Mercury Inventory for New Zealand: 2024

Report to the Ministry for the Environment

Prepared by Alistair Bingham, JCL Air & Environment Limited

Reviewed by Jenny Simpson, Tonkin & Taylor Ltd

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Executive Summary

This report provides an inventory of the annual distribution of mercury and mercury-containing goods and materials in New Zealand, from anthropogenic (man-made) sources, for a base year of 2024. It has been produced under a contract to the New Zealand Ministry for the Environment, and builds on the information reported in previous inventories for 2008, 2012, 2016 and 2020.

The inventory has been prepared generally in accordance with the guidance provided in the UNEP *Toolkit for identification and quantification of mercury releases* (the Toolkit). The latest version of the Toolkit, published in 2023 has been used to provide the basic framework for this work. The methodology involves the collection of activity data for a wide range of possible mercury sources, coupled with calculations to determine the quantities of mercury brought into, or mobilised, within the country (the **Inputs**), and the quantities of mercury released into the different environmental compartments of air, water, land, and releases in wastes or in products (the **Outputs**).

Estimated mercury inputs and outputs

The primary results of this assessment are summarised in the table below. Bracketed results are mean of the range.

Category	Mercury Inputs, kg/year	Mercury Outputs, kg/yr				
		Air	Water	Land	Product	Waste
1. Extraction and use of fuels/energy sources	358 - 2733 (1546)	348 – 2494 (1421)	6.46 – 58.8 (32.6)	2.31 – 17.1 (9.70)	--	1.7 – 163 (82.4)
2. Primary (virgin) metal production	257 – 391 (324)	28.7 – 89.9 (59.3)	10.8 – 18.9 (14.8)	155 – 220 (188)	5.69	57.0
3. Production of minerals and materials with mercury impurities	138 – 154(146)	0.92 -2.27 (1.60)	-	137 – 151 (144)	0.394- 0.973 (0.683)	-
4. Intentional use of mercury in industrial processes	-	-	-	-	-	-
5. Consumer products with intentional use of mercury	71.1 – 76.8 (73.9)	0.76 – 1.05 (0.90)	0.00015- 0.0015 (0.00083)	0.64	28.9	40.8 – 46.3 (43.6)
6. Other intentional products/processes	3.43	0.116	0.403	-	1.10	1.81
7. Production of recycled metals	-	-	-	-	-	-
8. Waste incineration	15.4 – 20.5 (18.0)	14.4 – 19.6 (17.0)	-	-	-	0.975
9. Waste deposition/landfill and wastewater treatment	3366 – 9763 (6564)	30.3	168.6 – 3367 (1768)	67.3 – 1347 (707)	-	101 – 2020 (1061)
10. Crematoria and cemeteries	36.5 – 146 (91.1)	25.4 – 102 (63.57)	-	11.0 – 44.1 (27.6)	-	-
Totals	**4,244 – 13,285 (8766)**	**447 – 2,736 (1,594)**	**186 – 3,445 (1,816)**	**373 – 1,780- (1,076)**	**36.0 – 36.6 (36.3)**	**203 – 2289 (1246)**

(Note: Landfill reservoir (2998 kg) is not included in outputs here so total outputs will not equal total inputs. Also the totals in the table may not exactly equal the sum of displayed data, due to rounding.)

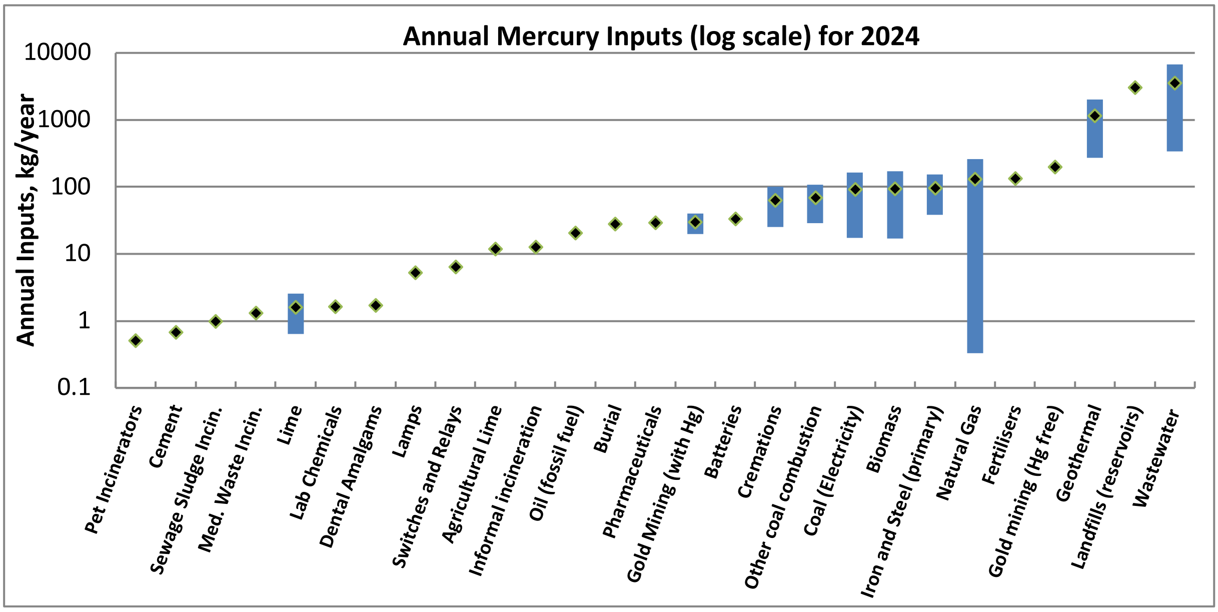
By far the greatest quantities in the inputs column are for category nine, waste disposal. However, most of the mercury in the solid waste stream is placed into long-term storage (ie. controlled landfill), rather than being mobilised into the environment. This was assigned to a 'Reservoir' output category, which has not been included in the table. As a result, the total quantity of outputs shown in the table is much less than the total inputs.

Apart from the waste category, the next highest input is the extraction and use of fuels and other energy sources, with the dominant contributor here being geothermal energy.

The next highest input category is from primary metal production and, in particular gold and silver mining. In this case, the bulk of the inputs and outputs are associated with the extraction of very large volumes of ore, which contain very small amounts of mercury.

Inputs from individual sources

The relative inputs from each of the individual sources identified in the inventory are illustrated in the figure below, with the size of each bar giving an indication of the level of uncertainty associated with each estimate. As shown in the figure, the most significant input sources are waste water treatment and disposal, solid waste disposal (landfills), the extraction and utilisation of geothermal energy, large scale gold and silver mining and phosphate fertiliser application. The extraction and processing of natural gas may also be a significant contributor but the uncertainties associated with the estimates for this source are very high, as indicated by the relative size of the error bar.



The estimated total input of mercury for New Zealand for 2024 is 8,766 kg which is 525 kg less than the 9,291 kg estimated for 2020.

Compared to 2020 the biggest mercury reduction for an individual source occurred for landfills, which had a 2024 input 421 kg less than for 2020 resulting from a significant reduction of waste going to landfill. Large scale gold mining (not using mercury amalgamation) also saw a significant reduction of 189 kg for 2024 which was due to a decrease in the mercury concentration of ore at the Macraes mine. Other large reductions were observed for natural gas (59 kg) fertilisers (55 kg), dental amalgam (46 kg) and coal combustion in boilers (21 kg) all arising from reduced consumption of materials. The reduction for batteries (30 kg) was mostly due to the acceptance that cylindrical alkaline batteries are now mercury free.

On the other hand some sources have seen significant increases in their mercury estimates. The estimated releases from wastewater were 231 kg higher for 2024 compared to 2020 mostly due to population increase. Geothermal power emissions were also 119 kg higher as a result of new geothermal power stations coming on-line increasing the consumption of geothermal stream.

Estimated mercury outputs

The distributions of outputs to air, water, land, waste, and in products, are summarised in a series of charts given in Section 14 of this report, and the key points noted from these charts are as follows:

- The outputs to air are dominated by fuel/energy use, especially geothermal. Other notable contributors, in decreasing order of significance are crematoria, primary metal production, waste disposal and waste incineration.
- The outputs to water are totally dominated by waste disposal, especially wastewater discharges. Extraction and use of fuels and primary metal production are the next most significant contributors.
- The outputs to land are dominated by waste disposal with primary metal production (largely gold mining), production of minerals with mercury impurities (largely phosphate fertilisers) and cemeteries also making significant contributions.
- The outputs to products are comprised mostly of consumer products with intentional use of mercury (largely pharmaceuticals) and production of primary metals.
- The outputs to waste feature waste disposal as the largest sources with other notable contributions from extraction and use of fuels (dominated by natural gas extraction), primary metal production and consumer products with intentional use of mercury.

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Units and abbreviations

Units

°C	degrees Celsius or centigrade
g	gram
kg	kilogram (10^3 or 1 thousand grams)
tonne	10^6 or 1 million grams
Mt	megatonne (10^6 or 1 million tonnes)
µg	microgram (10^{-6} grams or 1 millionth of a gram)
MJ	megajoule (10^6 or 1 million joules)
GJ	gigajoule (10^9 or 1 thousand million joules)
TJ	terajoule (10^{12} or 1 million million joules)
PJ	petajoule (10^{15} or 1 thousand million million joules)
L	litre
m^3	cubic metre
ppm	parts per million
kW	kilowatt (10^3 or 1 thousand watts of thermal or electrical energy)
kWh	kilowatt-hour (equivalent to 1 kilowatt generated or consumed over 1 hour)
MW	megawatt (10^6 or 1 million watts of thermal energy)
MWe	megawatt of electrical energy
GWh	gigawatt-hour (equivalent to 1 thousand million watts consumed over 1 hour)

Abbreviations

EECA	Energy Efficiency & Conservation Authority
EU	European Union
LPG	liquefied petroleum gas
RMA	Resource Management Act 1991
UNEP	United Nations Environment Programme
USA	United States of America
US EPA	United States Environmental Protection Agency

Mercury Inventory for New Zealand: 2024

1 Introduction

This report provides an inventory of the annual distribution of mercury and mercury-containing goods and materials in New Zealand, from anthropogenic (man-made) sources, for a base year of 2024. It has been produced under a contract to the New Zealand Ministry for the Environment, and builds on the information reported in previous inventories for 2008, 2012, 2016 and 2020 (MfE, 2008, MfE 2013, MfE 2018, MfE 2022).

The inventory has been prepared generally in accordance with the guidance provided in the UNEP *Toolkit for identification and quantification of mercury releases* (the UNEP Toolkit), which aims to assist countries to build a knowledge base that identifies the sources of mercury releases in their country and estimates or quantifies the releases (UNEP, 2023). This information is expected to assist in decision-making with regard to possible control measures on mercury releases; in communicating with stakeholders; and in monitoring changes over time.

1.1 Background

After negotiation, the text of the Minamata Convention was formulated in January 2013. It was adopted by the Conference of Plenopotentiaries in October 2013, and in the following year was was signed by 127 states. The Convention came into force on 16 August 2017 after ratification by 50 countries (UNEP, 2024). New Zealand is a signatory nation but has not yet ratified. Ratification requires that a state aligns its legislation and policies to comply with the obligations of the Convention. New Zealand is currently considering the legislative changes necessary to achieve ratification. With regard to New Zealand's obligations in the interim, the Convention provides the following advice: *The signature is the formal expression of intent to be bound and become a party but it does not prejudge ratification. The signature does not bear legal obligation as such; however, a State is expected to refrain from acts that would defeat the object and purpose of a treaty it has signed* (UNEP, 2022).

The objective of the Convention is to protect human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds. Measures to achieve this include: controlling the supply and trade of mercury, setting limits on primary mercury mining, controlling products to which mercury is added and controlling processes in which mercury or mercury compounds are used. It is expected that member state adoption of the Convention obligations will lead to an overall reduction in mercury levels in the environment over time.

The Minamata Convention holds a Conference of Parties (COP) every one or two years and these are opportunities to make changes and improvements to regulations. There have been two COP meetings since the last inventory update. In COP 5, held in November 2023, agreement was reached to phase out additional products containing mercury including certain fluorescent lamps, button batteries, switches and relays and to ban mercury containing cosmetics (UNEP, 2024). COP 6, held in November 2025, agreed to phase out the use of mercury dental amalgam by 2034 (UNEP, 2025).

The Convention's regulations are specified in 14 Articles each of which cover different aspects of mercury control. The requirement for signatories to compile national mercury inventories is contained in Article 9 entitled "Releases" where clause 6 states: *Each Party shall establish, as soon as practicable and no later than five years after the date of entry into force of the Convention for it, and maintain thereafter, an inventory of releases from relevant sources.*

This document is New Zealand's fifth mercury inventory. The 2008 and 2012 New Zealand mercury inventories provided background information for the government leading up to the decision to sign the Convention with the 2016, 2020 and the current inventory prepared after it came into force. All Inventories have been prepared in accordance with the UNEP mandated approach described as the "Mercury Toolkit" which is discussed in Section 2.1. The Toolkit process assists in identifying the most significant sources of mercury and mercury-containing goods and materials in New Zealand, and the activities, and key individuals or organisations, associated with these (the stakeholders).

1.2 Methodology

The basic methodology used for this work was the latest version of the UNEP Toolkit, which was published in February 2023. This methodology was applied using the following general approach:

1. Reviews of the information given in the updated Toolkit for each source category, noting in particular any significant changes since the previous version, which was published in December 2019
2. Contacts with government agencies, importers, manufacturers, industry associations, regional and local councils, as appropriate, to obtain up to date activity data and/or release information.
3. Input/output calculations using the Toolkit spreadsheet and drafting of the relevant subsections of the inventory report, including overall summary and analysis sections. Wherever possible local output factors have been determined, with use of Toolkit default factors reserved for situations where this was not feasible or practicable.

1.3 Report layout and content

Details of the UNEP Toolkit methodology and related aspects are presented in section 2 of this report. This is followed by individual sections covering each of the 11 Toolkit source categories, a summary and discussion section, and a section containing relevant industry profiles.

