recycled; for example. • Confined deposition of solid residues from flue gas cleaning on coal-fired power plants on dedicated sites. • Hazardous industrial waste with high mercury content which is deposited in dedicated, safe sites • Hazardous consumer waste with mercury content, mainly separately collected and safely treated batteries, thermometers, mercury switches, lost teeth with amalgam fillings, etc. • Confined deposition of tailings and high volume rock/waste from extraction of non-ferrous metals The country-specific waste treatment/disposal method is described for each sub-category in the detailed report sections below.

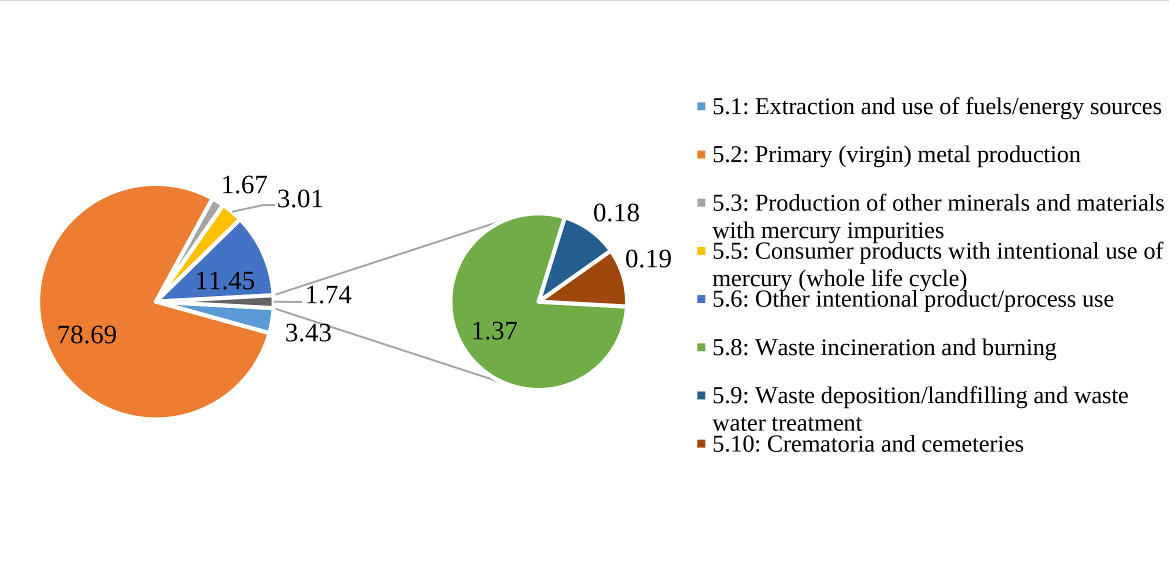

Figure 2-1. Percent of total mercury releases by source category

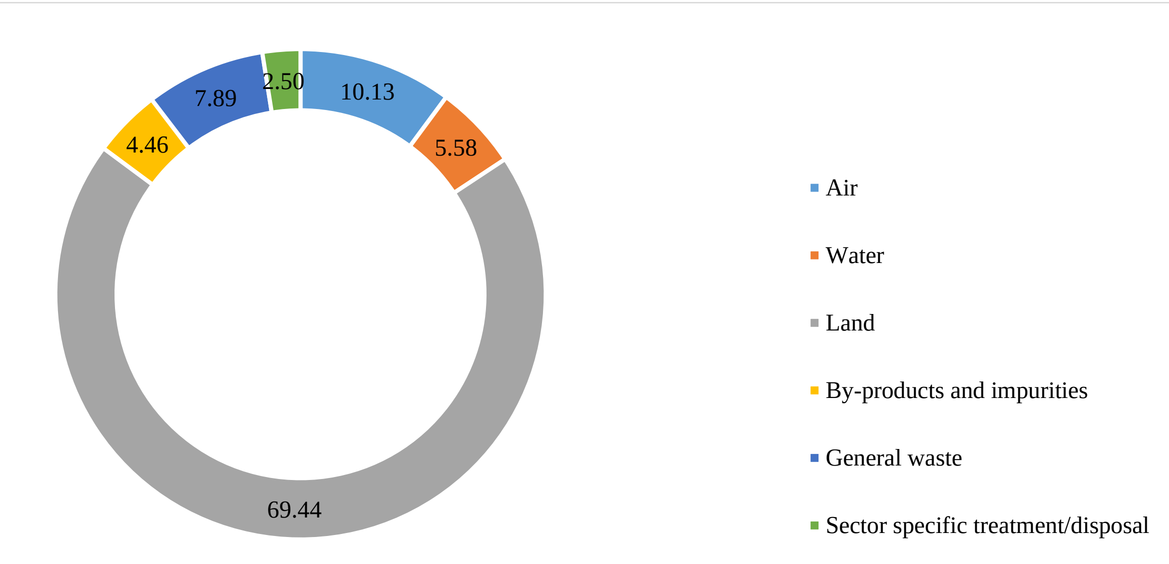

Figure 2-2. Percent of total mercury releases to different environmental compartments

The distribution of the total mercury released by the source category is shown in Figure. As shown, primary metal production (gold mining) is with the highest share, while the unintentional product use is the second largest. The distribution of total mercury releases to different environmental compartments indicates that the major release is onto land.

2.2 Data and Inventory on Extraction and Use of Fuels/Energy Sources

2.2.1 Coal combustion in large power plants

This sub-category covers large combustion plants (typically with thermal boiler effect above 300 MW). To estimate mercury releases from coal combustion in large power plants, the amount of each main type of coal burned (activity rate data) and concentration of mercury in each primary type of coal burned (mercury input factor) are required. Within the scope of this sub-category, pre-combustion coal wash was not considered since it is not applied in large power plants. In this section, how mercury releases from coal combustion in large power plants were estimated using the information provided in "Toolkit for Identification and Quantification of Mercury Releases" (2017) and some selected input and output distribution factors are explained. Another coal combustion was not considered since further research is necessary and it was categorized as possible but not positively identified source. Calculation details regarding the estimated mercury releases from coal combustion in power plants are given in Annex 2. A summary of inputs and results are provided in the following section.

2.2.1.1 Summary of inputs and results

Table 2-5 summarizes the estimated mercury releases from coal combustion in power plants.

Table 2-5. Coal combustion in power plants -summary of estimated mercury releases for the country

[Coal combustion in power plants]	**Unit**	**Production**	**Use (hard coal)**	**Use (lignite)**	**Disposal**	**Sum of releases to pathway from assessed part of life-cycle**
Activity rate	t/y	-	15,853,639	54,779,257	-	-
Input factor for phase	g Hg/t	-	0.15	0.15	-	-
Calculated input to phase	kg Hg/y	-	2378	8217	-	-
Output distribution factors for phase:						
- Air	-	-	0.75	0.98	-	NA
- Water	-	-	0.0	0.0	-	NA
- Land	-	-	0.0	0.0	-	NA
- Products	-	-	0.0	0.0	-	NA
- General waste treatment	-	-	0.0	0.0	-	NA
- Sector specific waste treatment	-	-	0.25	0.02	-	NA
Calculated outputs/releases to:						
- Air	kg Hg/y	-	1784	8053	-	9837
- Water	kg Hg/y	-	0.0	0.0	-	0.0
- Land	kg Hg/y	-	0.0	0.0	-	0.0
- Products	kg Hg/y	-	0.0	0.0	-	0.0
- General waste treatment	kg Hg/y	-	0.0	0.0	-	0.0
- Sector specific waste treatment	kg Hg/y	-	595	164	-	759

Notes: NA- not applicable

2.2.2 Other coal use

This sub-category covers two groups of sources: coal-fired industrial boilers and other coal uses. To estimate mercury releases from other coal use sub-categories, the amount of each main type of coal processed or burned (activity rate data), and concentration of mercury in each main type of coal processed or burned (mercury input factor) is required. Within the scope of this sub-category, pre-combustion coal wash was not considered since it is not applied in coal-fired industrial boilers. In this section, how mercury releases from coal combustion in coal-fired industrial boilers and coke production were estimated using the information provided in “Toolkit for Identification and Quantification of Mercury Releases” (2017) and some selected input and output distribution factors are explained. Another coal combustion was not considered since further research is necessary and it was categorized as possible but not positively identified source. Calculation details regarding the estimated mercury releases from coal burned industrial boilers and coke production are given in Annex 2. A summary of inputs and results are provided in the following section.

2.2.2.1 Summary of inputs and results

Table 2-6 summarizes the estimated mercury releases from coal burned industrial boilers and coke production.

Table 2-6. Combustion in industrial boilers and coke production -summary of estimated mercury releases for the country

[Other coal use]	**Unit**	**Production**	**Use**			**Disposal**	**Sum of releases to pathway from assessed part of life-cycle**
			Hard coal	**Lignite**	**Coke**		
Activity rate	t/y	-	5,363,075	3,910,316	5,760,962	-	-
Input factor for phase	g Hg/t	-	0.15	0.1	0.15	-	-
Calculated input to phase	kg Hg/y	-	804	391	864	-	-
Output distribution factors for phase:							
- Air	-	-	0.75	0.95	1.0	-	NA
- Water	-	-	0.0	0.0	0.0	-	NA
- Land	-	-	0.0	0.0	0.0	-	NA
- Products	-	-	0.0	0.0	0.0	-	NA
- General waste treatment	-	-	0.0	0.0	0.0	-	NA
- Sector specific waste treatment	-	-	0.25	0.05	0.0	-	NA
Calculated outputs/releases to:							

[Other coal use]	Unit	Production	Use			Disposal	Sum of releases to pathway from assessed part of life-cycle
			Hard coal	Lignite	Coke		
- Air	kg Hg/y	-	603	371.5	864	-	1838.5
- Water	kg Hg/y	-	0.0	0.0	0.0	-	0.0
- Land	kg Hg/y	-	0.0	0.0	0.0	-	0.0
- Products	kg Hg/y	-	0.0	0.0	0.0	-	0.0
- General waste treatment	kg Hg/y	-	0.0	0.0	0.0	-	0.0
- Sector specific waste treatment	kg Hg/y	-	201	19.5	0.0	-	220.5

Notes: NA- not applicable

2.2.3 Mineral oils - extraction, refining, and use

This category includes extraction, refining, and uses of mineral oil. Sub-categories of mineral oils – extraction, refining, and use are as follows;

- Extraction
- Refining
- Use of heavy oil and petroleum coke
    - Uses (other than combustion facilities)
    - Oil combustion facilities
- Use of gasoline, diesel, light fuel oil, kerosene, LPG and other light to medium distillates
    - Transportation and other uses than residential heating and other oil combustion facilities
    - Residential heating with no controls
    - Other oil combustion facilities

Within this scope, oil combustion facilities were not considered. To estimate mercury releases from mineral oils – extraction, refining, and use, the most important factors are the amount of input crude oil and each type of oil (activity rate data) and concentration of mercury in crude oil mix used and in every kind of oil burned/used (mercury input factor). In this section, how mercury releases from mineral oils – extraction, refining, and use were estimated using the information provided in “Toolkit for Identification and Quantification of Mercury Releases” (2017) and some selected input and output distribution factors are explained. Calculation details regarding the estimated mercury releases from mineral oils – extraction, refining and, use are given in Annex 2. A summary of inputs and results are provided in the following section.

2.2.3.1 Summary of inputs and results

Table 2-7 summarizes the estimated mercury releases from mineral oils – extraction, refining, and use.

Table 2-7. Mineral oils – extraction, refining, and use -summary of estimated mercury releases for the country

[Mineral oils - extraction, refining, and use]	Unit	Extraction	Refining	Use of heavy oil and petroleum coke	Use of gasoline, diesel, light fuel oil, kerosene, LPG and other light to medium distillates	Disposal	Sum of releases to pathway from assessed part of life-cycle
Activity rate	t/y	2,499,400	26,553,400	3,940,554	30,954,000	-	-
Input factor for phase	mg Hg/t	3.4	3.4	20	2	-	-
Calculated input to phase	kg Hg/y	8	90	79	62	-	-
Output distribution factors for phase:							
- Air	-	0.0	0.25	1.0	1.0	1.0	NA
- Water	-	0.2	0.01	0.0	0.0	0.0	NA
- Land	-	0.0	0.0	0.0	0.0	0.0	NA
- Products	-	0.0	0.0	0.0	0.0	0.0	NA
- General waste treatment	-	0.0	0.0	0.0	0.0	0.0	NA
- Sector specific waste treatment	-	0.0	0.15	0.0	0.0	0.0	NA
Calculated outputs/releases to:							
- Air	kg Hg/y	0.0	22.5	79	62	-	163.5
- Water	kg Hg/y	1.6	0.9	0.0	0.0	-	3.5
- Land	kg Hg/y	0.0	0.0	0.0	0.0	-	0.0
- Products	kg Hg/y	0.0	0.0	0.0	0.0	-	0.0
- General waste treatment	kg Hg/y	0.0	0.0	0.0	0.0	-	0.0
- Sector specific waste treatment	kg Hg/y	0.0	13.5	0.0	0.0	-	13.5

Notes: NA- not applicable

2.2.4 Natural gas - extraction, refining, and use

Natural gas is a fossil fuel used for different purposes, especially for combustion to produce electricity and heat. It contains trace amounts of mercury impurities. These impurities are introduced into the biosphere during extraction, refining, and combustion processes (United Nations Environment, 2017). As the name implies, this sub-category includes extraction/refining, use of raw or pre-cleaned gas, and use of pipeline gas (consumer quality).

In the estimation of mercury releases from natural gas – extraction, refining, and use, the most important factors are the amount of gas extracted, refined or combusted (activity rate data), and the mercury levels in the natural gas (mercury input factor). In this section, how mercury releases for natural gas – extraction, refining, and use were estimated using the information provided in “Toolkit for Identification and Quantification of Mercury Releases” (2017) and some selected input and output distribution factors are explained. Calculation details regarding the estimated mercury releases from natural gas – extraction, refining and, use are given in Annex 2. A summary of inputs and results are provided in the following section.

2.2.4.1 Summary of inputs and results

Table 2-8 summarizes the estimated mercury releases from natural gas – extraction, refining, and use.

Table 2-8. Natural gas – extraction, refining, and use -summary of estimated mercury releases for the country

[Natural gas - extraction, refining, and use]	**Unit**	**Production**	**Use of raw or pre-cleaned gas**	**Use of pipeline gas**	**Disposal**	**Sum of releases to pathway from assessed part of life-cycle**
Activity rate	Sm^3/y	426.6 x 10^6	49334.6 x 10^6	48128.8 x 10^6	-	-
Input factor for phase	µg Hg/Nm^3	100	100	0.22	-	-
Calculated input to phase	kg Hg/y	40	4687	10	-	-
Output distribution factors for phase:						
- Air	-	0.2	1.0	1.0	-	NA
- Water	-	0.2	0.0	0.0	-	NA
- Land	-		0.0	0.0	-	NA
- Products	-	0.5	0.0	0.0	-	NA
- General waste treatment	-		0.0	0.0	-	NA
- Sector specific waste treatment	-	0.1	0.0	0.0	-	NA
Calculated outputs/releases to:						
- Air	kg Hg/y	8	4687	10	-	4695
- Water	kg Hg/y	8	0.0	0.0	-	8
- Land	kg Hg/y	0.0	0.0	0.0	-	0.0
- Products	kg Hg/y	20	0.0	0.0	-	20
- General waste treatment	kg Hg/y	0.0	0.0	0.0	-	0.0
- Sector specific waste treatment	kg Hg/y	4	0.0	0.0	-	4

Notes: NA- not applicable

2.2.5 Biomass fired power and heat production

Power and heat production in many countries and regions rely heavily on the combustion of biomass (United Nations Environment, 2017). This sub-category includes the use of biomass and charcoal combustion. Within the scope of this sub-category, the only use of biomass was considered since there is no data regarding charcoal combustion after 2014 in the energy balance tables, which are available on the website of the General Directorate of Energy Affairs. Therefore, it has been assumed that this source no longer exists.

To estimate mercury releases from biomass use, activity rate data and mercury input factor are required. In this section, how mercury releases for biomass use were calculated using the information provided in "Toolkit for Identification and Quantification of Mercury Releases" (2017), and some selected input and output distribution factors are explained. Calculation details regarding the estimated mercury releases from biomass-fired power and heat production are given in Annex 2. A summary of inputs and results are provided in the following section.

2.2.5.1 Summary of inputs and results

Table 2-9 summarizes the estimated mercury releases from biomass-fired power and heat production.

Table 2-9. Biomass fired power and heat production-summary of estimated mercury releases for the country

[Biomass fired power and heat production]	**Unit**	**Production**	**Use**	**Disposal**	**Sum of releases to pathway from assessed part of life-cycle**
Activity rate	t (dry weight)/y	-	8955400	-	-
Input factor for phase	g Hg/t (dry weight)	-	0.03	-	-
Calculated input to phase	kg Hg/y	-	269	-	-
Output distribution factors for phase:				-	
- Air	-	-	1.0	-	NA
- Water	-	-	0.0	-	NA
- Land	-	-	0.0	-	NA
- Products	-	-	0.0	-	NA
- General waste treatment	-	-	0.0	-	NA
- Sector specific waste treatment	-	-	0.0	-	NA
Calculated outputs/releases to:					
- Air	kg Hg/y	-	269	-	269
- Water	kg Hg/y	-	0.0	-	0.0
- Land	kg Hg/y	-	0.0	-	0.0
- Products	kg Hg/y	-	0.0	-	0.0
- General waste treatment	kg Hg/y	-	0.0	-	0.0
- Sector specific waste treatment	kg Hg/y	-	0.0	-	0.0

Notes: NA- not applicable

2.2.6 Geothermal power production

Geothermal power plants exploit elevated underground temperatures for energy production and geothermal gases in steam may contain traces of mercury. To estimate mercury releases from geothermal power production, activity rate data and mercury input factor are required. In this section, how mercury releases for geothermal power production were estimated using the information provided in "Toolkit for Identification and Quantification of Mercury Releases" (2017), and some selected input and output distribution factors is explained. However, the input factor and output scenario for this sub-category is not available in the Toolkit. Calculation details regarding the estimated mercury releases from geothermal power production are given in Annex 2. A summary of inputs and results are provided in the following section.

2.2.6.1 Summary of inputs and results

Table 2-10 summarizes the estimated mercury releases from geothermal power production.

Table 2-10. Geothermal power production-summary of estimated mercury releases for the country

[Geothermal power production]	Unit	Production	Use	Disposal	Sum of releases to pathway from assessed part of life-cycle
Activity rate	GWh/y	1730.6	-	-	-
Input factor for phase	g/MWh	0.44	-	-	-
Calculated input to phase	kg Hg/y	761	-	-	-
Output distribution factors for phase:					
- Air	-	1.0	-	-	NA
- Water	-	0.0	-	-	NA
- Land	-	0.0	-	-	NA
- Products	-	0.0	-	-	NA
- General waste treatment	-	0.0	-	-	NA
- Sector specific waste treatment	-	0.0	-	-	NA
Calculated outputs/releases to:					
- Air	kg Hg/y	761	-	-	761
- Water	kg Hg/y	-	-	-	0.0
- Land	kg Hg/y	-	-	-	0.0
- Products	kg Hg/y	-	-	-	0.0
- General waste treatment	kg Hg/y	-	-	-	0.0
- Sector specific waste treatment	kg Hg/y	-	-	-	0.0

Notes: NA- not applicable

2.3 Data and Inventory on Primary (Virgin) Metal Production

This category includes nine sub-categories, which are mercury (primary) extraction and initial processing, gold (and silver) extraction with mercury amalgamation processes, zinc extraction and initial processing, copper extraction and initial processing, lead extraction and initial processing, gold extraction and initial processing by methods other than mercury amalgamation, aluminum extraction and initial processing, other non-ferrous metals – extraction and processing and primary ferrous metal production. Other non-ferrous metals – extraction and processing were not considered since further research is necessary and it was categorized as possible but not positively identified source. On the other hand, mercury (primary) extraction and initial processing, gold (and silver) extraction with mercury amalgamation processes, zinc extraction, and initial processing and lead extraction and initial processing are not performed in the country.

2.3.1 Copper extraction and initial processing

This sub-category includes mining and concentrating and production of copper from concentrates. The latter performed in the country. In the estimation of mercury releases from the production of copper from concentrates, the point-source approach was adopted, and point source-specific data from the operating company was used. To this end, metric tons of concentrate used per year (activity rate data) and mercury input factors are required. In this section, how mercury releases for production of copper from concentrates were estimated using the information provided in "Toolkit for Identification and Quantification of Mercury Releases" (2017), and some selected input and output distribution factors are explained. Calculation details regarding the estimated mercury releases from the production of copper from concentrates are given in Annex 2. A summary of inputs and results are provided in the following section.

2.3.1.1 Summary of inputs and results

Table 2-11 summarizes the estimated mercury releases from the production of copper from concentrates.

Table 2-11. Production of copper from concentrates-summary of estimated mercury releases for the country

[Copper extraction and initial processing]	**Unit**	**Production**	**Use**	**Disposal**	**Sum of releases to pathway from assessed part of life-cycle**
Activity rate	t concentrate/y	381216	-	-	-
Input factor for phase	g Hg/t of concentrate	30	-	-	-
Calculated input to phase	kg Hg/y	11,436	-	-	-
Output distribution factors for phase:					
- Air	-	0.1	-	-	NA
- Water	-	0.02	-	-	NA
- Land	-	0.0	-	-	NA
- Products	-	0.42	-	-	NA
- General waste treatment	-	0.0	-	-	NA
- Sector specific waste treatment	-	0.46	-	-	NA
Calculated outputs/releases to:					
- Air	kg Hg/y	1144	-	-	1144
- Water	kg Hg/y	229	-	-	229
- Land	kg Hg/y	0.0	-	-	0.0
- Products	kg Hg/y	4803	-	-	4803
- General waste treatment	kg Hg/y	0.0	-	-	0.0
- Sector specific waste treatment	kg Hg/y	5261	-	-	5261

Notes: NA- not applicable

2.3.2 Gold extraction and initial processing by methods other than mercury amalgamation

To estimate mercury releases from gold extraction and initial processing by methods other than mercury amalgamation, the amount of ore processed per year (activity rate data) and concentration of Hg in ore processed (mercury input factor) are required. In this section, how mercury releases for gold extraction and initial processing by methods other than mercury amalgamation were estimated using the information provided in “Toolkit for Identification and Quantification of Mercury Releases” (2017) and some selected input and output distribution factors are explained. Calculation details regarding the estimated mercury releases from gold extraction and initial processing by methods other than mercury amalgamation are given in Annex 2. A summary of inputs and results are provided in the following section.

2.3.2.1 Summary of inputs and results

Table 2-12 summarizes the estimated mercury releases from gold extraction and initial processing by methods other than mercury amalgamation.

Table 2-12. Gold extraction and initial processing by methods other than mercury amalgamation - summary of estimated mercury releases for the country

[Gold extraction and initial processing by methods other than mercury amalgamation]	Unit	Production	Use	Disposal	Sum of releases to pathway from assessed part of life-cycle
Activity rate	t ore/y	27661000	-	-	-
Input factor for phase	g Hg/t ore	15	-	-	-
Calculated input to phase	kg Hg/y	414915	-	-	-
Output distribution factors for phase:					
- Air	-	0.04	-	-	NA
- Water	-	0.02	-	-	NA
- Land	-	0.9	-	-	NA
- Products	-	0.04	-	-	NA
- General waste treatment	-	0.0	-	-	NA
- Sector specific waste treatment	-	0.0	-	-	NA
Calculated outputs/releases to:					
- Air	kg Hg/y	16597	-	-	16,597
- Water	kg Hg/y	8298	-	-	8298
- Land	kg Hg/y	373424	-	-	373,424
- Products	kg Hg/y	16597	-	-	16,597
- General waste treatment	kg Hg/y	0.0	-	-	0.0
- Sector specific waste treatment	kg Hg/y	0.0	-	-	0.0

Notes: NA- not applicable

2.3.3 Aluminum extraction and initial processing

Aluminum ore, bauxite, is refined into aluminum oxide trihydrate (alumina) and then electrolytically reduced into metallic aluminum. This sub-category includes alumina production from bauxite and aluminum production from alumina. The latter was not considered since no data are available to form default input factors for aluminum production from alumina. In the estimation of mercury releases from alumina production from bauxite, the point-source approach was adopted, and point source-specific data from the operating company was used. To this end, metric tons of bauxite used per year (activity rate data) and mercury input factors are required. In this section, how mercury releases for alumina production from bauxite were estimated using the information provided in "Toolkit for Identification and Quantification of Mercury Releases" (2017) and some selected input and output distribution factors are explained. Calculation details regarding the estimated mercury releases from the production of alumina from bauxite are given in Annex 2. A summary of inputs and results are provided in the following section.

2.3.3.1 Summary of inputs and results

Table 2-13 summarizes the estimated mercury releases from the production of alumina from bauxite.

Table 2-13. Production of alumina from bauxite-summary of estimated mercury releases for the country

[Aluminium extraction and initial processing]	Unit	Production	Use	Disposal	Sum of releases to pathway from assessed part of life-cycle
Activity rate	t bauxite/y	494,092	-	-	-
Input factor for phase	g Hg/t bauxite	0.5	-	-	-
Calculated input to phase	kg Hg/y	247	-	-	-
Output distribution factors for phase:					
- Air	-	0.15	-	-	NA
- Water	-	0.1	-	-	NA
- Land	-	0.0	-	-	NA
- Products	-	0.0	-	-	NA
- General waste treatment	-	0.65	-	-	NA
- Sector specific waste treatment	-	0.1	-	-	NA
Calculated outputs/releases to:					
- Air		37	-	-	37
- Water		25	-	-	25
- Land		0.0	-	-	0.0
- Products		0.0	-	-	0.0
- General waste treatment		161	-	-	161
- Sector specific waste treatment		25	-	-	25

Notes: NA- not applicable

2.3.4 Primary ferrous metal production

To estimate mercury releases from the production of primary ferrous metal, point-source approach was adopted, and point source-specific data from the operating company was used. To this end, metric tons of pig-iron produced per year (activity rate data) and mercury input factor are required. In this section, how mercury releases for production of primary ferrous were estimated using the information provided in "Toolkit for Identification and Quantification of Mercury Releases" (2017), and some selected input and output distribution factors are explained. Calculation details regarding the estimated mercury releases from production of primary ferrous are given in Annex 2. A summary of inputs and results are provided in the following section.

2.3.4.1 Summary of inputs and results

Table 2-14 summarizes the estimated mercury releases from production of primary ferrous.

Table 2-14. Production of primary ferrous-summary of estimated mercury releases for the country

[Primary ferrous metal production]	Unit	Production	Use	Disposal	Sum of releases to pathway from assessed part of life-cycle
Activity rate	t pig-iron produced/y	10,026,244	-	-	-
Input factor for phase	g Hg/t pig-iron produced	0.05	-	-	-
Calculated input to phase	kg Hg/y	501	-	-	-
Output distribution factors for phase:					
- Air		0.95	-	-	NA
- Water		0.0	-	-	NA
- Land		0.0	-	-	NA
- Products		0.0	-	-	NA
- General waste treatment		0.0	-	-	NA
- Sector-specific waste treatment		0.05	-	-	NA
Calculated outputs/releases to:					
- Air	kg Hg/y	476	-	-	476
- Water	kg Hg/y	0.0	-	-	0.0
- Land	kg Hg/y	0.0	-	-	0.0
- Products	kg Hg/y	0.0	-	-	0.0
- General waste treatment	kg Hg/y	0.0	-	-	0.0
- Sector-specific waste treatment	kg Hg/y	25	-	-	25

Notes: NA- not applicable

2.4 Data and Inventory on Production of Other Minerals and Materials with Mercury Impurities

This category includes four sub-categories, which are cement production, pulp, and paper production, production of lime and lightweight aggregates and other minerals and materials. Production of lime and lightweight aggregates and other minerals and materials were not considered since further research is necessary and it was categorized as possible but not positively identified source. On the other hand, pulp and paper production are not performed in the country. Therefore, only cement production was considered under this category.

2.4.1 Cement production

To estimate mercury releases from cement production, metric tons of cement produced per year (activity rate data) and g mercury per metric ton of cement produced (mercury input factor) are required. In this section, how mercury releases for production of cement were estimated using the information provided in "Toolkit for Identification and Quantification of Mercury Releases" (2017), and some selected input and output distribution factors are explained. Calculation details regarding the estimated mercury releases from cement production are given in Annex 2. A summary of inputs and results are provided in the following section.

2.4.1.1 Summary of inputs and results

Table 2-15 summarizes the estimated mercury releases from cement production.

Table 2-15. Cement production-summary of estimated mercury releases for the country

[Cement production]		**Unit**	**Production**		**Use**	**Disposal**	**Sum of releases to pathway from assessed part of life-cycle**
			Without co-incineration of waste	**With co-incineration of waste**			
Activity rate		t cement produced/y	76,480,000	3,520,000	-	-	-
Input factor for phase		g Hg/t cement produced	0.11	0.15	-	-	-
Calculated input to phase		kg Hg/y	8487	594	-	-	-
Output distribution factors for phase:							
- Air			0.6	0.6	-	-	NA
- Water			0.0	0.0	-	-	NA
- Land			0.0	0.0	-	-	NA
- Products			0.2	0.2	-	-	NA
- General waste treatment			0.0	0.0	-	-	NA
- Sector specific waste treatment			0.2	0.2	-	-	NA
Calculated outputs/releases to:							
- Air		kg Hg/y	5092	356	-	-	5448
- Water		kg Hg/y	0.0	0.0	-	-	0.0
- Land		kg Hg/y	0.0	0.0	-	-	0.0
- Products		kg Hg/y	1697	119	-	-	1816
- General waste treatment		kg Hg/y	0.0	0.0	-	-	0.0
- Sector specific waste treatment		kg Hg/y	1697	119	-	-	1816

Notes: NA- not applicable

2.5 Data and Inventory on Consumer Products with Intentional Use of Mercury

2.5.1 Thermometers with mercury

2.5.1.1 Production

Thermometers with mercury are not produced in the country. Therefore, the production of mercury-containing thermometers was not considered.