2 Inventory methodology

2.1 The UNEP Mercury Toolkit

The UNEP Toolkit was first published as a pilot draft in November 2005, and this was the version used in the preparation of the 2008 Inventory Report. The most recent revisions of the Toolkit available were used for the other inventories: 2012: version 1.2 (UNEP, 2013), 2016: version 1.4 (UNEP, 2017), 2020: version 1.5 (UNEP, 2019). The most recent version (version1.7) was published in February 2023 (UNEP, 2023). This version of the Toolkit was used for the current work. Only one change to input factors was relevant for New Zealand. The input factor for "Electrical switches and relays with mercury" was updated based on newer data from the EU. This will result in lower mercury input and output estimates for this sub-category.

The Toolkit is intended to provide a simple methodology and accompanying database to enable the assembly of consistent national and regional mercury inventories. It comprises a UNEP recommended procedure for the effective compilation of source and release inventories of mercury. Comparable sets of mercury source release data are intended to enhance international co-operation, discussion, goal definition and assistance.

The Toolkit includes two levels for inventory assessment; an overview (Level 1) and a detailed source by source assessment (Level 2). The Level 2 option is designed to be adaptable to differences between countries, but it must be stressed that it is still just a screening tool. It is designed to ensure the positive identification of the bulk of significant sources, rather than the unattainable goal of 100 per cent accuracy.

Both the current inventory and those previously prepared are based on the use of the Level 2 option. The Toolkit documentation is supported by an Excel spreadsheet, which has also been used for this assessment.

2.2 Toolkit methodology

The Toolkit considers potential mercury inputs and outputs for the following source categories[1]:

1. Extraction and use of fuels/energy sources
2. Primary (virgin) metal production
3. Production of other minerals and materials with mercury impurities
4. Intentional use of mercury in industrial processes
5. Consumer products with intentional use of mercury
6. Other intentional product/process uses
7. Production of recycled metals (secondary metal production)
8. Waste incineration
9. Waste deposition/landfilling and wastewater treatment
10. Crematoria and cemeteries
11. Identification of potential hot-spots

[1] The source categories are numbered 5.1, 5.2, 5.3, etc in the Toolkit, simply because the detailed source coverage appears in section 5 of the Toolkit document. This numbering has been included in the sub-category tables given at the start of each section, but in all other text references to category numbers the 5 has been ignored.

Terminology

The two key terms used in the Toolkit are inputs and outputs.

Inputs: refers to the quantities of mercury brought into, or mobilised, within the country.

Outputs: refers to the quantities of mercury released into different environmental compartments of air, water, land, and releases in wastes or in products.

There is potential for confusion round the use of some of the output terms, and especially the differences between discharges to land, materials disposed to land as wastes; and wastes that are recycled or reused. The following approach has been adopted for differentiating between these terms:

The **land** output category has only been used for materials which are deposited directly to land during processing (eg drilling muds from oil exploration and production) or which are disposed in a waste treatment facility directly associated with the processing operation (eg, a tailings dam for a mining operation, or an ash disposal facility for a large power plant).

Wastes that are sent directly to a municipal landfill and those taken away by a waste contractor for treatment and disposal (which may include disposal to landfill) have all been classified as **wastes**.

Wastes that are sold, or taken away by a contractor, for recycling and reuse have been classified as **products**.

Methodology for estimating inputs and outputs

The basic methodology for estimating inputs and outputs starts with the annual activity rate for a source, which is multiplied by the mercury content of the input material. The activity data may be based on the numbers of individual items imported, the quantities of raw materials or fuels used, or the annual production rate.

The outputs are estimated from the information available for each source on the rates of release to the different environmental compartments. Generally this information takes the form of individual factors showing the proportion of inputs distributed to each compartment.

The overall methodology is summarised in the Toolkit as follows:

*Estimated mercury release to each pathway = activity rate * input factor * output distribution factor for that pathway*

Toolkit default factors

The Toolkit provides default input and output factors for some, but not all, of the mercury sources. These are based on reviews of published information, and are intended for use when national factors are not available. Each of the default factors is usually expressed as a range of possible values, along with a recommended ‘intermediate’ value. The Toolkit default factors have been used for many of the current estimates.

2.3 Reference year

The reference year for this inventory is the 2024 calendar year, and the activity data for that year has been used wherever possible. However, the use of data from earlier years has been noted where relevant.

2.4 Reporting

The estimated mercury inputs and outputs have been reported for each source in units of kilograms of mercury per year. In most cases, the results are reported as a range of values, to reflect the uncertainties in the estimates. The results for each source are also given certainty estimates, in accordance with the following general approach:

Activity data

- A high certainty ranking was assigned if the assessment was based on national or specific industry data, or was derived from comprehensive survey data;
- A medium certainty ranking was applied if limited data were available, or the data were modified to account for confounding factors;
- A low certainty ranking was assigned if there was no data available, and the level of activity was based on subjective assessment.

Input and output estimates

- A high certainty ranking was assigned if a reasonable amount of mercury content data and/or emissions data were available for the specific sources;
- A medium certainty ranking was assigned if the mercury content data and/or emissions data was limited;
- A low certainty was assigned if there were no New Zealand data available, and the estimates were based solely on the Toolkit default factors.

Precision

The input and output estimates have been calculated to a high level of precision – typically to 1 to 3 decimal places. However, the results have been rounded off when calculating group and overall totals, to better reflect the uncertainties in the estimates. As a result, the totals shown in some tables may not exactly equal the sum of the displayed data.

Double accounting

Wherever possible, double accounting has been avoided. For example the inputs and outputs from the coal used in steel manufacture were subtracted from the estimates for national coal usage. Another example of potential double accounting relates to the differentiation noted previously for waste materials that are taken away for recycling and reuse. One example of this is liquid mercury, which can be collected from a variety of sources; but is then transferred to a mercury recycler; and is then sold to small-scale gold miners and ultimately becomes a discharge to air, water and land. The double accounting here has been avoided by classifying the initial waste as a product.

Reservoirs/stocks/exports

The focus of the inventory is on annual inputs and outputs for New Zealand. However, there are also some significant reservoirs or stock holdings, which may not change very much from year to year. One example of this is the mercury in blood pressure devices (sphygmomanometers) that are still used by many medical professionals. These reservoirs or stocks have been noted at the relevant points in the main body of the report and have also been identified separately in the data summaries.

Another matter that has also been noted is the export of mercury-containing products and materials. These are identified in the overall national accounting, usually as a product or waste, but should also be flagged as eventually being removed from the national stocks.

3 Extraction and use of fuels/energy sources

This category covers all forms of energy use including fossil fuels, biomass, biogas and geothermal energy (UNEP, 2023). It includes the fuel and energy used for electricity generation and in cogeneration plants, direct fuel use in industrial facilities[2], and the fuel used for commercial and residential cooking and heating. It also covers fuel used for transportation, and the energy used in the initial production (refining) of that fuel. The seven sub-categories within this source group are shown in Table 3-1 below, which has been copied directly from the Toolkit. The main pathways of mercury releases are to air, water and waste/residues. Land may also be a release pathway in domestic heating and cooking, either using woody biomass or fossil fuels, and from the extraction of mineral oil. In addition, land is often the ultimate receptor for wastes and residues.

Table 3-1: Toolkit framework for category 1 - extraction and use of fuels/energy sources

Toolkit Chapter	Sub-category	Air	Water	Land	Product	Waste/ residue	Main approach
5.1.1	Coal combustion in large power plants	**X**	x	x	x	**X**	PS
5.1.2	Other coal combustion	**X**		x	x	x	OW
5.1.3	Extraction, refining and use of mineral oil	**X**	**X**	x	x	x	OW/PS
5.1.4	Extraction, refining and use of natural gas	**X**	**X**	**X**		**X**	OW/PS
5.1.5	Extraction and use of other fossil fuels	**X**	x	x		x	OW
5.1.6	Biomass fired power and heat production	**X**	x	x		x	OW
5.1.7	Geothermal power production	**X**					PS

Notes: PS = Point source by point source approach; OW = National/overview approach;

X - Release pathway expected to be predominant for the sub-category;

x - Additional release pathways to be considered, depending on specific source and national situation.

3.1 Coal combustion in large power plants

The UNEP Toolkit defines large power plants as those with a capacity greater than 300MW. The only coal-fired installation of this size within New Zealand is the Huntly Power Station run by Genesis Energy which, when first built, had a capacity of 1000 MW. This was based on four separate Rankine units of 250 MW each – known as Units 1 to 4 - which could be fired on natural gas or coal. One of the Rankine units has since been decommissioned permanently but three units were in full operation in 2024 (MBIE,2025).

The amount of coal burnt in any particular year at Huntly power station is dependent on a number of factors including the amount of electricity that can be provided by hydro generation. 2024 was an unfavourable year for hydro generation and coupled with lower gas supply and an un-planned outage for Huntly's Unit 5 combined cycle

2 Some industrial fuel use is also considered under other categories (eg. metal production, minerals) and is therefore excluded from the general fuel use category, to avoid double accounting.

gas turbine meant that coal use tripled from 5.68 PJ in 2023 to 18.47 PJ in 2024 (MBIE, 2025).)[3,4]. 2024 coal consumption was in fact comparable to the 19.5 PJ used in the previous 2020 Inventory which was also a dry year.

Genesis Energy is currently working to replace coal with biomass (carbonised wood pellets) and are targeting biomass use to exceed coal use by FY 28 provided a suitable fuel supply can be arranged (Genesis Energy, 2025)

The coal used at Huntly Power Station in 2024 was principally coal imported from Indonesia comprising 85% with the remainder Waikato sub-bituminous coal from the Rotowaro mine. The total coal consumption by Huntly Power Station in 2024 was 870,446 tonnes (M Hodges, Genesis Energy, pers comm, 2025).

The mercury content of the coal used at Huntly Power Station was summarised in the 2012 Inventory Report and no new data is available. Therefore the mercury input calculations have been based on the same range as used for the 2012 estimates (ie 0.02 – 0.19 mg/kg, with no distinction between Waikato and Indonesian coal).

The Huntly Power Station units are fitted with electrostatic precipitators for the control of particulate emissions to air, and the output calculations are based on the Toolkit default factors of 90% being released to air and 10% to ash. The fly ash collected by the Huntly precipitators is disposed to land in a specially designed ash disposal facility and, in accordance with the rationale provided in section 2.2, has been classed as a release to land.

The mercury input and output calculations for the power station are shown in Table 3-2, along with the previous Inventory estimates.

Table 3-2: Input and output estimates for coal combustion in large power plants

Source	Activity Rate, tonnes/yr	Mercury content, mg/kg	Annual Mercury Inputs, kg/yr	Annual Mercury Outputs, kg/yr	
				Air	Land
Huntly Power Station, 2012	1,270,000	0.02 - 0.19	25.4 – 241 (133)	22.9 – 217 (120.0)	2.5 – 24.1 (13.3)
Huntly Power Station, 2016	223,242	0.02 - 0.19	4.5 – 42.4 (23.4)	4.0– 38.2 (21.1)	0.5 – 4.2 (2.3)
Huntly Power Station, 2020	898,500	0.02 -0.19	18.0 – 171 (94.3)	16.2 – 154 (84.9)	1.8 – 17.1 (9.45)
Huntly Power Station, 2024	870,446	0.02 -0.19	17.4 – 165 (91.4)	15.7 – 149 (82.3)	1.74 – 16.5 (9.14)

(Note: the numbers shown in brackets in this and most other tables are the means of the reported ranges.)

Certainty assessment

Activity data: HIGH (because it was obtained from the plant operator)

Input estimates: MEDIUM (because they are based on a range of coal analyses)

Output estimates: LOW (because they are based on the default Toolkit output factors).

[3] 1 Petajoules = 1 x 10^{15} Joules of energy. Most of the energy data in this section is expressed on both an energy and mass basis. The latter values will be more meaningful to the reader, but the energy-based values are used as a more precise measure of usage, because the energy content of coal is variable.

[4] Most of the energy data used here has been taken from the annual energy data reports produced by MBIE, along with the more recent data available on-line, https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-statistics

3.2 Other coal use

This Toolkit sub-category covers all other uses of coal. It also considers potential releases from coal washing.

Coal production and use

New Zealand produces three types of coal – bituminous, sub-bituminous and lignite. Bituminous coal has the highest energy value and is mined solely on the South Island's West Coast. Of New Zealand's total production of bituminous coal in 2024 (1,209,649 tonnes) almost all was exported (1,089,854 tonnes) to be used as coking coal in the world's steel blast furnaces (MBIE 2025).

Lignite has the lowest energy of the three coal types and is mined chiefly at two Southland coal fields – Waimumu and Ashers (NZ Petroleum and Minerals 2022) and is used in the lower South Island. New Zealand produced 239,877 tonnes of lignite in 2024 (MBIE 2025)

Sub-bituminous coal is intermediate in energy quality and is mined at several opencast mines in both the North Island and the South Island with production figures of 1,059,500 tonnes. The New Zealand Steel plant at Glenbrook and Huntly Power Station are major sub-bituminous users in the North Island while the food manufacturing industry is the principal South Island user (MBIE, 2025).

In addition to domestic coal production, New Zealand also imports significant quantities. In 2024 New Zealand imported 1,014,562 tonnes of coal, mostly sub-bituminous from Indonesia (MBIE 2025).

Total national coal consumption in 2024 was 2,490,498 tonnes (MBIE 2025). About half of this coal was used for electricity generation and primary steel manufacturing with food manufacturing being another large coal consumer, particularly in the South Island where there is no access to reticulated natural gas. The distribution of domestic coal consumption across MBIE's sector descriptions was as follows:

Electricity generation (Huntly)	871,619[5]
Use in co-generation plants	343,392 tonnes
Other transformation (steel manufacture)	445,805 tonnes
Industrial use	714,285 tonnes
Agriculture, forestry and fishing	65,604
Commercial/institutional use	15,467 tonnes
Residential use	7,251 tonnes
Production losses	27,075tonnes

The figure for total coal consumption (2,490,498 tonnes) has been used as a starting point for the input estimates. However, the following uses have been subtracted from this total, because they are covered elsewhere:

Electricity generation	871,619 tonnes
Steel manufacturing	755,664 tonnes[6]

5 There is a discrepancy of 1,173 tonnes between this figure and the one noted in section 3.1, which was provided by Genesis Energy. This is most likely because the NZEDF figure is based on supply while Genesis' figure is based on actual consumption. It is considered more appropriate to use the NZEDF figure in this section, because the calculations here are all based on the national data. This is consistent with the approach used in the previous inventory.