2.5.1.2 Use and disposal

Although mercury-containing thermometers are not produced, they are imported. Therefore, it has been assumed that they are used and disposed of. To estimate mercury releases from the use and disposal of mercury-containing thermometers, the number of mercury thermometers consumed per year by type (activity rate data) and g mercury per thermometer supplied by type (mercury input factor) is required. In this section, how mercury releases for use and disposal of mercury-containing thermometers were estimated using the information provided in "Toolkit for Identification and Quantification of Mercury Releases" (2017) and some selected input and output distribution factors are explained. Calculation details regarding the estimated mercury releases from the use and disposal of mercury containing thermometers are given in Annex 2. A summary of inputs and results are provided in the following section.

2.5.1.3 Summary of inputs and results

Table 2-16 summarizes the estimated mercury releases from the use and disposal of mercury-containing thermometers.

Table 2-16. Use and disposal of mercury-containing thermometers -summary of estimated mercury releases for the country

[Thermometers with mercury]	**Unit**	**Production**	**Use**	**Disposal**	**Sum of releases to pathway from assessed part of life-cycle**
Activity rate • **Medical thermometers** • **Ambient air temperature thermometers**	items/y	-	41,000 466,620		-
Input factor for phase • Medical thermometers • Ambient air temperature thermometers	g Hg/item	-	1 3.5		-
Calculated input to phase	kg Hg/y	-	1674		-
Output distribution factors for phase:					
- Air	-	-	0.1		NA
- Water	-	-	0.3		NA
- Land	-	-	0.0		NA
- Products	-	-	0.0		NA
- General waste treatment	-	-	0.6		NA
- Sector specific waste treatment	-	-	0.0		NA

[Thermometers with mercury]	Unit	Production	Use	Disposal	Sum of releases to pathway from assessed part of life-cycle
Calculated outputs/releases to:					
- Air	kg Hg/y	-	167		167
- Water	kg Hg/y	-	502		502
- Land	kg Hg/y	-	0.0		0.0
- Products	kg Hg/y	-	0.0		0.0
- General waste treatment	kg Hg/y	-	1004		1004
- Sector specific waste treatment	kg Hg/y	-	0.0		0.0

Notes: NA- not applicable

2.5.2 Electrical switches and relays with mercury

2.5.2.1 Production

Electrical switches and relays with mercury are not produced in the country. Therefore, the production of mercury-containing electrical switches and relays was not considered.

2.5.2.2 Use and disposal

Although mercury-containing electrical switches and relays are not produced, they are imported. Therefore, it has been assumed that they are used and disposed of. To estimate mercury releases from the use and disposal of mercury-containing electrical switches and relays, the national population (activity rate data) and g mercury per inhabitant per year (mercury input factor) are required. In this section, how mercury releases for use and disposal of mercury-containing electrical switches and relays were estimated using the information provided in “Toolkit for Identification and Quantification of Mercury Releases” (2017) and some selected input and output distribution factors are explained. Calculation details regarding the estimated mercury releases from mercury – containing electrical switches and relays are given in Annex 2. A summary of inputs and results are provided in the following section.

2.5.2.3 Summary of inputs and results

Table 2-17 summarizes the estimated mercury releases from mercury-containing electrical switches and relays.

Table 2-17. Use and disposal of mercury-containing electrical switches and relays-summary of estimated mercury releases for the country

[Electrical switched and relays with mercury]	Unit	Production	Use	Disposal	Sum of releases to pathway from assessed part of life-cycle
Activity rate	inhabitants	-	82,003,882		-
Input factor for phase	g Hg/inhabitants.y	-	0.14		-
Calculated input to phase	kg Hg/y	-	11,481		-
Output distribution factors for phase:					
- Air	-	-	0.1		NA
- Water	-	-	0.0		NA
- Land	-	-	0.1		NA
- Products	-	-	0.0		NA
- General waste treatment	-	-	0.8		NA
- Sector specific waste treatment	-	-	0.0		NA
Calculated outputs/releases to:					
- Air	kg Hg/y	-	1148		1148
- Water	kg Hg/y	-	0.0		0.0
- Land	kg Hg/y	-	1148		1148
- Products	kg Hg/y	-	0.0		0.0
- General waste treatment	kg Hg/y	-	9185		9185
- Sector specific waste treatment	kg Hg/y	-	0.0		0.0

Notes: NA- not applicable

2.5.3 Light sources with mercury

2.5.3.1 Production

Light sources with mercury (fluorescent tubes (double end), compact fluorescent lamp (CFL single end), high-pressure mercury vapor, high-pressure sodium lamps, a UV light for tanning, metal halide lamps) are not produced in the country. Therefore, light sources with mercury were not considered.

2.5.3.2 Use and disposal

Although light sources with mercury are not produced, they are imported. Therefore, it has been assumed that they are used and disposed of. To estimate mercury releases from the use and disposal of light sources with mercury, the number of mercury lamps supplied per year by lamp type (activity rate data) and mg of mercury per lamp by lamp type (mercury input factor) is required. In this section, how mercury releases for use and disposal of light sources with mercury were estimated using the information provided in "Toolkit for Identification and Quantification of Mercury Releases" (2017) and some selected input and output distribution factors are explained. Calculation details regarding the estimated mercury releases from the use and disposal of light sources with mercury are given in Annex 2. A summary of inputs and results are provided in the following section.

2.5.3.3 Summary of inputs and results

Table 2-18 summarizes the estimated mercury releases from the use and disposal of light sources with mercury.

Table 2-18. Use and disposal of light sources with mercury-summary of estimated mercury releases for the country

[Light sources with mercury]	Unit	Production	Use	Disposal	Sum of releases to pathway from assessed part of life-cycle
Activity rate	items/y	-	3,212,830		-
Input factor for phase	mg Hg/item	-	25		-
Calculated input to phase	kg Hg/y	-	80		-
Output distribution factors for phase:					
- Air	-	-	0.05		NA
- Water	-	-	0.0		NA
- Land	-	-	0.0		NA
- Products	-	-	0.0		NA
- General waste treatment	-	-	0.8		NA
- Sector specific waste treatment	-	-	0.15		NA
Calculated outputs/releases to:					
- Air	kg Hg/y	-	4		4
- Water	kg Hg/y	-	0.0		0.0
- Land	kg Hg/y	-	0.0		0.0
- Products	kg Hg/y	-	0.0		0.0
- General waste treatment	kg Hg/y	-	64		64
- Sector specific waste treatment	kg Hg/y	-	12		12

Notes: NA- not applicable

2.5.4 Batteries with mercury

2.5.4.1 Production

Batteries with mercury are not produced in the country. Therefore, the production of batteries with mercury was not considered.

2.5.4.2 Use and disposal

Although batteries with mercury are not produced, they are imported. Therefore, it has been assumed that they are used and disposed of. To estimate mercury releases from the use and disposal of batteries with mercury, metric tons of batteries supplied per year (activity rate data) and kg mercury per metric ton of batteries supplied of each type (mercury input factor) are required. In this section, how mercury releases for use and disposal of batteries with mercury were estimated using the information provided in “Toolkit for Identification and Quantification of Mercury Releases” (2017) and some selected input and output distribution factors are explained. According to Toolkit, releases from the use of batteries with mercury is negligible. Calculation details regarding the estimated mercury releases from the disposal of mercury – containing batteries are given in Annex 2. A summary of inputs and results are provided in the following section.

2.5.4.3 Summary of inputs and results

Table 2-19 summarizes the estimated mercury releases from the disposal of mercury-containing batteries.

Table 2-19. Disposal of mercury-containing batteries-summary of estimated mercury releases for the country

[Batteries with mercury]	Unit	Production	Use	Disposal	Sum of releases to pathway from assessed part of life-cycle
Activity rate • **Mercury oxide** • **Zinc-air button cells** • **Silver oxide button cells**	t batteries/y t batteries/y t batteries/y	-	-	0.24 44 12	-
Input factor for phase • **Mercury oxide** • **Zinc-air button cells** • **Silver oxide button cells**	kg Hg/t batteries kg Hg/t batteries kg Hg/t batteries	-	-	320 12 4	-
Calculated input to phase	kg Hg/y	-	-	653	-
Output distribution factors for phase:					
- Air	-	-	-	0.0	NA
- Water	-	-	-	0.0	NA
- Land	-	-	-	0.0	NA
- Products	-	-	-	0.0	NA
- General waste treatment	-	-	-	1	NA
- Sector specific waste treatment	-	-	-	0.0	NA
Calculated outputs/releases to:					
- Air	kg Hg/y	-	-	0.0	0.0
- Water	kg Hg/y	-	-	0.0	0.0
- Land	kg Hg/y	-	-	0.0	0.0
- Products	kg Hg/y	-	-	0.0	0.0
- General waste treatment	kg Hg/y	-	-	653	653
- Sector specific waste treatment	kg Hg/y	-	-	0.0	0.0

Notes: NA- not applicable

2.5.5 Polyurethane with mercury catalysts

2.5.5.1 Production

Polyurethane with mercury catalysts is not produced in the country. Therefore, the production of polyurethane with mercury catalysts was not considered.

2.5.5.2 Use and disposal

Although polyurethane with mercury catalysts are not produced, they are imported. Therefore, it has been assumed that they are used and disposed of. To estimate mercury releases from the use and disposal of polyurethane with mercury catalysts, the national population (activity rate data) and g mercury in polyurethane consumed per inhabitant per year (mercury input factor) are required. In this section, how mercury releases for use and disposal of polyurethane with mercury catalysts were estimated using the information provided in "Toolkit for Identification and Quantification of Mercury Releases" (2017) and some selected input and output distribution factors are explained. Calculation details regarding the estimated mercury releases from the use and disposal of polyurethane with mercury catalysts are given in Annex 2. A summary of inputs and results are provided in the following section.

2.5.5.3 Summary of inputs and results

Table 2-20 summarizes the estimated mercury releases from the use and disposal of polyurethane with mercury catalysts.

Table 2-20. Use and disposal of polyurethane with mercury catalysts -summary of estimated mercury releases for the country

[Polyurethane with mercury catalysts]	**Unit**	**Production**	**Use**	**Disposal**	**Sum of releases to pathway from assessed part of life-cycle**
Activity rate	inhabitants	-	82,003,882		-
Input factor for phase	g Hg/inhabitants.y	-	0.03		-
Calculated input to phase	kg Hg/y	-	2460		-
Output distribution factors for phase:					
- Air	-	-	0.1		NA
- Water	-	-	0.05		NA
- Land	-	-	0.0		NA
- Products	-	-	0.0		NA
- General waste treatment	-	-	0.85		NA
- Sector specific waste treatment	-	-	0.0		NA
Calculated outputs/releases to:					
- Air	kg Hg/y	-	246		246
- Water	kg Hg/y	-	123		123
- Land	kg Hg/y	-	0.0		0.0
- Products	kg Hg/y	-	0.0		0.0
- General waste treatment	kg Hg/y	-	2091		2091
- Sector specific waste treatment	kg Hg/y	-	0.0		0.0

Notes: NA- not applicable

2.6 Data and Inventory on Other Intentional Product/Process Uses

2.6.1 Dental mercury-amalgam fillings

2.6.1.1 Preparations of fillings at dentist clinics

To estimate mercury releases from preparations of fillings at dental clinics, the national population (activity rate data) and estimated mercury consumption for amalgam fillings per capita (mercury input factor) are required. In this section, how mercury releases from preparations of fillings at dentist clinics were estimated using the information provided in “Toolkit for Identification and Quantification of Mercury Releases” (2017) and some selected input and output distribution factors are explained.

2.6.1.2 Use

To estimate mercury releases from use (fillings in the mouth), the national population (activity rate data) and estimated mercury consumption per capita per year (mercury input factor) are required. In this section, how mercury releases from use were estimated using the information provided in “Toolkit for Identification and Quantification of Mercury Releases” (2017), and some selected input and output distribution factors are explained.

2.6.1.3 Disposal

To estimate mercury releases from the disposal, the national population (activity rate data) and estimated mercury consumption for amalgam fillings per capita (mercury input factor) are required. In this section, how mercury releases from disposal were estimated using the information provided in “Toolkit for Identification and Quantification of Mercury Releases” (2017), and some selected input and output distribution factors is explained.

Calculation details regarding the estimated mercury releases from production, use, and disposal of mercury containing amalgam fillings are given in Annex 2. A summary of inputs and results are provided in the following section.

2.6.1.4 Summary of inputs and results

Table 2-21 summarizes the estimated mercury releases from production, use, and disposal of mercury-containing amalgam fillings.

Table 2-21. Production, use, and disposal of mercury-containing amalgam fillings-summary of estimated mercury releases for the country

[Dental mercury amalgam fillings]	**Unit**	**Productio n**	**Use**	**Disposal**	**Sum of releases to pathway from assessed part of life-cycle**
Activity rate	inhabitants	82,003,882	82,003,882	82,003,882	-
Input factor for phase	g Hg/y.inhabitants	0.2	0.2	0.2	-
Calculated input to phase	kg Hg/y	16,401	16,401	16,401	-
Output distribution factors for phase:					
- Air	-	0.02			NA
- Water	-	0.14	0.02	0.28	NA
- Land	-	0.0		0.08	NA
- Products	-	0.0		0.06	NA
- General waste treatment	-	0.12		0.08	NA
- Sector specific waste treatment	-	0.12		0.08	NA

[Dental mercury amalgam fillings]	Unit	Productio n	Use	Disposal	Sum of releases to pathway from assessed part of life-cycle
Calculated outputs/releases to:					
- Air	kg Hg/y	328	0.0	0.0	328
- Water	kg Hg/y	2296	328	4592	7216
- Land	kg Hg/y	0.0	0.0	1312	1312
- Products	kg Hg/y	0.0	0.0	984	984
- General waste treatment	kg Hg/y	1968	0.0	1312	3280
- Sector specific waste treatment	kg Hg/y	1968	0.0	1312	3280

Notes: NA- not applicable

2.6.2 Manometers and gauges with mercury

2.6.2.1 Production

Manometers and gauges with mercury are not produced in the country. Therefore, the production of mercury-containing manometers and gauges was not considered.

2.6.2.2 Use and disposal

Although mercury-containing manometers and gauges are not produced, they are imported. Therefore, it has been assumed that they are used and disposed of. To estimate mercury releases from the use and disposal of mercury-containing manometers and gauges, the number of devices supplied and disposed annually (activity rate data) and amount of mercury in each type of device (mercury input factor) are required. In this section, how mercury releases for use and disposal of mercury-containing manometers and gauges were estimated using the information provided in “Toolkit for Identification and Quantification of Mercury Releases” (2017) and some selected input and output distribution factors are explained. Calculation details regarding the estimated mercury releases from the use and disposal of mercury – containing manometers and gaıges are given in Annex 2. A summary of inputs and results are provided in the following section.

2.6.2.3 Summary of inputs and results

Table 2-22 summarizes the estimated mercury releases from the use and disposal of mercury-containing manometers and gauges.

Table 2-22. Use and disposal of mercury-containing manometers and gauges -summary of estimated mercury releases for the country

[Manometers and gauges with mercury]	Unit	Production	Use	Disposal	Sum of releases to pathway from assessed part of life-cycle
Activity rate • **Medical blood pressure gauges** • **Other manometers and gauges**	items/y inhabitants	-	510,145 82,003,822		-
Input factor for phase • Medical blood pressure gauges • Other manometers and gauges	g Hg/item g Hg/y.inhabitant	-	80 0.005		-
Calculated input to phase	kg Hg/y	-	41,222		-
Output distribution factors for phase:					
- Air	-	-	0.1		NA
- Water	-	-	0.3		NA
- Land	-	-	0.0		NA
- Products	-	-	0.0		NA
- General waste treatment	-	-	0.6		NA
- Sector specific waste treatment	-	-	0.0		NA
Calculated outputs/releases to:					
- Air	kg Hg/y	-	4122		4122
- Water	kg Hg/y	-	12,367		12,367
- Land	kg Hg/y	-	0.0		0.0
- Products	kg Hg/y	-	0.0		0.0
- General waste treatment	kg Hg/y	-	24,733		24,733
- Sector specific waste treatment	kg Hg/y	-	0.0		0.0

Notes: NA- not applicable

2.6.3 Laboratory chemicals and equipment with mercury

2.6.3.1 Use and disposal

To estimate mercury releases from the use and disposal of laboratory chemicals and other laboratory equipment, activity rate data and mercury input factor are required. In this section, how mercury releases for use and disposal of laboratory chemicals and other laboratory equipment were estimated using the information provided in "Toolkit for Identification and Quantification of Mercury Releases" (2017) and some selected input and output distribution factors are explained. Calculation details regarding the estimated mercury releases from the use and disposal of mercury – containing laboratory chemicals and equipment are given in Annex 2. A summary of inputs and results are provided in the following section.

2.6.3.2 Summary of inputs and results

Table 2-23 summarizes the estimated mercury releases from the use and disposal of mercury-containing laboratory chemicals and equipment.

Table 2-23. Use and disposal of mercury-containing laboratory chemicals and equipment -summary of estimated mercury releases for the country

[Laboratory chemicals and equipment with mercury]	Unit	Production	Use	Disposal	Sum of releases to pathway from assessed part of life-cycle
Activity rate					
• **Laboratory chemicals**	inhabitants	-	82,003,882		-
• **Other laboratory equipment**	inhabitants		82,003,882		
Input factor for phase					
• Laboratory chemicals	g Hg/inhabitant	-	0.01		-
• Other laboratory equipment	g Hg/inhabitant		0.04		
Calculated input to phase	kg Hg/y	-	4100		-
Output distribution factors for phase:					
- Air	-	-	0.0		NA
- Water	-	-	0.33		NA
- Land	-	-	0.0		NA
- Products	-	-	0.0		NA
- General waste treatment	-	-	0.33		NA
- Sector specific waste treatment	-	-	0.34		NA
Calculated outputs/releases to:					
- Air	kg Hg/y	-	0.0		0.0
- Water	kg Hg/y	-	1353		1353
- Land	kg Hg/y	-	0.0		0.0
- Products	kg Hg/y	-	0.0		0.0
- General waste treatment	kg Hg/y	-	1353		1353
- Sector specific waste treatment	kg Hg/y	-	1394		1394

Notes: NA- not applicable

2.7 Data and Inventory on Production of Recycled Metals

This category includes three sub-categories, which are the production of recycled mercury ("secondary production"), production of recycled ferrous metals (iron and steel), and production of other recycled metals. The third sub-category was not considered since further research is necessary and it was categorized as possible but not positively identified source.

2.7.1 Production of recycled mercury ("secondary production")

Secondary mercury production is performed in two ways: recovery of mercury from dismantled equipment and from scrap products using extractive processes (United Nations Environment, 2017).
To estimate mercury releases from the production of recycled mercury, amounts of produced mercury (activity rate data) and mercury input factors are required. In this section, how mercury releases for production of recycled mercury were estimated using the information provided in "Toolkit for Identification and Quantification of Mercury Releases" (2017), and some selected input and output distribution factors is explained. Calculation details regarding the estimated mercury releases from the production of recycled mercury are given in Annex 2. A summary of inputs and results are provided in the following section.

2.7.1.1 Summary of inputs and results

Table 2-24 summarizes the estimated mercury releases from the production of recycled mercury.

Table 2-24. Production of recycled mercury-summary of estimated mercury releases for the country

[Production of recycled mercury ("secondary production")]	Unit	Production	Use	Disposal	Sum of releases to pathway from assessed part of life-cycle
Activity rate	kg/y	90	-	-	-
Input factor for phase	kg Hg input/kg total Hg output	1.00452	-	-	-
Calculated input to phase	kg Hg/y	90	-	-	-
Output distribution factors for phase:					
- Air	-	0.002	-	-	NA
- Water	-	0.0024	-	-	NA
- Land	-	0.0	-	-	NA
- Products	-	0.0	-	-	NA
- General waste treatment	-	0.0	-	-	NA
- Sector specific waste treatment	-	0.00012	-	-	NA
Calculated outputs/releases to:					
- Air	kg Hg/y	0.18	-	-	0.18
- Water	kg Hg/y	0.216	-	-	0.216
- Land	kg Hg/y	0.0	-	-	0.0
- Products	kg Hg/y	0.0	-	-	0.0
- General waste treatment	kg Hg/y	0.0	-	-	0.0
- Sector specific waste treatment	kg Hg/y	0.011	-	-	0.011

Notes: NA- not applicable

2.7.2 Production of recycled ferrous metals (iron and steel)

Iron and steel are produced from scrap metal via various high-temperature processes. Mercury may be present as natural mercury impurities or as mercury contamination originating from anthropogenic use of mercury in scrap metals (United Nations Environment, 2017). Within the scope of this category, the latter source is considered to be the predominant source.

To estimate mercury releases from the production of recycled ferrous metals, the number of vehicles recycled annually (activity rate data) and mercury content per vehicle recycled (mercury input factor) are required. In this section, how mercury releases from the production of recycled ferrous metals were estimated using the information provided in "Toolkit for Identification and Quantification of Mercury Releases" (2017) and some selected input and output distribution factors are explained. Calculation details regarding the estimated mercury releases from the production of recycled ferrous metals are given in Annex 2. A summary of inputs and results are provided in the following section.

2.7.2.1 Summary of inputs and results

Table 2-25 summarizes the estimated mercury releases from the production of recycled ferrous metals.

Table 2-25. Production of recycled ferrous metals-summary of estimated mercury releases for the country

[Production of recycled ferrous metals (iron and steel)]	Unit	Production	Use	Disposal	Sum of releases to pathway from assessed part of life-cycle
Activity rate	vehicles recycled/y	14,645	-	-	-
Input factor for phase	g Hg/vehicle	1.1	-	-	-
Calculated input to phase	kg Hg/y	16	-	-	-
Output distribution factors for phase:					
- Air	-	0.33	-	-	NA
- Water	-	0.0	-	-	NA
- Land	-	0.34	-	-	NA
- Products	-	0.0	-	-	NA
- General waste treatment	-	0.33	-	-	NA
- Sector specific waste treatment	-	0.0	-	-	NA
Calculated outputs/releases to:					
- Air	kg Hg/y	5.3	-	-	5.3
- Water	kg Hg/y	0.0	-	-	0.0
- Land	kg Hg/y	5.4	-	-	5.4
- Products	kg Hg/y	0.0	-	-	0.0
- General waste treatment	kg Hg/y	5.3	-	-	5.3
- Sector specific waste treatment	kg Hg/y	0.0	-	-	0.0

Notes: NA- not applicable

2.8 Data and Inventory on Waste Incineration and Burning

2.8.1 Incineration of municipal/general waste

To estimate mercury releases from the incineration of municipal/general waste, the amount of waste burned (activity rate data) and concentration of mercury in the waste (mercury input factor) is required. In this section, how mercury releases from the incineration of municipal/general waste were estimated using the information provided in "Toolkit for Identification and Quantification of Mercury Releases" (2017) and some selected input and output distribution factors are explained. Calculation details regarding the estimated mercury releases from the incineration of municipal waste are given in Annex 2. A summary of inputs and results are provided in the following section.

2.8.1.1 Summary of inputs and results

Table 2-26 summarizes the estimated mercury releases from the incineration of municipal waste.

Table 2-26. Incineration of municipal/general waste-summary of estimated mercury releases for the country

[Municipal waste incineration]	Unit	Production	Use	Disposal	Sum of releases to pathway from assessed part of life-cycle
Activity rate	t waste incinerated/y	-	-	7235	-
Input factor for phase	g Hg/t waste incinerated	-	-	5	-
Calculated input to phase	kg Hg/y	-	-	36	-
Output distribution factors for phase:					
- Air	-	-	-	0.9	NA
- Water	-	-	-	0.0	NA
- Land	-	-	-	0.0	NA
- Products	-	-	-	0.0	NA
- General waste treatment	-	-	-	0.0	NA
- Sector specific waste treatment	-	-	-	0.1	NA
Calculated outputs/releases to:					
- Air	kg Hg/y	-	-	32	32
- Water	kg Hg/y	-	-	0.0	0.0
- Land	kg Hg/y	-	-	0.0	0.0
- Products	kg Hg/y	-	-	0.0	0.0
- General waste treatment	kg Hg/y	-	-	0.0	0.0
- Sector specific waste treatment	kg Hg/y	-	-	4	4

Notes: NA- not applicable

2.8.2 Incineration of hazardous waste

To estimate mercury releases from the incineration of hazardous waste, the amount of waste incinerated (activity rate data) and concentration of mercury in the waste (mercury input factor) is required. In this section, how mercury releases from the incineration of hazardous waste were estimated using the information provided in "Toolkit for Identification and Quantification of Mercury Releases" (2017) and some selected input and output distribution factors are explained. Calculation details regarding the estimated mercury releases from hazardous waste incineration are given in Annex 2. A summary of inputs and results are provided in the following section.

2.8.2.1 Summary of inputs and results

Table 2-27 summarizes the estimated mercury releases from hazardous waste incineration.

Table 2-27. Incineration of hazardous waste-summary of estimated mercury releases for the country

[Hazardous waste incineration]	Unit	Production	Use	Disposal	Sum of releases to pathway from assessed part of life-cycle
Activity rate	t waste incinerated/y	-	-	286,872	-
Input factor for phase	g Hg/t waste incinerated	-	-	24	-
Calculated input to phase	kg Hg/y	-	-	6885	-
Output distribution factors for phase:					
- Air	-	-	-	0.9	NA
- Water	-	-	-	0.0	NA
- Land	-	-	-	0.0	NA
- Products	-	-	-	0.0	NA
- General waste treatment	-	-	-	0.0	NA
- Sector specific waste treatment	-	-	-	0.1	NA
Calculated outputs/releases to:					
- Air	kg Hg/y	-	-	6196.5	6196.5
- Water	kg Hg/y	-	-	0.0	0.0
- Land	kg Hg/y	-	-	0.0	0.0
- Products	kg Hg/y	-	-	0.0	0.0
- General waste treatment	kg Hg/y	-	-	0.0	0.0
- Sector specific waste treatment	kg Hg/y	-	-	688.5	688.5

Notes: NA- not applicable

2.8.3 Incineration of medical waste

To estimate mercury releases from the incineration of medical waste, the amount of waste incinerated (activity rate data) and concentration of mercury in the waste (mercury input factor) is required. In this section, how mercury releases from the incineration of medical waste were estimated using the information provided in "Toolkit for Identification and Quantification of Mercury Releases" (2017) and some selected input and output distribution factors are explained. Calculation details regarding the estimated mercury releases from the incineration of medical waste are given in Annex 2. A summary of inputs and results are provided in the following section.

2.8.3.1 Summary of inputs and results

Table 2-28 summarizes the estimated mercury releases from the incineration of medical waste.

Table 2-28. Incineration of medical waste-summary of estimated mercury releases for the country

[Medical waste incineration]	Unit	Production	Use	Disposal	Sum of releases to pathway from assessed part of life-cycle
Activity rate	t waste incinerated/y	-	-	11,602	-
Input factor for phase	g Hg/t waste incinerated	-	-	24	-
Calculated input to phase	kg Hg/y	-	-	278	-
Output distribution factors for phase:					
- Air	-	-	-	0.9	NA
- Water	-	-	-	0.0	NA
- Land	-	-	-	0.0	NA
- Products	-	-	-	0.0	NA
- General waste treatment	-	-	-	0.0	NA
- Sector specific waste treatment	-	-	-	0.1	NA
Calculated outputs/releases to:					
- Air	kg Hg/y	-	-	250	250
- Water	kg Hg/y	-	-	0.0	0.0
- Land	kg Hg/y	-	-	0.0	0.0
- Products	kg Hg/y	-	-	0.0	0.0
- General waste treatment	kg Hg/y	-	-	0.0	0.0
- Sector specific waste treatment	kg Hg/y	-	-	28	28

Notes: NA- not applicable

2.8.4 Sewage sludge incineration

Sewage sludge originates from wastewater treatment processes. The mercury concentration of sewage sludge incinerated highly depends on the mercury concentration in wastewater, and it varies. To estimate mercury releases from sewage sludge incineration, amount of sewage sludge incinerated (activity rate data) and concentration of mercury in sewage sludge incinerated (mercury input factor) are required. In this section, how mercury releases from sewage sludge incineration were estimated using the information provided in "Toolkit for Identification and Quantification of Mercury Releases" (2017) and some selected input and output distribution factors are explained. Calculation details regarding the estimated mercury releases from sewage sludge incineration are given in Annex 2. A summary of inputs and results are provided in the following section.

2.8.4.1 Summary of inputs and results

Table 2-29 summarizes the estimated mercury releases from sewage sludge incineration.

Table 2-29. Sewage sludge incineration-summary of estimated mercury releases for the country

[Sewage sludge incineration]	Unit	Production	Use	Disposal	Sum of releases to pathway from assessed part of life-cycle
Activity rate	t sludge incinerated/y	-	-	30,453	-
Input factor for phase	g Hg/t sludge incinerated	-	-	2	-
Calculated input to phase	kg Hg/y	-	-	61	-
Output distribution factors for phase:					
- Air	-	-	-	0.9	NA
- Water	-	-	-	0.0	NA
- Land	-	-	-	0.0	NA
- Products	-	-	-	0.0	NA
- General waste treatment	-	-	-	0.0	NA
- Sector specific waste treatment	-	-	-	0.1	NA
Calculated outputs/releases to:					
- Air	kg Hg/y	-	-	55	55
- Water	kg Hg/y	-	-	0.0	0.0
- Land	kg Hg/y	-	-	0.0	0.0
- Products	kg Hg/y	-	-	0.0	0.0
- General waste treatment	kg Hg/y	-	-	0.0	0.0
- Sector specific waste treatment	kg Hg/y	-	-	6	6

Notes: NA- not applicable

2.8.5 Informal waste burning

Informal waste burning is banned in the country. However, TUIK includes data regarding this sub-category. Therefore, it was considered as a mercury source. To estimate mercury releases from informal waste burning, activity rate data and mercury input factors are required. In this section, how mercury releases from informal waste burning were estimated using the information provided in “Toolkit for Identification and Quantification of Mercury Releases” (2017), and some selected input and output distribution factors is explained. Calculation details regarding the estimated mercury releases from informal waste burning are given in Annex 2. A summary of inputs and results are provided in the following section.

2.8.5.1 Summary of inputs and results

Table 2-30 summarizes the estimated mercury releases from informal waste burning.

Table 2-30. Informal waste burning-summary of estimated mercury releases for the country

[Informal waste burning]	Unit	Production	Use	Disposal	Sum of releases to pathway from assessed part of life-cycle
Activity rate	t/y	-	-	39,734	-

[Informal waste burning]	Unit	Production	Use	Disposal	Sum of releases to pathway from assessed part of life-cycle
Input factor for phase	g Hg/t	-	-	5	-
Calculated input to phase	kg Hg/y	-	-	199	-
Output distribution factors for phase:					
- Air	-	-	-	1.0	NA
- Water	-	-	-	0.0	NA
- Land	-	-	-	0.0	NA
- Products	-	-	-	0.0	NA
- General waste treatment	-	-	-	0.0	NA
- Sector specific waste treatment	-	-	-	0.0	NA
Calculated outputs/releases to:					
- Air	kg Hg/y	-	-	199	199
- Water	kg Hg/y	-	-	0.0	0.0
- Land	kg Hg/y	-	-	0.0	0.0
- Products	kg Hg/y	-	-	0.0	0.0
- General waste treatment	kg Hg/y	-	-	0.0	0.0
- Sector specific waste treatment	kg Hg/y	-	-	0.0	0.0

Notes: NA- not applicable

2.9 Data and Inventory on Waste Disposal, Deposition/Landfilling

This category includes five sub-categories, which are controlled landfills/deposits, diffuse disposal under some control, informal local disposal of industrial production of waste, informal dumping of general waste, and wastewater system/treatment. Diffuse disposal under some control, informal local disposal of industrial production of waste were not considered since further research is necessary and they were categorized as possible but not positively identified sources.

2.9.1 Controlled landfills/deposits

To estimate mercury releases from controlled landfills/deposits, amounts of waste landfilled (activity rate data) and mercury concentration in the waste (mercury input factor) are required. In this section, how mercury releases from controlled landfills/deposits were estimated using the information provided in "Toolkit for Identification and Quantification of Mercury Releases" (2017), and some selected input and output distribution factors are explained. Calculation details regarding the estimated mercury releases from controlled landfills are given in Annex 2. A summary of inputs and results are provided in the following section.

2.9.1.1 Summary of inputs and results

Table 2-31 summarizes the estimated mercury releases from controlled landfills.

Table 2-31. Controlled landfills-summary of estimated mercury releases for the country

[Controlled landfills/deposits]	Unit	Production	Use	Disposal	Sum of releases to pathway from assessed part of life-cycle
Activity rate	t waste landfilled/y	-	-	17,543,176	-
Input factor for phase	g Hg/t waste landfilled	-	-	5	-
Calculated input to phase	kg Hg/y	-	-	87,716	-
Output distribution factors for phase:					
- Air	-	-	-	0.01	NA
- Water	-	-	-	0.0001	NA
- Land	-	-	-	0.0	NA
- Products	-	-	-	0.0	NA
- General waste treatment	-	-	-	0.0	NA
- Sector specific waste treatment	-	-	-	0.0	NA
Calculated outputs/releases to:					
- Air	kg Hg/y	-	-	877	877
- Water	kg Hg/y	-	-	9	9
- Land	kg Hg/y	-	-	0.0	0.0
- Products	kg Hg/y	-	-	0.0	0.0
- General waste treatment	kg Hg/y	-	-	0.0	0.0
- Sector specific waste treatment	kg Hg/y	-	-	0.0	0.0

Notes: NA- not applicable

2.9.2 Informal dumping of general waste

Informal dumping of general waste is defined as waste dumping undertaken under informal conditions. Therefore, there is no control to minimize releases of pollutants to the soil, air, groundwater and surface waters (United Nations Environment, 2017). To estimate mercury releases from informal dumping of general waste, activity rate data and mercury input factors are required. In this section, how mercury releases from informal dumping of general waste were estimated using the information provided in "Toolkit for Identification and Quantification of Mercury Releases" (2017) and some selected input and output distribution factors are explained. Calculation details regarding the estimated mercury releases from informal waste dumping are given in Annex 2. A summary of inputs and results are provided in the following section.

2.9.2.1 Summary of inputs and results

Table 2-32 summarizes the estimated mercury releases from informal waste dumping.

Table 2-32. Informal waste dumping-summary of estimated mercury releases for the country

[Informal waste dumping]	Unit	Production	Use	Disposal	Sum of releases to pathway from assessed part of life-cycle
Activity rate	t/y	-	-	52,675	-
Input factor for phase	g Hg/t	-	-	5	-
Calculated input to phase	kg Hg/y	-	-	263	-
Output distribution factors for phase:					
- Air	-	-	-	0.1	NA
- Water	-	-	-	0.1	NA
- Land	-	-	-	0.8	NA
- Products	-	-	-	0.0	NA
- General waste treatment	-	-	-	0.0	NA
- Sector specific waste treatment	-	-	-	0.0	NA
Calculated outputs/releases to:					
- Air	kg Hg/y	-	-	26	26
- Water	kg Hg/y	-	-	26	26
- Land	kg Hg/y	-	-	211	211
- Products	kg Hg/y	-	-	0.0	0.0
- General waste treatment	kg Hg/y	-	-	0.0	0.0
- Sector specific waste treatment	kg Hg/y	-	-	0.0	0.0

Notes: NA- not applicable

2.9.3 Wastewater system/treatment

To estimate mercury releases from wastewater system/treatment, amounts of treated or conveyed wastewater (activity rate data) and average mercury concentrations in input wastewater (mercury input factor) are required. In this section, how mercury releases from wastewater system/treatment were estimated using the information provided in “Toolkit for Identification and Quantification of Mercury Releases” (2017), and some selected input and output distribution factors are explained. Calculation details regarding the estimated mercury releases from wastewater treatment are given in Annex 2. A summary of inputs and results are provided in the following section.

2.9.3.1 Summary of inputs and results

Table 2-33 summarizes the estimated mercury releases from wastewater treatment.

Table 2-33. Wastewater treatment-summary of estimated mercury releases for the country

[Wastewater treatment]	Unit	Production	Use	Disposal	Sum of releases to pathway from assessed part of life-cycle
Activity rate	m^3/y	-	-	18,232,053	-
Input factor for phase	mg Hg/ m^3	-	-	5.25	-
Calculated input to phase	kg Hg/y	-	-	96	-
Output distribution factors for phase:					

[Wastewater treatment]	Unit	Production	Use	Disposal	Sum of releases to pathway from assessed part of life-cycle
- Air	-	-	-	0.0	NA
- Water	-	-	-	0.5	NA
- Land	-	-	-	0.0	NA
- Products	-	-	-	0.0	NA
- General waste treatment	-	-	-	0.3	NA
- Sector specific waste treatment	-	-	-	0.2	NA
Calculated outputs/releases to:					
- Air	kg Hg/y	-	-	0.0	0.0
- Water	kg Hg/y	-	-	48	48
- Land	kg Hg/y	-	-	0.0	0.0
- Products	kg Hg/y	-	-	0.0	0.0
- General waste treatment	kg Hg/y	-	-	29	29
- Sector specific waste treatment	kg Hg/y	-	-	19	19

Notes: NA- not applicable

2.10 Data and Inventory on Crematoria and Cemeteries

This category includes two sub-categories, which are crematoria and cemeteries. Since cremation is not performed in the country, it was not considered.

2.10.1 Cemeteries

The main sources of mercury releases from cemeteries are the presence of dental amalgam fillings that contain mercury and trace amounts of mercury present in body tissues (United Nations Environment, 2017). To estimate mercury releases from cemeteries, the number of corpses buried (activity rate data) and the average amount of mercury contained in each corpse (mercury input factor) are required. The latter depends on the number of dental amalgam fillings and the size of the fillings. In this section, how mercury releases from cemeteries were estimated using the information provided in "Toolkit for Identification and Quantification of Mercury Releases" (2017), and some selected input and output distribution factors are explained. Calculation details regarding the estimated mercury releases from cemeteries are given in Annex 2. A summary of inputs and results are provided in the following section.

2.10.1.1 Summary of inputs and results

Table 2-34 summarizes the estimated mercury releases from cemeteries.

Table 2-34. Cemeteries-summary of estimated mercury releases for the country

[Cemeteries]	Unit	Production	Use	Disposal	Sum of releases to pathway from assessed part of life-cycle
Activity rate	Corpse buried/y	-	-	403,303	-
Input factor for phase	g Hg/corpse buried	-	-	2.5	-
Calculated input to phase	kg Hg/y	-	-	1008	-
Output distribution factors for phase:					
- Air	-	-	-	0.0	NA
- Water	-	-	-	0.0	NA
- Land	-	-	-	1.0	NA
- Products	-	-	-	0.0	NA
- General waste treatment	-	-	-	0.0	NA
- Sector specific waste treatment	-	-	-	0.0	NA
Calculated outputs/releases to:					
- Air	kg Hg/y	-	-	0.0	0.0
- Water	kg Hg/y	-	-	0.0	0.0
- Land	kg Hg/y	-	-	1008	1008
- Products	kg Hg/y	-	-	0.0	0.0
- General waste treatment	kg Hg/y	-	-	0.0	0.0
- Sector specific waste treatment	kg Hg/y	-	-	0.0	0.0

Notes: NA- not applicable

2.11 Stocks of Mercury and/or Mercury Compounds, and Storage Conditions

2.11.1 Overview of stocks of mercury and/or mercury compounds

Within the scope of Article 3 of the Minamata Convention, each party is required to identify individual stocks of mercury or mercury compounds exceeding 50 metric tons and sources of mercury supply generating stocks exceeding 10 metric tons annually within its territory. Although what is meant by stocks is not explained in the convention text, stock can be defined as the quantity of mercury or mercury compounds that are accumulated or available for future use (such as mercury held at existing premises and stored in decommissioned facilities). Therefore, it does not include quantities of mercury that are disposed of and categorized as waste and are available in contaminated sites or geological reserves.

To determine the levels of mercury stocks at any given time, the first step is to focus on the identification of entities and facilities that may store or use mercury. UNEP (2015) lists potential entities and facilities as follows;

(a) mercury traders that buy and sell, including through imports and exports, mercury or mercury compounds and may have varying amounts on hand at any time,

(b) primary mercury mines, which may have stocks of mercury awaiting sale and therefore may have large quantities on hand at certain times, depending on demand,

(c) other facilities or activities that produce mercury or mercury compounds, including mercury waste treatment facilities, which may also have large stocks on hand, depending on the overall mercury demand or on whether mercury is held pending a final decision on whether it is destined for disposal,

(d) national governments, which may have stocks of mercury on hand resulting from the seizure of mercury and authorized uses such as military storage,

(e) production facilities for mercury-added products or for facilities reliant on processes that use mercury or mercury compounds, which may also maintain significant stocks of mercury depending on the supply chain and current demand.

After the identification of potential entities and facilities, they should be evaluated to determine whether they hold stocks of mercury or mercury compounds exceeding 50 metric tons. This evaluation should be carried out by considering;

(a) current and past quantities of mercury or mercury compounds used,

(b) quantities of mercury or mercury compounds purchased,

(c) the process design capacity of any facility that uses or produces mercury or mercury compounds,

(d) existing on-site storage capacity,

(e) quantities of mercury waste disposed of or managed,

(f) quantities of mercury sold,

(g) estimated quantities of mercury or mercury compounds lost to the environment or recovered from processes.

UNEP (2015) also lists possible sources of mercury supply generating mercury stocks exceeding 10 metric tons annually within the territory of each party (therefore, imports of mercury or mercury compounds are not classified as possible sources) as follows;

(a) primary mining,

(b) decommissioning of industrial facilities that have previously used mercury or mercury compounds, such as chlor-alkali facilities, which may produce mercury not only from defined chlor-alkali cells but also through the cleaning of equipment and structures where mercury may have deposited,

(c) collection of mercury and mercury compounds from non-ferrous metal mining,

(d) collection of mercury and mercury compounds recovered during the cleaning of fossil fuels such as natural gas,

(e) mercury compound and catalyst producers,

(f) recovery, recycling or reclamation of mercury from mercury waste.

Questions listed in UNEP (2015) to assist the identification of stocks of mercury or mercury compounds exceeding 50 metric tons and sources of mercury supply generating stocks exceeding ten metric tons annually were considered to assess the country's stocks.

(a) Is primary mining occurring within the country's territory?
(b) Are there identified sites where mercury is stored before use within the territory?
(c) Are recycling or recovery activities that may produce mercury undertaken within the territory? If so, what quantity of mercury is produced by those activities?
(d) Is there any proposed decommissioning of chlor-alkali plants, vinyl chloride monomer plants, or other facilities with manufacturing processes in which mercury or mercury compounds are used?
(e) Are there facilities that may result in the production of by-product mercury within the territory? If so, what quantity of mercury is generated by those facilities?

2.11.2 Evaluation of potential storage needs in the future once the Convention is implemented

Höglund (n.d.) defined storage facility as a facility where mercury is stored under supervised conditions for a limited time. The storage time can be months or years. "Technical options for storage and disposal of mercury" prepared by Höglund (n.d.) lists both storage facility options and options for the physical and chemical form of stored mercury. According to this document, mercury can be stored in;

- above ground in a storage building, stored in a retrievable manner,
- above ground in a landfill, stored in a retrievable way,
- near-surface below ground in a landfill, stored in a retrievable manner,
- near-surface in shallow rock cavern, stored in a retrievable manner,
- near-surface in an excavated storage location in surface soil, stored in a retrievable manner,
- deep rock storage in crystalline rock caverns, stored in a retrievable way,
- deep rock storage in salt rock caverns, stored in a retrievable manner,
- deep rock storage in sedimentary rock caverns, stored in a retrievable manner.

Mercury stored in a storage facility can be;

- liquid mercury in free form,
- liquid mercury in steel flasks (a few liters size),
- liquid mercury in containers (up to about 1 m^3),
- physical stabilization of mercury, e.g., cement solidified form and amalgamation,
- chemical stabilization of mercury into solid form, e.g., as mercury sulfide,
- combined physical and chemical stabilization, e.g., cement+sulphide stabilization, the SPSS-method, the MBS-method, and the Mersade-method.

Although long-term storage of mercury (from several years to a few decades) is possible under well-controlled conditions like many other types of chemicals, further measures specific to mercury need to be taken per the legal requirements. Table 2-35 provides an overview of different storage options.

Table 2-35. Overview of different storage options (Höglund, n.d.)

Storage facility options		Above ground in the storage building	Above ground in landfill	Near-surface below ground in landfill	Near-surface in a shallow rock cavern	Near-surface in an excavated storage location in surface soil	Deep rock storage in crystalline rock caverns	Deep rock storage in salt rock caverns	Deep rock storage in sedimentary rock caverns
Common demands	Mercury can be stored over a limited period of time.	X	X	X	X	X	X	X	X
	Method requires supervision and a certain amount of maintenance.	X	X	X	X	X	X	X	X
	Mercury can be stored in a retrievable manner	X	X	X	X	X	X	X	X
	Mercury is a toxic element. The storage facility can be protected against intrusion to avoid the risk of human health and the environment.	X	X	X	X	X	X	X	X
	The stored mercury can be protected from direct exposure to rain, sun, wind, flooding, extremely cold conditions, etc	X	X	X	X	X	X	X	X
	Mercury stored in the storage facility can be kept separate from other contaminants and materials in the storage facility, e.g. by compartmentalization of the storage facility.	X	X	X	X	X	X	X	X
	Mercury put into a disposal facility intended as a temporary storage solution can be constructed in such a way that retrieval of the mercury can be done efficiently and without jeopardizing the integrity of the facility, or that any risk for an uncontrolled release of mercury would appear.	X	X	X	X	X	X	X	X

Storage facility options		Above ground in the storage building	Above ground in landfill	Near-surface below ground in landfill	Near-surface in a shallow rock cavern	Near-surface in an excavated storage location in surface soil	Deep rock storage in crystalline rock caverns	Deep rock storage in salt rock caverns	Deep rock storage in sedimentary rock caverns
	Specific requirements must and can be fulfilled regarding the competence of the storage facilities where the mercury is kept.	X	X	X	X	X	X	X	X
Specific demands	The geotechnical and tectonic conditions at the site must be thoroughly evaluated to ensure the physical stability of the storage facility	X	X	X	X	X	X	X	X
	Protection against digging and construction work etc	X	X	X		X			
	Protection against mining/quarrying etc				X		X		X
	Protection against digging, salt mining/salt extraction, and construction work, etc							X	
	The rock mechanic conditions at the site must be thoroughly evaluated to ensure the physical stability of the storage facility				X		X	X	X
	These factors can be expected to be well fulfilled	X	X	X			X	X	X
	Under the condition that the requirements on geotechnical and tectonic stability can be assured, all these factors can be expected to be well fulfilled					X			
	Can be excavated in hill slopes or vertically in shallow bedrock				X				
	A typical rock overburden required is on the order of a few tens of meters				X				

Storage facility options		Above ground in the storage building	Above ground in landfill	Near-surface below ground in landfill	Near-surface in a shallow rock cavern	Near-surface in an excavated storage location in surface soil	Deep rock storage in crystalline rock caverns	Deep rock storage in salt rock caverns	Deep rock storage in sedimentary rock caverns
	Cavern may have been excavated and used for other purposes, such as oil storage, military purposes, etc. This may call for specific measures before use, e.g. clean-up				X	X	X	X	X
	A typical surface soil deposit depth required for an excavated storage facility is on the order of a few tens of meters					X			
	Supporting constructions in the excavated facility, e.g. supporting walls may be required to assure mechanical stability			X		X			
	Excavations may be quite large and finding separate storage locations for mercury would seem possible				X		X	X	X
	The storage facility would typically be located at a depth of several hundred meters below ground						X	X	X
	The storage facility may be situated below the natural groundwater table and may require pumping of drainage water during operation				(X)	(X)	X		X
	The storage facility may be situated below the natural groundwater table, whereas the salt formation may be quite impermeable to water. However, the construction of the							X	

Storage facility options		Above ground in the storage building	Above ground in landfill	Near-surface below ground in landfill	Near-surface in a shallow rock cavern	Near-surface in an excavated storage location in surface soil	Deep rock storage in crystalline rock caverns	Deep rock storage in salt rock caverns	Deep rock storage in sedimentary rock caverns
	underground facilities, such as excavations, shafts, etc, may constitute passages for water into the facility, hence it cannot be ruled out								

2.12 Impacts of Mercury on Human Health and the Environment

Mercury, which is highly toxic to human health, occurs naturally in the environment and it is found in air, water, and soil. World Health Organization (WHO) classifies mercury as one of the top ten chemicals or groups of chemicals of primary health concern (WHO, 2017). Commonly found forms in nature are elemental (or metallic), inorganic (mercury chloride), and organic (methyl- and ethylmercury). Their toxicities, health effects and measures to be taken to prevent exposure vary depending on the mercury form.

Sources of exposure to mercury are widespread. Naturally occurring mercury is released into the environment from volcanic activity, weathering of rocks, water movements and biological processes (WHO, n.d.). In addition to the natural processes, the leading cause of mercury detected in the environmental compartments is anthropogenic sources such as coal-fired power plants, mining activities, waste incinerators, residential heating, and cooling systems and industrial production processes. On the other hand, Hyman (2004) claimed that nearly all human exposures to methylmercury occur by eating fish and shellfish contaminated with methylmercury since once elemental mercury is introduced into the environment, it is naturally transformed into methylmercury which bioaccumulates in fish and shellfish. In addition to the abovementioned mercury sources, 5% of all mercury released in wastewater can be attributed to the use of thermometers, blood pressure monitors, and dental amalgam and to the incineration of medical waste (WHO, n.d.).

The health effects of mercury depend on;

- the type of mercury,
- the dose,
- the age or development stage of the person exposed,
- the duration of exposure,
- the route of exposure (WHO, n.d.).

Although mercury poses a particular threat to the development of the child in utero and early in life, depending on its form, it has toxic effects on the nervous, digestive, and immune systems and on lungs, kidneys, skin, and eyes (WHO, 2019). For example, mercury vapor inhalation can result in adverse impacts on the nervous, digestive, and immune systems, lungs and kidneys, and may be fatal. On the other hand, inorganic salts of mercury show corrosive effects on the skin, eyes and gastrointestinal tract, and may induce kidney toxicity if they are ingested. After inhalation, ingestion, or dermal application of different mercury compounds, neurological and behavioral disorders may be observed with symptoms including tremors, insomnia, memory loss, neuromuscular effects, headaches, and cognitive and motor dysfunction (WHO, n.d.).

2.13 References

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3 CHAPTER 3. POLICY, REGULATORY AND INSTITUTIONAL FRAMEWORK ASSESSMENT

Legal and Institutional Gap Analysis Report for Minamata Convention in the context of Turkish Institutional and Legal Structure was prepared within the scope of the project entitled “Minamata Initial Assessment for Minamata Convention on Mercury”. This project was supported by the Global Environment Facility and implemented with the close cooperation of United Nations Industrial Development Organization and Ministry of Environment and Urbanization. In this context, a legal and institutional gap assessment survey was sent to potential stakeholders. This section was prepared based on this report.

3.1 Policy and Regulatory Assessment

As ratification by Turkey of the Minamata Convention on Mercury legally binds the country to the Convention’s obligations. The ratification process involves carrying out a national situation analysis, identifying existing relevant domestic legislation and identifying legal or administrative actions that may be needed. Within the scope of the aforementioned report, legal structure and status of Turkey for implementation of the Minamata Convention on Mercury were assessed. This assessment was based on;

- the evaluation of existing structures, policies, strategies, laws and regulations,
- providing information to policy makers regarding legal gaps,
- the preparation a list of required mercury related regulations by considering the target groups,
- the determination of responsible parties and their roles for implementation of the Convention.

The main conclusion that can be drawn from the abovementioned assessment is that a limited number of adjustments and extensions to the Turkish legislations are required since Turkey already has a well-developed legislative framework for elimination the risk posed by mercury. Current national legislations are provided in Table 3-1. Table 3-2 summarizes the provisions of the Minamata Convention, and relevant European Union and Turkish legislations.

Table 3-1. National legislations related to mercury

National legislation	Date	Number
Environmental Law	10.08.1983	2872
Mining Law	15.06.1985	18785
Regulation on the Registration, Evaluation, Authorization and Restriction of Chemicals	23.06.2017	30105
Regulation on Control of Waste Electrical and Electronic Equipment	22.05.2012	28300
Regulation on Waste Management	02.04.2015	29314
Regulation on Landfill of Wastes	26.03.2010	27533
Regulation on the Incineration of Wastes	06.10.2010	27721
Communique on Shipment of Waste	20.03.2015	29301
Regulation on End of Life Vehicles	30.12.2009	27448
Communique on Storage, Purification, Removal and Processing of End of Life	06.07.2011	27986
Regulation on Control of Packaging Wastes	27.12.2017	30283
Regulation on Control of Waste Batteries and Accumulators	31.08.2004	25569
Regulation on Control of Excavation, Construction and Demolishing Wastes	18.03.2004	25406
Regulation on Control of Medical Wastes	25.01.2017	29959
Regulation on Air Quality Assessment and Management	06.06.2008	26898

National legislation	Date	Number
Regulation on Control of Air Pollution Arising from Industrial Facilities	03.07.2009	27277
Regulation on Use of Domestic and Urban Wastewater Treatment Sludge in Soil	03.08.2010	27661
Water Pollution Control Regulation	31.12.2004	25687
Regulation on Control of Pollution Caused by Hazardous Substances in Aquatic Environment	26.11.2005	26005
Regulation on Protection of Groundwater from Pollution and Degradation	07.04.2012	28257
Regulation on Monitoring the Surface Water and Groundwater	11.02.2014	28910
Regulation on Control of Soil Pollution and Sites Contaminated by Point Sources	08.06.2010	27605
Regulation on Surface Water Quality	30.11.2012	28483
Regulation Concerning Water Intended for Human Consumption	17.02.2005	25730
Regulation on Cosmetics	23.05.2005	25823
Regulation on Biocidal Products	31.12.2009	27449
Regulation on Toy Safety	04.10.2016	29847
Turkish Food Codex Regulation on Contaminants	29.12.2011	28157
Turkish Food Codex Regulation on Maximum Pesticide Residue Limits	25.11.2016	29899
Regulation on Works that must be less than 7.5 Hours or less with regard to Health Rules	16.07.2013	28709
Regulation on Health and Safety Measures for Works with Chemicals Substances	12.08.2013	28733

Table 3-2. Overview of the provisions of the Minamata Convention, and relevant European Union and Turkish legislations (Ministry of Environment and Urbanization, 2018)

Article and clause in Minamata Convention	Impact of Minamata Convention provision	European Union legislation addressing the provision	Relevant Turkish legislation	Responsible institution
3 (3)	Not allow new primary mercury mining	Mercury Regulation	Mining Law; Since 1994, mercury mining has not been licensed.	Ministry of Energy and Natural Resources
3 (4)	Phase out existing primary mercury mining	Mercury Regulation	Mining Law; Since 1994, mercury mining has not been licensed.	Ministry of Energy and Natural Resources
3 (5a)	Identification of mercury stocks	None	-	Ministry of Environment and Urbanization
3 (5b)	Disposal of excess mercury from chlor-alkali facilities as waste	Mercury Regulation	There is no legislation. But, mercury is not used in chlorine plants since 2007.	Ministry of Environment and Urbanization
3 (6)	Not allow mercury export	Mercury Regulation	-	Ministry of Environment and Urbanization
3 (8)	Not allow mercury import	None	-	Ministry of Environment and Urbanization

Article and clause in Minamata Convention	**Impact of Minamata Convention provision**	**European Union legislation addressing the provision**	**Relevant Turkish legislation**	**Responsible institution**
4 (1)	Prohibition of manufacture/import/export of mercury-added products	Batteries Directive, Restriction of Hazardous Substances in Electrical and Electronic Equipment Directive (RoHS), Regulation on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), Cosmetics Regulation, Legislation on Plant Protection Products (PPP), Biocides Regulation	-Regulation on the Registration, Evaluation, Authorization and Restriction of Chemicals -Regulation on Control of Waste Batteries and Accumulators -Regulation on Control of Waste Electrical and Electronic Equipment	Ministry of Environment and Urbanization
			-Regulation on Cosmetics -Regulation on Biocidal Products	Ministry of Health
			By-law on Turkish Food Codex Maximum Pesticide Residue Limits	Ministry of Agriculture and Forestry
4 (3)	Measures with respect to mercury-added products	-	-	Ministry of Environment and Urbanization
4 (5)	Preventing the incorporation of mercury-added products in assembled products	REACH, RoHS Directive, further market-based product legislation	-Regulation on the Registration, Evaluation, Authorization and Restriction of Chemicals -Regulation on Control of Waste Electrical and Electronic Equipment	Ministry of Environment and Urbanization
4 (6)	Obligation to "discourage" manufacture and distribution of new products	-	-	-
5 (2)	Prohibition of mercury use in the process listed in part I of Annex B	Industrial Emissions Directive	Regulation on Control of Air Pollution Arising from Industrial Facilities	Ministry of Environment and Urbanization
5 (3)	Obligation to restrict the use of mercury in the processes listed in part II of Annex B	Industrial Emissions Directive	Regulation on Control of Air Pollution Arising	Ministry of Environment and Urbanization

Article and clause in Minamata Convention	Impact of Minamata Convention provision	European Union legislation addressing the provision	Relevant Turkish legislation	Responsible institution
			from Industrial Facilities	
5 (5)	Obligation to take measures to "address" emissions and releases from all processes / to endeavor to identify facilities	Industrial Emissions Directive	Regulation on Control of Air Pollution Arising from Industrial Facilities	Ministry of Environment and Urbanization
5 (6)	Prohibition of using mercury in new facilities	Industrial Emissions Directive	Regulation on Control of Air Pollution Arising from Industrial Facilities	Ministry of Environment and Urbanization
5 (7)	Discourage "the development of new facilities using any other mercury-based manufacturing process	-	-	
7 (2)	Reduce/eliminate emissions from ASGM	Industrial Emissions Directive	-	Ministry of Environment and Urbanization
7 (3)	Determination of significance of ASGM / Developing and implementing a national action plan if applicable	-	-	
8 (3)	Controlling emissions: Develop a national plan	-	-	
8 (4)	Require best available techniques (BAT)/best environmental practices (BEP) for new sources	Industrial Emissions Directive	-	Ministry of Environment and Urbanization
8 (5)	Emission control measures for existing sources	Industrial Emissions Directive	Regulation on Control of Air Pollution Arising from Industrial Facilities	Ministry of Environment and Urbanization
8 (7)	Establish emissions inventory	European Pollutant Release and Transfer Register Regulation	Draft Regulation on Pollutant Release and Transport Registration	Ministry of Environment and Urbanization
9 (3)	Identify relevant sources for releases (to water and land)	Industrial Emissions Directive	Regulation on Control of Air Pollution Arising from Industrial Facilities	Ministry of Environment and Urbanization

Article and clause in Minamata Convention	Impact of Minamata Convention provision	European Union legislation addressing the provision	Relevant Turkish legislation	Responsible institution
9 (4)	Releases control	Industrial Emissions Directive	Regulation on Control of Air Pollution Arising from Industrial Facilities	Ministry of Environment and Urbanization
9 (6)	Establish release inventory	European Pollutant Release and Transfer Register Regulation	Draft Regulation on Pollutant Release and Transport Registration	Ministry of Environment and Urbanization
10 (2)	Storage of such mercury and its compounds intended for a use	Industrial Emissions Directive, Seveso Directive, Waste Directive, Waste Framework Directive	-Regulation on Control of Air Pollution Arising from Industrial Facilities -Regulation on Waste Management -Regulation on Prevention of Major Industrial Accidents and Reducing their Effects	Ministry of Environment and Urbanization
11 (3)	Mercury waste	Waste Framework Directive, Waste Shipment Regulation	-Regulation on Waste Management -Communique on Shipment of Waste	Ministry of Environment and Urbanization
16 (1)	Health aspects	Diverse legal acts in the following policy fields: Water, Drinking Water, Food Safety, Cosmetics, Toys and Occupational Health and Safety aiming at protecting general public, vulnerable groups, and workers	-Regulation on Air Quality Assessment and Management - Water Pollution Control Regulation -Regulation Concerning Water for Human Consumption -Regulation on Cosmetics -Regulation on Toy Safety -Regulation on Works that must be less than 7,5 Hours or less with regard to Health Rules -Regulation on Health and Safety Measures for Works with Chemicals Substances	-Ministry of Environment and Urbanization -Ministry of Health -Ministry of Trade -Ministry of Family, Labor and Social Services

Table 3-3 was prepared in accordance with the provisions of the Minamata Convention. It presents a summary assessment of existing national policies and regulatory measures and their scope. In addition, Table 3-3 provides an analysis of existing gaps that would need to be addressed to ensure compliance with the Minamata Convention.