6 The coal used in steel manufacturing is a combination of that used in a cogeneration plant and in the actual manufacturing process (other transformation).

Cement and lime manufacturing	107,520 tonnes.

Subtracting the sum of the three sectors considered elsewhere (1,734,803) from New Zealand's total coal consumption gives an amended quantity of 755,695 tonnes for Other Coal Use in 2025.

As mentioned earlier this coal is produced in different parts of the country and as discussed below shows a little variation in mercury concentration. After accounting for lignite, previous inventories have distributed the remaining quantity of coal to Waikato and South Island regions, apportioning on the basis of their production data. However this approach may have led to an over-estimation of the Waikato fraction. Having already taken out consumption by coal fired electricity generation, steel making and cement and lime manufacturing and given that Fonterra no longer has any coal fired boilers in the North Island there are essentially no major industrial users of Waikato coal left and domestic use is also likely to be minor. Consequently after subtracting lignite production, the remainder of the Other Coal Fraction has been assigned to South Island sub-bituminous coal use. The following approximate distribution has been adopted:

Southland lignite	239,877 tonnes
South Island sub-bituminous coal	515,818 tonnes

Coal mercury content

The mercury content of coal varies across different coal mines, and can also vary markedly within each coal seam. For example, Li (2002) reported a range of 0.009 to 0.193 mg/kg, with a mean value of 0.034 mg/kg, for thirty samples taken from within a single coal seam at the Stockton mine.

The only published data available on the mercury content of New Zealand coals is that quoted previously for Huntly Power Station, the Stockton data noted above, and the following indicative values listed by Li (2002) from an unpublished CRL Energy report: West Coast coal, 0.07 mg/kg; Southland coal, 0.06 - 0.07 mg/kg; Waikato coal, 0.07 – 0.12 mg/kg. In addition, CRL Energy has provided the following indicative values: Waikato coal, 0.2 mg/kg; West Coast coal, 0.1 mg/kg, Southland lignite, 0.25 mg/kg (N. Newman, CRL Energy, pers comm, 2013).

The CRL Energy estimates for mercury content are either towards the top of, or above, the ranges given in the published sources, and have been taken as upper estimates for the range of possible mercury contents. In addition, the West Coast figure has been assumed to apply to all South Island coal. The lower limit for each of the coal types has been based on the following values: Waikato coal, 0.04 mg/kg; South Island coal, 0.03 mg/kg; Southland lignite, 0.06 mg/kg.

Input and output estimates

The coal usage in this category is split across numerous industrial and commercial boilers, with a very minor proportion (0.1%) used for domestic heating and cooking. The most recent estimate is that there are about 160 coal-fired boilers in New Zealand ranging in size from 1 to 43 MW (CRL Energy, 2011). The reduction in coal consumption in this category compared to previous inventories may reflect the decommissioning or conversion of some coal fired boilers to alternative fuels (such as biomass). Most New Zealand boilers have cyclones for the control of particulate emissions and some also have bag filters. However, the Toolkit makes no distinction between these systems and suggests default distribution factors of 95% mercury discharges to air and 5% to waste. As noted previously in section 3.1, some of the studies noted in the Toolkit have suggested a 75/25% distribution. Hence, the output calculations shown below may be over-estimating the releases to air and under-estimating the releases via ash. The Toolkit default factors have been applied to all of the coal usage in this category.

The mercury input and output calculations for Other Coal Combustion are shown in Table 3-3.

Table 3-3: Input and output estimates for other coal combustion

Source	Activity Rate, tonnes/yr	Mercury content, mg/kg	Annual Mercury Inputs, kg/yr	Annual Mercury Outputs, kg/yr	
				Air	Waste
Waikato Coal, 2012	300,000	0.04 - 0.20	12 - 60	11.4 – 57.0	0.6 – 3.0
Waikato Coal, 2016	224,000	0.04 – 0.20	9.0 – 44.8	8.5 – 42.6	0.5 – 2.1
Waikato Coal, 2020	202,430	0.04 – 0.20	8.1 – 40.5	7.7 – 38.5	0.4 – 2.0
Waikato Coal 2024	-	-	-	-	-
South Island Coal, 2012	505,000	0.03 – 0.10	15.2 – 50.5	14.4 – 48.0	0.8 – 2.5
South Island Coal, 2016	640,000	0.03 – 0.10	19.2 - 64	18.2 – 60.8	1.0 – 3.2
South Island Coal, 2020	470,631	0.03 – 0.10	14.1 – 47.0	13.4 – 44.7	0.7 – 2.4
South Island Coal, 2024	515,818	0.03 – 0.10	15.5 – 51.6	14.7 – 49.0	0.77– 2.58
Southland lignite, 2012	307,000	0.06 – 0.25	18.4 – 76.8	17.5 – 72.9	0.9 – 3.8
Southland Lignite, 2016	313,000	0.06 – 0.25	18.8 – 78.3	17.9 – 74.4	0.9 – 3.9
Southland Lignite, 2020	221,473	0.06 – 0.25	13.3 – 55.4	12.6 – 52.6	0.7 – 2.8
Southland Lignite, 2024	239,877	0.06 – 0.25	14.39 – 59.97	13.67 – 56.97	0.720 – 2.998
Totals, 2012	**1,112,000**		**45.6 – 187.3 (116.4)**	**43.3 – 177.9 (110.6)**	**2.3 – 9.3 (5.8)**
Totals, 2016	**1,177,000**		**47.0 – 187.1 (117.1)**	**44.6 – 177.8 (111.2)**	**2.4 – 9.2 (5.8)**
Totals, 2020	**894,534**		**35.5 – 142.9 (89.2)**	**33.7 – 135.8 (84.8)**	**1.8 – 7.2 (4.5)**
Totals, 2024	**755,695**		**29.9– 111.6 (70.71)**	**28.4 – 105.6 (67.17)**	**1.49 – 5.58 (3.54)**

Certainty assessment

Activity data: HIGH (because it was obtained from a national database)

Input estimates: LOW (because they are based on a limited range of published data and industry estimates)

Output estimates: LOW (because they are based on the default Toolkit output factors).

3.3 Mineral oils - extraction, refining and use

This Toolkit sub-category covers the extraction, refining, and uses of mineral oil (ie, petroleum products). This includes the combustion of oil to provide power, heat, and transportation, and other related uses, such as in bitumen. However, despite the relative potential complexity of these different areas, the input and output estimates can be broken down into a set of relatively straightforward calculations for the following three basic stages: oil extraction, oil refining and oil/petroleum combustion.

Oil extraction

There are currently 16 productive oil fields in New Zealand, although the majority of production is accounted for by nine of these: Maari, Maui, Kapuni, Turangi, Mangahewa, Pohokura, Cheal, Kupe and Ngatoro. The combined production is a mixture of crude oil, natural gas liquids, condensates and naphtha, with a total production in 2024 of 830,480 tonnes (MBIE, 2025). This is about 14% lower than the 2020 production of 963,860 tonnes and 52% lower than the 2016 production of 1,584,650 tonnes. No data are available on the mercury content of any of this production, but the Toolkit recommends a default factor of 3.4 mg/tonne. Using this factor gives a total annual mercury input for New Zealand oil extraction of 2.82 kg in 2024.

The Toolkit indicates that there may be some minor releases of mercury (and other oil components) via the wastewater produced during oil extraction. This wastewater is usually processed through oil/water separators so only minor amounts of contaminants are released via the waste discharge. The Toolkit classifies the discharge as being to water but at the New Zealand on-shore oil fields it is more likely to be to land. The default distribution factor is 0.2 (ie 20%), which indicates a potential release to land of 0.564 kg/year.

Virtually all of New Zealand's indigenous oil production is exported (MBIE, 2025). Hence, the remainder of the 2.82 kg of mercury inputs noted above (ie. 2.26 kg) has not been included in this inventory.

Oil refining

New Zealand's only oil refinery at Marsden Point closed permanently for economic reasons on 31 March 2022. The remaining facility is an import terminal for refined fuels, mainly petrol, diesel and jet fuel (MBIE, 2025). With the closure of the refinery New Zealand's imports of crude oil have dropped to zero, hence there are now no mercury emissions associated with this category.

Use of refined products

The Toolkit makes very little distinction between the different ways in which oil products may be used, because it assumes that most of them will ultimately be burned, and all of the mercury will be discharged to air. The only sub-classes considered are residential heating and cooking, and industrial combustion facilities with a high degree of emission control. Residential heating and cooking is a very minor component of total petroleum product consumption in New Zealand (MBIE, 2025), and there are no oil-fired industrial facilities in New Zealand with an advanced level of emission control. Hence the total consumption of refined oil products has been accounted for under the 'other combustion' Toolkit category, which includes all uses in transportation, and in industrial and commercial applications.

Total imports across all fuel types in 2024 were 7,291,170 tonnes (MBIE, 2025). There is no data available on the mercury content of imported fuel products. This has been calculated using the Toolkit default factor of 3.4 mg/tonne and subtracting the 20% fraction that remains with the country of origin in wastewater. This indicates a total mercury input from use of refined products of about 19.83 kg/year, and the same output quantity, in the form of discharges to air.

Input and output estimates

The mercury input and output calculations for Mineral Oils – Extraction, Refining and Use are summarised in Table 3-4.

Table 3-4: Input and output estimates for mineral oils - extraction, refining and use

Source	Activity Rate, tonnes/yr	Mercury content, mg/kg	Annual Mercury Inputs, kg/yr	Annual Mercury Outputs, kg/yr			
				Air	Water	Land	Waste
Extraction, 2012	1,851,000	0.0034	1.26[a]	-	-	1.3	-
Extraction, 2016	1,584,650	0.0034	1.08[a]	-	-	1.1	-
Extraction 2020	963,860	0.0034	0.66[a]			0.66	
Extraction 2024	830,480	0.0034	0.565[a]			0.565 [a]	
Refining, 2012	5,529,000	0.0034	18.8	4.7	0.2	-	2.8
Refining, 2016	5,529,950	0.0034	18.8	4.7	0.2	-	2.8
Refining 2020	3,942,100	0.0034	13.4	3.35	0.1		2.0
Refining 2024	-	-	-	-	-	-	-
Use, 2012	-	-	14.42	14.4	-	-	-
Use, 2016	-	-	14.5	14.5	-	-	-
Use 2020			11.14	11.14			
Use 2024			19.83	19.83			
Totals, 2012	**-**	**-**	**23.4[b]**	**19.1**	**0.2**	**1.3**	**2.8**
Totals, 2016	**-**	**-**	**23.2[b]**	**19.1**	**0.2**	**1.1**	**2.8**
Totals, 2020	**-**	**-**	**17.3[b]**	**14.5**	**0.1**	**0.66**	**2.0**
Totals 2024	**-**	**-**	**20.40**	**19.83**		**0.565**	

Notes: a a further 5.04 kg was removed through oil exports in 2012, 5.39 kg in 2016, 3.06 kg in 2020 and 2.26 kg in 2024.

b individual inputs do not add up to this total because 59% of the refining input (11.09 kg/yr) carries over into the oil use inputs.

Certainty assessment

Activity data: HIGH (because it was obtained from a national database)

Input estimates: LOW (because they are based on the default Toolkit input factors)

Output estimates: LOW (because they are based on the default Toolkit output factors).

3.4 Natural gas - extraction, refining and use

As with mineral oils, the mercury releases from natural gas are considered through all three stages of gas extraction, processing and use.

Gas extraction, processing and use

Natural gas is produced from the same 16 fields as noted previously for oil (MBIE, 2025). About 96% of the gas production comes from the Maui, Pohokura, Kapuni, Mangahewa, Kupe and Turangi fields, and the total gas production in 2024 from all fields was 3,272 million cubic metres (Mm^3), with an energy content of 125 PJ. This is only 60% of the 5,557 million cubic metres (Mm^3), or 221 PJ, produced in 2016 and continues the significant downward trend in New Zealand's gas production since 2017. The net gas production is only about 95% of these totals due to losses from reinjection, flaring, and other production processes.

A limited amount of data for the mercury content of New Zealand natural gas was used for calculating the input estimates for the 2012 Inventory Report and there has been no new data available since. Applying the same factors to the 2024 gas volumes gives a total mercury input of between 0.33 and 262 kg, with a mid-range value of 131 kg for 2024.

The Toolkit notes that where natural gas is used as an industrial feedstock, there is a requirement for low residual levels of mercury to prevent problems such as catalyst poisoning and deterioration of aluminium surfaces. In addition, treatment processes designed for hydrogen sulphide removal will also be effective in removing mercury. Consequently the output factors given by the Toolkit for gas processing with mercury removal are appropriate as a starting point for the New Zealand distribution calculations. These assume that 10% of mercury in the gas is discharged to air, 20% to water, 10% in product and 60% in wastes. However, when the product gas is used (by burning) the mercury in the product is discharged to air. Hence the overall distribution becomes 20% to both air and water and 60% to waste.

Input and output estimates

The mercury input and output calculations for Natural Gas – Extraction, Refining and Use are summarised in Table 3-5.

Table 3-5: Input and output estimates for natural gas - extraction, refining and use

Source	Activity Rate, Mm^3/yr	Mercury content, $\mu g/m^3$	Annual Mercury Inputs, kg/yr	Annual Mercury Outputs, kg/yr			
				Air	Water	Waste	Product
Gas Extraction and Use, 2012	4,642	0.1 - 80	0.46 – 371.4 (185.9)	0.09 – 74.3 (37.2)	0.09 – 74.3 (37.2)	0.27 – 219.1 (109.7)	<0.01 – 3.7[a] (1.86)
Gas Extraction and Use, 2016	5,557	0.1 - 80	0.56 – 444.6 (222.6)	0.1 – 89 (44.5)	0.1 – 89 (44.5)	0.3 – 266.8 (133.6)	-
Gas Extraction and Use, 2020	4,737	0.1 - 80	0.47 – 379 (189.7)	0.09 - 76 (37.9)	0.09 – 76 (37.9)	0.28 – 227.4 (113.8)	
Gas Extraction and Use, 2024	3,272	0.1 - 80	0.33 – 262 (131.0)	0.065 – 52.4 (26.2)	0.065 – 52.4 (26.2)	0.198 – 157.2 (78.6)	

Note: a: The releases in product were reported separately in 2012 but since 2016 they have been included in the total releases to air because that is where they will ultimately be released when the gas is burned.

Certainty assessment

Activity data: HIGH (because it was obtained from a national database)

Input estimates: LOW (because they are based on limited historical mercury in natural gas data)

Output estimates: LOW (because they are based on the default Toolkit output factors).

3.5 Other fossil fuels – extraction and use

This Toolkit sub-category covers materials such as oil shale and peat. There is no oil shale extraction in New Zealand and peat is not used as a fuel. There may be some mercury releases from accidental fires in peat bogs, but the quantities involved in these (ie the activity rate) would be virtually impossible to determine. Hence this sub-category has not been assessed.

3.6 Biomass-fired power and heat production

The mercury in wood and other biomass originates from that taken up naturally from the soil, and mercury deposition from the atmosphere as a result of natural and anthropogenic emissions to air. Most of the mercury is discharged back into the air when the biomass is burned. This Toolkit sub-category is concerned with the burning of wood and other biomass as an industrial fuel, and in residential heating and cooking.

As shown in the previous sections, accurate statistical information is available for national annual consumption of coal, natural gas and petroleum products. Such statistics are not available for biomass (essentially wood waste) because the tonnages used are either not recorded or are recorded indirectly such as in the form tonnes of steam raised per hour. In addition, wood waste can vary significantly in its composition and moisture content– off cuts, shavings, saw dust, bark etc. which will affect its energy content. The 2012 and 2016 mercury inventories used the boiler rating (MW) of industrial wood burning heat plant listed in the Heat Plant Database (CRL Energy 2011) and derived the total energy consumed by assuming that plant is operated at 70% load for 320 days per year. Estimates of domestic biomass consumption from Census data were then added to obtain a total annual biomass figure.

For the 2020 Inventory and the current Inventory, the MBIE derived estimates for annual industrial and domestic energy raised by biomass have been used (MBIE, 2025).

MBIE use the Scion Wood Processing Database (MBIE, 2017) developed by the Crown Research Institute Scion in 2017 to assess the wood related consumption of energy raising plant in currently operating wood processing and pulp and paper operations in New Zealand. The database uses two approaches to derive estimates of fuel use. In the first, the nameplate power rating (MW) of the boiler is combined with estimates of loading (percentage of time the boiler is used in a year), estimates of capacity (the ratio between typical heat demand and the boiler's nameplate capacity to supply heat) and efficiency (assumed to be 0.85 for all boilers, that is 85% of the energy in the fuel is converted to useful heat). In the second approach, annual production levels of wood products and estimates of the energy required to produce each product are used to derive a total fuel use figure.

Biomass consumption estimates are not yet available for 2024 but MBIE estimated total annual usage (including domestic consumption) of 51.98 PJ, 51.11 PJ and 44.37 PJ for the preceding 3 years (MBIE, 2025). This allows an estimate of 49.15 PJ to be derived for 2024.

Converting wood energy (PJ) to mass of wood (tonnes) is achieved by dividing the energy term by the average gross calorific value of oven dried Pinus radiata (0% moisture) which is 20.2 GJ/tonne (MBIE, 2017). 49.15 PJ is therefore equivalent to 2.433 million tonnes/year of dry wood.

There is no published data available on the mercury content of New Zealand wood so the input estimates have been based on the Toolkit default factor of 0.0385 mg/kg, or a range of 0.007 – 0.07 mg/kg. It also assumed that all of the mercury is released to air.

The mercury input and output calculations for the biomass-fired power and heat production are shown in Table 3-6

Table 3-6: Input and output estimates for biomass-fired power and heat production

Source	Activity Rate, tonnes/yr	Mercury content, mg/kg	Annual Mercury Inputs, kg/yr	Annual Mercury Outputs, kg/yr
				Air
Biomass usage, 2012 & 2016	1,800,000	0.007 - 0.07	12.6 – 126 (69.3)	12.6 – 126 (69.3)
Biomass usage, 2020	2,390,000	0.007 – 0.07	16.7 – 167 (92.0)	16.7 – 167 (92.0)
Biomass usage, 2024	2,433,000	0.007 – 0.07	17.0 – 170 (93.7)	17.0 – 170 (93.7)

Certainty assessment

Activity data: MEDIUM (because it was obtained from a combination of national data and estimated operating loads)

Input estimates: LOW (because they are based on the default Toolkit input factors)

Output estimates: LOW (because they are based on the default Toolkit output factors).

3.7 Geothermal power production and use

Geothermal steam contains small quantities of mercury, and most of this is released to air if the steam is discharged to air after direct use as a source of heat, or if the steam is used for electricity generation. Most geothermal power stations in New Zealand re-inject the geothermal fluids back into the ground after use, to assist in maintaining reservoir pressures. However, the mercury is mainly present in the steam and non-condensable gases which are separated from the fluids, and are not 'captured' by the re-injection process (Thain, 2009).

Currently New Zealand has an installed geothermal electric power generation capacity of 1207 MW from 17 geothermal power plants across 8 geothermal fields. Geothermal electricity generation hit a record 8741 Gigawatt-hours in 2024, an increase of 11% on the 2020 figure of 7834 Gigawatt-hours. Part of this increase can be credited to the opening of the Tauhara and Te Hua 3 plants during 2024 which contributed an additional 225 MW of geothermal capacity (MBIE, 2025).

The mercury content of geothermal fluids varies between different geothermal fields. The mercury emission rates for 10 of the existing and proposed power stations have been obtained from the estimates given in the application documents for various power station developments in the Bay of Plenty and Waikato regions (Contact Energy, 2007, 2009 and 2012, and Mighty River Power, 2010a and 2010b). The emission rates indicate mercury emission factors, for the discharges to air, in the range of 0.03 – 0.22 grams per Megawatt-hour (MWh), with an average of 0.114 g/MWh.

The Wairakei Power Station differs from all of the others in that most of the condensed steam, is not re-injected after use, but is discharged to the Waikato River. This includes a portion of the mercury present in the associated gases, which in other stations is all discharged to air. The estimated discharge from the Wairakei Power Station for 2024 was < 6.43 kg (Matt Stulen, Contact Energy, pers comm, 2025).

The mercury input and output calculations for geothermal power are shown in Table 3-7 below. In addition to electricity generation, an allowance has been made for direct uses of total geothermal energy. This assumes that direct use emissions will be the same as those for electricity generation on a proportional basis when both are recorded on a gross geothermal utilisation basis. 2024 data is not yet available for either electricity generation or direct use of geothermal energy on a gross basis. Data is however available for 2023: 206.2 PJ for electricity and 8.7 PJ for direct use (MBIE, 2025) Consequently direct use accounts for an estimated additional 4.2% of geothermal , energy emissions (MBIE, 2025b).

Table 3-7: Input and output estimates for geothermal power production and use

Source	Activity Rate, GWh/yr	Mercury content, g/MWh	Annual Mercury Inputs, kg/yr	Annual Mercury Outputs, kg/yr	
				Air	Water
Geothermal power, 2012	5,770	0.03 - 0.22	173.1 – 1,269.4	126.6-1,222.9[a]	46.5
Geothermal power, 2016	7,411	0.03 - 0.22	222 – 1,630	213.4 – 1,621.4 [a]	8.6
Geothermal power, 2020	7,834	0.03 – 0.22	235 – 1723	227.8 – 1715.8[a]	7.2
Geothermal power, 2024	8,741	0.03 – 0.22	262 - 1923	255.6 – 1916.6 [a]	6.4
Direct use, 2012	based on 6% of the above		10.4 – 76.1	10.4 – 76.1	-
Direct use, 2016	based on 3.8% of the above		8.5 – 62.4	8.5 – 62.4	-
Direct use, 2020	based on 4.2% of the above		9.8 – 72	9.8 - 72	-
Direct use, 2024	based on 4.2% of the above		11.0 – 80.8	11.0 – 80.8	-
Totals, 2012	**-**	**-**	**184 – 1,346 (765)**	**137 – 1,299 (718)**	**46.5**
Totals, 2016	**-**	**-**	**231 – 1,692 (962)**	**222 – 1684 (953)**	**8.6**
Totals, 2020	**-**	**-**	**245 – 1795 (1020)**	**238 – 1788 (1013)**	**7.2**
Totals, 2024	**-**	**-**	**273 – 2004 (1138)**	**267 – 1997 (1132)**	**6.4**

Notes: a the Wairakei releases to water have been subtracted from the total inputs to give the releases to air.

Certainty assessment

Activity data: HIGH (because it was obtained from a national database)

Input estimates: MEDIUM (because they are based on a range of published data)

Output estimates: MEDIUM (because they are based on a range of published data).

3.8 Summary for this category

The estimated inputs and outputs for the Fuel/Energy Use category are summarised in Table 3-8. From this it can be seen that the greatest inputs are associated with the use of geothermal energy, followed by natural gas extraction and refining. The dominant release route is to air.

Table 3-8: Summary of inputs and outputs for the fuel use category, for 2024

Category	Mercury Inputs, kg/year	Mercury Outputs, kg/yr				
		Air	Water	Land	Product	Waste
Coal – large power plants	17.4 – 165. (91.4)	15.7 – 149 (82.3)	-	1.74 – 16.5 (9.14)	-	-
Other coal combustion	29.9– 111.6 (70.7)	28.4 – 106 (67.2)		-	-	1.50 – 5.58 (3.54)
Oil extraction, refining and use	20.4	19.8		0.565	-	
Gas extraction, refining and use	0.33 – 262 (131)	0.065 – 52.4 (26.2)	0.065 – 52.4 (26.2)		-	0.198 – 157 (78.7)
Other fossil fuels	-	-	-	-	-	-
Biomass fuel	17.0 – 170 (93.7)	17.0 – 170 (93.7)	-	-	-	-
Geothermal power	273 – 2004 (1138)	267 – 1997 (1132)	6.4	-	-	-
Totals	**358– 2733 (1546)**	**348 – 2494 (1421)**	**6.47 – 58.8 (32.6)**	**2.31 –17.1 (9.70)**	**-**	**1.70 – 163 (82.4)**

4 Primary (virgin) metal production

This category covers mercury releases from the mining and processing of metal-containing ores for the purposes of primary (virgin) metal production (UNEP, 2023). The sub-categories and the primary release pathways are summarised in Table 4-1, which has been copied directly from the UNEP Toolkit.

Table 4-1: Toolkit framework for category 2 – primary metal production

Toolkit Chapter	Sub-category	Air	Water	Land	Product	Waste/ residue	Main approach
5.2.1	Mercury	**X**	**X**	**X**	**X**	**X**	PS
5.2.2	Gold and silver, using mercury amalgamation	**X**	**X**	**X**			OW
5.2.3	Zinc	**X**	**X**	**X**	**X**	**X**	PS
5.2.4	Copper	**X**	**X**	**X**	**X**	**X**	PS
5.2.5	Lead	**X**	**X**	**X**	**X**	**X**	PS
5.2.6	Gold and silver, not using mercury	**X**	**X**	**X**	**X**	**X**	PS
5.2.7	Aluminium	**X**		X		**X**	PS
5.2.8	Other non-ferrous metals	**X**	**X**	**X**		**X**	PS
5.2.9	Ferrous metals (iron & steel)	**X**				x	PS

Notes: PS = Point source by point source approach; OW = National/overview approach;

X - Release pathway expected to be predominant for the sub-category;

x - Additional release pathways to be considered, depending on specific source and national situation.

4.1 Primary metals not produced in New Zealand

There is no significant primary metal production in New Zealand for the following Toolkit sub-categories: mercury, zinc, copper, lead and other non-ferrous metals.

4.2 Gold and silver, using mercury amalgamation

Throughout the world large scale gold mining operations generally use a cyanide process to extract gold from ores. However many small scale miners, referred to as “artisanal” miners by the Minamata Convention, use the simpler traditional method of mercury amalgamation. Here liquid mercury is added to refined ore concentrates where the gold present forms a solid amalgam with mercury. Excess liquid mercury is then recovered, and the amalgam separated from other solid impurities. Gold is recovered by heating the amalgam to volatilise the mercury leaving the gold as a porous solid referred to as “sponge gold”. This process should occur in a retort where the gaseous mercury is condensed and recovered.

Artisanal gold mining occurs in 70 countries involving 10 – 19 million miners, of which 4 - 5 million can be women and children (Esdaile L J and Chalker J. M, 2018)

There can be considerable losses of mercury with artisanal gold mining operations, estimated at about 410-1400 tonnes per year (Esdaile L J and Chalker J M, 2018). Assuming artisanal miners produce 15-25% of total gold production, their share of the 2024 global gold production of 3660 tonnes would be about 730 tonnes. This means that for every tonne of gold produced by artisanal miners about 0.5 – 2 tonnes of mercury is released to the environment.

A recent New Zealand study stated that mercury amalgamation is still carried out in New Zealand mostly by recreational and small scale commercial gold miners and commented that procedures are generally well confined, apart from occasional lapses, and that New Zealand contributions to global mercury releases are relatively trivial. (Craw, D and Palmer, M, 2025)

Using New Zealand's placer gold production figures, that is gold produced from stream bed deposits, sands and gravels and some assumptions regarding mercury application rates and losses, it is possible to derive an approximate estimate of mercury lost to the environment from amalgamation practices in New Zealand.

A total of 1064 kg of placer gold was produced in New Zealand in 2024 (NZPAM, 2025). If we assume 25% of this quantity underwent mercury amalgamation and that mercury was applied at a ratio of 1.5 mercury to gold on a weight per weight basis (Craw, D and Palmer, M, 2025), this would mean a total of 399 kg mercury was used annually. Further if we assume that between 5 and 10% of the mercury was lost, either in physical handling, remaining on gold particles or to evaporation during retorting this would mean that losses of mercury were between 20 and 40 kg for 2024.

Applying this range to the Toolkit distribution factors for 'extraction from ore concentrate with use of retorts and recycling' which specifies that 20% of the mercury will ultimately be discharged to air, and 40% each to water and to land gives rise to the amounts shown in Table 4-2.

The mercury input and output calculations for gold and silver production using mercury are shown in Table 4-2.