Table 3-3. Policy and regulatory measures in Turkey and remaining gaps (Ministry of Environment and Urbanization, 2018)

Article 3 – Mercury supply and trade	
Description of Article:	
Succinct summary of provisions relevant to Turkey	• Not allow new primary mercury mining • Phase out existing primary mercury mining within 15 years • Restrict the export and use of mercury from primary mercury mining, so that the mercury is not available for ASGM • In accordance with Article 3.5(b), severely restrict the use of excess mercury from the decommissioning of chlor-alkali plants • Obtain information on stocks of mercury or mercury compounds exceeding 50 metric tons, and mercury supply generating stocks exceeding 10 metric tons/yr • Not allow the export of mercury unless the importing country provides written consent, the mercury is for an allowed use or environmentally sound storage, and all other conditions of Article 3.6 are met • Not allow the import of mercury without consent by the relevant government unit, ensuring both the mercury source and proposed use are allowed under the Convention (and applicable domestic law)
Policy and regulatory measures in place that enable the country to comply with above listed provisions:	
Title and reference/number of relevant policy and regulatory measure, as well as date	**Explanation on what aspects of the above provisions are being addressed by policy/regulatory measure**
Mining Law	The mercury mines were closed in 1994 and there has not been allowed new primary mercury mining since then.
Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provision:	
• Draft legislation has been prepared to fulfill the other obligations under Article 3.	
Article 4 – Mercury-added products	
Description of Article:	
Succinct summary of provisions relevant to Turkey	• Not allow the manufacture, import, and export of products listed in Part I of Annex A, following the phase out date in Annex A

	• Phase down the use of dental amalgam through two or more measures listed in Part II of Annex A • Prevent the incorporation of products listed in Part I of Annex A (i.e., switches and relays, batteries) into larger, assembled products • Discourage the manufacture and distribution of mercury-added products not covered by any known use before the Convention entered into force
Policy and regulatory measures in place that enable the country to comply with above listed provisions:	
Title and reference/number of relevant policy and regulatory measure, as well as date	**Explanation on what aspects of the above provisions are being addressed by policy/regulatory measure**
Regulation on the Registration, Evaluation, Authorization and Restriction of Chemicals	This regulation prohibits the use of mercury in medical thermometers and other measuring instruments such as pressure gauges, barometers, sphygmomanometers and thermometers designed for public offering. Some devices have been banned or restricted from being offered to the market by 2018.
Regulation on Control of Waste Batteries and Accumulators	Manufacture and import of button type batteries containing two percent (2%) excess mercury oxide or mercury is prohibited by this regulation. Marks that must be found on the label of mercury-containing pills are indicated.
Regulation on Control of Waste Electrical and Electronic Equipment	This regulation restricts mercury in the use of electrical and electronic goods, electric bulbs and lighting equipment used for domestic purposes. The maximum permissible concentration of mercury in a homogeneous material is determined as 0.1% by weight.
Cosmetics Regulation	This regulation banned marketing of the cosmetics containing mercury, including skin lightening creams and soaps, excluding eye area cosmetics.
Regulation on Turkish Food Codex Maximum Pesticide Residue Limits	The use of plant protection products containing mercury in agricultural protection applications was banned in 1982.
Regulation on Biocidal Products	The use of biocidal products containing mercury was banned in 2009.
Regulation on Toy Safety	This regulation restricts mercury in the use of toy and components of toy.
Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provision:	
Draft legislation has been prepared to fulfill the other obligations under Article 4.	
Article 5 – Manufacturing processes in which mercury or mercury compounds are used	

Description of Article:	
Succinct summary of provisions relevant to Turkey	• Not allow the use of mercury or mercury compounds in the manufacturing processes listed in Part I of Annex B, following the Annex B phase out date • Restrict (as specified in the Annex) the use of mercury in the processes listed in Part II of Annex B • Not allow new facilities to use mercury in the regulated processes under Article 5, as specified in Annex B • 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 • Discourage new uses of mercury in industrial processes
Policy and regulatory measures in place that enable the country to comply with above listed provisions:	
Title and reference/number of relevant policy and regulatory measure, as well as date	**Explanation on what aspects of the above provisions are being addressed by policy/regulatory measure**
	There is no use of mercury or mercury compounds in the manufacturing processes listed in Part I of Annex B.
Regulation on the Control of Air Pollution Caused by Industrial Facilities	Limit values for mercury emissions from industry have been determined within the scope of the legislation.
Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provision:	
Draft legislation has been prepared to fulfill the other obligations under Article 5.	
Article 6 – Exemptions available to a Party upon request	
Description of Article:	
Succinct summary of provisions relevant to Turkey	• A Party require more time to meet their obligations under Article 4 or Article 5, or both, they may register for an exemption for up to five years from the phase-out dates listed in Annex A or Annex B by notifying the Secretariat in writing.
Policy and regulatory measures in place that enable the country to comply with above listed provisions:	
Title and reference/number of relevant policy and regulatory measure, as well as date	**Explanation on what aspects of the above provisions are being addressed by policy/regulatory measure**
Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provision:	
Draft legislation has been prepared to fulfill the obligations under Article 6.	
Article 7 – Artisanal and small-scale gold mining	
Description of Article:	

<table>
<tr><td>Succinct summary of provisions relevant to Turkey</td><td>
Reduce, and where feasible, eliminate mercury and mercury compound use, emissions (to air), and releases (to land and water) associated with ASGM
Establish a coordinating mechanism and delineate agency roles for development/implementation of an ASGM National Action Plan (NAP),
Define and formalize or regulate ASGM consistent with the Convention
Eliminate whole ore amalgamation, open burning of amalgam or processed amalgam, burning of amalgam in residential areas, and cyanide leaching of mercury-laden sediment, ore or tailings (the “worst practices”)
Set mercury use reduction goals or targets consistent with the timely elimination of the worst practices and other use reduction efforts
Reduce mercury emissions, releases, and exposures associated with ASGM, and prevent mercury exposures of vulnerable populations (particularly women of child-bearing age and children)
Prevent the diversion of mercury and mercury compounds from other sectors to ASGM, and manage mercury trade consistent with the NAP
Implement a public health strategy to address mercury exposures to ASGM miners and communities
</td></tr>
<tr><td colspan="2">Policy and regulatory measures in place that enable the country to comply with above listed provisions:</td></tr>
<tr><td>Title and reference/number of relevant policy and regulatory measure, as well as date</td><td>Explanation on what aspects of the above provisions are being addressed by policy/regulatory measure</td></tr>
<tr><td></td><td>There is no usage of mercury in ASGM</td></tr>
<tr><td colspan="2">Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention’s provision:</td></tr>
<tr><td colspan="2">Draft legislation has been prepared to fulfill the other obligations under Article 7.</td></tr>
<tr><td colspan="2">Article 8 – Emissions</td></tr>
<tr><td colspan="2">Description of Article:</td></tr>
<tr><td>Succinct summary of provisions relevant to Turkey</td><td>
Require best available techniques/best environmental practices (BAT/BEP) or associated emission limit values (ELVs) for new facilities (as defined in Article 8.2(c))
Require one or more measures identified in Article 8.5 to control/reduce mercury emissions from existing sources listed in
</td></tr>
</table>

	Annex D, which shall be operational at the source within 10 years, • Require monitoring/reporting and/or otherwise establish a mercury emissions inventory for sources listed in Annex D.
Relevant national stakeholder:	• Ministry of Environment and Urbanization
Policy and regulatory measures in place that enable the country to comply with above listed provisions:	
Title and reference/number of relevant policy and regulatory measure, as well as date	**Explanation on what aspects of the above provisions are being addressed by policy/regulatory measure**
Regulation on the Control of Air Pollution Caused by Industrial Facilities	Limit values for mercury emissions from industry have been determined within the scope of the legislation.
Regulation on the Incineration of Wastes	In the scope of the regulation, the emission limit value of mercury for cement plants that burn the wastes together is 0.05 mg / m^3 and the emission limit value for the discharge of wastewater from the flue gas emissions is 0.03 mg / m^3.
Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provision:	
Draft legislation has been prepared to fulfill the other obligations under Article 8.	
Article 9 – Releases	
Description of Article:	
Succinct summary of provisions relevant to Turkey	• Require reporting and/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, • Require one or more measures specified in Article 9.5 to control/reduce mercury and mercury compound releases to land and water from significant sources a country identifies.
Policy and regulatory measures in place that enable the country to comply with above listed provisions:	
Title and reference/number of relevant policy and Regulatory measure, as well as date	**Explanation on what aspects of the above provisions are being addressed by policy/regulatory measure**
Water Pollution Control Regulation	Allowable mercury concentration values under the regulation is 0.05 mg/l for mining, petroleum and chemical industry wastewater, 0.01 mg/l for metal industry, permissible maximum mercury value of wastewater from industrial activities to pre-treatment channel discharge standards is 0.2 mg/l .
Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provision:	
Draft legislation has been prepared to fulfill the other obligations under Article 9.	
Article 10 – Environmentally sound interim storage of mercury, other than waste mercury	
Description of Article:	

Succinct summary of provisions relevant to Turkey	• 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)
Policy and regulatory measures in place that enable the country to comply with above listed provisions:	
Title and reference/number of relevant policy and Regulatory measure, as well as date	**Explanation on what aspects of the above provisions are being addressed by policy/regulatory measure**
Regulation on Landfill of Wastes	In the regulation, the mercury limit value for the 3rd class storage facilities under the heading of regular storage of inert wastes is 0.001mg/L, the mercury limit value for the 2 class storage facilities under the heading of regular storage of non-hazardous wastes is 0.02 mg/L, non-reactive and stable Mercury limit value of 0.02 mg/L was determined to be accepted to 2nd class storage facilities and mercury limit value for 1st class storage facilities was determined as 0.2 mg/L.
Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provision:	
Draft legislation has been prepared to fulfill the other obligations under Article 10.	
Article 11 – Mercury wastes	
Description of Article:	
Succinct summary of provisions relevant to Turkey	• Use a definition of mercury waste consistent with Article 11.2 • 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 • Restrict mercury derived from the treatment or re-use of mercury waste to allowed uses under the Convention or environmentally sound disposal • 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.
Policy and regulatory measures in place that enable the country to comply with above listed provisions:	
Title and reference/number of relevant policy and Regulatory measure, as well as date	**Explanation on what aspects of the above provisions are being addressed by policy/regulatory measure**
Regulation on Waste Management	This regulation includes waste management provisions regarding to waste including mercury
Communique on Shipment of Waste	With this communiqué, the principles regarding the transportation of wastes by road have been determined.
Regulation on End of Life Vehicles	In the scope of the Regulation, vehicles and spare parts that have been approved before the year 2012

	are forbidden to use mercury in vehicles and spare parts except for fluorescent bulbs used in the dashboard and discharge lamps in headlamp systems. In homogeneous materials, mercury with a concentration of up to 0.1% by weight is tolerated.
Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provision:	
Draft legislation has been prepared to fulfill the other obligations under Article 11.	
Article 12 – Contaminated sites	
Description of Article:	
Succinct summary of provisions relevant to Turkey	• Develop strategies for identifying and assessing mercury/mercury compound contaminated sites • If risk reduction activities are taken at contaminated sites, they are taken in an environmentally sound manner, incorporating risk assessment where appropriate.
Policy and regulatory measures in place that enable the country to comply with above listed provisions:	
Title and reference/number of relevant policy and Regulatory measure, as well as date	**Explanation on what aspects of the above provisions are being addressed by policy/regulatory measure**
Regulation on Control of Soil Pollution and Sites Contaminated by Point Sources	This by-law is containing mercury as a generic polluter and has threshold values for mercury contaminated soil. It also has a systematic inventory obligation for mercury contaminated sites.
Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provision:	
Draft legislation has been prepared to fulfill the other obligations under Article 12.	
Article 13 – Financial resources and mechanism	
Description of Article:	
Succinct summary of provisions relevant to Turkey	• Access domestic resources as may be needed to implement Convention obligations • Particularly for developing countries, access financial resources available under the Convention financial mechanism and other resources available from multilateral, regional, and bilateral funding sources
Policy and regulatory measures in place that enable the country to comply with above listed provisions:	
Title and reference/number of relevant policy and Regulatory measure, as well as date	**Explanation on what aspects of the above provisions are being addressed by policy/regulatory measure**
Not available	
Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provision:	
Draft legislation has been prepared to fulfill the other obligations under Article 13.	
Article 14 – Capacity building, technical assistance and technology transfer	
Description of Article:	
Succinct summary of provisions relevant to Turkey	• Provide capacity building and technical assistance to developing countries, within their respective capabilities

	• Facilitate and promote technology transfer to strengthen the capacity of developing countries to meet their obligations under the Convention
Policy and regulatory measures in place that enable the country to comply with above listed provisions:	
Title and reference/number of relevant policy and Regulatory measure, as well as date	**Explanation on what aspects of the above provisions are being addressed by policy/regulatory measure**
Not available	
Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provision:	
Draft legislation has been prepared to fulfill the other obligations under Article 14.	
Article 16 – Health aspects	
Description of Article:	
Succinct summary of provisions relevant to Turkey	• Promote the development and implementation of strategies to identify and protect populations at risk, such as developing fish consumption guidelines • Promote occupational exposure educational and prevention programs • Promote prevention, treatment, and care services for affected populations • Strengthen institutional and professional capacities for addressing health risks associated with mercury exposure
Policy and regulatory measures in place that enable the country to comply with above listed provisions:	
Title and reference/number of relevant policy and Regulatory measure, as well as date	**Explanation on what aspects of the above provisions are being addressed by policy/regulatory measure**
By-law on Air Quality Assessment and Management	This Regulation covers air quality standards and assessment of air quality, creation of "regions" and "sub-regions" and measures to be taken to ensure good air quality in all regions.
Regulation Concerning Water Intended for Human Consumption	The amount of mercury allowed for drinking and utility water is 1 µg / l.
Regulation on the Quality of Surface Waters to be Obtained or Planned for Drinking Water	This Regulation covers the characteristics of surface waters used or intended to be used for drinking water supply, types of treatment to be applied according to the category of water and reference measurement methods for the parameters to be monitored in these waters, sampling and analysis frequencies.
Regulation on Cosmetics	This regulation banned marketing of the cosmetics containing mercury, including skin lightening creams and soaps, excluding eye area cosmetics.
Regulation on Toy Safety	This regulation restricts mercury in the use of toy and components of toy.
Regulation on Works that must be less than 7.5 Hours or less with regard to Health Rules	With this regulation, the maximum working time of the employees in terms of health rules is organized in the works specified in the Regulation.
Regulation on Health and Safety Measures for Works with Chemicals Substances	Occupational exposure limit values for mercury have been determined by this regulation.

Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provision:	
Draft legislation has been prepared to fulfill the other obligations under Article 16.	
Article 17– Information exchange	
Description of Article:	
Succinct summary of provisions relevant to Turkey	• Share information on the health and safety of humans and the environment as non-confidential, in accordance with Article 17.5
Policy and regulatory measures in place that enable the country to comply with above listed provisions:	
Title and reference/number of relevant policy and regulatory measure, as well as date	• **Explanation on what aspects of the above provisions are being addressed by policy/regulatory measure**
Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provision:	
Draft legislation has been prepared to fulfill the other obligations under Article 17.	
Article 18– Public information, awareness and education	
Description of Article:	
Succinct summary of provisions relevant to Turkey	• Collect and disseminate information on annual quantities of mercury and mercury compounds emitted, released, or disposed; and other information specified in Article 18
Policy and regulatory measures in place that enable the country to comply with above listed provisions:	
Title and reference/number of relevant policy and regulatory measure, as well as date	• **Explanation on what aspects of the above provisions are being addressed by policy/regulatory measure**
Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provision:	
Draft legislation has been prepared to fulfill the other obligations under Article 18.	
Article 19– Research, development and monitoring	
Description of Article:	
Succinct summary of provisions relevant to Turkey	• Cooperation among countries to develop and improve on key areas of research that can support effective implementation of the Convention
Policy and regulatory measures in place that enable the country to comply with above listed provisions:	
Title and reference/number of relevant policy and regulatory measure, as well as date	• **Explanation on what aspects of the above provisions are being addressed by policy/regulatory measure**
Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provision:	
Draft legislation has been prepared to fulfill the other obligations under Article 19.	
Article 21– Reporting	
Description of Article:	
Succinct summary of provisions relevant to Turkey	• Report to the COP on progress in implementing Convention obligations under Article 21.
Policy and regulatory measures in place that enable the country to comply with above listed provisions:	

Title and reference/number of relevant policy and regulatory measure, as well as date	• **Explanation on what aspects of the above provisions are being addressed by policy/regulatory measure**
Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provision:	
Draft legislation has been prepared to fulfill the other obligations under Article 21.	
Article 25-30– Participation as Party/Administrative Matters	
Description of Article:	
Succinct summary of provisions relevant to Turkey	• Participate in the COP, including voting, if and when required • Participate in one of the dispute resolution processes specified if needed, under Article 25 of the Convention • Determine how future Convention annex amendments will be ratified under Article 30.5 of the Convention
Policy and regulatory measures in place that enable the country to comply with above listed provisions:	
Title and reference/number of relevant policy and regulatory measure, as well as date	• **Explanation on what aspects of the above provisions are being addressed by policy/regulatory measure**
Outstanding regulatory or policy aspects that would need to be addressed/developed to ensure compliance with the Convention's provision:	
Draft legislation has been prepared to fulfill the other obligations under Article 25-30.	

3.2 Institutional Assessment

In order to ensure effective implementation of the Minamata Convention through coordinated actions from institutions and stakeholders in the country, it is important to identify the relevant ministries, agencies and institutions as well as non-government institutions, private sector stakeholders and others as well as their respective roles and responsibilities. Table 3-4 provides the responses of related institutions to the survey sent to potential stakeholders including the Ministry of Environment and Urbanization, Ministry of Health, Ministry of Agriculture and Forestry, Ministry of Energy and Natural Resources, Ministry of Family, Labor and Social Services, Ministry of Trade and Ministry of Industry and Technology within the scope of the aforementioned project. It presents the related institutions with respect to related obligation of the convention.

Table 3-4. Existing national institutional assessment (Ministry of Environment and Urbanization, 2018)

Article 3 – Mercury supply and trade	
Description of Article:	
Succinct summary of provisions relevant to the country in question	• Not allow new primary mercury mining • Phase-out existing primary mercury mining • Identification of mercury stocks • Disposal of excess mercury from chlor-alkali facilities as waste • Not allow mercury export • Not allow mercury import

Relevant national stakeholder:	
Name of institution/stakeholder:	• Ministry of Energy and Natural Resources
Article 4 – Mercury-added products	
Description of Article:	
Succinct summary of provisions relevant to the country in question	• Prohibition of manufacture/import/export of mercury-added products • Measures with respect to mercury-added products • Preventing the incorporation of mercury-added products in assembled products • Obligation to "discourage" manufacture and distribution of new products
Relevant national stakeholder:	• Ministry of Environment and Urbanization • Ministry of Health • Ministry of Agriculture and Forestry
Article 5 – Manufacturing processes in which mercury or mercury compounds are used	
Description of Article:	
Succinct summary of provisions relevant to the country in question	• Prohibition of mercury use in the process listed in part I of Annex B • Obligation to restrict the use of mercury in the processes listed in part II of Annex B • Obligation to take measures to "address" emissions and releases from all processes / to endeavor to identify facilities • Prohibition of using mercury in new facilities • Discourage "the development of new facilities using any other mercury-based manufacturing process
Relevant national stakeholder:	• Ministry of Environment and Urbanization
Article 7 – Artisanal and small-scale gold mining	
Description of Article:	
Succinct summary of provisions relevant to the country in question	• Reduce/eliminate emissions from ASGM • Determination of significance of ASGM / Developing and implementing a national action plan if applicable
Relevant national stakeholder:	• None
Article 8 – Emissions	
Description of Article:	
Succinct summary of provisions relevant to the country in question	• Controlling emissions: Develop a national plan • Require best available techniques (BAT)/best environmental practices (BEP) for new sources • Emission control measures for existing sources • Establish emissions inventory
Relevant national stakeholder:	• Ministry of Environment and Urbanization
Article 9 – Releases	

Description of Article:	
Succinct summary of provisions relevant to the country in question	• Identify relevant sources for releases (to water and land) • Releases control • Establish release inventory
Relevant national stakeholder:	• Ministry of Environment and Urbanization
Article 10 – Environmentally sound interim storage of mercury, other than waste mercury	
Description of Article:	
Succinct summary of provisions relevant to the country in question	• Storage of such mercury and its compounds intended for a use
Relevant national stakeholder:	• Ministry of Environment and Urbanization
Article 11 – Mercury wastes	
Description of Article:	
Succinct summary of provisions relevant to the country in question	• Mercury waste
Relevant national stakeholder:	• Ministry of Environment and Urbanization
Article 16 – Health aspects	
Description of Article:	
Succinct summary of provisions relevant to the country in question	• Health aspects
Relevant national stakeholder:	• Ministry of Environment and Urbanization • Ministry of Health • Ministry of Trade • Ministry of Family, Labor and Social Services

4 CHAPTER 4. IDENTIFICATION OF POPULATIONS AT RISK AND GENDER DIMENSIONS

4.1 Preliminary Review of Potential Populations at Risk and Potential Health Risks

"Guidance for Identifying Populations at Risk from Mercury Exposure" prepared by WHO and United Nations Environment Programme (UNEP) (2008) revealed the potential health impacts of mercury pollution and specific subpopulations at risk.

As mentioned in Section 2.12 in detail, the health effects of mercury depend on several factors including the chemical form of mercury, the dose, the age or developmental stage of the person exposed, the duration of exposure and the route of exposure. Toxicity of mercury and mercury compounds primarily targets the nervous system, the kidneys, and the cardiovascular system. Among them, the fetal nervous system is the most sensitive to the toxic effects of mercury. Also, mercury and mercury compounds have potentially adverse impacts on the respiratory, gastrointestinal, hematologic, immune and reproductive systems. While there is a link between effects on the nervous system and exposure to elemental mercury, effects on the kidneys result from exposure to inorganic mercury compounds.

There are two susceptible subpopulations which are those who are more sensitive to the effects of mercury and those who are exposed to higher levels of mercury (WHO and UNEP, 2008). The susceptible population can be defined as a group that may experience more severe adverse impacts at comparable exposure levels or lower exposure levels when compared to the general population. Developing organisms, especially the fetus, is the most sensitive sub-population in the case of mercury. Results of the studies indicated that the presence of methylmercury in pregnant women's diets, even at levels that do not affect mothers could affect the development of the child in utero and early in life (ATSDR, 1999; UNEP, 2002). Therefore, especially pregnant women, mothers and women who may be pregnant should understand the potential impacts of methylmercury. FAO and WHO (2006) revealed that life-stages other than the development of the child in utero might be less sensitive to the negative effects of methylmercury on the nervous system. Although there is no firm conclusion regarding the comparison of the sensitivity of infants and children aged up to about 17 years and adults, it can be claimed that infants and children aged up to about 17 years are less sensitive to the negative impacts of methylmercury on the nervous system than the child in utero and more responsive than adults (Grandjean et al., 2004; WHO and UNEP, 2008).

Methylmercury also poses a significant threat to the sub-populations that regularly consume fish and seafood. Other sub-populations at risk from mercury exposure are workers subjected to high occupational exposure, individuals who use a wide variety of consumer products containing mercury, individuals with dental amalgams and individuals who suffer from the liver, kidneys, nerves and lung-related diseases (ATSDR, 1999; UNEP, 2002; WHO and UNEP, 2008).

4.2 Assessment of Potential Gender Dimensions Related to the Management of Mercury

Sound management of chemicals can be defined as the application of management practices throughout the life cycle of chemicals for minimization and elimination of the potential for exposure of people and the environment to toxic and hazardous chemicals. Gender dimensions have to be considered to ensure the sound management of chemicals since women, men, and children are exposed to various chemicals at different levels. Both exposure levels to toxic chemicals and their impacts on human health depend on social and biological factors (UNDP, 2007). Social factors including occupational roles and household responsibilities, have a direct impact on the types of chemicals encountered and the frequency of exposures. In addition to social factors, biological factors such as size and physiological differences between different genders and age groups lead to variation in sensitivity to the toxic effects of chemicals.

Occupational roles have a significant impact on the differences in workplace exposure of mercury since social conditions provide a different role for women and men. For example, mercury may pose a higher risk to men working in artisanal gold mining, tannery operations, and mechanical workshops while women are more likely to be exposed mercury due to mercury-containing cleaning agents, personnel care products, professional cosmetics, textile products, and medical procedures. Differences in household responsibilities between men and women also influence mercury exposure levels. Mercury resulting from cosmetics, personnel care products and cleaning agents have a more significant impact on women when compared to men.

As mentioned in Section 4.1, children are more sensitive to the impacts of mercury than men and women. On the other hand, women are more vulnerable to the health effects of mercury especially at particular stages of their lives, such as pregnancy, lactation, and menopause (UNDP, 2007).

5 CHAPTER 5. AWARENESS/UNDERSTANDING OF WORKERS AND THE PUBLIC; AND EXISTING TRAINING AND EDUCATION OPPORTUNITIES OF TARGET GROUPS AND PROFESSIONALS

Within the scope of Article 18 of the Minamata Convention, each party is required to provide information to the public regarding;

- the health and environmental effects of mercury and its compounds,
- alternatives to mercury and its compound,
- the reduction or elimination of the production, use, trade, emissions and releases of mercury and its compounds,
- technically and economically viable alternatives to mercury-added products, manufacturing processes in which mercury and its compounds are used, activities and processes that emit or release mercury and its compounds,
- the results of research and monitoring activities related to mercury and its compounds,
- activities performed to meet the requirement stated under the Convention.

In addition; education, training, and public awareness activities related to the effects of exposure to mercury and its compounds on human health and the environment in collaboration with relevant authorities, non-governmental organizations and target groups should be performed. As indicated in Article 18 of the Convention, successful implementation of the Convention depends on raising awareness of the public about the potential risks posed by the use of and exposed to mercury and its compounds (Okoh, 2017). Reduction in the use and release of mercury and its compounds can be accomplished via well-operated facilities, well-trained personnel, regular monitoring of the processes and well-informed public. The inclusion of public and stakeholder participation in the future implementation of the Minamata Convention is critical. Therefore, people should be aware of the listed items in Article 18 of the Convention. To this end, the key element of public awareness-raising activity is to develop and produce public awareness programs, which cover mercury and its compounds related problems on the national and international scales and their alternatives. In addition to the public, industries, public sectors and non-governmental organizations play a significant role in the success of the reduction and elimination plan of the risks associated with mercury. Therefore, an effective and reliable coordination mechanism between parties should be established, and information flow regarding the concerns of each party should be provided.