Table 4-2: Input and output estimates for gold and silver production using mercury

Source	Annual Mercury Inputs, kg/yr	Annual Mercury Outputs, kg/yr		
		Air	Water	Land
Gold & silver, with mercury	20 – 40 (30)	4 - 8 (6)	8 – 16 (12)	8 – 16 (12)

Certainty assessment

Activity data: LOW (because amalgamation activity is based on an assumed proportion of total placer activity)

Input estimates: LOW (because mercury losses are an assumed proportion of total mercury usage)

Output estimates: LOW (because they are based on the default Toolkit output factors).

4.3 Gold and silver, not using mercury amalgamation

Oceana Gold Corporation operate major gold and silver mining operations at two locations in New Zealand. The Macraes Operations in Otago include the Macraes open pit gold mines and Frasers underground mine. The Waihi Gold Mine Operations in the Waikato include the Martha open pit and the Correnso underground gold mine. These are regarded as hard rock mines where gold is extracted chemically from crushed ore as opposed to placer mines where gold in stream bed deposits, sands and gravels is recovered largely using water and gravity but, as discussed in Section 4.2, may involve mercury amalgamation.

The Oceana operations produced about 84% of New Zealand's gold recovered in 2024. Of the remaining production a further 14% is attributed to placer mining on the West Coast with much smaller quantities mined at placer sites in Otago/Southland, Marlborough and Nelson/Tasman (NZPAM, 2025).

In 2024 125,000 ounces of gold and 4,000 ounces of silver were produced from the Macraes' operation, while Waihi produced 53,000 ounces of gold and 193,000 ounces of silver.

In order to produce the quantities of gold and silver in 2024, a total of 559,988 tonnes of ore was processed at the Waihi site. The average mercury concentration in Waihi ore for Martha samples from previous exploration results is 0.254 g/tonne (M Burroughs, Oceana Gold, pers comm, 2025).

Mercury concentrations for Macraes ore are inferred from analysis of iron in pyrite mineral after the ore has been crushed, ground and concentrated in a series of floatation cells. This assumes a constant gold to mercury ratio and gold to pyrite ratio in the pyrite mineral being separated by floatation. Because the mercury is amalgamated to the gold in pyrite, it is tightly bound to the gold and is not lost in the concentration process. Mercury also forms a stable complex with cyanide which is similarly absorbed to carbon in the so-called carbon-in-leach enrichment system. This means that mercury follows gold to the refining stage and it is only here that separation occurs. The separated mercury is collected and is sent off-site to a waste management company.

The amount of concentrated ore processed in 2024 at Macraes was 111,676 tonnes and the average derived mercury concentration for the concentrate was 0.51 g/tonne (S. Rodger Oceana Gold, pers comm, 2025). The mercury concentration is about a fifth of the average concentration used for the 2020 inventory.

The reported mercury concentrations in ore combined with ore quantities for 2024 have been used to generate mercury releases separately for the Macraes and Waihi operations. The Toolkit default factors for estimating the output distributions of 0.04 (4%) releases to air, 0.02 (2%) releases to water, 0.9 (90%) releases to land, and 0.04 (4%) releases in product have been used for Waihi but replaced by a factor of 1.0 (100%) for releases to waste for Macraes.

The mercury input and output calculations for gold and silver production not using mercury are shown in Table 4-3, along with the previous inventory estimates. It is now considered that mercury input estimates for both the 2012 and 2016 Inventories were too high as a result of the Macraes mercury in ore estimate being applied to the total weight of ore handled rather than the weight of concentrated ore produced after floatation treatment.

Table 4-3: Input and output estimates for gold and silver production not using mercury

Source	Activity Rate, Mt/yr	Mercury content, g/tonne	Annual Mercury Inputs, kg/yr	Annual Mercury Outputs, kg/yr				
				Air	Water	Waste	Land	Product
Gold/silver production, 2012	2.5	0.5 – 1.0	1,250 – 2,500 (1,875)	50 – 100 (75)	25 – 50 (37.5)	-	1,125 – 2,250 (1,687.5)	50 - 100 (75)
Gold/silver production, 2016	6.56	0.23 – 2.0	1,508 – 13,114 (4,918)	60.3 – 525 (196.7)	30.2 – 263 (98.4)	-	1,357 – 11,803 (4,426)	60.3 – 525 (197)
Gold/silver production, 2020	0.126 (Macraes) 0.137 (Waihi)	2.8 (Macraes) 0.26 (Waihi)	389	1.42	0.71	354	32.0	1.42
Gold/silver production, 2024	0.112 (Macraes) 0.560 (Waihi)	0.51 (Macraes) 0.254 (Waihi)	199	5.7	2.85	57.0	128	5.69

(The figures shown in brackets for 2016 are based on a mid-range ore factor of 0.75 g/tonne rather than the mean value of the range shown).

Certainty assessment

Activity data:	HIGH (because they are based on company data)
Input estimates:	MEDIUM -HIGH (because they are based on recent analytical data)
Output estimates:	MEDIUM (because the waste output, the largest category, is based on company data)

4.4 Aluminium production

The Toolkit covers two stages in the aluminium production cycle; initial refining of alumina from bauxite, and the production of aluminium metal from alumina, by smelting. The only primary aluminium production plant in New Zealand is the aluminium smelter at Tiwai Point in Southland and this fits into the latter category. As indicated in the 2012 Inventory Report, the alumina is imported from other countries in a highly refined form, and is believed to contain no significant concentrations of mercury.

There may be some minor releases of mercury on the refinery site from the use of fuel oil in ancillary processes, such as anode manufacture. However, the releases from fuel combustion were previously assessed in section 3.3 so do not need to be covered here.

On the basis of the above, the inputs and outputs from primary aluminium manufacture can be assessed as zero.

4.5 Ferrous metal production (iron and steel)

The only primary iron and steel production in New Zealand is at the New Zealand Steel[7] plant located in Glenbrook, south of Auckland. This plant is quite unique in that it obtains the iron input from nearby reserves of iron sand, which is a mixture of magnetite and titanomagnetite, plus sand and clay (NZIC, 1998a). A concentrate of the iron sand is mixed with coal, and heated in special gas-fired multi-hearth furnaces, followed by further processing in rotary kilns, to form Reduced Primary Concentrate (RPC). The RPC is then heated in electric arc melters to produce metallic iron, which is further processed in a KOBM (Klockner Oxygen Blown Maxhutte) Converter to produce steel. The total steel production for the 2024 calendar year was 571,804 tonnes and the mill used 755,664 tonnes of Waikato and Indonesian coal[8], and 52,291 tonnes of lime (C Brown, New Zealand Steel, pers. comm, 2025).

The ferrous metal sub-category in the Toolkit refers to a much more common iron making process which involves the processing of iron ore – usually haematite - in a sintering plant, followed by treatment in a blast furnace to produce pig iron, and subsequent processing into iron and steel. In terms of mercury inputs, the key differences between this and the New Zealand process would be the mercury content of the iron sand or iron ore, and the relative amounts of coal used. In both processes most of the mercury is likely to be released to air during the first two processing stages (ie, for New Zealand, in the manufacture of RPC and processing in the KOBM).

Mercury analysis of the extracts from leaching tests conducted on KOBM slag, KOBM Baghouse dust, VRU dropout box wastes, Clay Slimes and iron bearing sludge from the IP were found to be less than 0.00008 g/m^3 for tests conducted in 2024 (C Brown, New Zealand Steel, pers comm, 2025).

An initial assessment of the likely mercury inputs and releases can be obtained from consideration of the coal and limestone inputs to the process, as these are likely to be the main contributors to the releases. The mercury content

7 New Zealand Steel is a wholly owned subsidiary of BlueScope Steel Limited.

8 27% of the coal was from Indonesia.

of Waikato coal was discussed in section 3.2, and the content of lime is discussed in section 5.3, and the same ranges of values have been used for the steel input estimates. The steel mill air emissions are passed through bag filters prior to discharge, so the Toolkit distribution factors for fabric filters on coal combustion plants have been used for the output distribution; ie. 50% to air and 50% to land as the baghouse dusts go to a controlled landfill at the NZ Steel site.

The mercury input and output calculations for primary ferrous metal production are shown in Table 4-4.

Table 4-4: Input and output estimates for primary ferrous metal production

Source	Activity Rate, tonnes/yr	Mercury content, mg/kg	Annual Mercury Inputs, kg/yr	Annual Mercury Outputs, kg/yr	
				Air	Land
Waikato Coal, 2012	805,000	0.05 - 0.20	40.3 – 161	20.15 – 80.5	20.15 – 80.5
Waikato Coal, 2016	847,920	0.05 – 0.20	42.4 - 170	21.2 – 85.0	21.2 – 85.0
Waikato Coal, 2020	782,240	0.05 – 0.20	39.1 - 156	19.6 – 78.0	19.6 – 78.0
Waikato Coal, 2024	755,664	0.05 – 0.20	37.78 – 151.13	18.89 – 75.65	18.89 – 75.65
Limestone, 2012	43,000	0.005 – 0.02	0.22 – 0.86	0.11 – 0.43	0.11 – 0.43
Limestone, 2016	61,398	0.005 – 0.02	0.31 – 1.23	0.16 – 0.62	0.16 – 0.62
Limestone, 2020	62,526	0.005 – 0.02	0.31 – 1.25	0.16 – 0.63	0.16 – 0.63
Limestone, 2024	52,291	0.005 – 0.02	0.26 – 1.05	0.13 – 0.523	0.13 – 0.523
Total, 2012			**40.5 – 162 (101)**	**20.3 – 80.9 (50.6)**	**20.3 – 80.9 (50.6)**
Total, 2016			**42.7 - 171 (107)**	**21.4 – 85.6 (53.5)**	**21.4 – 85.6 (53.5)**
Total, 2020			**39.4 – 157 (98.6)**	**19.8 – 78.6 (49.3)**	**19.8– 78.6 (49.3)**
Total, 2024			**38.0 – 152 (95.1)**	**19.0 – 76.2 (47.6)**	**19.0 – 76.2 (47.6)**

Certainty assessment

Activity data: HIGH (because it was based on company data)

Input estimates: LOW (because they are based on a limited range of published data and industry estimates)

Output estimates: LOW (because they are based on default Toolkit output factors for another category).

4.6 Summary for this category

The estimated inputs and outputs for the Primary Metal Production category are summarised in Table 4-5. From this it can be seen that the inputs are dominated by the use of ore in gold and silver production, which is largely separated from the product as a waste stream.

Table 4-5: Summary of inputs and outputs for the primary metal production category for 2024

Category	Mercury Inputs, kg/year	Mercury Outputs, kg/yr				
		Air	Water	Land	Product	Waste
Mercury	-	-	-	-	-	-
Gold & silver, with mercury amalgamation	20 – 40 (30)	4 - 8 (6)	8 – 16 (12)	8 – 16 (12)	-	-
Zinc, copper, lead	-	-	-	-	-	-
Gold & silver, without mercury	199	5.69	2.85	128	5.69	57.0
Aluminium	-	-	-	-	-	-
Ferrous metals	38.0– 152 (95.1)	19.0 - 76.2 (47.6)		19.0 - 76.2 (47.60)	-	
Totals	**257– 391 (324)**	**28.7 – 89.9 (59.3)**	**10.9 – 18.9 (14.9)**	**155 – 220 (187.6)**	**5.69**	**57.0**

5 Production of minerals and materials with mercury impurities

This category covers mercury releases from the production of minerals and related materials with mercury impurities (UNEP, 2023). The sub-categories and the primary release pathways are summarised in Table 5-1 which has been copied directly from the UNEP Toolkit. For the New Zealand inventory, the use of phosphate-based fertilisers and agricultural lime has also been considered under the catch-all sub-category of 'other minerals and materials'.

Table 5-1: Toolkit framework for category 3 –production of minerals and materials with mercury impurities

Toolkit Chapter	Sub-category	Air	Water	Land	Product	Waste/ residue	Main approach
5.3.1	Cement production	**X**		x	x	**x**	PS
5.3.2	Pulp and paper production	**X**	x	x		x	PS
5.3.3	Lime production and light-weight aggregate kilns	**X**			x		PS
5.3.4	Other minerals and materials						PS

Notes: PS = Point source by point source approach;

X - Release pathway expected to be predominant for the sub-category;

x - Additional release pathways to be considered, depending on specific source and national situation.

5.1 Cement production

Currently New Zealand has only one cement manufacturer - Golden Bay Cement in Whangarei. Historically the cement kiln has been fired on coal supplemented by waste wood, but the recent introduction of tyre derived fuel from granulated waste tyres coupled with the purchase of a shredder machine in 2023 has enabled the company to reduce its coal use by 50% (Fletcher Building, 2025).

Total cement production for 2024 is estimated to be one million tonnes. (Fletcher Building, 2025). The primary raw ingredient for cement manufacturing is limestone, which contains traces of mercury (see section 5.3). There is also mercury in the coal used as fuel and in the supplementary fuels. The emissions to air from the kiln are tested annually. The annual mercury emission rate derived from air emission testing carried out in 2024 was 0.47 kg/year. (T Davies, Golden Bay Cement pers comm). This figure has been used to estimate the annual mercury inputs for cement production, including those due to fuel use.

The input factors given in the Toolkit cover a range of 0.004 to 0.05 g/tonne of cement. Applying these factors to a total annual production rate of one million tonnes gives mercury inputs of from 4 to 50 kg/year. Even the bottom of this range is about nine times higher than the Northland data, while the upper value is based on a highly conservative assessment of international information. As a consequence, the Toolkit default factors have not been used for this source category because the available emissions data provides a more relevant estimate.

The Toolkit indicates that there is some partitioning of the mercury between the air emissions and the clinker product. In the Toolkit terminology, the New Zealand plant would be described as having simple particulate controls[9], with output distribution factors of 0.7 (70%) to air and 0.3 (30%) to product. Applying these to the air

9 The particulate control system on the New Zealand plant is actually quite complex. However, it does not include advanced control systems, such as selective non-catalytic reduction for NOx control.

emission rate of 0.47 kg/year, gives an estimated release in product of 0.20 kg/year, and a total production input of 0.67 kg/year.

The mercury input and output estimates for cement production are shown in Table 5-2. The 2012 estimates were much higher because the emissions from the now closed Holcim Westport plant were greater than at Golden Bay Cement.

Table 5-2: Input and output estimates for cement production

Source	Activity Rate, tonnes/yr	Annual Mercury Inputs, kg/yr	Annual Mercury Outputs, kg/yr	
			Air	Product
Cement production, 2012	1,110,000	6.3	4.4	1.9
Cement production, 2016	887,025	0.47	0.33	0.14
Cement production, 2020	802,121	1.31	0.92	0.39
Cement production, 2024	1,000,000	0.67	0.47	0.20

Certainty assessment

Activity data: HIGH (because it was based on plant production data).