As a party to the Minamata Convention on Mercury, Turkey is in the process of the development of the Mercury Initial Assessment which includes creating a national inventory and country profile and preparing the initial assessment report. Training target groups for the development and implementation of policies, strategies, monitoring programs, and enforcement activities for the protection of human health and the environment from the negative impacts of mercury and its compounds are the key initial activity that should be undertaken within the scope of the initial assessment project. As part of the Minamata Initial Assessment project, the inception meeting was held on 13th September 2017. The overall purpose of the project is to assist Turkey in completing pre-ratification activities under the Convention to enable policy and strategic decision making and to prioritize areas for future interventions. One of the outputs of the project is to disseminate information among academia, public and private sectors and non-governmental organizations (URL 1, 2019). Within the scope of the same project, Minamata Convention: Initial Assessment in Turkey Inventory Training and Mercury Inventory

Workshop were held between 29th-31st January 2018 and on 20th June 2018, respectively (URL 2, 2019).

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ANNEX 1. UNEP TOOLKIT CALCULATION SPREADSHEET

ANNEX 2. INVENTORY CALCULATION DETAILS

Data and Inventory on Extraction and Use of Fuels/Energy Sources

Coal combustion in large power plants

Determination of activity rate, input factors, and output distribution factors for the different lifecycle phases

Within the scope of this sub-category, combustion of hard coal and lignite were considered. The total annual amounts of hard coal and lignite burned in large power plants in the country were calculated by taking the average of the coal burned between the years of 2013-2017 (Table A.2. 1). These data are called as activity rates and are equal to 15,853,639 t per year for hard coal and 54,779,257 t per year for lignite.

Table A.2. 1. Coal burned in large power plants with respect to years (General Directorate of Energy Affairs, n.d.)

Year	**Hard coal (t/y)**
2013	11,707,000
2014	14,039,000
2015	16,071,000
2016	17,966,197
2017	19,485,000
Annual average	15,853,639
Year	**Lignite (t/y)**
2013	45,919,000
2014	57,411,000
2015	48,755,000
2016	58,974,410
2017	62,836,875
Annual average	54,779,257

Site-specific data cannot be gathered for input factor due to resource limitations. Therefore, default input factors given in the Toolkit was used (Table A.2. 2). For the calculation of mercury input from this sub-category, 0.15 g Hg/t selected from the range given in Table A.2. 2 as mercury input factor for lignite, respectively.

Table A.2. 2. Default input factors for mercury in coal for energy production in power plants (United Nations Environment, 2017)

Material	**Default input factors (g Hg/t)**
Coal used in power plants (for all main types)	0.05-0.5

<u>Hard coal</u>

Total mercury input can be calculated as follows;

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right)$$
$$= Activity\ rate\ \left(\frac{t}{y}\right) \times Input\ factor\ \left(\frac{g\ Hg}{t}\right) \times Conversion\ factor$$

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = 15{,}853{,}639\ \times 0.15\ \left(\frac{g\ Hg}{t}\right) \times \frac{kg}{1000\ g} =\ 2378\ kg\frac{Hg}{y}$$

Output distribution factors for Level 1 (particulate matter simple APC: ESP/PS/CYC) output scenario provided in the Toolkit was used. Distribution factors for lignite used power plants are as follows;

Air = 0.75
Water = 0.0
Land = 0.0
Products = 0.0
General waste = 0.0
Sector specific treatment/disposal = 0.25

Lignite

Total mercury input can be calculated as follows;

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right)$$
$$= Activity\ rate\ \left(\frac{t}{y}\right) \times Input\ factor\ \left(\frac{g\ Hg}{t}\right) \times Conversion\ factor$$
$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = 54{,}779{,}257\ \left(\frac{t}{y}\right) \times 0.15\ \left(\frac{g\ Hg}{t}\right) \times \frac{kg}{1000\ g}\ = 8217\ kg\frac{Hg}{y}$$

Output distribution factors for Level 1 (particulate matter simple APC: ESP/PS/CYC) output scenario provided in the Toolkit was used. Distribution factors for lignite used power plants are as follows;

Air = 0.98
Water = 0.0
Land = 0.0
Products = 0.0
General waste = 0.0
Sector specific treatment/disposal = 0.02

Estimation of mercury releases to each pathway

Hard coal

Using the calculated total Hg input and the distribution factor above, the releases can be calculated as follows;

$$Releases\ to\ air\ from\ hard\ coal\ used\ in\ power\ plants\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ air$$

$$Releases\ to\ air\ from\ hard\ coal\ used\ in\ power\ plants\ \left(kg\frac{Hg}{y}\right) = 2378\ \left(kg\frac{Hg}{y}\right) \times 0.75 = 1784\ kg\frac{Hg}{y}$$

$$Releases\ as\ sector\ specific\frac{treatment}{disposal}from\ \text{hard coal used in power plants}\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ forsector\ specific\ treatment/disposal$$

$$Releases\ as\ sector\ specific\frac{treatment}{disposal}from\ \text{hard coal used in power plants}\ \left(kg\frac{Hg}{y}\right) = 2378\left(kg\frac{Hg}{y}\right) \times 0.25 = 595\ kg\frac{Hg}{y}$$

Lignite

Using the calculated total Hg input and the distribution factor above, the releases can be calculated as follows;

$$Releases\ to\ air\ from\ lignite\ used\ in\ power\ plants\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ air$$

$$Releases\ to\ air\ from\ lignite\ used\ in\ power\ plants\ \left(kg\frac{Hg}{y}\right) = 8217\ \left(kg\frac{Hg}{y}\right) \times 0.98 = 8053\ kg\frac{Hg}{y}$$

$$Releases\ as\ sector\ specific\ treatment/disposal\ from\ \text{lignite used in power plants}\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ forsector\ specific\ treatment/disposal$$

$$Releases\ as\ sector\ specific\ treatment/disposal\ from\ \text{lignite used in power plants}\ \left(kg\frac{Hg}{y}\right) = 8217\left(kg\frac{Hg}{y}\right) \times 0.02 = 164\ kg\frac{Hg}{y}$$

Other coal use

Determination of activity rate, input factors, and output distribution factors for the different lifecycle phases

The total annual amount of each type of coal burned in coal fired industrial boilers in the country was calculated by taking the average of the coal burned between the years of 2013-2017 (Table A.2. 3). This data is called as activity rate and is equal to 5,363,075 t per year for hard coal and 3,910,316 t per year for lignite. In addition, the total annual amount of coal processed in coke production is calculated based on the data given in Table A.2. 3 and the activity rate is equal to 5,760,962 t per year.

Table A.2. 3. Coal burned and processed in coal fired industrial boilers and coke production with respect to years (General Directorate of Energy Affairs, n.d.)

Year	Coal burned in coal fired industrial boilers (t/y)	
	Hard coal	**Lignite**
2013	4,693,303	4,046,590
2014	4,955,000	3,901,000
2015	5,453,950	3,723,000
2016	5,953,804	3,726,967
2017	5,759,317	4,154,024
Annual average	5,363,075	3,910,316
Year	**Coal processed in coke production (t/y)**	
2013	5,571,239	
2014	5,721,754	
2015	6,040,000	
2016	5,674,815	
2017	5,797,000	
Annual average	5,760,962	

Site-specific data cannot be gathered for input factor due to resource limitations. Therefore, default input factors given in the Toolkit was used (Table A.2. 4). For the calculation of mercury input from this sub-category, 0.15 g Hg/t, 0.1 g Hg/t and 0.15 g Hg/t was selected from the range given in Table A.2. 4 as mercury input factor for hard coal, lignite and coke, respectively.

Table A.2. 4. Default input factors for mercury in coal for energy production in industrial and other facilities (United Nations Environment, 2017)

Material	Default input factors (g Hg/t)
Hard coal	0.05-0.5
Lignite	0.05-0.2
Coke	0.05-0.5

Hard coal combustion in industrial boilers

Total mercury input can be calculated as follows;

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = Activity\ rate\ \left(\frac{t}{y}\right) \times Input\ factor\ \left(\frac{g\ Hg}{t}\right) \times Conversion\ factor$$

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = 5{,}363{,}075\ \left(\frac{t}{y}\right) \times 0.15\ \left(\frac{g\ Hg}{t}\right) \times \frac{kg}{1000\ g}\ = 804\ kg\frac{Hg}{y}$$

Output distribution factors for Level 1 (particulate matter simple APC: ESP/PS/CYC) output scenario provided in the Toolkit was used. Distribution factors for hard coal combustion in industrial boilers are as follows;

Air = 0.75
Water = 0.0
Land = 0.0
Products = 0.0
General waste = 0.0
Sector specific treatment/disposal = 0.25

Lignite combustion in industrial boilers

Total mercury input can be calculated as follows;

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = Activity\ rate\ \left(\frac{t}{y}\right) \times Input\ factor\ \left(\frac{g\ Hg}{t}\right) \times Conversion\ factor$$

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = 3{,}910{,}316\ \left(\frac{t}{y}\right) \times 0.1\ \left(\frac{g\ Hg}{t}\right) \times \frac{kg}{1000\ g}\ = 391\ kg\frac{Hg}{y}$$

Output distribution factors for Level 1 (particulate matter simple APC: ESP/PS/CYC) output scenario provided in the Toolkit was used. Distribution factors for lignite combustion in industrial boilers are as follows;

Air = 0.95
Water = 0.0
Land = 0.0
Products = 0.0
General waste = 0.0
Sector specific treatment/disposal = 0.05

Coke production

Total mercury input can be calculated as follows;

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right)$$
$$= Activity\ rate\ \left(\frac{t}{y}\right) \times Input\ factor\ \left(\frac{g\ Hg}{t}\right) \times Conversion\ factor$$

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = 5{,}760{,}962\ \left(\frac{t}{y}\right) \times 0.15\ \left(\frac{g\ Hg}{t}\right) \times \frac{kg}{1000\ g}\ = 864\ kg\frac{Hg}{y}$$

Output distribution factors for Level 1 (particulate matter simple APC: ESP/PS/CYC) output scenario provided in the Toolkit was used. Distribution factors for coke production are as follows;

Air = 1.0
Water = 0.0
Land = 0.0
Products = 0.0
General waste = 0.0
Sector specific treatment/disposal = 0.0

Estimation of mercury releases to each pathway

<u>Hard coal combustion in industrial boilers</u>

Using the calculated total Hg input and the distribution factor above, the releases can be calculated as follows;

$$Releases\ to\ air\ from\ hard\ coal\ combustion\ in\ industrial\ boilers\ \left(kg\frac{Hg}{y}\right)$$
$$= Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ air$$

$$Releases\ to\ air\ from\ hard\ coal\ combustion\ in\ industrial\ boilers\ \left(kg\frac{Hg}{y}\right)$$
$$= 804\ \left(kg\frac{Hg}{y}\right) \times 0.75 = 603\ kg\frac{Hg}{y}$$

$$Releases\ as\ sector\ specific\ treatment$$
$$/disposal\ from\ \text{hard coal}\ combustion\ in\ industrial\ boilers\ \left(kg\frac{Hg}{y}\right)$$
$$= Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right)$$
$$\times Distribution\ factor\ forsector\ specific\ treatment/disposal$$

$$Releases\ as\ sector\ specific\ treatment\ /disposal\ from\ \text{hard coal}\ combustion\ in\ industrial\ boilers\ \left(kg\frac{Hg}{y}\right) = 804\left(kg\frac{Hg}{y}\right) \times 0.25 = 201\ kg\frac{Hg}{y}$$

Lignite combustion in industrial boilers

Using the calculated total Hg input and the distribution factor above, the releases can be calculated as follows;

$$Releases\ to\ air\ from\ lignite\ combustion\ in\ industrial\ boilers\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ air$$

$$Releases\ to\ air\ from\ lignite\ combustion\ in\ industrial\ boilers\ \left(kg\frac{Hg}{y}\right) = 391\ \left(kg\frac{Hg}{y}\right) \times 0.95 = 371.5\ kg\frac{Hg}{y}$$

$$Releases\ as\ sector\ specific\ treatment\ /disposal\ from\ \text{lignite combustion in industrial boilers}\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ forsector\ specific\ treatment/disposal$$

$$Releases\ as\ sector\ specific\ treatment\ /disposal\ from\ \text{lignite combustion in industrial boilers}\ \left(kg\frac{Hg}{y}\right) = 391\left(kg\frac{Hg}{y}\right) \times 0.05 = 19.5\ kg\frac{Hg}{y}$$

Coke production

Using the calculated total Hg input and the distribution factor above, the releases can be calculated as follows;

$$Releases\ to\ air\ from\ coke\ production\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ air$$

$$Releases\ to\ air\ from\ coke\ production\ \left(kg\frac{Hg}{y}\right) = 864\ \left(kg\frac{Hg}{y}\right) \times 1.0 = 864\ kg\frac{Hg}{y}$$

Mineral oils – extraction, refining and use

Determination of activity rate, input factors, and output distribution factors for the different lifecycle phases

The total annual mineral oils – extraction and refining and use of heavy oil and petroleum coke in the country was calculated by taking the average of the mineral oils produced and used between the years of 2013-2017 (Table A.2. 5). These data are called as activity rates and are equal to 2,499,400 t oil per year, 26,553,400 t oil per year and 3,940,554 t oil per year for extraction, refining, use of heavy oil and petroleum coke, respectively. Activity rate for use of gasoline, diesel, light fuel oil, kerosene, LPG and other light to medium distillates is equal to 30,954,000 t oil per year. In addition, total annual use of gasoline, diesel, light fuel oil, kerosene, LPG and other light to medium distillates in residential heating was calculated by taking the average of the mineral oils used between the years of 2013-2017 (Table A.2. 5) and is equal to 288,565 t oil per year. The difference between activity rates for use of gasoline, diesel, light fuel oil, kerosene, LPG and other light to medium distillates and residential heating is equal to the total annual amount used for transportation and other uses than residential heating and other oil combustion facilities

Table A.2. 5. Mineral oils – extraction/refining, use of heavy oil and petroleum coke with respect to years (General Directorate of Energy Affairs, n.d.; Energy Market Regulatory Authority-Directorate of Strategy Development, n.d.)

Year	**Extraction (t/y)**
2013	2,399,000
2014	2,456,000
2015	2,516,000
2016	2,573,000
2017	2,553,000
Annual average	2,499,400
Year	**Refining (t/y)**
2013	21,548,000
2014	20,862,000
2015	28,646,000
2016	29,605,000
2017	32,106,000
Annual average	26,553,400
Year	**Use of petroleum coke (t/y)**
2013	3,610,817
2014	4,073,602
2015	4,123,066
2016	3,780,794
2017	4,114,491
Annual average	3,940,554
Year	**Use for residential heating (t/y)**
2013	319,067
2014	296,818
2015	299,557

2016	277,140
2017	250,245
Annual average	288,565
	Use for transportation and other uses (t/y)
Annual average	30,665,435

Site-specific data cannot be gathered for input factor due to resource limitations. Therefore, default input factors given in the Toolkit was used (Table A.2. 6). For the calculation of mercury input from this sub-category, 3.4 mg Hg/t, 20 mg Hg/t and 2 mg Hg/t was selected from the range given in Table A.2. 6 as mercury input factor for mineral oils – extraction, refining, use of petroleum coke and heavy oil and use of petrol/gasoline, diesel, distilled fuel oil, kerosene and other light distillates, respectively.

Table A.2. 6. Default input factors for mercury in mineral oils - extraction, refining and use (United Nations Environment, 2017)

Life-cycle phase	Default input factors (mg Hg/t)
Extraction/refining	1-66
Use • Petroleum coke and heavy oil • Petrol/gasoline, diesel, distilled fuel oil, kerosene and other light distillates	10-100 1-10

Total mercury input can be calculated as follows;

<u>Extraction</u>

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = Activity\ rate\ \left(\frac{t}{y}\right) \times Input\ factor\ \left(\frac{mg\ Hg}{t}\right) \times Conversion\ factor$$

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = 2{,}499{,}400\ \left(\frac{t}{y}\right) \times 3.4\ \left(\frac{mg\ Hg}{t}\right) \times \frac{kg}{10^6\ mg} = 8\ kg\frac{Hg}{y}$$

Output distribution factors provided in the Toolkit was used. Distribution factors for mineral oils extraction are as follows;

Air = 0.0
Water = 0.2
Land = 0.0
Products = 0.0
General waste = 0.0
Sector specific treatment/disposal = 0.0

<u>Refining</u>

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = Activity\ rate\ \left(\frac{t}{y}\right) \times Input\ factor\ \left(\frac{mg\ Hg}{t}\right) \times Conversion\ factor$$

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = 26{,}553{,}400\ \left(\frac{t}{y}\right) \times 3.4\ \left(\frac{mg\ Hg}{t}\right) \times \frac{kg}{10^6\ mg} = 90\ kg\frac{Hg}{y}$$

Output distribution factors provided in the Toolkit was used. Distribution factors for mineral oils refining are as follows;

Air = 0.25
Water = 0.01
Land = 0.0
Products = 0.0
General waste = 0.0
Sector specific treatment/disposal = 0.15

<u>Use of heavy oil and petroleum coke</u>

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = Activity\ rate\ \left(\frac{t}{y}\right) \times Input\ factor\ \left(\frac{mg\ Hg}{t}\right) \times Conversion\ factor$$

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = 3{,}940{,}554\ \left(\frac{t}{y}\right) \times 20\ \left(\frac{mg\ Hg}{t}\right) \times \frac{kg}{10^6\ mg} = 79\ kg\frac{Hg}{y}$$

Output distribution factors provided in the Toolkit was used. Distribution factors for use of heavy oil and petroleum coke are as follows;

Air = 1.0
Water = 0.0
Land = 0.0
Products = 0.0
General waste = 0.0
Sector specific treatment/disposal = 0.0

<u>Use of gasoline, diesel, light fuel oil, kerosene, LPG and other light to medium distillates</u>

- ***<u>Transportation and other uses than residential heating and other oil combustion facilities</u>***

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = Activity\ rate\ \left(\frac{t}{y}\right) \times Input\ factor\ \left(\frac{mg\ Hg}{t}\right) \times Conversion\ factor$$

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = 30{,}665{,}435\ \left(\frac{t}{y}\right) \times 2\ \left(\frac{mg\ Hg}{t}\right) \times \frac{kg}{10^6\ mg} = 61\ kg\frac{Hg}{y}$$

Output distribution factors provided in the Toolkit was used. Distribution factors for use as transportation and other uses than residential heating and other oil combustion facilities are as follows;

Air = 1.0
Water = 0.0
Land = 0.0
Products = 0.0
General waste = 0.0
Sector specific treatment/disposal = 0.0

- ***Residential heating***

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = Activity\ rate\ \left(\frac{t}{y}\right) \times Input\ factor\ \left(\frac{mg\ Hg}{t}\right) \times Conversion\ factor$$

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = 288{,}565\ \left(\frac{t}{y}\right) \times 2\ \left(\frac{mg\ Hg}{t}\right) \times \frac{kg}{10^6\ mg} = 1\ kg\frac{Hg}{y}$$

Output distribution factors provided in the Toolkit was used. Distribution factors for use as residential heating are as follows;

Air = 1.0
Water = 0.0
Land = 0.0
Products = 0.0
General waste = 0.0
Sector specific treatment/disposal = 0.0

Estimation of mercury releases to each pathway

Extraction

Using the calculated total Hg input and the distribution factor above, the releases can be calculated as follows;

$$Releases\ to\ water\ from\ mineral\ oils\ extraction\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ water$$

$$Releases\ to\ water\ from\ mineral\ oils\ extraction\ \left(kg\frac{Hg}{y}\right) = 8\ \left(kg\frac{Hg}{y}\right) \times 0.2 = 1.6\ kg\frac{Hg}{y}$$

Refining

Using the calculated total Hg input and the distribution factor above, the releases can be calculated as follows;

$$Releases\ to\ air\ from\ mineral\ oils\ refining\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ air$$

$$Releases\ to\ air\ from\ mineral\ oils\ refining\ \left(kg\frac{Hg}{y}\right) = 90\ \left(kg\frac{Hg}{y}\right) \times 0.25 = 22.5\ kg\frac{Hg}{y}$$

$$Releases\ to\ water\ from\ mineral\ oils\ refining\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ water$$

$$Releases\ to\ water\ from\ mineral\ oils\ refining\ \left(kg\frac{Hg}{y}\right) = 90\ \left(kg\frac{Hg}{y}\right) \times 0.01 = 0.9\ kg\frac{Hg}{y}$$

$$Releases\ as\ sector\ specific\ treatment/disposal\ from\ mineral\ oils\ refining\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ for\ sector\ specific\ treatment/disposal$$

$$Releases\ as\ sector\ specific\ treatment/disposal\ from\ mineral\ oils\ refining\ \left(kg\frac{Hg}{y}\right) = 90\ \left(kg\frac{Hg}{y}\right) \times 0.15 = 13.5\ kg\frac{Hg}{y}$$

Use of heavy oil and petroleum coke

Using the calculated total Hg input and the distribution factor above, the releases can be calculated as follows;

$$Releases\ to\ air\ from\ use\ of\ heavy\ oil\ and\ petroleum\ coke\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ air$$

$$Releases\ to\ air\ from\ use\ of\ heavy\ oil\ and\ petroleum\ coke\ \left(kg\frac{Hg}{y}\right) = 79\ \left(kg\frac{Hg}{y}\right) \times 1.0 = 79\ kg\frac{Hg}{y}$$

Use of gasoline, diesel, light fuel oil, kerosene, LPG and other light to medium distillates

- ***Transportation and other uses than residential heating and other oil combustion facilities***

Using the calculated total Hg input and the distribution factor above, the releases can be calculated as follows;

$$Releases\ to\ air\ from\ use\ of\ oil\ in\ transportation\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ air$$

$$Releases\ to\ air\ from\ use\ of\ oil\ in\ transportation\ \left(kg\frac{Hg}{y}\right) = 61\ \left(kg\frac{Hg}{y}\right) \times 1.0 = 61\ kg\frac{Hg}{y}$$

- ***Residential heating***

Using the calculated total Hg input and the distribution factor above, the releases can be calculated as follows;

$$Releases\ to\ air\ from\ use\ of\ oil\ in\ residential\ heating\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ air$$

$$Releases\ to\ air\ from\ use\ of\ oil\ in\ residential\ heating\ \left(kg\frac{Hg}{y}\right) = 1\ \left(kg\frac{Hg}{y}\right) \times 1.0 = 1\ kg\frac{Hg}{y}$$

Natural gas – extraction, refining and use

Determination of activity rate, input factors, and output distribution factors for the different lifecycle phases

The total annual natural gas – extraction and refining, use of raw or pre-cleaned gas and use of pipeline gas (consumer quality) in the country was calculated by taking the average of the natural gas produced and used between the years of 2013-2017 (Table A.2. 7). These data are called as activity rates and are equal to 423.6 x 10^6 Sm^3 per year, 49334.6 x 10^6 Sm^3 per year and 48128.8 x 10^6 Sm^3 per year for extraction/refining, use of raw or pre-cleaned gas and use of pipeline gas (consumer quality), respectively.

Table A.2. 7. Natural gas – extraction/refining, use of raw or pre-cleaned gas and use of pipeline gas (consumer quality) with respect to years (General Directorate of Energy Affairs, n.d.)

Year	**Extraction/refining (Sm^3/y)**
2013	537 x 10^6

2014	479 x 10^6
2015	381 x 10^6
2016	367 x 10^6
2017	354 x 10^6
Annual average	423.6 x 10^6
Year	**Use of raw or pre-cleaned gas (Sm^3/y)**
2013	45801 x 10^6
2014	49741 x 10^6
2015	48808 x 10^6
2016	46719 x 10^6
2017	55604 x 10^6
Annual average	49334.6 x 10^6
Year	**Use of pipeline gas (consumer quality) (Sm^3/y)**
2013	45510 x 10^6
2014	48681 x 10^6
2015	47880 x 10^6
2016	45619 x 10^6
2017	52954 x 10^6
Annual average	48128.8 x 10^6

Site-specific data cannot be gathered for input factor due to resource limitations. Therefore, default input factors given in the Toolkit was used (Table A.2. 8). For the calculation of mercury input from this sub-category, 100 µg Hg/Nm^3 gas was selected from the range given in Table A.2. 8 as mercury input factor for natural gas – extraction/refining and use of raw or pre-cleaned gas. For the use of pipeline gas (consumer quality), 0.22 µg Hg/Nm^3 gas was selected.

Table A.2. 8. Default input factors for mercury in natural gas – extraction, refining and use (United Nations Environment, 2017)

Life-cycle phase	Default input factors (µg Hg/Nm^3 gas)
Extraction/refining	2-200
Use • Raw or pre-cleaned gas • Pipeline gas (consumer quality)	 2-200 0.03-0.4

Natural gas production and use data given in **Error! Reference source not found.** are in Sm^3 (standard cubic meters). However, the unit required in the Toolkit is Nm^3 (normal cubic meters). Therefore, when calculating total mercury input form this sub-category, unit conversion is necessary. Total mercury input can be calculated as follows;

Extraction/refining

$$Total\ mercury\ input\ \left(kg\,\frac{Hg}{y}\right) = Activity\ rate\ \left(\frac{Sm^3}{y}\right) \times Input\ factor\ \left(\frac{\mu g\ Hg}{Nm^3}\right) \times Conversion\ factor$$

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = 423.6\ \times 10^{6}\ \left(\frac{Sm^{3}}{y}\right) \times 100\ \left(\frac{\mu g\ Hg}{Nm^{3}}\right) \times \frac{kg}{10^{9}\ \mu g}\ \times \frac{0.95Nm^{3}}{Sm^{3}}$$
$$= 40\ kg\frac{Hg}{y}$$

Output distribution factors provided in the Toolkit was used. Distribution factors for natural gas extraction/refining are as follows;

Air = 0.2
Water = 0.2
Land = 0.0
Products = 0.5
General waste = 0.0
Sector specific treatment/disposal = 0.1

Output scenario was selected as gas processing without mercury removal to represent the worst-case scenario.

<u>Use of raw or pre-cleaned gas</u>

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = Activity\ rate\ \left(\frac{Sm^{3}}{y}\right) \times Input\ factor\ \left(\frac{\mu g\ Hg}{Nm^{3}}\right) \times Conversion\ factor$$

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = 49334.6\ \times 10^{6}\ \left(\frac{Sm^{3}}{y}\right) \times 100\ \left(\frac{\mu g\ Hg}{Nm^{3}}\right) \times \frac{kg}{10^{9}\ \mu g}\ \times \frac{0.95Nm^{3}}{Sm^{3}}$$
$$= 4687\ kg\frac{Hg}{y}$$

Output distribution factors provided in the Toolkit was used. Distribution factors for use of raw or pre-cleaned gas are as follows;
Air = 1.0
Water = 0.0
Land = 0.0
Products = 0.0
General waste = 0.0
Sector specific treatment/disposal = 0.0

<u>Use of pipeline gas (consumer quality)</u>

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = Activity\ rate\ \left(\frac{Sm^{3}}{y}\right) \times Input\ factor\ \left(\frac{\mu g\ Hg}{Nm^{3}}\right) \times Conversion\ factor$$

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = 48128.8\ \times 10^{6}\ \left(\frac{Sm^{3}}{y}\right) \times 0.22\ \left(\frac{\mu g\ Hg}{Nm^{3}}\right) \times \frac{kg}{10^{9}\ \mu g}\ \times \frac{0.95Nm^{3}}{Sm^{3}}$$
$$= 10\ kg\frac{Hg}{y}$$

Output distribution factors provided in the Toolkit was used. Distribution factors for use of pipeline gas (consumer quality) are as follows;

Air = 1.0
Water = 0.0
Land = 0.0
Products = 0.0
General waste = 0.0
Sector specific treatment/disposal = 0.0
Estimation of mercury releases to each pathway

Extraction/refining

Using the calculated total Hg input and the distribution factor above, the releases can be calculated as follows;

$$Releases\ to\ air\ from\ natural\ gas\ extraction\ and\ refining\ \left(kg\frac{Hg}{y}\right)$$
$$= Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ air$$

$$Releases\ to\ air\ from\ natural\ gas\ extraction\ and\ refining\ \left(kg\frac{Hg}{y}\right) = 40\ \left(kg\frac{Hg}{y}\right) \times 0.2$$
$$= 8\ kg\frac{Hg}{y}$$

$$Releases\ to\ water\ from\ natural\ gas\ extraction\ and\ refining\ \left(kg\frac{Hg}{y}\right)$$
$$= Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ water$$

$$Releases\ to\ water\ from\ natural\ gas\ extraction\ and\ refining\ \left(kg\frac{Hg}{y}\right) = 40\ \left(kg\frac{Hg}{y}\right) \times 0.2$$
$$= 8\ kg\frac{Hg}{y}$$

$$Releases\ via\ product\ from\ natural\ gas\ extraction\ and\ refining\ \left(kg\frac{Hg}{y}\right)$$
$$= Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ for\ product$$

$$Releases\ \ via\ product\ from\ natural\ gas\ extraction\ and\ refining\ \left(kg\frac{Hg}{y}\right)$$
$$= 40\ \left(kg\frac{Hg}{y}\right) \times 0.5 = 20\ kg\frac{Hg}{y}$$

$$Releases\ as\ sector\ specific\ treatment$$
$$/disposal\ from\ natural\ gas\ extraction\ and\ refining\ \left(kg\frac{Hg}{y}\right)$$
$$= Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right)$$
$$\times Distribution\ factor\ forsecor\ specific\ treatment/disposal$$

$$Releases\ as\ sector\ specific\ treatment$$
$$/disposal\ from\ natural\ gas\ extraction\ and\ refining\ \left(kg\frac{Hg}{y}\right)$$
$$= 40\ \left(kg\frac{Hg}{y}\right) \times 0.1 = 4\ kg\frac{Hg}{y}$$

<u>Use of raw or pre-cleaned gas</u>

Using the calculated total Hg input and the distribution factor above, the releases can be calculated as follows;

$$Releases\ to\ air\ from\ use\ of\ raw\ or\ pre-cleaned\ gas\ \left(kg\frac{Hg}{y}\right)$$
$$= Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ air$$

$$Releases\ to\ air\ from\ use\ of\ raw\ or\ pre-cleaned\ gas\ \ \left(kg\frac{Hg}{y}\right) = 4687\ \left(kg\frac{Hg}{y}\right) \times 1.0$$
$$= 4687\ kg\frac{Hg}{y}$$

<u>Use of pipeline gas (consumer quality)</u>

Using the calculated total Hg input and the distribution factor above, the releases can be calculated as follows;

$$Releases\ to\ air\ from\ use\ of\ pipeline\ gas\ (consumer\ qulity)\ \left(kg\frac{Hg}{y}\right)$$
$$= Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ air$$

$$Releases\ to\ air\ from\ use\ of\ pipeline\ gas\ (consumer\ qulity)\ \left(kg\frac{Hg}{y}\right) = 10\ \left(kg\frac{Hg}{y}\right) \times 1.0 = 10\ kg\frac{Hg}{y}$$

Biomass fired power and heat production

Determination of activity rate, input factors, and output distribution factors for the different lifecycle phases

The total annual biomass use in the country was calculated by taking the average of the biomass use between the years of 2013-2017 (Table A.2. 9). This data is called as activity rate and is equal to 8,955,400 t (dry weight) per year.

Table A.2. 9. Biomass use with respect to years (General Directorate of Energy Affairs, n.d.)

Year	**Biomass use (t (dry weight))**
2013	4,752,000
2014	5,400,000
2015	11,900,000
2016	11,900,000
2017	10,825,000
Annual average	8,955,400

Site-specific data cannot be gathered for input factor due to resource limitations. Therefore, default input factors given in the Toolkit was used (Table A.2. 10). For the calculation of mercury input from this sub-category, 0.03 g Hg/t (dry weight) was selected from the range given in Table A.2. 10 as mercury input factor for biomass use.

Table A.2. 10. Default input factors for mercury in biomass used for energy production (United Nations Environment, 2017)

Material	**Default input factors (g Hg/t(dry weight)**
Biomass used in combustion	0.007-0.07

Total mercury input can be calculated as follows;

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = Activity\ rate\ \left(\frac{t\ (dry\ weight)}{y}\right) \times Input\ factor\ \left(\frac{g\ Hg}{t\ (dry\ weight)}\right) \times Conversion\ factor$$

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = 8{,}955{,}400\ \left(\frac{t\ (dry\ weight)}{y}\right) \times 0.03\ \left(\frac{g\ Hg}{t\ (dry\ weight)}\right) \times \frac{kg}{1000\ g} = 269\ kg\frac{Hg}{y}$$

Output distribution factors provided in the Toolkit was used. Distribution factors for biomass use are as follows;

Air = 1.0
Water = 0.0
Land = 0.0
Products = 0.0
General waste = 0.0
Sector specific treatment/disposal = 0.0

Estimation of mercury releases to each pathway

Using the calculated total Hg input and the distribution factor above, the releases can be calculated as follows;

$$Releases\ to\ air\ from\ biomass\ used\ in\ combustion\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ air$$

$$Releases\ to\ air\ from\ biomass\ used\ in\ combustion\ \left(kg\frac{Hg}{y}\right) = 269\ \left(kg\frac{Hg}{y}\right) \times 1.0 = 269\ kg\frac{Hg}{y}$$

Geothermal power production

Determination of activity rate, input factors, and output distribution factors for the different lifecycle phases

The total annual electricity production from geothermal power plants in the country was calculated by taking the average of the electricity produced between the years of 2009-2016 (Table A.2. 11). This data is called as activity rate and is equal to 1730.6 GWh per year.

Table A.2. 11. Electricity production from geothermal power plants with respect to years (Geothermal Power Generation Statistics, 2017)

Year	Electricity produced (GWh)
2009	436
2010	668
2011	694
2012	899
2013	1364
2014	2252
2015	3318
2016	4214
Annual average	1730.6

Site-specific data cannot be gathered for input factor due to resource limitations. Therefore, input factor resulting from the measurements performed by the Environmental Protection Agency of the Toscana region, Italy was used (Table A.2. 12). This region is the main producer of geothermal energy in Europe. For the calculation of mercury input from this sub-category, 0.44 g Hg/MWh was selected from the range given in Table A.2. 12 as mercury input factor for geothermal power production.

Table A.2. 12. Default input factors for mercury in geothermal power production (European Environment Agency, 2016)

Material	Default input factors (g Hg/MWh)
Geothermal power production	0.26-1.3

Total mercury input can be calculated as follows;

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = Activity\ rate\ \left(\frac{GWh}{y}\right) \times Input\ factor\ \left(\frac{g\ Hg}{MWh}\right) \times Conversion\ factor$$

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = 1730.6\ \left(\frac{GWh}{y}\right) \times 0.44\ \left(\frac{g\ Hg}{MWh}\right) \times 1000\frac{MWh}{GWh} \times \frac{kg}{1000\ g} = 761\ kg\frac{Hg}{y}$$

Output distribution factors provided in the Toolkit was used. Distribution factors for geothermal power production are as follows;

Air = 1.0
Water = 0.0
Land = 0.0
Products = 0.0
General waste = 0.0
Sector specific treatment/disposal = 0.0

Estimation of mercury releases to each pathway

Using the calculated total Hg input and the distribution factor above, the releases can be calculated as follows;

$$Releases\ to\ air\ from\ geothermal\ power\ production\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ air$$

$$Releases\ to\ air\ from\ geothermal\ power\ production\ \left(kg\frac{Hg}{y}\right) = 761\ \left(kg\frac{Hg}{y}\right) \times 1.0 = 761\ kg\frac{Hg}{y}$$

Data and Inventory on Primary (Virgin) Metal Production
Copper extraction and initial processing
Determination of activity rate, input factors, and output distribution factors for the different lifecycle phases

The total annual copper production from concentrates in the country was taken as activity rate and is equal to 381,216 t concentrate used per year.

Site-specific data are not available for input factor due to resource limitations. Therefore, default input factors given in the Toolkit was used (Table A.2. 13). For the calculation of mercury input from this sub-category, 30 g Hg/t of concentrate was selected from the range given in Table A.2. 13 as mercury input factor for this sub-category.

Table A.2. 13. Default input factors for mercury in copper production from concentrates (United Nations Environment, 2017)

Material	Default input factors (g Hg/t of concentrate)
Copper concentrate	1-100

Total mercury input can be calculated as follows;

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = Activity\ rate\ \left(\frac{t\ concentrate}{y}\right) \times Input\ factor\ \left(\frac{g\ Hg}{t\ of\ concentrate}\right) \times Conversion\ factor$$

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = 381{,}216\ \left(\frac{t\ concentrate}{y}\right) \times 30\ \left(\frac{g\ Hg}{t\ concentrate}\right) \times \frac{kg}{1000\ g} = 11{,}436\ kg\frac{Hg}{y}$$

Output distribution factors for smelters with wet gas cleaning and acid plant provided in the Toolkit was used. Distribution factors for production of copper from concentrates are as follows;

Air = 0.1
Water = 0.02
Land = 0.0
Products = 0.42
General waste = 0.0
Sector specific treatment/disposal = 0.46

Estimation of mercury releases to each pathway

Using the calculated total Hg input and the distribution factor above, the releases can be calculated as follows;

$$Releases\ to\ air\ from\ \text{production of copper from concentrates}\ \left(kg\frac{Hg}{y}\right)$$
$$= Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ air$$

$$Releases\ to\ air\ from\ \text{production of copper from concentrates}\ \left(kg\frac{Hg}{y}\right)$$
$$= 11{,}436\ \left(kg\frac{Hg}{y}\right) \times 0.1 = 1144\ kg\frac{Hg}{y}$$

$$Releases\ to\ water\ from\ \text{production of copper from concentrates}\ \left(kg\frac{Hg}{y}\right)$$
$$= Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ water$$
$$Releases\ to\ water\ from\ \text{production of copper from concentrates}\ \left(kg\frac{Hg}{y}\right)$$
$$= 11436\ \left(kg\frac{Hg}{y}\right) \times 0.02 = 229\ kg\frac{Hg}{y}$$

$$Releases\ via\ products\ from\ \text{production of copper from concentrates}\ \left(kg\frac{Hg}{y}\right)$$
$$= Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ for\ products$$

$$Releases\ via\ products\ from\ \text{production of copper from concentrates}\ \left(kg\frac{Hg}{y}\right)$$
$$= 11{,}436\ \left(kg\frac{Hg}{y}\right) \times 0.42 = 4803\ kg\frac{Hg}{y}$$

$$\begin{aligned} &Releases\ as\ sector\ specific\ treatment \\ &\quad /disposal\ \ \text{production of copper from concentrates}\left(kg\frac{Hg}{y}\right) \\ &\quad = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \\ &\quad \times Distribution\ factor\ for\ sector\ specific\ treatment/disposal \end{aligned}$$

$$\begin{aligned} &Releases\ as\ sector\ specific\ treatment \\ &\quad /disposal\ from\ \ \text{production of copper from concentrates}\ \left(kg\frac{Hg}{y}\right) \\ &\quad = 11{,}436\left(kg\frac{Hg}{y}\right) \times 0.46 = 5261\ kg\frac{Hg}{y} \end{aligned}$$

Gold extraction and initial processing by methods other than mercury amalgamation
Determination of activity rate, input factors, and output distribution factors for the different lifecycle phases

The total annual gold ore used in the country was taken as activity rate and is equal to 27,661,000 t ore used per year.

Site-specific data are not available for input factor due to resource limitations. Therefore, default input factors given in the Toolkit was used (Table A.2. 14). For the calculation of mercury input from this sub-category, 15 g Hg/t ore used was selected from the range given in Table A.2. 14 as mercury input factor for this sub-category.

Table A.2. 14. Default input factors for gold extraction and initial processing by methods other than mercury amalgamation (United Nations Environment, 2017)

Material	Default input factors (g Hg/t ore)
Gold ore	1-30

Total mercury input can be calculated as follows;

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = Activity\ rate\ \left(\frac{t\ ore\ used}{y}\right) \times Input\ factor\ \left(\frac{g\ Hg}{t\ of\ ore}\right) \times Conversion\ factor$$

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = 27{,}661{,}000\ \left(\frac{t\ ore\ used}{y}\right) \times 15\ \left(\frac{g\ Hg}{t\ ore}\right) \times \frac{kg}{1000\ g} = 414{,}915\ kg\frac{Hg}{y}$$

Output distribution factors provided in the Toolkit was used. Distribution factors for gold extraction and initial processing by methods other than mercury amalgamation are as follows;

Air = 0.04
Water = 0.02
Land = 0.9
Products = 0.04
General waste = 0.0
Sector specific treatment/disposal = 0.0

Estimation of mercury releases to each pathway

Using the calculated total Hg input and the distribution factor above, the releases can be calculated as follows;

$Releases\ to\ air\ from$ gold extraction and initial processing by methods other than mercury

$$\text{amalgamation } \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ air$$

$$Releases\ to\ air\ from\ \text{gold extraction and initial processing by methods other than mercury amalgamation } \left(kg\frac{Hg}{y}\right) = 414{,}915\ \left(kg\frac{Hg}{y}\right) \times 0.04 = 16597\ kg\frac{Hg}{y}$$

$$Releases\ to\ water\ from\ \text{gold extraction and initial processing by methods other than mercury amalgamation } \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ water$$

$$Releases\ to\ water\ from\ \text{gold extraction and initial processing by methods other than mercury amalgamation } \left(kg\frac{Hg}{y}\right) = 414{,}915\ \left(kg\frac{Hg}{y}\right) \times 0.02 = 8298\ kg\frac{Hg}{y}$$

$$Releases\ to\ land\ from\ \text{gold extraction and initial processing by methods other than mercury amalgamation } \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ land$$

$$Releases\ to\ land\ from\ \text{gold extraction and initial processing by methods other than mercury amalgamation } \left(kg\frac{Hg}{y}\right) = 414{,}915\ \left(kg\frac{Hg}{y}\right) \times 0.9 = 373{,}424\ kg\frac{Hg}{y}$$

$$Releases\ via\ products\ from\ \text{gold extraction and initial processing by methods other than mercury amalgamation } \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ for\ products$$

$$Releases\ via\ products\ from\ \text{gold extraction and initial processing by methods other than mercury amalgamation } \left(kg\frac{Hg}{y}\right) = 414{,}915\ \left(kg\frac{Hg}{y}\right) \times 0.04 = 16{,}597\ kg\frac{Hg}{y}$$

Aluminium extraction and initial processing

Determination of activity rate, input factors, and output distribution factors for the different lifecycle phases

The total annual alumina production from bauxite in the country was taken as activity rate and is equal to 494,092 t bauxite used per year.

Site-specific data are not available for input factor due to resource limitations. Therefore, default input factors given in the Toolkit was used (Table A.2. 15). For the calculation of mercury input from this sub-category, 0.5 g Hg/t of bauxite was selected from the range given in Table A.2. 15 as mercury input factor for this sub-category.

Table A.2. 15. Default input factors for mercury in alumina production from bauxite (United Nations Environment, 2017)

Material	Default input factors (g Hg/t of bauxite)
Production of alumina	0.07-1

Total mercury input can be calculated as follows;

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = Activity\ rate\ \left(\frac{t\ bauxite}{y}\right) \times Input\ factor\ \left(\frac{g\ Hg}{t\ of\ bauxite}\right) \times Conversion\ factor$$

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = 494{,}092\ \left(\frac{t\ bauxite}{y}\right) \times 0.5\ \left(\frac{g\ Hg}{t\ bauxite}\right) \times \frac{kg}{1000\ g} = 247\ kg\frac{Hg}{y}$$

Output distribution factors provided in the Toolkit was used. Distribution factors for alumina production from bauxite are as follows;

Air = 0.15
Water = 0.1
Land = 0.0
Products = 0.0
General waste = 0.65
Sector specific treatment/disposal = 0.1

Estimation of mercury releases to each pathway

Using the calculated total Hg input and the distribution factor above, the releases can be calculated as follows;

$$Releases\ to\ air\ from\ \text{alumina production from bauxite}\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ air$$

$$Releases\ to\ air\ from\ \text{alumina production from bauxite}\ \left(kg\frac{Hg}{y}\right) = 247\ \left(kg\frac{Hg}{y}\right) \times 0.15 = 37\ kg\frac{Hg}{y}$$

$$Releases\ to\ water\ from\ \text{alumina production from bauxite}\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ water$$

$$Releases\ to\ water\ from\ \text{alumina production from bauxite}\ \left(kg\frac{Hg}{y}\right) = 247\ \left(kg\frac{Hg}{y}\right) \times 0.1 = 25\ kg\frac{Hg}{y}$$

$$Releases\ as\ general\ waste\ from\ \text{alumina production from bauxite}\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ for\ general\ waste$$

$$Releases\ as\ general\ waste\ from\ \text{alumina production from bauxite}\ \left(kg\frac{Hg}{y}\right) = 247\ \left(kg\frac{Hg}{y}\right) \times 0.65 = 161\ kg\frac{Hg}{y}$$

$$Releases\ as\ sector\ specific\ treatment/disposal\ \text{alumina production from bauxite}\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ for\ sector\ specific\ treatment/disposal$$

$$Releases\ as\ sector\ specific\ treatment\ /disposal\ from\ \text{alumina production from bauxite}\ \left(kg\frac{Hg}{y}\right) = 247\left(kg\frac{Hg}{y}\right) \times 0.1 = 25\ kg\frac{Hg}{y}$$

Primary ferrous metal production

Determination of activity rate, input factors, and output distribution factors for the different lifecycle phases

The total annual pig-iron production form integrated iron and steel plants in the country was calculated by taking the average of the pig-iron produced between the years of 2013-2018 (Table A.2. 16). This data is called as activity rate and is equal to 10,026,244 t pig-iron produced per year.

Table A.2. 16. Pig-iron production from integrated iron and steel plants with respect to years (Turkish Steel Producers Association, 2019)

Year	Pig-iron produced (t/y)
2013	9,180,165
2014	9,363,555
2015	10,184,100
2016	10,304,272

2017	10,589,021
2018	10,536,349
Annual average	10,026,244

Site-specific data are not available for input factor due to resource limitations. Therefore, default input factor given in the Toolkit was used (Table A.2. 17). For the calculation of mercury input from this sub-category, 0.05 g Hg/t of pig-iron produced was selected from the range given in Table A.2. 17 as mercury input factor for this sub-category.

Table A.2. 17. Default input factor for mercury in primary ferrous production (United Nations Environment, 2017)

Material	Default input factor (g Hg/t of pig-iron produced)
Pig-iron production	0.05

Total mercury input can be calculated as follows;

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = Activity\ rate\ \left(\frac{t\ pig-iron\ produced}{y}\right) \times Input\ factor\ \left(\frac{g\ Hg}{t\ of\ pig-iron\ produced}\right) \times Conversion\ factor$$

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = 10{,}026{,}244\ \left(\frac{t\ concentrate}{y}\right) \times 0.05\ \left(\frac{g\ Hg}{t\ concentrate}\right) \times \frac{kg}{1000\ g} = 501\ kg\frac{Hg}{y}$$

Output distribution factors provided in the Toolkit was used. Distribution factors for production primary ferrous are as follows;

Air = 0.95
Water = 0.0
Land = 0.0
Products = 0.0
General waste = 0.0
Sector specific treatment/disposal = 0.05

Estimation of mercury releases to each pathway

Using the calculated total Hg input and the distribution factor above, the releases can be calculated as follows;

$$Releases\ to\ air\ from \text{ production of primary ferrous } \left(kg\frac{Hg}{y}\right)$$
$$= Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ air$$

$$Releases\ to\ air\ from \text{ production of primary ferrous } \left(kg\frac{Hg}{y}\right) = 501\ \left(kg\frac{Hg}{y}\right) \times 0.95$$
$$= 476\ kg\frac{Hg}{y}$$

$$Releases\ as\ sector\ specific\ treatment/disposal\ from \text{ production of primary ferrous } \left(kg\frac{Hg}{y}\right)$$
$$= Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right)$$
$$\times Distribution\ factor\ for\ sector\ specific\ treatment/disposal$$

$$Releases\ as\ sector\ specific\ treatment$$
$$/disposal\ from \text{ production of primary ferrous } \left(kg\frac{Hg}{y}\right) = 501\left(kg\frac{Hg}{y}\right) \times 0.05$$
$$= 25\ kg\frac{Hg}{y}$$

Data and Inventory on Production of Other Minerals and Materials with Mercury Impurities

Cement production

Determination of activity rate, input factors, and output distribution factors for the different lifecycle phases

The total annual cement production in the country is called as activity rate and is equal to 80,000,000 t cement produced per year. However, cement is produced in two ways; without co-incineration of waste and with co-incineration of waste. Therefore, two activity rates for both production are required. In order to determine the total annual cement production with co-incineration of waste, annual average value for percent of waste used in cement production given in Table A.2. 18 was used. Activity rates for cement production with and without co-incineration of waste is equal to 3,520,000 t per year (which is equal to 4.4 % of 80,000,000 t per year) and 76,480,000 t per year, respectively. In addition, fossil fuels combusted in cement production were included under this sub-category. Within this scope, data regarding fossil fuels combusted in cement production were obtained from Turkish Cement Manufacturers' Association and provided in Table A.2. 19.

Table A.2. 18. Percent of waste used in cement production with respect to years (Turkish Cement Manufacturers' Association, 2019)

Year	**Percent of waste used in cement production (%)**
2014	3.6
2015	3.8
2016	3.9
2017	4.5
2018	6.0
Annual average	4.4

Table A.2. 19. Fossil fuels use in cement production (Turkish Cement Manufacturers' Association, 2019)

Year	Petroleum coke (t/y)	Hard coal (t/y)	Lignite (t/y)	Fuel oil (t/y)	Natural gas (m^3/y)
2014	3,313,947	2,827,948	1,537,783	15,872	48,574,690
2015	3,640,542	2,834,826	959,741	17,004	34,090,541
2016	3,940,136	3,417,660	699,683	13,403	39,994,989
2017	4,206,240	2,968,817	1,079,798	29,188	45,443,430
2018	4,114,260	3,136,997	827,833	15,010	38,280,731
Annual average	3,843,025	3,037,250	1,020,968	18,095	41,276,876

Site-specific data are not available for input factor due to resource limitations. Therefore, default input factor given in the Toolkit was used (Table A.2. 20). For the calculation of mercury input from this sub-category, 0.11 g Hg/t of cement produced and 0.15 g Hg/t of cement produced were selected from the range given in Table A.2. 20 as mercury input factors for cement production without and with co-incineration of waste, respectively. Input factors selected for fossil fuels used in cement production are also provided in Table A.2. 20.

Table A.2. 20. Default input factor for mercury in cement production (United Nations Environment, 2017)

Gas quality		Default input factor (g Hg/t of cement produced)	Selected input factor (g Hg/t of cement produced)
Cement production without co-incineration of waste (excluding fossil fuel contributions)		0.004-0.5	0.11
Cement production with co-incineration of waste (excluding fossil fuel contributions)		0.06-1	0.15
Cement production without co-incineration of	**Fossil fuels use in production:**	**Default input factor (g Hg/t of cement produced with the listed fuel)**	**Selected input factor (g Hg/t of cement produced with the listed fuel)**
	Petroleum coke (pet coke)	0.001-0.008	0.002
	Hard coal (anthrasite, bituminous or cooking coal)	0.006-0.05	0.016
	Lignite (brown coal)	0.009-0.04	0.017
	Fuel oil	0.0007-0.007	0.001
	Natural gas	0.000002-0.00003	0.00002
Cement production with co-incineration of waste	**Fossil fuels use in production:**	**Default input factor (g Hg/t of cement produced with the listed fuel)**	**Selected input factor (g Hg/t of cement produced with the listed fuel)**
	Petroleum coke (pet coke)	0.001-0.007	0.002

	Hard coal (anthrasite, bituminous or cooking coal)	0.005-0.04	0.014
	Lignite (brown coal)	0.008-0.03	0.015
	Fuel oil	0.001-0.006	0.001
	Natural gas	0.000002-0.00003	0.00002

Cement production without co-incineration of waste

Total mercury input can be calculated as follows;

$$Mercury\ input\ from\ cement\ production\ \left(kg\frac{Hg}{y}\right) = Activity\ rate\ \left(\frac{t\ cement\ produced}{y}\right) \times Input\ factor\ \left(\frac{g\ Hg}{t\ cement\ produced}\right) \times Conversion\ factor$$

$$Mercury\ input\ from\ cement\ production\ \left(kg\frac{Hg}{y}\right) = 76{,}480{,}000\ \left(\frac{t\ cement\ produced}{y}\right) \times 0.11\ \left(\frac{g\ Hg}{t\ cement\ produced}\right) \times \frac{kg}{1000\ g} = 8413\ kg\frac{Hg}{y}$$

$$Mercury\ input\ from\ fossil\ fuels\ use\ \left(kg\frac{Hg}{y}\right) = Activity\ rate\ \left(\frac{t\ fossil\ fuel\ used}{y}\right) \times Input\ factor\ \left(\frac{g\ Hg}{t}\right) \times Conversion\ factor$$

$$\begin{aligned} Mercury\ input\ from\ fossil\ fuels\ use\ \left(kg\frac{Hg}{y}\right) &= 3{,}843{,}025\ \left(\frac{t\ petroleum\ coke}{y}\right) \times 0.002\ \left(\frac{g\ Hg}{t}\right) \times \frac{kg}{1000\ g} \\ &+ 3{,}037{,}250\ \left(\frac{t\ hard\ coal}{y}\right) \times 0.016\ \left(\frac{g\ Hg}{t}\right) \times \frac{kg}{1000\ g} \\ &+ 1{,}020{,}968\ \left(\frac{t\ lignite}{y}\right) \times 0.017\ \left(\frac{g\ Hg}{t}\right) \times \frac{kg}{1000\ g} \\ &+ 18{,}095\ \left(\frac{t\ fuel\ oil}{y}\right) \times 0.001\ \left(\frac{g\ Hg}{t}\right) \times \frac{kg}{1000\ g} \\ &+ 33{,}021{,}501\ \left(\frac{m^3\ natural\ gas}{y}\right) \times 0.002\ \left(\frac{g\ Hg}{t}\right) \times \frac{kg}{1000\ g} \times \frac{0.8\ kg}{m^3} \\ &\times \frac{t}{1000\ kg} = 74\ kg\frac{Hg}{y} \end{aligned}$$

$$Total\ mercury\ input\ from\ cement\ production\ without\ co-incineration\ \left(kg\frac{Hg}{y}\right)$$
$$= 8413\ \left(kg\frac{Hg}{y}\right) + 75\ \left(kg\frac{Hg}{y}\right) = 8487\ kg\frac{Hg}{y}$$

Output distribution factors for simple particle control (ESP/PS/FF) output scenario provided in the Toolkit was used. Distribution factors for production of cement without co-incineration of waste are as follows;

Air = 0.6
Water = 0.0
Land = 0.0
Products = 0.2
General waste = 0.0
Sector specific treatment/disposal = 0.2

Cement production with co-incineration of waste

Total mercury input can be calculated as follows;

$$Mercury\ input\ from\ cement\ production\ \left(kg\frac{Hg}{y}\right)$$
$$= Activity\ rate\ \left(\frac{t\ cement\ produced}{y}\right) \times Input\ factor\ \left(\frac{g\ Hg}{t\ cement\ produced}\right)$$
$$\times Conversion\ factor$$

$$Mercury\ input\ from\ cement\ production\ \left(kg\frac{Hg}{y}\right)$$
$$= 3{,}520{,}000\ \left(\frac{t\ cement\ produced}{y}\right) \times 0.15\ \left(\frac{g\ Hg}{t\ cement\ produced}\right) \times \frac{kg}{1000\ g}$$
$$= 528\ kg\frac{Hg}{y}$$

$$Mercury\ input\ from\ fossil\ fuels\ use\ \left(kg\frac{Hg}{y}\right)$$
$$= Activity\ rate\ \left(\frac{t\ fossil\ fuel\ used}{y}\right) \times Input\ factor\ \left(\frac{g\ Hg}{t}\right)$$
$$\times Conversion\ factor$$

$$Mercury\ input\ from\ fossil\ fuels\ use\ \left(kg\frac{Hg}{y}\right)$$
$$= 3{,}843{,}025\ \left(\frac{t\ petroleum\ coke}{y}\right) \times 0.002\ \left(\frac{g\ Hg}{t}\right) \times \frac{kg}{1000\ g}$$
$$+ 3{,}037{,}250\ \left(\frac{t\ hard\ coal}{y}\right) \times 0.014\ \left(\frac{g\ Hg}{t}\right) \times \frac{kg}{1000\ g}$$
$$+ 1{,}020{,}968\ \left(\frac{t\ lignite}{y}\right) \times 0.015\ \left(\frac{g\ Hg}{t}\right) \times \frac{kg}{1000\ g}$$
$$+ 18{,}095\ \left(\frac{t\ fuel\ oil}{y}\right) \times 0.001\ \left(\frac{g\ Hg}{t}\right) \times \frac{kg}{1000\ g}$$
$$+ 33{,}021{,}501\ \left(\frac{m^3\ natural\ gas}{y}\right) \times 0.002\ \left(\frac{g\ Hg}{t}\right) \times \frac{kg}{1000\ g} \times \frac{0.8\ kg}{m^3}$$
$$\times \frac{t}{1000\ kg} = 66\ kg\frac{Hg}{y}$$
$$Total\ mercury\ input\ from\ cement\ production\ without\ co-incineration\ \left(kg\frac{Hg}{y}\right)$$
$$= 528\ \left(kg\frac{Hg}{y}\right) + 66\ \left(kg\frac{Hg}{y}\right) = 594\ kg\frac{Hg}{y}$$

Output distribution factors for simple particle control (ESP/PS/FF) output scenario provided in the Toolkit was used. Distribution factors for production of cement without co-incineration of waste are as follows;

Air = 0.6
Water = 0.0
Land = 0.0
Products = 0.2
General waste = 0.0
Sector specific treatment/disposal = 0.2

Estimation of mercury releases to each pathway

<u>Cement production without co-incineration of waste</u>

Using the calculated total Hg input and the distribution factor above, the releases can be calculated as follows;

$$Releases\ to\ air\ from\ \text{cement production}\ \left(kg\frac{Hg}{y}\right)$$
$$= Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ air$$

$$Releases\ to\ air\ from\ \text{cement production}\ \left(kg\frac{Hg}{y}\right) = 8487\ \left(kg\frac{Hg}{y}\right) \times 0.6 = 5092\ kg\frac{Hg}{y}$$

$$Releases\ via\ products\ from\ \text{cement production}\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ for\ products$$

$$Releases\ via\ products\ from\ \text{cement production}\ \left(kg\frac{Hg}{y}\right) = 8487\ \left(kg\frac{Hg}{y}\right) \times 0.2 = 1697\ kg\frac{Hg}{y}$$

$$Releases\ as\ sector\ specific\ treatment/disposal\ from\ \text{cement production}\left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ for\ sector\ specific\ treatment/disposal$$

$$Releases\ as\ sector\ specific\ treatment/disposal\ from\ \text{cement production}\ \left(kg\frac{Hg}{y}\right) = 8487\left(kg\frac{Hg}{y}\right) \times 0.2 = 1697\ kg\frac{Hg}{y}$$

<u>Cement production with co-incineration of waste</u>

Using the calculated total Hg input and the distribution factor above, the releases can be calculated as follows;

$$Releases\ to\ air\ from\ \text{cement production}\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ air$$

$$Releases\ to\ air\ from\ \text{cement production}\ \left(kg\frac{Hg}{y}\right) = 594\ \left(kg\frac{Hg}{y}\right) \times 0.6 = 356\ kg\frac{Hg}{y}$$

$$Releases\ via\ products\ from\ \text{cement production}\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ for\ products$$

$$Releases\ via\ products\ from\ \text{cement production}\ \left(kg\frac{Hg}{y}\right) = 594\ \left(kg\frac{Hg}{y}\right) \times 0.2 = 119\ kg\frac{Hg}{y}$$

$$Releases\ as\ sector\ specific\ treatment/disposal\ from\ \text{cement production}\left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ for\ sector\ specific\ treatment/disposal$$

$$Releases\ as\ sector\ specific\ treatment/disposal\ from\ \text{cement production}\ \left(kg\frac{Hg}{y}\right) = 594\left(kg\frac{Hg}{y}\right) \times 0.2 = 119\ kg\frac{Hg}{y}$$

Data and Inventory on Consumer Products with International Use of Mercury

Thermometers with mercury

Determination of activity rate, input factors, and output distribution factors for the different lifecycle phases

The total annual import data is available for only medical and ambient air thermometers and are equal to 820 kg/y and 23,331 kg/y, respectively. In order to convert these values to activity rate (number of thermometers consumed per year), weights of medical and ambient air thermometers were assumed as 20 and 50 g, respectively. Therefore, activity rates are equal to 41,000 and 466,620 items per year for medical and ambient air thermometers.