Input estimates: MEDIUM (because they are based on a limited amount of measured data).

Output estimates: MEDIUM (because the product release was estimated from a default factor).

5.2 Pulp and paper production

Pulp and paper production is treated as a separate sub-category in the Toolkit because historically there were significant uses of mercury within the industry; especially in chlor-alkali plants (see section 6.1), and as a slimicide (see section 7.6). However, both of these uses no longer occur in New Zealand, so the only significant source of mercury inputs and outputs is via the use of wood, as both a fuel and a raw material. These mercury releases have already been addressed under section 3.5 (biomass combustion).

5.3 Production of lime and light-weight aggregate

This Toolkit sub-category covers the production of burnt lime from the high-temperature treatment (calcination) of limestone, and the similar processes used for manufacturing light-weight aggregate from clay, shale or slate. There are a number of lime kilns in New Zealand, but no evidence has been found to indicate any significant production of the type of aggregate covered by the Toolkit.

There are 5 lime kilns in New Zealand which produce burnt lime from limestone. The two North Island pulp and paper mills also operate lime kilns but these do not process limestone[10]. The other 5 kilns are located in Te Kuiti, Otorohanga (2), and Te Kumi, all in the Waikato region, and Dunback, in Otago (MfE, 2025). Data is not available for the total burnt lime production in New Zealand in 2024. However it is possible to derive a production figure from the carbon dioxide emission figures that burnt lime manufacturers must declare annually to New Zealand's Emission Trading Scheme. This calculation takes the form: total carbon dioxide emissions (tonnes) = 0.748 x (tonnes calcium oxide produced). Data given in the most recent New Zealand Greenhouse Gas Inventory report

[10] The pulp mill lime kilns form part of an internal chemical recycling process for the so-called 'lime mud' produced in the pulp making process. Some minor calcium additions are required to make up for losses in wastes, but these are obtained from baked lime rather than limestone.

for 2023 gives a greenhouse gas emission from lime production of 96,200 tonnes CO2. (MfE 2025). This allows an estimate of actual lime production of 128,610 tonnes in 2023 (MfE, 2025). This is lower than the 144,385 tonnes produced in 2019 used for the previous inventory.

The Toolkit does not recommend any default factors for lime manufacture because the available data is very limited. However, it does note a US EPA study which reported a mercury release rate of 9 mg/tonne of lime produced. This is consistent with the results of <10 and 20 mg/tonne reported by McBride and Spiers (2001) for two samples of agricultural lime (limestone) sourced from the north-eastern United States. Within New Zealand, Curtis (2007) reported that a sample of Otago limestone collected had a mercury content of 20 mg/tonne.

In the absence of any recommended Toolkit factors, a range of 5 to 20 mg/tonne[11] will be used for the mercury inputs estimates. Some of the lime kilns are fired on coal but the inputs and outputs from this component have already been accounted for under section 3.2 and the carbon dioxide emissions described above are for the calcination process only. In accordance with the Toolkit guidance, the output distribution factors will be assumed to be the same as those used for cement production.

The mercury input and output estimates for lime production are shown in Table 5-3.

Table 5-3: Input and output estimates for lime production

Source	Activity Rate, tonnes/yr	Mercury content, mg/t	Annual Mercury Inputs, kg/yr	Annual Mercury Outputs, kg/yr	
				Air	Product
Lime production, 2012	170,000	5 - 20	0.85 – 3.4 (2.1)	0.60 – 2.38 (1.5)	0.255– 1.02 (0.64)
Lime production, 2016	245,700	5 - 20	1.23 – 4.91 (3.07)	0.86 – 3.44 (2.15)	0.37 – 1.47 (0.92)
Lime production, 2020	144,385	5 - 20	0.72 – 2.89 (1.81)	0.50 – 2.02 (1.26)	0.22 – 0.867 (0.54)
Lime production, 2024	128,610	5 - 20	0.64 – 2.57 (1.61)	0.45 -1.80 (1.13)	0.19 – 0.77 (0.48)

Certainty assessment

Activity data: HIGH (because it was based on published data)

Input estimates: LOW - MEDIUM (because they are based on limited published data)

Output estimates: LOW (because the releases were estimated from default factors for cement production).

5.4 Other minerals and materials

Two other New Zealand sources of mercury releases from minerals have been identified for this inventory; the application of phosphatic fertilisers and agricultural lime to land.

11 The lower figure of 5 is based on half the limit of detection (LOD) reported by McBride and Spiers. This is the approach normally used when laboratory results are reported as being less than the LOD.

Phosphate fertilisers

New Zealand agriculture uses a significant amount of superphosphate fertiliser, which is manufactured from imported phosphate rock (NZIC, 1998b). There are 6 manufacturing plants in New Zealand, located in Northland, Bay of Plenty, Hawkes Bay, Canterbury, Otago and Southland regions.

The phosphate rock is imported from numerous other countries and contains varying amounts of mercury. For the 2012 and 2016 inventories the amount of mercury introduced to New Zealand from phosphate rock was estimated by converting import quantities into weight of superphosphate equivalent and then using the mean and range of superphosphate analytical results available to derive a range for mercury inputs. For example measurements in 2015 and 2016 conducted on 65 monthly samples had values in the range < 0.05 - 2.7 mg/kg superphosphate with a mean of 0.09 mg/kg superphosphate (G Sneath, Fertiliser Association, pers comm, 2017). The latter concentration figure was used for the upper limit[12] in the input and output estimates, along with a lower level of 0.05 mg/kg to give a mercury input range of 54.8 – 98.6 kg/year for 2016.

However according to the Fertiliser Association of New Zealand, superphosphate is not the only phosphate product which is applied in New Zealand. Other products include Sulphur Super and Di-ammonium Phosphate (DAP). Superphosphate and Sulphur Super now comprise the majority of phosphate fertiliser applications with DAP holding the 40% of market share remaining (G Sneath, Fertiliser Association, pers comm, 2025). It should be noted that these comparisons are based on the phosphorous content of the fertiliser. New Zealand fertiliser application records are recorded on the basis of the amount of phosphorous applied rather than the weight of the fertiliser itself because they vary in their phosphorous content. For example superphosphate is 9% phosphorous and DAP is 20% phosphorous. As with previous inventories the approach used for fertiliser consumption is based on the average of the reference year and the two preceding years. In 2024 122,000 tonnes of phosphorous in fertiliser were applied in New Zealand (G Sneath, Fertiliser Association, pers comm, 2025). This is significantly lower than the figure of 149,000 tonnes used for the 2020 Inventory and reflects a long term trend in decreases of application of phosphate fertilisers.

Using average mercury analysis results for DAP and superphosphate over the same three years (where non-detected results contribute a concentration of half the detection limit and assuming the superphosphate/DAP market share is 60/40) the annual mercury release associated with the application of 122,000 tonnes of phosphorous in fertiliser is 132 kg (G Sneath, Fertiliser Association, pers comm, 2025). As with previous inventories the mercury is assumed to be discharged to land.

Agricultural lime

Agricultural lime is applied directly to pastures in New Zealand as a soil conditioner. This material is manufactured simply by grinding limestone to produce a coarse powder, and the total quantity produced in 2023 was 940,364 tonnes (NZ Petroleum and Minerals, 2023). 2024 quantities are not yet available so this value will be used as an estimate. It is similar to the quantities reported for 2016 and 2020.

The mercury content has been assumed to be the same as that noted previously in section 5.3; ie, 5 to 20 mg/tonne.

Input and output estimates

The mercury input and output estimates for the use of other mineral products are shown in

Table 5-4.

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12 The use of the mean value instead of the maximum was adopted because the analytical data is highly skewed towards the mean.

Table 5-4: Input and output estimates for other mineral products

Source	Activity Rate, tonnes/yr	Mercury content, g/tonne	Annual Mercury Inputs, kg/yr	Annual Mercury Outputs, kg/yr
				Land
Phosphate fertiliser, 2012	630,750	0.05 – 0.34	31.5 – 214.5 (123)	31.5 – 214.5 (123)
Phosphate fertiliser, 2016	1,096,000	0.05 – 0.09	54.8 – 98.6 (76.7)	54.8 – 98.6 (76.7)
Phosphate fertiliser, 2020	149,000 (as P)	1.255 (as P)	187	187
Phosphate fertiliser, 2024	122,000 (as P)	1.082 (as P)	132	132
Agricultural lime, 2012	1,370,000	0.005 -0.02	7 – 27 (17)	7 – 27 (17)
Agricultural lime, 2016	975, 538	0.005 – 0.02	4.88 – 19.5 (12.2)	4.88 – 19.5 (12.2)
Agricultural lime, 2020	986,870	0.005 – 0.02	4.93 – 19.7 (12.3)	4.93 – 19.7 (12.3)
Agricultural Lime, 2024	940,364	0.005 – 0.02	4.70 – 18.8 (11.8)	4.70 – 18.81 (11.8)

Certainty assessment

Activity data: HIGH (because it is based on national statistics)

Input estimates: HIGH for phosphate fertiliser (because it is based on a comprehensive analytical programme)
LOW – MEDIUM for agricultural lime (because they are based on limited published data)

Output estimates: LOW (because no manufacturing release factors were available).

5.5 Summary for this category

The estimated inputs and outputs for the minerals category are summarised in Table 5-5.

Table 5-5: Summary of inputs and outputs for production of minerals and related materials with mercury impurities for 2024

Category	Mercury Inputs, kg/year	Mercury Outputs, kg/yr				
		Air	Water	Land	Product	Waste
Cement	0.67	0.47	-	-	0.20	-
Pulp and paper	-	-	-	-	-	-
Lime	0.643 – 2.57 (1.61)	0.450 -1.80 (1.13)	-	-	0.193 – 0.772 (0.483)	-
Phosphate fertiliser	132		-	132	-	-
Agricultural lime	4.70 – 18.8 (11.8)	-	-	4.70 – 18.8 (11.8	-	-
Totals	**138 – 154 (146)**	**0.92 – 2.27 (1.60)**	**-**	**136.7– 150.8 (144)**	**0.393 – 0.972 (0.683)**	**-**

6 Intentional use of mercury in industrial processes

This category covers mercury releases from several industrial chemical processes (UNEP, 2023), none of which exist in New Zealand. However, for the sake of completeness, the sub-categories and the primary release pathways are summarised in Table 6-1, which has been copied directly from the UNEP Toolkit, and information on the relevance to New Zealand is presented below.

Table 6-1: Toolkit framework for category 4 – intentional use of mercury in industrial processes

Toolkit Chapter	Sub-category	Air	Water	Land	Product	Waste/ residue	Main approach
5.4.1	Chlor-alkali production with mercury technology	X	X	X	X	X	PS
5.4.2	VCM (vinyl chloride monomer) production with $HgCl_2$ catalyst	x	x			X	PS
5.4.3	Acetaldehyde production with $HgSO_4$ as catalyst						PS
5.4.4	Other chemicals and polymers with mercury catalysts						PS

Notes: PS = Point source by point source approach;

X - Release pathway expected to be predominant for the sub-category;

x - Additional release pathways to be considered, depending on specific source and national situation.

6.1 Industrial uses of mercury in New Zealand[13]

Chlor-alkali plants were used at one of the pulp and paper mills until the early 1980s, when they were replaced with a modern system based on a membrane cell technology which does not involve mercury (NZIC, 1998c).

Vinyl chloride monomer is not manufactured in New Zealand, although significant volumes of the polymerised form of vinyl chloride (ie polyvinyl chloride, PVC) are imported for use in making PVC products.

Similarly, there is no manufacturing of acetaldehyde in New Zealand, or of two-part polyurethanes involving mercury catalysts.

In 2021 the Minister for the Environment, Hon David Parker, recommended to Cabinet that the National Emission Standards for Air Quality be amended to specifically prohibit the use of mercury in chlor alkali, acetaldehyde, vinyl chloride monomer, sodium or potassium methylate or ethylate and polyurethane production (Office of the Minister for the Environment, 2021).

13 A more detailed discussion of each of these potential sources was given in the 2012 Inventory Report.

7 Consumer products with intentional use of mercury

This category covers mercury uses in a wide range of different consumer products (UNEP, 2023). The various sub-categories and the primary release pathways are summarised in Table 7-1.

Table 7-1: Toolkit framework for category 5 – consumer products with intentional use of mercury

Toolkit Chapter	Sub-category	Air	Water	Land	Product	Waste/ residue	Main approach
5.5.1	Thermometers with mercury	**X**	**X**	**X**	**X**	**X**	OW
5.5.2	Electrical switches, contacts and relays with mercury	**X**	x	**X**	**X**	**X**	OW
5.5.3	Light sources with mercury	**X**	x	**X**	**X**	**X**	OW
5.5.4	Batteries containing mercury	**X**	x	**X**	**X**	**X**	OW
5.5.5	Polyurethane with mercury catalyst	**X**	x	**X**	**X**	**X**	OW
5.5.6	Biocides and pesticides	**X**	**X**	**X**	**X**	**X**	OW
5.5.7	Paints	**X**	x	x	**X**	x	OW
5.5.8	Pharmaceuticals for human and veterinary uses	**X**	x	x	x	**X**	OW
5.5.9	Cosmetics and related products		**X**		**X**	x	OW

Notes: OW = National/overview approach;

X - Release pathway expected to be predominant for the sub-category;

x - Additional release pathways to be considered, depending on specific source and national situation.

7.1 Mercury thermometers

No New Zealand manufacturers of mercury in glass thermometers were identified in this survey.

Imports/sales

Import data for Customs' code 9025.11.00.00 (liquid-filled, direct-reading, thermometers and pyrometers) was obtained from Statistics New Zealand for 2024. However, this only indicates the total value of the imports, which was $828,664. In addition, the data cover all types of thermometers, including those not containing mercury, such as alcohol-filled thermometers.

There is only one New Zealand supplier of mercury containing thermometers. Only one thermometer was sold by them in 2024.

Mercury thermometers are listed as non-electronic measuring devices which cannot be manufactured, imported or exported after 2020 as required by The Minamata Convention. An exception is made if the thermometers are installed in large-scale equipment or used for high precision measurement where no suitable mercury-free alternative is available (UNEP, 2024)

Current Stocks

An estimate of 'current' thermometer stocks in New Zealand was prepared for the 2012 Inventory Report through a survey of hospitals and laboratories throughout the country. The total stocks were estimated at 53,400 units, with a total mercury content of between 26.7 and 267 kg. This work has not been repeated for the current inventory, but it could be expected that the total will have declined, as the organisations continue to move towards using non-mercury alternatives.

Input and output estimates

The Toolkit indicates that medical thermometers typically contain 0.5 – 1.5 grams of mercury each, while laboratory thermometers can contain 1 – 40 grams per unit. The upper limit for laboratory thermometers appears quite extreme, so for the purposes of this inventory, the estimate has been based on an overall range of 0.5 – 5 grams/unit (also noting that the majority of units are 'medical' size).

For estimating outputs, the Toolkit recommends distribution factors of 0.1 (10%) to air, 0.3 (30%) to water and 0.6 (60%) to waste, for countries with publicly controlled waste collection services. It should be noted that these factors should only be applied to the annual imports/sales numbers, rather than the total thermometer stocks in a country, on the basis that the former most likely represent the annual turnover rate for the current stocks. In addition, the current stocks should not be counted as part of the annual inputs because the mercury is not 'mobilised' until the thermometers are disposed.

The mercury input and output estimates for the use of thermometers are shown in Table 7-2.

Table 7-2: Input and output estimates for mercury thermometers

Source	Activity Rate, units/yr	Mercury content, g/unit	Annual Mercury Inputs, kg/yr	Annual Mercury Outputs, kg/yr		
				Air	Water	Waste
Annual sales, 2012	6,500	0.5 – 5	3.25 – 32.5 (17.9)	0.325 – 3.25 (1.8)	0.975 – 9.75 (5.4)	1.95 – 19.5 (10.7)
Annual sales, 2016	3,810	0.5 - 5	1.91 – 19.05 (10.48)	0.19 – 1.91 (1.05)	0.57 – 5.72 (3.14)	1.14 – 11.4 (6.29)
Annual sales, 2020	1,107	0.5 - 5	0.554 – 5.54 (3.04)	0.055 – 0.554 (0.305)	0.166 – 1.66 (0.91)	0.332 – 3.32 (1.83)
Annual sales, 2024	1	0.5 - 5	0.0005 – 0.005 (0.0028)	0.00005 – 0.0005 (0.00028)	0.00015 – 0.0015 (0.00083)	0.0003 – 0.003 (0.0017)

Certainty assessment

Activity data: MEDIUM (because it is based on limited survey data)

Input estimates: LOW (because they are based on the Toolkit default factors)

Output estimates: LOW (because they are based on the Toolkit default factors).

7.2 Electrical and electronic switches, contacts and relays

Mercury has been used, and continues to be used, in a variety of electrical switches and relays. Historically, one of the largest uses by volumes of mercury, per unit, was in electrical rectifiers and mercury arc valves, which were used in electricity distribution networks and industrial facilities. This type of equipment has a long service life, so there may still be a significant number of items still in use, despite the ready availability of non-mercury alternatives. At the consumer level, small mercury tilt switches have been widely used in many electrical appliances, and in car boot light switches and ABS braking systems. Mercury switches can also be found in some electrical thermostats, flame sensors, and bilge pumps for boats (UNEP, 2023).

Mercury containing switches and relays are products which cannot be manufactured, imported or exported after 2020 as required by The Minamata Convention. Exceptions include very high accuracy capacitance and loss measurement bridges and high frequency radio frequency switches and relays in monitoring and control instruments with a maximum mercury content of 20 mg per bridge, switch or relay (UNEP, 2024).

2012 survey of current stocks, imports, sales and use

The work for the 2012 Inventory included an extensive survey of possible importers, distributors and users of electrical equipment to identify possible stocks of mercury-containing equipment. No significant imports were identified but one supplier was found to have about 200 small switches in stock, with a mercury content of about 1 gram per switch, and annual sales of about 10 switches. It was concluded that the total quantities of mercury possibly being distributed through sales of switches would be very small.

The survey of possible users of electrical equipment identified total current stock holdings of about 170 kg of mercury, mainly in old relays and switches. This survey has not been repeated for the current inventory, but it should be expected that the stock holdings will be gradually decreasing, as most people contacted in 2012 indicated that they were phasing out any mercury-containing equipment.

Input and output estimates

The methodology given in the Toolkit is based on a simple population-based estimate. A new lower input factor for electrical switches and relays of 0.0012 g/ year per capita was introduced in the latest version of the Toolkit. For previous New Zealand inventories prepared since 2012, factors of 0.002 - 0.02 grams/year per capita were used. The New Zealand population at June 30 2024 was 5,338,500 (Statistics NZ, 2024)

For outputs, the Toolkit recommends distribution factors of 0.1 (10%) to air, 0.1 (10%) to land and 0.8 (80%) to waste, for countries with publicly controlled waste collection services, but only limited waste separation. These factors have been applied to the per capita inputs estimated using the modified Toolkit factors.

The mercury input and output estimates for mercury switches and relays are shown in Table 7-3.

Table 7-3: Input and output estimates for mercury switches and relays

Source	'Activity' (population)	Mercury input rate, g/capita	Annual Mercury Inputs, kg/yr	Annual Mercury Outputs, kg/yr		
				Air	Land	Waste
Annual usage, 2012	4.4 x 10^6	0.002 – 0.02	8.8 – 88 (48.4)	0.9 – 8.8 (4.84)	0.9 – 8.8 (4.84)	7.0 – 70.4 (38.7)
Annual usage, 2016	4.7 x 10^6	0.002 – 0.02	9.4 - 94 (51.70)	0.94 – 9.4 (5.17)	0.94 – 9.4 (5.17)	7.5 – 75.2 (41.36)
Annual usage, 2020	5.0 x 10^6	0.002 – 0.02	10 – 100 (55.3)	1.0 – 10 (5.50)	1.0 – 10 (5.50)	8.0 – 80.0 (44.2)
Annual usage, 2024	5.34 x 10^6	0.0012	6.4	0.64	0.64	5.12

Certainty assessment

Activity data: HIGH (because it is based on national population)

Input estimates: LOW (because they are based on the Toolkit default factors)

Output estimates: LOW (because they are based on the Toolkit default factors).

7.3 Light sources (lamps)

Mercury is used in small amounts (per lamp) in fluorescent tubes (LFLs) and compact fluorescent lamps (CFLs), and in high-pressure discharge types, such as metal halide, mercury vapour, sodium, and neon lamps (UNEP, 2023).

The most common use for the discharge lamps is in street lighting. Increasingly in New Zealand high discharge street lamps are being replaced by light emitting diode (LED) lights which do not contain mercury and which are more energy efficient, have lower maintenance costs and produce a safer driving environment due to improved white light clarity and colour recognition for drivers. (IPWEA, 2016). Auckland Transport's design code for street lighting specifies: "all new or replacement luminaries must be LED luminaries" (Auckland Transport, 2022).

LFLs and CFLs

LFLs and CFLs use a small amount of mercury and argon in a tube to produce ultraviolet light when an electric current is passed through the tube. This stimulates a phosphor coating to produce visible light. Modern triband phosphor lamps utilise three combined materials to create an overall white hue and are the technical successor of the original halophosphate lamps (UNEP, 2023).

A CFLi lamp includes the ballast which initially powers up the light and then controls the current. These CFLs can be inserted directly into a light socket. CFLni lamps do not include a ballast and can only operate in a luiminaire unit which contains one and tend to be used for commercial lighting applications rather than domestic.

Import data for fluorescent lamps and tubes was obtained from Statistics New Zealand for 2024 (HS Code: 8539.31.00.00). This indicated total annual imports of LFLs and CFLs of 763,148 units per year.

The Energy Efficiency & Conservation Authority (EECA) collects sales data for all regulated appliances (EECA, 2025). From 1 April 2023 – 31 March 2024 there were 122,640 CFLs and 314,193 LFLs sold in New Zealand. This sales data has been used in estimating the mercury inputs, rather than the bulk import information noted above. Since peaking in 2014 with sales figures of 2.72 million, annual CFL light sales have declined steadily as they are replaced with LED lamps. Sales for 2024 were 30% lower than those for 2023.

Since 2020 the Minamata Convention has not permitted import or export of CFLs less than 30 watts with a mercury content exceeding 5 mg per lamp. All CFLi lamps less than 30 watts are banned from 2025. CFLs greater than 30 watts and all CFLni lamps will be banned from 2026 (UNEP, 2024).

Similarly LFLs of the triband phosphor type less than 60 Watts with a mercury content greater than 5 mg and halophosphor LFLs less than 60 W and mercury content less 10 mg than have not been permitted for import or export since 2020. The remaining LFLs are scheduled to be phased out in 2026 and 2027 (UNEP, 2024).

With regard to the mercury content of CFLs it is expected that most New Zealand products sold will comply with Australian requirements (M Hammond-Blain, EECA, pers comm, 2022). Under Australian regulations maximum mercury levels for CFL lights are 5 mg for lights 30 Watts and over and 2.5 mg for lights under 30 Watts. The Toolkit's most recent revision (UNEP, 2023) recommended a default input factor of 2.7 mg mercury per CFL and this has been adopted.

From 2017 Australian regulations required LFL lights to have a mercury content below 5 mg. Previous New Zealand mercury inventories have used a range from 1.1 – 5 mg mercury per LFL. This is is lower than the current Toolkit default factor of 8 mg mercury / LFL but is more appropriate for the New Zealand market. A recent lighting product review gives a mercury content range of 1.5 – 3.3 mg for triband phosphor LFLs and 8 – 10 mg for halophosphate LFLs (UNEP, 2020).

Other discharge lamps

Import data was also obtained for a range of other discharge lamps, using 7 different HS codes (ie. those in the range 8539.32.00.01 to 8539.49.90.00). This showed total imports in 2024 of about 41,000 high-intensity discharge lamps, and about 201,000 'other' lamps', many of which are ultra violet lights with or without a filament.

With regard to the high intensity lamps the Lighting Council of New Zealand has raised the issue of failed power correction capacitors for this type of light, leading to a perceived increased risk of electrical fires (Lighting Council NZ, 2024). The Lighting Council regard all high intensity discharge lamps as obsolete technologies and encourage their replacement with light emitting diode lights (LEDs) which have substantially lower energy use, maintenance needs and operating costs.

As can be seen in Table 7-4, high pressure mercury vapour lamps (HPMVs) have continued their steep decline with only 1504 units imported in 2024. These lights are typically used in factories and warehouses. The Minamata Convention has not allowed import and export of HPMVs since 2020 (UNEP, 2024).

Imports of high pressure sodium (HPS) lamps in 2024 at 23,781 units have increased 50% compared to 2020 although that year's activity may have been affected by the Covid pandemic. It would appear that these lamps are still being used for street lighting and other commercial and industrial applications despite initiatives like those of Auckland Transport mentioned above to replace them with LEDs. Given that the life of an HPS lamp is about 4 years (NZ Transport Agency, 2025) the 2024 HPS import quantities suggest there are still about 95,000 such street lights operating out of a total of about 300,000 street lights in New Zealand (Te Ara Encyclopedia, 2009).

Metal halide lamp imports have declined since 2020, although 16,163 units were still imported. These lights are used in car headlamps and it is not possible to retrofit with mercury free replacements without replacing the lighting control circuit which may be uneconomic. It can also be difficult to obtain an LED lamp with the same shape (UNEP, 2020).

Numbers of ultraviolet lights imported in 2024 were similar to those imported in 2020. While it is assumed many of these lamps are used in the cosmetic tanning industry, other potential applications include wastewater sterilisation, light sources for the operation and calibration of scientific instruments, bank note recognition projector lamps, studio lighting, show effect lighting and theatre lighting, insect zapping, and various medical applications including skin conditions and gastric endoscopes. (UNEP, 2020). These processes often have specific requirements in terms of ultraviolet light wavelength which may not be matched by potential LED replacements.

Input and output estimates

The estimates for the total mercury inputs for all lamps are summarised in Table 7-4. This has been based on the mercury content information given above or the Toolkit default factors when local information was not available.

For outputs, the Toolkit recommends distribution factors of 0.05 (5%) to air, and 0.95 (95%) to waste, for countries with publicly controlled waste collection services, but only limited waste separation. These factors will be applied to the New Zealand input estimates.

Table 7-4: Input estimates for lamps

Lamp type	Mercury content, mg/lamp	Number of lamps, thousands	Total mercury input, kg/year
Fluorescent Tubes (LFLs), 2012	2 – 5	3,000 – 3,500	6 – 17.5
Fluorescent Tubes (LFLs), 2016	1.1 - 5	1,600	1.76 – 8.0
Fluorescent Tubes (LFLs), 2020	1.1 - 5	832	0.92 – 4.2
Fluorescent Tubes (LFLs), 2024	1.1 - 5	314	0.35 – 1.57
Compact Fluorescent Lamps (CFLs), 2012	1 – 3	2,500 – 3,500	2.5 – 10.5
Compact Fluorescent Lamps (CFLs), 2016	1.1 - 5	1,400	1.54 – 7.0
Compact Fluorescent Lamps (CFLs), 2020	2.7	943	2.55
Compact Fluorescent Lamps (CFLs), 2024	2.7	123	0.331
High Pressure Mercury Vapour, 2012	30	50	1.5
High Pressure Mercury Vapour, 2016	30	35	1.1
High Pressure Mercury Vapour, 2020	40	15	0.61
High Pressure Mercury Vapour, 2024	40	1.50	0.060
High Pressure Sodium Lamps (HPS), 2012	10 - 30	120	1.2 - 3.6
High Pressure Sodium Lamps (HPS), 2016	10 – 30	56	1.7 – 2.8
High Pressure Sodium Lamps (HPS), 2020	10 - 30	16	0.16 – 0.48
High Pressure Sodium Lamps (HPS), 2024	10 - 30	24	0.24 – 0.71
UV lamps for tanning, 2012	5 – 25	50 - 100	0.25 – 2.5
UV lamps for tanning, 2016	5 – 25	92	0.46 – 2.3
UV lamps for tanning, 2020	5 - 25	210	1.1 – 5.3
UV lamps for tanning, 2024	5 - 25	201	1.0 – 5.0
Metal halide lamps, 2012	25	500	12.5
Metal halide lamps, 2016	25	106	1.6 – 5.3
Metal halide lamps, 2020	25	27	0.68
Metal halide lamps, 2024	25	16	0.40

The mercury input and output estimates for mercury lamps are shown in Table 7.5.