Site-specific data are not available for input factor due to resource limitations. Therefore, default input factors given in the Toolkit was used (Table A.2. 21). For the calculation of mercury input from this sub-category, 1 and 3.5 g Hg/item was selected for medical and ambient air thermometers from the range given in Table A.2. 21 as mercury input factor for this sub-category.

Table A.2. 21. Default input factors for mercury in use and disposal of mercury containing thermometers (United Nations Environment, 2017)

Thermometer type	Default input factors (g Hg/item)
Medical thermometers	0.5-1.5
Ambient air temperature thermometer	2-5

Total mercury input can be calculated as follows;

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = Activity\ rate\ \left(\frac{items}{y}\right) \times Input\ factor\ \left(\frac{g\ Hg}{item}\right) \times Conversion\ factor$$

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = 41{,}000\ \left(\frac{items}{y}\right) \times 1\ \left(\frac{g\ Hg}{item}\right) \times \frac{kg}{1000\ g} + \ 466{,}620\ \left(\frac{items}{y}\right) \times 3.5\ \left(\frac{g\ Hg}{item}\right) \times \frac{kg}{1000\ g} = 1674\ kg\frac{Hg}{y}$$

Output distribution factors provided in the Toolkit for no or very limited separate thermometer collection and all or most general waste is collected and handled in a publicly controlled manner was used. Distribution factors for use and disposal of thermometers with mercury are as follows;

Air = 0.1
Water = 0.3
Land = 0.0
Products = 0.0

General waste = 0.6
Sector specific treatment/disposal = 0.0

Estimation of mercury releases to each pathway

Using the calculated total Hg input and the distribution factor above, the releases can be calculated as follows;

$$Releases\ to\ air\ from\ \text{use and disposal of thermometers with mercury}\ \left(kg\frac{Hg}{y}\right)$$
$$= Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ air$$

$$Releases\ to\ air\ from\ \text{use and disposal of thermometers with mercury}\ \left(kg\frac{Hg}{y}\right)$$
$$= 1674\ \left(kg\frac{Hg}{y}\right) \times 0.1 = 167\ kg\frac{Hg}{y}$$

$$Releases\ to\ water\ from\ \text{use and disposal of thermometers with mercury}\ \left(kg\frac{Hg}{y}\right)$$
$$= Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ water$$

$$Releases\ to\ water\ from\ \text{use and disposal of thermometers with mercury}\ \left(kg\frac{Hg}{y}\right)$$
$$= 1674\ \left(kg\frac{Hg}{y}\right) \times 0.3 = 502\ kg\frac{Hg}{y}$$

$$Releases\ as\ general\ waste\ from\ \text{use and disposal of thermometers with mercury}\left(kg\frac{Hg}{y}\right)$$
$$= Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ for\ general\ waste$$

$$Releases\ as\ general\ waste\ from\ \text{use and disposal of thermometers with mercury}\ \left(kg\frac{Hg}{y}\right)$$
$$= 1674\left(kg\frac{Hg}{y}\right) \times 0.6 = 1004\ kg\frac{Hg}{y}$$

Electrical switches and relays with mercury

Determination of activity rate, input factors, and output distribution factors for the different lifecycle phases

National population in 2018 was taken as activity rate data and is equal to 82,003,882 inhabitants (Turkish Statistical Institute, 2018).

Site-specific data are not available for input factor due to resource limitations. Therefore, default input factors given in the Toolkit was used (Table A.2. 22). For the calculation of mercury input from this sub-category, 0.14 g Hg/inhabitant.y was selected from the range given in Table A.2. 22 as mercury input factor for this sub-category.

Table A.2. 22. Default input factors for mercury in use and disposal of mercury containing electrical switches and relays (United Nations Environment, 2017)

	Default input factors (g Hg consumed/inhabitants.y)
Mercury consumed annually with mercury switches and relays	0.02-0.25

Total mercury input can be calculated as follows;

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = Activity\ rate\ (inhabitants) \times Input\ factor\ \left(\frac{g\ Hg}{inhabitants.y}\right) \times Conversion\ factor$$

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = 82{,}003{,}882\ (inhabitants) \times 0.14\left(\frac{g\ Hg}{inhabitants.y}\right) \times \frac{kg}{1000\ g} = 11{,}481\ kg\frac{Hg}{y}$$

Output distribution factors provided in the Toolkit when there is no separate collection and all or most general waste is collected and handled in a publicly controlled manner was used. Distribution factors for use and disposal of mercury containing electrical switches and relays are as follows;

Air = 0.1
Water = 0.0
Land = 0.1
Products = 0.0
General waste = 0.8
Sector specific treatment/disposal = 0.0

Estimation of mercury releases to each pathway

Using the calculated total Hg input and the distribution factor above, the releases can be calculated as follows;

$$Releases\ to\ air\ from\ \text{use and disposal of mercury containing electrical switches and relays}\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ air$$

$$Releases\ to\ air\ from \text{ use and disposal of mercury containing electrical switches and relays } \left(kg\frac{Hg}{y}\right) = 11{,}481\ \left(kg\frac{Hg}{y}\right) \times 0.1 = 1148\ kg\frac{Hg}{y}$$

$$Releases\ toland\ from \text{ use and disposal of mercury containing electrical switches and relays } \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ land$$

$$Releases\ to\ water\ from \text{ use and disposal of mercury containing electrical switches and relays } \left(kg\frac{Hg}{y}\right) = 11{,}481\ \left(kg\frac{Hg}{y}\right) \times 0.1 = 1148\ kg\frac{Hg}{y}$$

$$Releases\ as\ general\ waste\ from \text{ use and disposal of mercury containing electrical switches and relays } \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ for\ general\ waste$$

$$Releases\ as\ general\ waste\ from \text{ use and disposal of polyurethane with mercury catalysts } \left(kg\frac{Hg}{y}\right) = 11{,}481\left(kg\frac{Hg}{y}\right) \times 0.8 = 9185\ kg\frac{Hg}{y}$$

Light sources with mercury

Determination of activity rate, input factors, and output distribution factors for the different lifecycle phases

The total annual import data is available only for fluorescent tubes (double end) and is equal to 321,283 kg per year. In order to convert this value to activity rate, unit conversion given in Toolkit was used. For fluorescent tubes (double end), 0.1 kg/item was used to convert kg/y into items sold/y. Therefore, activity rate is equal to 3,212,830 items per year.

Site-specific data are not available for input factor due to resource limitations. Therefore, default input factors for given in the Toolkit was used (Table A.2. 23). For the calculation of mercury input from this sub-category, 25 mg Hg/item was selected from the range given in Table A.2. 23 as mercury input factor for this sub-category.

Table A.2. 23. Default input factors for mercury in use and disposal of light sources with mercury

Type of light source	Default input factors (mg Hg/item)
Fluorescent tubes (double end)	10-40

Total mercury input can be calculated as follows;

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = Activity\ rate\ \left(\frac{items}{y}\right) \times Input\ factor\ \left(\frac{mg\ Hg}{item}\right) \times Conversion\ factor$$

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = 3{,}212{,}830\ \left(\frac{items}{y}\right) \times 25\ \left(\frac{mg\ Hg}{item}\right) \times \frac{kg}{10^6\ mg} = 80\ kg\frac{Hg}{y}$$

Output distribution factors provided in the Toolkit when separate lamps collection and all or most general waste is collected and handled in a publicly controlled manner was used. Within the scope of the Regulation on the Control of Waste Electrical and Electronic Equipment, they are controlled. Distribution factors for use and disposal of light sources with mercury are as follows;

Air = 0.05
Water = 0.0
Land = 0.0
Products = 0.0
General waste = 0.8
Sector specific treatment/disposal = 0.15

Estimation of mercury releases to each pathway

Using the calculated total Hg input and the distribution factor above, the releases can be calculated as follows;

$$Releases\ to\ air\ from\ \text{use and disposal of light sources with mercury}\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ air$$

$$Releases\ to\ air\ from\ \text{use and disposal of light sources with mercury}\ \left(kg\frac{Hg}{y}\right) = 80\ \left(kg\frac{Hg}{y}\right) \times 0.05 = 4\ kg\frac{Hg}{y}$$

$$Releases\ as\ general\ waste\ from\ \text{use and disposal of light sources with mercury}\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ for\ general\ waste$$

$$Releases\ as\ general\ waste\ from\ \text{use and disposal of light sources with mercury}\ \left(kg\frac{Hg}{y}\right) = 80\left(kg\frac{Hg}{y}\right) \times 0.8 = 64\ kg\frac{Hg}{y}$$

$$Releases\ as\ sector\ specific\ treatment\ /disposal\ from\ \text{use and disposal of light sources with mercury}\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ forsector\ specific\ treatment/disposal$$

$$Releases\ as\ sector\ specific\ treatment\ /disposal\ from\ \text{use and disposal of light sources with mercury}\ \left(kg\frac{Hg}{y}\right) = 80\left(kg\frac{Hg}{y}\right) \times 0.15 = 12\ kg\frac{Hg}{y}$$

Batteries with mercury

Determination of activity rate, input factors, and output distribution factors for the different lifecycle phases

The total annual import data for batteries with mercury was taken as activity rate and are equal to 0.24, 44 and 12 t batteries per year for mercury oxide (all sizes), zinc-air button cells and silver oxide button cells, respectively.

Site-specific data are not available for input factor due to resource limitations. Therefore, default input factors given in the Toolkit was used (Table A.2. 24). For the calculation of mercury input from this sub-category, 320 kg Hg/t of mercury oxide batteries, 12 kg Hg/t of zinc-air button cells and 4 kg Hg/t of silver oxide button cells were selected as mercury input factors for this sub-category.

Table A.2. 24. Default input factor for mercury in disposal of batteries with mercury (United Nations Environment, 2017)

Battery type	Default input factor (kg Hg/t of batteries)
Mercury oxide (all sizes); also called mercury-zinc cells	320
Zinc-air button cells	12
Silver oxide button cells	4

Total mercury input can be calculated as follows;

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = Activity\ rate\ \left(\frac{t\ batteries}{y}\right) \times Input\ factor\ \left(\frac{kg\ Hg}{t\ of\ batteries}\right)$$

$$\begin{aligned}
&Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right)\\
&= 0.24\ \left(\frac{t\ batteries}{y}\right)\times 320\ \left(\frac{kg\ Hg}{t\ batteries}\right)\\
&+ 44\ \left(\frac{t\ batteries}{y}\right)\times 12\ \left(\frac{kg\ Hg}{t\ batteries}\right)+\ 12\ \left(\frac{t\ batteries}{y}\right)\times 4\ \left(\frac{kg\ Hg}{t\ batteries}\right)\\
&= 653\ kg\frac{Hg}{y}
\end{aligned}$$

Output distribution factors provided in the Toolkit when all or most general waste is collected and handled in a publicly controlled manner was used. Distribution factors for disposal of batteries with mercury are as follows;

Air = 0.0
Water = 0.0
Land = 0.0
Products = 0.0
General waste = 1
Sector specific treatment/disposal = 0.0

Estimation of mercury releases to each pathway

Using the calculated total Hg input and the distribution factor above, the releases can be calculated as follows;

$$\begin{aligned}
&Releases\ as\ general\ waste\ from\ \text{disposal of batteries with mercury}\left(kg\frac{Hg}{y}\right)\\
&= Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right)\times Distribution\ factor\ for\ general\ waste
\end{aligned}$$

$$\begin{aligned}
&Releases\ as\ general\ waste\ from\ \text{disposal of batteries with mercury}\ \left(kg\frac{Hg}{y}\right)\\
&= 653\left(kg\frac{Hg}{y}\right)\times 1 = 653\ kg\frac{Hg}{y}
\end{aligned}$$

Polyurethane with mercury catalyst

Determination of activity rate, input factors, and output distribution factors for the different lifecycle phases

National population in 2018 was taken as activity rate data and is equal to 82,003,882 inhabitants (Turkish Statistical Institute, 2018).

Site-specific data are not available for input factor due to resource limitations. Therefore, default input factors given in the Toolkit was used (Table A.2. 25). For the calculation of mercury input from this sub-category, 0.03 g Hg/inhabitant.y was selected from the range given in Table A.2. 25 as mercury input factor for this sub-category.

Table A.2. 25. Default input factors for mercury in use and disposal of polyurethane with mercury catalysts (United Nations Environment, 2017)

	Default input factors (g Hg consumed/inhabitants.y)
Mercury consumed annually with mercury containing polyurethanes	0.01-0.05

Total mercury input can be calculated as follows;

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = Activity\ rate\ (inhabitants) \times Input\ factor\ \left(\frac{g\ Hg}{inhabitants.y}\right) \times Conversion\ factor$$

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = 82{,}003{,}882\ (inhabitants) \times 0.03\ \left(\frac{g\ Hg}{inhabitants.y}\right) \times \frac{kg}{1000\ g} = 2460\ kg\frac{Hg}{y}$$

Output distribution factors provided in the Toolkit when all or most general waste is collected and handled in a publicly controlled manner was used. Distribution factors for use and disposal of polyurethane with mercury catalysts are as follows;

Air = 0.1
Water = 0.05
Land = 0.0
Products = 0.0
General waste = 0.85
Sector specific treatment/disposal = 0.0

Estimation of mercury releases to each pathway

Using the calculated total Hg input and the distribution factor above, the releases can be calculated as follows;

$$Releases\ to\ air\ from\ \text{use and disposal of polyurethane with mercury catalysts}\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ air$$

$$Releases\ to\ air\ from\ \text{use and disposal of polyurethane with mercury catalysts}\ \left(kg\frac{Hg}{y}\right) = 2460\ \left(kg\frac{Hg}{y}\right) \times 0.1 = 246\ kg\frac{Hg}{y}$$

$$Releases\ to\ water\ from \text{ use and disposal of polyurethane with mercury catalysts } \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ water$$

$$Releases\ to\ water\ from \text{ use and disposal of polyurethane with mercury catalysts } \left(kg\frac{Hg}{y}\right) = 2460\ \left(kg\frac{Hg}{y}\right) \times 0.05 = 123\ kg\frac{Hg}{y}$$

$$Releases\ as\ general\ waste\ from \text{ use and disposal of polyurethane with mercury catalysts } \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ for\ general\ waste$$

$$Releases\ as\ general\ waste\ from \text{ use and disposal of polyurethane with mercury catalysts } \left(kg\frac{Hg}{y}\right) = 2460\left(kg\frac{Hg}{y}\right) \times 0.85 = 2091\ kg\frac{Hg}{y}$$

Data and Inventory on Other Intentional Product/Process Uses

Dental mercury – amalgam fillings

Determination of activity rate, input factors, and output distribution factors for the different lifecycle phases

National population in 2018 was taken as activity rate data and is equal to 82,003,882 inhabitants (Turkish Statistical Institute, 2018).

Site-specific data are not available for input factor due to resource limitations. Therefore, default input factors given in the Toolkit was used (Table A.2. 26). For the calculation of mercury input from this sub-category, 0.2 g Hg/y.inhabitant was selected from the range given in **Error! Reference source not found.** as mercury input factor for this sub-category.

Table A.2. 26. Default input factors for mercury in preparations, use and disposal of dental amalgam fillings (United Nations Environment, 2017)

	Default input factors (g Hg consumed/per inhabitant per year)
Mercury used annually for dental amalgam preparations	0.05-0.2
Use	0.05-0.2
Disposal	0.05-0.2

Total mercury input can be calculated as follows;

<u>Preparations of fillings</u>

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right)$$
$$= Activity\ rate\ (inhabitants) \times Input\ factor\ \left(\frac{g\ Hg\ consumed}{y.inhabitant}\right) \times Conversion\ factor$$
$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = 82{,}003{,}882\ (inhabitants) \times 0.2\ \left(\frac{g\ Hg}{y.inhabitant}\right) \times \frac{kg}{1000\ g}$$
$$= 16{,}401\ kg\frac{Hg}{y}$$

Use

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right)$$
$$= Activity\ rate\ (inhabitants) \times Input\ factor\ \left(\frac{g\ Hg\ consumed}{y.inhabitant}\right) \times Conversion\ factor$$
$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = 82{,}003{,}882\ (inhabitants) \times 0.2\ \left(\frac{g\ Hg}{y.inhabitant}\right) \times \frac{kg}{1000\ g}$$
$$= 16{,}401\ kg\frac{Hg}{y}$$

Disposal

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right)$$
$$= Activity\ rate\ (inhabitants) \times Input\ factor\ \left(\frac{g\ Hg\ consumed}{y.inhabitant}\right) \times Conversion\ factor$$
$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = 82{,}003{,}882\ (inhabitants) \times 0.2\ \left(\frac{g\ Hg}{y.inhabitant}\right) \times \frac{kg}{1000\ g}$$
$$= 16{,}401\ kg\frac{Hg}{y}$$

Output distribution factors provided in the Toolkit for preparation of fillings was used. Distribution factors for preparation of fillings are as follows;

Air = 0.02
Water = 0.14
Land = 0.0
Products = 0.0
General waste = 0.12
Sector specific treatment/disposal = 0.12

Output distribution factors provided in the Toolkit for use are as follows;

Air = 0.0

Water = 0.02
Land = 0.0
Products = 0.0
General waste = 0.0
Sector specific treatment/disposal = 0.0

Output distribution factors provided in the Toolkit for disposal was used by assuming that Turkey is the country where only dental chair filters/strainers are used in most clinics. Distribution factors for disposal are as follows;

Air = 0.0
Water = 0.28
Land = 0.08
Products = 0.06
General waste = 0.08
Sector specific treatment/disposal = 0.08

Estimation of mercury releases to each pathway

Using the calculated total Hg input and the distribution factor above, the releases can be calculated as follows;

<u>Preparations of fillings</u>

$$Releases\ to\ air\ from\ \text{preparations of fillings}\ \left(kg\,\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\,\frac{Hg}{y}\right) \times Distribution\ factor\ to\ air$$

$$Releases\ to\ air\ from\ \text{preparations of fillings}\ \left(kg\,\frac{Hg}{y}\right) = 16{,}401\ \left(kg\,\frac{Hg}{y}\right) \times 0.02 = 328\ kg\,\frac{Hg}{y}$$

$$Releases\ to\ water\ from\ \text{preparations of fillings}\ \left(kg\,\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\,\frac{Hg}{y}\right) \times Distribution\ factor\ to\ water$$

$$Releases\ to\ water\ from\ \text{preparations of fillings}\ \left(kg\,\frac{Hg}{y}\right) = 16{,}401\ \left(kg\,\frac{Hg}{y}\right) \times 0.14 = 2296\ kg\,\frac{Hg}{y}$$

$$Releases\ as\ general\ waste\ from\ \text{preparations of fillings}\left(kg\,\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\,\frac{Hg}{y}\right) \times Distribution\ factor\ for\ general\ waste$$

$$Releases\ as\ general\ waste\ from\ \text{preparations of fillings}\ \left(kg\frac{Hg}{y}\right) = 16{,}401\left(kg\frac{Hg}{y}\right) \times 0.12 = 1968\ kg\frac{Hg}{y}$$

$$Releases\ as\ sector\ specific\ treatment/disposal\ from\ \text{preparations of fillings}\left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ for\ sector\ specific\ treatment/disposal$$

$$Releases\ as\ sector\ specific\ treatment/disposal\ from\ \text{preparations of fillings}\ \left(kg\frac{Hg}{y}\right) = 16{,}401\left(kg\frac{Hg}{y}\right) \times 0.12 = 1968\ kg\frac{Hg}{y}$$

Use

$$Releases\ to\ water\ from\ \text{use}\left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ water$$

$$Releases\ to\ water\ from\ \text{use}\left(kg\frac{Hg}{y}\right) = 16{,}401\ \left(kg\frac{Hg}{y}\right) \times 0.02 = 328\ kg\frac{Hg}{y}$$

Disposal

$$Releases\ to\ water\ from\ \text{disposal}\left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ water$$

$$Releases\ to\ water\ from\ \text{disposal}\ \left(kg\frac{Hg}{y}\right) = 16{,}401\ \left(kg\frac{Hg}{y}\right) \times 0.28 = 4592\ kg\frac{Hg}{y}$$

$$Releases\ to\ land\ from\ \text{disposal}\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ land$$

$$Releases\ to\ land\ from\ \text{disposal}\ \left(kg\frac{Hg}{y}\right) = 16{,}401\ \left(kg\frac{Hg}{y}\right) \times 0.08 = 1312\ kg\frac{Hg}{y}$$

$$Releases\ via\ products\ from\ \text{disposal}\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ for\ products$$

$$Releases\ via\ products\ from\ \text{disposal}\ \left(kg\frac{Hg}{y}\right) = 16{,}401\ \left(kg\frac{Hg}{y}\right) \times 0.06 = 984\ kg\frac{Hg}{y}$$

$$Releases\ as\ general\ waste\ from\ \text{disposal}\ \left(kg\frac{Hg}{y}\right)$$
$$= Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ for\ general\ waste$$

$$Releases\ as\ general\ waste\ from\ \text{disposal}\ \left(kg\frac{Hg}{y}\right) = 16{,}401 \left(kg\frac{Hg}{y}\right) \times 0.08 = 1312\ kg\frac{Hg}{y}$$

$$Releases\ as\ sector\ specific\ treatment/disposal\ from\ \text{disposal} \left(kg\frac{Hg}{y}\right)$$
$$= Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right)$$
$$\times\ Distribution\ factor\ for\ sector\ specific\ treatment/disposal$$

$$Releases\ as\ sector\ specific\ treatment/disposal\ from\ \text{disposal}\ \left(kg\frac{Hg}{y}\right)$$
$$= 16{,}401 \left(kg\frac{Hg}{y}\right) \times 0.08 = 1312\ kg\frac{Hg}{y}$$

Manometers and gauges with mercury

Determination of activity rate, input factors, and output distribution factors for the different lifecycle phases

The total annual import data is available for only medical blood pressure gauges and are equal to 765,218 kg per year. In order to convert these values to activity rate (number of devices supplied and disposed annually), weight medical blood pressure gauges of were assumed as 1500 g, respectively. Therefore, activity rate is equal to 510,145 items per year for medical blood pressure gauges. In addition, national population in 2018 was taken as activity rate data for other manometers and is equal to 82,003,882 inhabitants (Turkish Statistical Institute, 2018).

Site-specific data are not available for input factor due to resource limitations. Therefore, default input factors given in the Toolkit was used (Table A.2. 27). For the calculation of mercury input from this sub-category, 80 g Hg/item and 0.005 g Hg/y.inhabitant was taken as mercury input factor for medical blood pressure gauges and other manometers and gauges, respectively.

Table A.2. 27. Default input factors for mercury in use and disposal of mercury containing manometers and gauges (United Nations Environment, 2017)

Product type	**Default input factors (g Hg/item)**
Medical blood pressure gauges	70-85
Product type	**Default input factors (g Hg/y.inhabitant)**
Other manometers and gauges	0.005

Total mercury input can be calculated as follows;

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right)$$
$$= Activity\ rate\ \left(\frac{items}{y}\right) \times Input\ factor\ \left(\frac{g\ Hg}{item}\right) \times Conversion\ factor$$
$$+\ Activity\ rate\ (inhabitants) \times Input\ factor\ \left(\frac{g\ Hg}{y.inhabitant}\right)$$

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right)$$
$$= 510{,}145\ \left(\frac{items}{y}\right) \times 80\ \left(\frac{g\ Hg}{item}\right) \times \frac{kg}{1000\ g}$$
$$+ 82{,}003{,}822\ (inhabitants) \times 0.005\ \left(\frac{g\ Hg}{y.inhabitant}\right) \times \frac{kg}{1000\ g} = 41{,}222\ kg\frac{Hg}{y}$$

Output distribution factors provided in the Toolkit when there is no separate collection and all or most general waste is collected and handled in a publicly controlled manner was used. Distribution factors for use and disposal of mercury containing manometers and gauges are as follows;

Air = 0.1
Water = 0.3
Land = 0.0
Products = 0.0
General waste = 0.6
Sector specific treatment/disposal = 0.0

Estimation of mercury releases to each pathway

Using the calculated total Hg input and the distribution factor above, the releases can be calculated as follows;

$$Releases\ to\ air\ from\ \text{use and disposal of mercury containing manometers and gauges}\left(kg\frac{Hg}{y}\right)$$
$$= Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ air$$

$$Releases\ to\ air\ from\ \text{use and disposal of mercury containing manometers and gauges}\ \left(kg\frac{Hg}{y}\right)$$
$$= 41{,}222\ \left(kg\frac{Hg}{y}\right) \times 0.1 = 4122\ kg\frac{Hg}{y}$$

$$Releases\ to\ water\ from\ \text{use and disposal of mercury containing manometers and gauges}\ \left(kg\frac{Hg}{y}\right)$$
$$= Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ water$$

$$Releases\ to\ water\ from \text{ use and disposal of mercury containing manometers and gauges } \left(kg\frac{Hg}{y}\right)$$
$$= 41{,}222\ \left(kg\frac{Hg}{y}\right) \times 0.3 = 12{,}367\ kg\frac{Hg}{y}$$

$$Releases\ as\ general\ waste\ from \text{ use and disposal of mercury containing manometers and gauges} \left(kg\frac{Hg}{y}\right)$$
$$= Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ for\ general\ waste$$
$$Releases\ as\ general\ waste\ from \text{ use and disposal of mercury containing manometers and gauges } \left(kg\frac{Hg}{y}\right)$$
$$= 41{,}222\left(kg\frac{Hg}{y}\right) \times 0.6 = 24{,}733\ kg\frac{Hg}{y}$$

Laboratory chemicals and equipment with mercury

Determination of activity rate, input factors, and output distribution factors for the different lifecycle phases

National population in 2018 was taken as activity rate data and is equal to 82,003,882 inhabitants (Turkish Statistical Institute, 2018).

Site-specific data are not available for input factor due to resource limitations. Therefore, default input factor given in the Toolkit was used (Table A.2. 28). For the calculation of mercury input from this sub-category, 0.01 and 0.04 g Hg/y.inhabitant was used as mercury input factor for laboratory chemicals and other laboratory equipment, respectively.

Table A.2. 28. Default input factor for mercury in use and disposal of laboratory chemicals and other laboratory equipment (United Nations Environment, 2017)

	Default input factors (g Hg/y.inhabitant)
Laboratory chemicals	0.01
Other laboratory equipment	0.04

Total mercury input can be calculated as follows;

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right)$$
$$= Activity\ rate\ (inhabitants) \times Input\ factor\ \left(\frac{g\ Hg}{y.inhabitant}\right) \times Conversion\ factor$$
$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right)$$
$$= 82{,}003{,}882\ (inhabitants) \times 0.01\ \left(\frac{g\ Hg}{inhabitant}\right) \times \frac{kg}{1000\ g}$$
$$+ 82{,}003{,}882\ (inhabitants) \times 0.04\ \left(\frac{g\ Hg}{inhabitant}\right) \times \frac{kg}{1000\ g} = 4100\ kg\frac{Hg}{y}$$

Output distribution factors provided in the Toolkit was used. Distribution factors for use and disposal of laboratory chemicals and other laboratory equipment are as follows;

Air = 0.0
Water = 0.33
Land = 0.0
Products = 0.0
General waste = 0.33
Sector specific treatment/disposal = 0.34

Estimation of mercury releases to each pathway

Using the calculated total Hg input and the distribution factor above, the releases can be calculated as follows;

$Releases\ to\ water\ from$ use and disposal of laboratory chemicals and other laboratory equipment $\left(kg\,\frac{Hg}{y}\right)$

$$= Total\ mercury\ input\ \left(kg\,\frac{Hg}{y}\right) \times Distribution\ factor\ to\ water$$

$Releases\ to\ water\ from$ use and disposal of laboratory chemicals and other laboratory equipment $\left(kg\,\frac{Hg}{y}\right)$

$$= 4100\ \left(kg\,\frac{Hg}{y}\right) \times 0.33 = 1353\ kg\,\frac{Hg}{y}$$

$Releases\ as\ general\ waste\ from$ use and disposal of laboratory chemicals and other laboratory equipment $(kg$

$$= Total\ mercury\ input\ \left(kg\,\frac{Hg}{y}\right) \times Distribution\ factor\ for\ general\ waste$$

$Releases\ as\ general\ waste\ from$ use and disposal of laboratory chemicals and other laboratory equipment $(kg$

$$= 4100\left(kg\,\frac{Hg}{y}\right) \times 0.33 = 1353\ kg\,\frac{Hg}{y}$$

$Releases\ as\ sector\ specific\ treatment$
$/disposal\ from$ use and disposal of laboratory chemicals and other laboratory equipment $\left(kg\,\frac{Hg}{y}\right)$

$$= Total\ mercury\ input\ \left(kg\,\frac{Hg}{y}\right) \times Distribution\ factor\ for\ sector\ specific\ treatment$$
$$/disposal$$

$Releases\ as\ general\ waste\ from$ use and disposal of laboratory chemicals and other laboratory equipment $(kg$

$$= 4100\left(kg\,\frac{Hg}{y}\right) \times 0.34 = 1394\ kg\,\frac{Hg}{y}$$

Data and Inventory on Production of Recycled Metals
Production of recycled mercury ("secondary production")
Determination of activity rate, input factors, and output distribution factors for the different lifecycle phases

The total annual secondary mercury production in the country varies between 80-100 kg. The average of these values was taken as activity rate and is equal to 90 kg mercury recycled per year.

Site-specific data are not available for input factor due to resource limitations. Therefore, default input factors given in the Toolkit was used (Table A.2. 29). For the calculation of mercury input from this sub-category, 1.00452 kg Hg input/kg total Hg output was selected from the range given in Table A.2. 29 as mercury input factor for this sub-category.

Table A.2. 29. Default input factor for mercury in secondary mercury production (United Nations Environment, 2017)

Material	Default input factor (kg Hg input/kg total Hg output)
Mercury recycled	1.00452

Total mercury input can be calculated as follows;

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = Activity\ rate\ \left(\frac{kg}{y}\right) \times Input\ factor\ \left(\frac{kg\ Hg\ input}{kg\ total\ Hg\ output}\right)$$

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = 90\ \left(\frac{kg}{y}\right) \times 1.00452\ \left(\frac{kg\ Hg\ input}{kg\ total\ Hg\ output}\right)\ = 90\ kg\frac{Hg}{y}$$

Output distribution factors provided in the Toolkit was used. Distribution factors for secondary mercury production are as follows;

Air = 0.002
Water = 0.0024
Land = 0.0
Products = 0.0
General waste = 0.0
Sector specific treatment/disposal = 0.00012

Estimation of mercury releases to each pathway

Using the calculated total Hg input and the distribution factor above, the releases can be calculated as follows;

$$Releases\ to\ air\ from\ secondary\ mercury\ production\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ air$$

$$Releases\ to\ air\ from\ secondary\ mercury\ production\ \left(kg\frac{Hg}{y}\right) = 90\ \left(kg\frac{Hg}{y}\right) \times 0.002 = 0.18\ kg\frac{Hg}{y}$$

$$Releases\ to\ water\ from\ secondary\ mercury\ production\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ water$$

$$Releases\ to\ water\ from\ secondary\ mercury\ production\ \left(kg\frac{Hg}{y}\right) = 90\ \left(kg\frac{Hg}{y}\right) \times 0.0024 = 0.216\ kg\frac{Hg}{y}$$

$$Releases\ as\ sector\ specific\ treatment\ /disposal\ from\ secondary\ mercury\ production\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ for\ sector\ specific\ treatment/disposal$$

$$Releases\ as\ sector\ specific\ treatment\ /disposal\ from\ secondary\ mercury\ production\ \left(kg\frac{Hg}{y}\right) = 90\left(kg\frac{Hg}{y}\right) \times 0.00012 = 0.011\ kg\frac{Hg}{y}$$

Production of recycled ferrous metals (iron and steel)
Determination of activity rate, input factors, and output distribution factors for the different lifecycle phases

Number of vehicles recycled in 2016 was taken as activity rate and is equal to 14,645 vehicles recycled per year (Doğan Artukoğlu, 2018)

Site-specific data cannot be gathered for input factor due to resource limitations. Therefore, default input factors given in the Toolkit was used (Table A.2. 30). For the calculation of mercury input from this sub-category, 1.1 g Hg/vehicle was selected from the range given in Table A.2. 30 as mercury input factor for the production of recycled ferrous metals.

Table A.2. 30. Default input factors for mercury in biomass used for energy production (United Nations Environment, 2017)

Material	Default input factors (g Hg/vehicle)
Per vehicle recycled	0.2-2

Total mercury input can be calculated as follows;

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = Activity\ rate\ \left(\frac{vehicles\ recycled}{y}\right) \times Input\ factor\ \left(\frac{g\ Hg}{vehicle}\right) \times Conversion\ factor$$

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = 14{,}645\ \left(\frac{vehicles\ recycled}{y}\right) \times 1.1\ \left(\frac{g\ Hg}{vehicle}\right) \times \frac{kg}{1000\ g} = 16\ kg\frac{Hg}{y}$$

Output distribution factors provided in the Toolkit was used. Distribution factors for the production of recycled ferrous metals are as follows;

Air = 0.33
Water = 0.0
Land = 0.34
Products = 0.0
General waste = 0.33
Sector specific treatment/disposal = 0.0

Estimation of mercury releases to each pathway

Using the calculated total Hg input and the distribution factor above, the releases can be calculated as follows;

$$Releases\ to\ air\ from\ \text{production of recycled ferrous metals}\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ air$$

$$Releases\ to\ air\ from\ \text{production of recycled ferrous metals}\ \left(kg\frac{Hg}{y}\right) = 16\ \left(kg\frac{Hg}{y}\right) \times 0.33 = 5.3\ kg\frac{Hg}{y}$$

$$Releases\ to\ land\ from\ \text{production of recycled ferrous metals}\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ land$$

$$Releases\ to\ land\ from\ \text{production of recycled ferrous metals}\ \left(kg\frac{Hg}{y}\right) = 16\ \left(kg\frac{Hg}{y}\right) \times 0.34 = 5.4\ kg\frac{Hg}{y}$$

$$Releases\ as\ general\ waste\ from\ \text{production of recycled ferrous metals}\ \left(kg\,\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\,\frac{Hg}{y}\right) \times Distribution\ factor\ for\ general\ waste$$

$$Releases\ as\ general\ waste\ from\ \text{production of recycled ferrous metals}\ \left(kg\,\frac{Hg}{y}\right) = 16\ \left(kg\,\frac{Hg}{y}\right) \times 0.33 = 5.3\ kg\,\frac{Hg}{y}$$

Data and Inventory on Waste Incineration and Burning

Incineration of municipal/general waste

Determination of activity rate, input factors, and output distribution factors for the different lifecycle phases

The total annual municipal waste incinerated is called as activity rate and is equal to 7235 t waste incinerated per year.

Site-specific data are not available for input factor due to resource limitations. Therefore, default input factors given in the Toolkit was used (Table A.2. 31). For the calculation of mercury input from this sub-category, 5 g Hg/t waste incinerated was selected from the range given in Table A.2. 31 as mercury input factor for this sub-category.

Table A.2. 31. Default input factors for mercury in incineration of municipal/general waste (United Nations Environment, 2017)

Material	Default input factors (g Hg/t waste incinerated)
Municipal solid waste	1-10

Total mercury input can be calculated as follows;

$$Total\ mercury\ input\ \left(kg\,\frac{Hg}{y}\right) = Activity\ rate\ \left(\frac{t\ waste\ incinerated}{y}\right) \times Input\ factor\ \left(\frac{g\ Hg}{t\ waste\ incinerated}\right) \times Conversion\ factor$$

$$Total\ mercury\ input\ \left(kg\,\frac{Hg}{y}\right) = 7235\ \left(\frac{t\ waste\ incinerated}{y}\right) \times 5\ \left(\frac{g\ Hg}{t\ waste\ incinerated}\right) \times \frac{kg}{1000\ g} = 36\ kg\,\frac{Hg}{y}$$

Output distribution factors provided in the Toolkit was used. “Particulate material reduction with simple electrostatic precipitator or similar” option was selected as output scenario and corresponding distribution factors are as follows;

Air = 0.9
Water = 0.0
Land = 0.0
Products = 0.0
General waste = 0.0
Sector specific treatment/disposal = 0.1

Estimation of mercury releases to each pathway

Using the calculated total Hg input and the distribution factor above, the releases can be calculated as follows;

$$Releases\ to\ air\ from\ incineration\ of\ municipal\ waste\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ air$$

$$Releases\ to\ air\ from\ incineration\ of\ municipal\ waste\ \left(kg\frac{Hg}{y}\right) = 36\ \left(kg\frac{Hg}{y}\right) \times 0.9 = 32\ kg\frac{Hg}{y}$$

$$Releases\ as\ sector\ specific\ treatment\ /disposal\ from\ \ incineration\ of\ municipal\ waste\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ forsecor\ specific\ treatment/disposal$$

$$Releases\ as\ sector\ specific\ treatment\ /disposal\ from\ incineration\ of\ municipal\ waste\ \left(kg\frac{Hg}{y}\right) = 36\ \left(kg\frac{Hg}{y}\right) \times 0.1 = 4\ kg\frac{Hg}{y}$$

Incineration of hazardous waste

Determination of activity rate, input factors, and output distribution factors for the different lifecycle phases

The total annual hazardous waste incinerated is called as activity rate and is equal to 286,872 t waste incinerated per year.

Site-specific data are not available for input factor due to resource limitations. Therefore, default input factors given in the Toolkit was used (Table A.2. 32). For the calculation of mercury input from this sub-category, 24 g Hg/t waste incinerated was selected from the range given in Table A.2. 32 as mercury input factor for this sub-category.

Table A.2. 32. Default input factors for mercury in hazardous waste incineration (United Nations Environment, 2017)

Material	Default input factors (g Hg/t waste incinerated)
Hazardous waste	8-40

Total mercury input can be calculated as follows;

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = Activity\ rate\ \left(\frac{t\ waste\ incinerated}{y}\right) \times Input\ factor\ \left(\frac{g\ Hg}{t\ waste\ incinerated}\right) \times Conversion\ factor$$

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = 286{,}872\ \left(\frac{t\ waste\ incinerated}{y}\right) \times 24\ \left(\frac{g\ Hg}{t\ waste\ incinerated}\right) \times \frac{kg}{1000\ g} = 6885\ kg\frac{Hg}{y}$$

Output distribution factors provided in the Toolkit was used. "Particulate material reduction with simple electrostatic precipitator or similar" option was selected as output scenario and corresponding distribution factors are as follows;

Air = 0.9
Water = 0.0
Land = 0.0
Products = 0.0
General waste = 0.0
Sector specific treatment/disposal = 0.1

5.1.1.1 Estimation of mercury releases to each pathway

Using the calculated total Hg input and the distribution factor above, the releases can be calculated as follows;

$$Releases\ to\ air\ from\ incineration\ of\ hazardous\ waste\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ air$$

$$Releases\ to\ air\ from\ incineration\ of\ hazardous\ waste\ \left(kg\frac{Hg}{y}\right) = 6885\ \left(kg\frac{Hg}{y}\right) \times 0.9 = 6196.5\ kg\frac{Hg}{y}$$

$$Releases\ as\ sector\ specific\ treatment\ /disposal\ from\ incineration\ of\ hazardous\ waste\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ forsecor\ specific\ treatment/disposal$$

$$Releases\ as\ sector\ specific\ treatment\ /disposal\ from\ incineration\ of\ hazardous\ waste\ \left(kg\frac{Hg}{y}\right) = 6885\ \left(kg\frac{Hg}{y}\right) \times 0.1 = 688.5\ kg\frac{Hg}{y}$$

Incineration of medical waste

Determination of activity rate, input factors, and output distribution factors for the different lifecycle phases

The total annual medical waste incinerated in the country was calculated by taking the average of the waste incinerated in 2016 and 2017 (Table A.2. 33). This data is called as activity rate and is equal to 11,602 t waste incinerated per year.

Table A.2. 33. Medical waste incinerated with respect to years (Turkish Statistical Institute, 2017)

Year	**Medical waste incinerated (t/y)**
2016	12,566
2017	10,637
Annual average	11,602

Site-specific data are not available for input factor due to resource limitations. Therefore, default input factors given in the Toolkit was used (Table A.2. 34). For the calculation of mercury input from this sub-category, 24 g Hg/t waste incinerated was selected from the range given in Table A.2. 34 as mercury input factor for this sub-category.

Table A.2. 34. Default input factors for mercury in medical waste incineration (United Nations Environment, 2017)

Material	**Default input factors (g Hg/t waste incinerated)**
Medical waste	8-40

Total mercury input can be calculated as follows;

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = Activity\ rate\ \left(\frac{t\ waste\ incinerated}{y}\right) \times Input\ factor\ \left(\frac{g\ Hg}{t\ waste\ incinerated}\right) \times Conversion\ factor$$

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = 11{,}602\ \left(\frac{t\ waste\ incinerated}{y}\right) \times 24\ \left(\frac{g\ Hg}{t\ waste\ incinerated}\right) \times \frac{kg}{1000\ g} = 278\ kg\frac{Hg}{y}$$

Output distribution factors provided in the Toolkit was used. "Particulate material reduction with simple electrostatic precipitator or similar" option was selected as output scenario and corresponding distribution factors are as follows;
Air = 0.9
Water = 0.0
Land = 0.0
Products = 0.0
General waste = 0.0
Sector specific treatment/disposal = 0.1

Estimation of mercury releases to each pathway

Using the calculated total Hg input and the distribution factor above, the releases can be calculated as follows;

$$Releases\ to\ air\ from\ incineration\ of\ medical\ waste\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ air$$

$$Releases\ to\ air\ from\ incineration\ of\ medical\ waste\ \left(kg\frac{Hg}{y}\right) = 278\ \left(kg\frac{Hg}{y}\right) \times 0.9 = 250\ kg\frac{Hg}{y}$$

$$Releases\ as\ sector\ specific\ treatment\ /disposal\ from\ \ incineration\ of\ medical\ waste\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ forsecor\ specific\ treatment/disposal$$

$$Releases\ as\ sector\ specific\ treatment\ /disposal\ from\ incineration\ of\ medical\ waste\ \left(kg\frac{Hg}{y}\right) = 278\ \left(kg\frac{Hg}{y}\right) \times 0.1 = 28\ kg\frac{Hg}{y}$$

Sewage sludge incineration

Determination of activity rate, input factors, and output distribution factors for the different lifecycle phases

The total annual sewage sludge incinerated in the country is called as activity rate and is equal to 30,453 t sludge incinerated per year.

Site-specific data are not available for input factor due to resource limitations. Therefore, default input factor given in the Toolkit was used (Table A.2. 35). For the calculation of mercury input from this sub-category, 2 g Hg/t sludge incinerated was taken as mercury input factor for this sub-category.

Table A.2. 35. Default input factor for mercury in sewage sludge incineration (United Nations Environment, 2017)

Material	Default input factor (g Hg/t sludge incinerated)
Sewage sludge	2

Total mercury input can be calculated as follows;

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = Activity\ rate\ \left(\frac{t\ sludge\ incinerated}{y}\right) \times Input\ factor\ \left(\frac{g\ Hg}{t\ sludge\ incinerated}\right) \times Conversion\ factor$$

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = 30{,}453\ \left(\frac{t\ sludge\ incinerated}{y}\right) \times 2\ \left(\frac{g\ Hg}{t\ sludge\ incinerated}\right) \times \frac{kg}{1000\ g} = 61\ kg\frac{Hg}{y}$$

Output distribution factors provided in the Toolkit was used. Distribution factors for sewage sludge incineration are as follows;

Air = 0.9
Water = 0.0
Land = 0.0
Products = 0.0
General waste = 0.0

Sector specific treatment/disposal = 0.1

Estimation of mercury releases to each pathway

Using the calculated total Hg input and the distribution factor above, the releases can be calculated as follows;

$$Releases\ to\ air\ from\ sewage\ sludge\ incineration\ \left(kg\,\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\,\frac{Hg}{y}\right) \times Distribution\ factor\ to\ air$$

$$Releases\ to\ air\ from\ sewage\ sludge\ incineration\ \left(kg\,\frac{Hg}{y}\right) = 61\ \left(kg\,\frac{Hg}{y}\right) \times 0.9 = 55\ kg\,\frac{Hg}{y}$$

$$Releases\ as\ sector\ specific\ treatment/disposal\ from\ \ sewage\ sludge\ incineration\ \left(kg\,\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\,\frac{Hg}{y}\right) \times Distribution\ factor\ forsecor\ specific\ treatment/disposal$$

$$Releases\ as\ sector\ specific\ treatment/disposal\ from\ \ sewage\ sludge\ incineration\ \left(kg\,\frac{Hg}{y}\right) = 61\ \left(kg\,\frac{Hg}{y}\right) \times 0.1 = 6\ kg\,\frac{Hg}{y}$$

Informal waste burning

Determination of activity rate, input factors, and output distribution factors for the different lifecycle phases

The total annual informal waste burning in the country was calculated by taking the average of the waste amounts that were subjected to open burning in 2012, 2014 and 2016 (Table A.2. 36). This data is called as activity rate and is equal to 39,734 t per year.

Table A.2. 36. Informal waste burning with respect to years (Turkish Statistical Institute, 2018)

Year	**Waste amount subjected to open burning (t/y)**
2012	104,751
2014	4280
2016	10,172
Annual average	39,734

Site-specific data are not available for input factor due to resource limitations. Therefore, default input factors given in the Toolkit was used (Table A.2. 37). For the calculation of mercury input from this sub-category, 5 g Hg/t waste burned was selected from the range given in Table A.2. 37 as mercury input factor for this sub-category.

Table A.2. 37. Default input factors for mercury in informal waste burning (United Nations Environment, 2017)

	Default input factors (g Hg/t waste burned)
Informal waste burning	1-10

Total mercury input can be calculated as follows;

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = Activity\ rate\ \left(\frac{t}{y}\right) \times Input\ factor\ \left(\frac{g\ Hg}{t}\right) \times Conversion\ factor$$

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = 39{,}734\ \left(\frac{t}{y}\right) \times 5\ \left(\frac{g\ Hg}{t}\right) \times \frac{kg}{1000\ g}\ = 199\ kg\frac{Hg}{y}$$

Output distribution factors provided in the Toolkit was used. Distribution factors for informal waste burning are as follows;

Air = 1.0
Water = 0.0
Land = 0.0
Products = 0.0
General waste = 0.0
Sector specific treatment/disposal = 0.0

Estimation of mercury releases to each pathway

Using the calculated total Hg input and the distribution factor above, the releases can be calculated as follows;

$$Releases\ to\ air\ from\ informal\ waste\ burning\left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ air$$

$$Releases\ to\ air\ from\ informal\ waste\ burning\ \left(kg\frac{Hg}{y}\right) = 199\ \left(kg\frac{Hg}{y}\right) \times 1.0 = 199\ kg\frac{Hg}{y}$$

Data and Inventory on Waste Disposal, Deposition/Landfilling
Controlled landfills/deposits
Determination of activity rate, input factors, and output distribution factors for the different lifecycle phases

The total annual amount of waste landfilled in the country was calculated by taking the average of the waste amounts that were landfilled in 2012, 2014 and 2016 (Table A.2. 38). This data is called as activity rate and is equal to 17,543,176 t waste landfilled per year.

Table A.2. 38. Amount of waste landfilled with respect to years (Turkish Statistical Institute, 2018)

Year	**Amount of waste landfilled (t/y)**
2012	15,484,196
2014	17,807,424
2016	19,337,907
Annual average	17,543,176

Site-specific data are not available for input factor due to resource limitations. Therefore, default input factors given in the Toolkit was used (Table A.2. 39). For the calculation of mercury input from this sub-category, 5 g Hg/t waste landfilled was selected from the range given in Table A.2. 39 as mercury input factor for this sub-category.

Table A.2. 39. Default input factors for mercury in controlled landfills (United Nations Environment, 2017)

	Default input factors (g Hg/t waste landfilled)
Controlled landfills	1-10

Total mercury input can be calculated as follows;

$$Total\ mercury\ input\ \left(kg\,\frac{Hg}{y}\right) = Activity\ rate\ \left(\frac{t\ waste\ landfilled}{y}\right) \times Input\ factor\ \left(\frac{g\ Hg}{t\ waste\ landfilled}\right) \times Conversion\ factor$$

$$Total\ mercury\ input\ \left(kg\,\frac{Hg}{y}\right) = 17{,}543{,}176\ \left(\frac{t}{y}\right) \times 5\ \left(\frac{g\ Hg}{t}\right) \times \frac{kg}{1000\ g} = 87{,}716\ kg\,\frac{Hg}{y}$$

Output distribution factors provided in the Toolkit was used. Distribution factors for controlled landfills are as follows;

Air = 0.01
Water = 0.0001
Land = 0.0
Products = 0.0
General waste = 0.0
Sector specific treatment/disposal = 0.0

Estimation of mercury releases to each pathway

Using the calculated total Hg input and the distribution factor above, the releases can be calculated as follows;

$$Releases\ to\ air\ from\ controlled\ landfills\left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ air$$

$$Releases\ to\ air\ from\ controlled\ landfills\ \left(kg\frac{Hg}{y}\right) = 87{,}716\ \left(kg\frac{Hg}{y}\right) \times 0.01 = 877\ kg\frac{Hg}{y}$$

$$Releases\ to\ water\ from\ controlled\ landfills\left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ air$$

$$Releases\ to\ water\ from\ controlled\ landfills\ \left(kg\frac{Hg}{y}\right) = 87{,}716\ \left(kg\frac{Hg}{y}\right) \times 0.0001 = 9\ kg\frac{Hg}{y}$$

Informal dumping of general waste

Determination of activity rate, input factors, and output distribution factors for the different lifecycle phases

The total annual informal waste dumped in the country was calculated by taking the average of the waste amounts that are subjected to informal dumping in 2012, 2014 and 2016 (Table A.2. 40). This data is called as activity rate and is equal to 52,675 t waste dumped per year.

Table A.2. 40. Informal waste dumping with respect to years (Turkish Statistical Institute, 2018)

Year	Waste amount subjected to open burning (t/y)
2012	127,724
2014	23,090
2016	7210
Annual average	52,675

Site-specific data are not available for input factor due to resource limitations. Therefore, default input factors given in the Toolkit was used (Table A.2. 41). For the calculation of mercury input from this sub-category, 5 g Hg/t waste dumped was selected from the range given in Table A.2. 41 as mercury input factor for this sub-category.

Table A.2. 41. Default input factors for mercury in informal waste dumping (United Nations Environment, 2017)

	Default input factors (g Hg/t waste dumped)
Informal waste dumping	1-10

Total mercury input can be calculated as follows;

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = Activity\ rate\ \left(\frac{t\ waste\ dumped}{y}\right) \times Input\ factor\ \left(\frac{g\ Hg}{t\ waste\ dumped}\right) \times Conversion\ factor$$

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = 52675\ \left(\frac{t\ waste\ burned}{y}\right) \times 5\ \left(\frac{g\ Hg}{t\ waste\ burned}\right) \times \frac{kg}{1000\ g}$$
$$= 263\ kg\frac{Hg}{y}$$

Output distribution factors provided in the Toolkit was used. Distribution factors for informal waste dumping are as follows;

Air = 0.1
Water = 0.1
Land = 0.8
Products = 0.0
General waste = 0.0
Sector specific treatment/disposal = 0.0

Estimation of mercury releases to each pathway

Using the calculated total Hg input and the distribution factor above, the releases can be calculated as follows;

$$Releases\ to\ air\ from\ informal\ waste\ dumping\left(kg\frac{Hg}{y}\right)$$
$$= Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ air$$

$$Releases\ to\ air\ from\ informal\ waste\ dumping\ \left(kg\frac{Hg}{y}\right) = 263\ \left(kg\frac{Hg}{y}\right) \times 0.1 = 26\ kg\frac{Hg}{y}$$

$$Releases\ to\ water\ from\ informal\ waste\ dumping\left(kg\frac{Hg}{y}\right)$$
$$= Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ water$$

$$Releases\ to\ air\ from\ informal\ waste\ dumping\ \left(kg\frac{Hg}{y}\right) = 263\ \left(kg\frac{Hg}{y}\right) \times 0.1 = 26\ kg\frac{Hg}{y}$$

$$Releases\ to\ land\ from\ informal\ waste\ dumping\left(kg\frac{Hg}{y}\right)$$
$$= Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ land$$

$$Releases\ to\ land\ from\ informal\ waste\ dumping\ \left(kg\frac{Hg}{y}\right) = 263\ \left(kg\frac{Hg}{y}\right) \times 0.8 = 211\ kg\frac{Hg}{y}$$

Waste water system/treatment

Determination of activity rate, input factors, and output distribution factors for the different lifecycle phases

The total annual wastewater treated in the country is called as activity rate and is equal to 18,232,053 m^3 wastewater treated per year.

Site-specific data are not available for input factor due to resource limitations. Therefore, default input factors given in the Toolkit was used (Table A.2. 42). For the calculation of mercury input from this sub-category, 5.25 g Hg/m^3 wastewater treated was selected from the range given in Table A.2. 42 as mercury input factor for this sub-category.

Table A.2. 42. Default input factors for mercury in wastewater treatment (United Nations Environment, 2017)

Material	Default input factors (mg Hg/m^3 wastewater treated)
Municipal wastewater	0.5-10

Total mercury input can be calculated as follows;

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = Activity\ rate\ \left(\frac{m^3}{y}\right) \times Input\ factor\ \left(\frac{mg\ Hg}{m^3}\right) \times Conversion\ factor$$

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = 18{,}232{,}053\ \left(\frac{m^3}{y}\right) \times 5.25\ \left(\frac{mg\ Hg}{m^3}\right) \times \frac{kg}{10^6\ mg}\ = 96\ kg\frac{Hg}{y}$$

Output distribution factors provided in the Toolkit was used. Distribution factors for mechanical and biological (activated sludge) treatment; no land application of sludge are as follows;

Air = 0.0
Water = 0.5
Land = 0.0
Products = 0.0
General waste = 0.3
Sector specific treatment/disposal = 0.2

Estimation of mercury releases to each pathway

Using the calculated total Hg input and the distribution factor above, the releases can be calculated as follows;

$$Releases\ to\ water\ from\ wastewater\ treatment\left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ water$$

$$Releases\ to\ water\ from\ wastewater\ treatment\ \left(kg\frac{Hg}{y}\right) = 96\ \left(kg\frac{Hg}{y}\right) \times 0.5 = 48\ kg\frac{Hg}{y}$$

$$Releases\ as\ general\ waste\ from\ wastewater\ treatment\left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ for\ general\ waste$$

$$Releases\ as\ general\ waste\ from\ wastewater\ treatment\ \left(kg\frac{Hg}{y}\right) = 96\ \left(kg\frac{Hg}{y}\right) \times 0.3 = 29\ kg\frac{Hg}{y}$$

$$Releases\ as\ sector\ specific\ treatment/disposal\ from\ wastewater\ treatment\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ for\ secor\ specific\ treatment/disposal$$

$$Releases\ as\ sector\ specific\ treatment/disposal\ from\ wastewater\ treatment\ \left(kg\frac{Hg}{y}\right) = 96\ \left(kg\frac{Hg}{y}\right) \times 0.2 = 19\ kg\frac{Hg}{y}$$

Data and Inventory on Crematoria and Cemeteries

Cemeteries

Determination of activity rate, input factors, and output distribution factors for the different lifecycle phases

The total annual number of corpse buried in the country was calculated by taking the average of the number of corpse buried between the years of 2013-2017 (Table A.2. 43). This data is called as activity rate and is equal to 403,303 corpse buried per year.

Table A.2. 43. Corpse buried with respect to years (Turkish Statistical Institute, 2019)

Year	Number of corpse buried (corpse buried/y)
2013	372686
2014	390121
2015	405202
2016	422726
2017	425781
Annual average	403303

Source-specific data cannot be gathered for input factor due to resource limitations. Therefore, default input factors given in the Toolkit was used (Table A.2. 44). For the calculation of mercury input from this sub-category, 2.5 g Hg/corpse was selected from the range given in Table A.2. 44 as mercury input factor for cemeteries.

Table A.2. 44. Default input factors for mercury in biomass used for energy production (United Nations Environment, 2017)

	Default input factors (g Hg/corpse)
Burial	1-4

Total mercury input can be calculated as follows;

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = Activity\ rate\ \left(\frac{corpse\ buried}{y}\right) \times Input\ factor\ \left(\frac{g\ Hg}{corpse\ buried}\right) \times Conversion\ factor$$

$$Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) = 403{,}303\ \left(\frac{corpse\ buried}{y}\right) \times 2.5\ \left(\frac{g\ Hg}{corpse\ buried}\right) \times \frac{kg}{1000\ g} = 1008\ kg\frac{Hg}{y}$$

Output distribution factors provided in the Toolkit was used. Distribution factors for cemeteries are as follows;

Air = 0.0
Water = 0.0
Land = 1.0
Products = 0.0
General waste = 0.0
Sector specific treatment/disposal = 0.0

Estimation of mercury releases to each pathway

Using the calculated total Hg input and the distribution factor above, the releases can be calculated as follows;

$$Releases\ to\ land\ from\ cemeteries\ \left(kg\frac{Hg}{y}\right) = Total\ mercury\ input\ \left(kg\frac{Hg}{y}\right) \times Distribution\ factor\ to\ land$$

$$Releases\ to\ to\ land\ from\ cemeteries\ \left(kg\frac{Hg}{y}\right) = 1008\ \left(kg\frac{Hg}{y}\right) \times 1.0 = 1008\ kg\frac{Hg}{y}$$