Table 7-5: Input and output estimates for mercury lamps

Source	Annual Mercury Inputs, kg/yr	Annual Mercury Outputs, kg/yr	
		Air	Waste
All lamps (see details above), 2012	24 – 48.1 (36.0)	1.2 – 2.4 (1.8)	22.8 – 45.7 (34.2)
All lamps (see details above), 2016	8.16 – 26.5 (17.33)	0.41 – 1.33 (0.88)	7.75 – 25.18 (16.47)
All lamps (see details above), 2020	6.0 – 13.8 (9.83)	0.30 – 0.69 (0.50)	5.71 – 13.1 (9.3)
All lamps (see details above), 2024	2.4 – 8.1 (5.25)	0.12 – 0.41 (0.26)	2.27 – 7.71 (4.99)

Certainty assessment

Activity data: HIGH (because it is based on national import data)

Input estimates: MEDIUM (because they are based on published data and industry estimates)

Output estimates: LOW (because they are based on the Toolkit default factors).

7.4 Light sources (LCD screens)

LCD screens containing cold cathode fluorescent lamps (CCFLs) as the lighting source were considered a significant source of mercury for the 2012 Mercury Inventory. The intervening years have seen a period of rapid technological growth where light emitting diode (LED) lighting has completely replaced CCFL lighting in LCD television screens and computer monitors

Because LEDs are mercury free, television screens and computer monitors need no longer be considered as a continuing source of mercury inputs.

7.5 Batteries

Historically mercury was added to batteries for technical reasons such as the prevention of hydrogen gas production which can cause bulging and leaking. In mercury oxide cells it is a major active ingredient accounting for 32% of battery weight. Its uses have been predominantly restricted to primary batteries, that is batteries which are not rechargeable (UNEP, 2023).

The Statistics New Zealand's Infoshare site shows that approximately 72 million primary batteries were imported into New Zealand in 2024. Of this total about 18% comprise non-alkaline zinc carbon batteries (typically cylindrical AA and AAA and rectangular 9V types) and lithium batteries both of which are acknowledged to be mercury free globally.

The remaining 59 million batteries may contain mercury at trace to more significant levels. They have the following distribution:

- About 76% are alkaline manganese dioxide composition and like the zinc carbon batteries are typically sold as cylindrical AA, AAA and rectangular 9V products
- About 15% are alkaline button batteries used in products like digital thermometers and calculators.
- About 7% are air zinc button batteries predominantly used in hearing aids.
- About 0.7% are silver oxide button batteries used in watches and cameras
- About 0.04% are mercuric oxide batteries

42% of alkaline manganese dioxide batteries were imported from China with significant contributions also from Indonesia, Malaysia and Singapore. China also contributed the lion's share (95%) of alkaline button batteries. On the other hand Germany at 63% was the major contributor of air zinc button batteries with Singapore and China supplying 29%. Japan was the major supplier of silver oxide button batteries (60%). China is listed as the sole supplier of mercuric oxide batteries although only 22,877 units were imported.

According to legislation and regulations relevant for the countries supplying New Zealand, cylindrical batteries imported in 2024 should now be mercury free. Annex A of the Minamata Convention details the prohibition of importing or exporting of batteries containing mercury and this has been a requirement since 2020. Button zinc silver oxide and button zinc air batteries with a mercury content less than 2% have been exempt but must be phased out by 2025 (UNEP, 2024).

EU Regulation 2017/852 prohibited export, import and manufacturing of batteries that contain more than 0.0005% of mercury by weight after 31 December 2018 (UNEP, 2023).

In China, from 1 January 2021, manufacture of the following battery types was prohibited: mercury oxide batteries, cylindrical alkaline manganese batteries with mercury concentration more than 0.0001% and alkaline manganese batteries with mercury concentration more than 0.0005%. Zinc-silver oxide and zinc air batteries with mercury concentrations below 2% were exempted (UNEP, 2023).

The National Electrical Manufacturers Association (NEMA) in the US reports that there are examples of mercury use in cylindrical batteries (China) and zinc air batteries (Japan) but with low sales volumes, roughly estimated less than 5% for cylindrical (China) and less than 10% for zinc air (Japan). It is NEMA's understanding that all other types are globally mercury free.

A 2019 UNEP study revealed that the major battery suppliers Duracell, Energizer, Varta and Panasonic supplied only mercury free alkaline button, silver oxide and zinc air batteries (UNEP, 2023).

With respect to mercury oxide batteries, the Toolkit comments that there are instances where national trade statistics may be inaccurate. This arises because they are normally sold in small quantities and consequently are vulnerable to mis-categorisation of other batteries in traders' reports to statistics bureaus. This can have significant consequences, because even moderate reported sales of mercury-oxide batteries may represent a very high mercury turnover because of the high mercury content in these batteries (UNEP, 2023). On the other hand UNEP note that the high frequency of mercury oxide battery registrations confirms the continued trade of these batteries.

Input and output estimates

In order to estimate mercury inputs from batteries, import data was obtained for each battery type, using HS codes 8506.10.00.01 to 8506.80.00.19.

Where batteries have been adjudged to contain mercury, the quantities of mercury were calculated by multiplying the number of units by their respective average weights and by the mercury content of each cell.

In line with the discussion in the preceding section it has been assumed that all alkaline cylindrical batteries imported in 2024 were mercury free. After 2025 it may be possible to assume that all primary battery types imported are mercury free but until then alkaline, silver oxide and zinc air button batteries have been treated as in the 2016 and 2020 inventories where it was assumed that 25% of the total imports from each category still contain mercury. Toolkit factors have been modified to accommodate this.

The estimated mercury inputs for the different battery types are shown in Table 7-6[14]. For the outputs it was assumed that all of the batteries were disposed to waste (landfill). The Toolkit notes that even in countries with separate battery collection, a major proportion of the consumed batteries are disposed of with general household waste. (UNEP, 2023).

A report by Consumer NZ discussed the used battery disposal options for households (Consumer NZ, 2019). The options available were either disposal at the local council run hazardous waste collection facility at transfer stations or landfills or depositing with a battery recycling scheme. In the former case batteries are typically treated by encapsulation in concrete and then transferred to landfill. For the latter, battery recycling was estimated to cover only 0.2% of annual battery sales[15] and the batteries are currently being stored by the recyclers because there are no local companies capable of recycling batteries in New Zealand.

WasteMINZ is currently investigating issues associated with the small battery sector in New Zealand including disposal with a report due in January 2026.

The input and output calculations are shown in Table 7-7. The figures shown in brackets are the mean of the reported ranges.

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14 The data given in Table 7-6 of the 2012 Inventory report included small contributions from Zinc-Carbon, and Other MnO_2 batteries. However, according to the Toolkit these can be regarded as mercury-free. Hence these batteries have not been included the current table 7-6. In addition, the 2012 totals given in Table 7-7 have been adjusted to exclude the zinc carbon and other MnO_2 data.

15 For button batteries such as zinc air the recycling rate may be higher because many audiology companies collect hearing aid batteries and provide specific disposal containers for their customers.

Table 7-6: Estimated mercury inputs for batteries

Type	Size, cm^3	Mercury content g/kg	Number of batteries	Weight per battery, g	Total weight of batteries, kg	Mercury inputs, kg
Mercury oxide button, 2012	<300	320	98,126	1	98	31.4
Mercury oxide button, 2016	<300	320	2,543	1	2.5	0.81
Mercury oxide button, 2020	<300	320	14,287	1	14.3	4.57
Mercury oxide button, 2024	< 300	320	22,877	1	22.9	7.32
Silver oxide button, 2012	all	3.4 – 10	653,266	1	653	2.2 – 6.5
Silver oxide button, 2016	all	1	815,320	1	815	0.82
Silver oxide button, 2020	all	1	305,051	1	305	0.31
Silver oxide button, 2024	all	1	398,040	1	398	0.40
Zinc air button, 2012	all	0 - 30	2,754,161	1	2,754	0 – 82.6
Zinc air button, 2016	all	3	3,748,150	1	3,748	11.2
Zinc air button, 2020	all	3	3,975,291	1	3,975	11.9
Zinc air button, 2024	all	3	4,810,097	1	4,810	14.4
Alkaline button, 2016[a]	all	1.25	6,828,996	1	6,829	8.54
Alkaline button, 2020[a]	all	1.25	8,474,609	1	8,475	10.6
Alkaline button, 2024 [a]	all	1.25	9,031,832	1	9,032	11.3
Alkaline MnO_2, 2012	<300	0 – 0.00006[b]	36,705,233	12	440,462	0 – 0.026
Alkaline MnO_2, 2016	<300	0.25	31,167,321	12	374,004	23.4
Alkaline MnO_2, 2020	<300	0.063	47,043,112	12	564,516	35.6
Alkaline MnO_2, 2024	<300	0	44,579,939	12	534,959.3	0

Footnotes: a. the import data provided in 2012 did not provide separate data for alkaline button batteries b. the mercury content factor used in 2012 was not correct.

Table 7-7: Input and output estimates for batteries

Source	Activity Rate, units/yr	Mercury content, g/kg	Annual Mercury Inputs, kg/yr	Annual Mercury Outputs, kg/yr
				Waste
Batteries, 2012	40,240,776	0 - 320	33.6 – 120.6 (77.1)	33.6 – 120.6 (77.1)
Batteries, 2016	42,936,897	0 - 320	44.77	44.77
Batteries, 2020	59,812,360	0 - 320	62.99	62.99
Batteries, 2024	58,842,785	0 - 320	33.44	33.44

Certainty assessment

Activity data: HIGH (because it was obtained from national import statistics)

Input estimates: MEDIUM (because they are based on product data and the default Toolkit factors)

Output estimates: HIGH (because essentially all batteries are disposed to landfill).

7.6 Polyurethanes with mercury catalyst

As discussed in Section 6.1, in 2021 the Minister for the Environment, Hon David Parker, recommended to Cabinet that the National Emission Standards for Air Quality be amended to specifically prohibit the use of mercury in polyurethane production (Office of the Minister for the Environment, 2021). For the 2012 and 2016 Inventory reports it was estimated that sales of mercury catalyst were occurring from a single importer with a total quantity of 200 grams. With the impending ban and the small quantities previously involved it has been assumed that releases from this source are insignificant.

7.7 Biocides and pesticides

Most substances intended for use as agricultural or veterinary medicines in New Zealand are required to be registered under the Agricultural Chemicals and Veterinary Medicines Act. A database of current registrations is maintained by the Ministry for Primary Industries (MPI, 2025), and a search of this database showed no mercury-containing chemicals.

On the basis of the above, it can be concluded that there is no current use of mercury-based biocides as agricultural or veterinary medicines in New Zealand. However, it should be noted that some minor uses have been identified in animal vaccines and eye drops, where the mercury compounds act as a preservative. These uses are covered under section 7.9.

7.8 Paints

The report for the 2012 Inventory indicated that mercury pigments were believed to be no longer used in New Zealand, and there is no reason to expect that this situation has changed. Some additional support for this position can be taken from the fact that no mercury – based products could be identified in a search of the national databases of substances approved under the *Hazardous Substances and New Organisms Act 1996*. (EPA, 2017).

7.9 Pharmaceuticals for human and veterinary use

Mercury compounds have been used in the past in various pharmaceuticals such as vaccines, eye drops, topical antiseptics, and other products, functioning mainly as a preservative. In addition, it is still used today in animal vaccines, with the most common additive being Thiomersal[16]. This chemical is listed in the specific exclusions given in Annex 1 of the Minamata Convention (UNEP, 2024).

A Ministry of Health immunization handbook (Ministry of Health, 2025) states that none of the vaccines on the New Zealand National Immunisation schedule contain thiomersal. A search of the Medsafe database showed that there are currently no mercury-containing human pharmaceutical products registered for use in New Zealand . In the previous inventory one eye drop product contained phenylmercuric nitrate with a total input of 0.021 kg of mercury. The manufacturer confirmed that this product had not been produced in 2024. (A Lal, Teva Pharma (NZ) Ltd, pers comm, 2026).

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16 The chemical name for Thiomersal is ethyl(2-mercaptobenzoato-(2-)-O,S) Mercurate (1-) sodium, and it is also known as thiomerosal, and merthiolate)

A survey of Thiomersal use by local manufacturers and distributors of veterinary medicines was conducted on the Ministry for the Environment's behalf by Animal and Plant Health New Zealand. Information was requested for the 2024 calendar year on the amounts of Thiomersal raw material imported for further formulation and the amounts of Thiomersal in ready to use animal products that were imported. Respondents to the survey indicated that a total of 50 kg of Thiomersal raw material and 8.224 kg of Thiomersal in animal formulations were imported. No thiomersal containing animal products were exported.

The total imported quantity of 58.224 kg for Thiomersal in animal products contains 28.85 kg mercury and this represents the total input for pharmaceuticals for human and veterinary use.

7.10 Cosmetics and related products

Cosmetic product rules were updated by New Zealand's Environmental Protection Authority on 1 January 2026. Mercury and its compounds are prohibited in cosmetics except those special cases included in Schedule 7 where thiomersal and phenylmercuric salts are permitted for use as preservatives in eye products at concentrations of no more than 0.007% (as Hg). Checks with 5 cosmetics manufacturers found no evidence of mercury use in 2012, and there is no reason to expect that this situation will be any different for 2024.

7.11 Summary for this category

The estimated inputs and outputs for the consumer products category are summarised in Table 7-8, which shows that the most significant inputs are from pharmaceuticals (vaccines) and mercury switches and relays, lamps and batteries.

Table 7-8: Summary of inputs and outputs for consumer products with intentional use of mercury for 2024

Category	Mercury Inputs, kg/year	Mercury Outputs, kg/yr				
		Air	Water	Land	Product	Waste
Thermometers with mercury	0.0005 – 0.005 (0.0028)	0.00005 – 0.0005 (0.00028)	0.00015 – 0.0015 (0.00083)	-	-	0.0003 – 0.003 (0.0017)
Switches, contacts and relays	6.4	0.64	-	0.64	-	5.12
Lamps	2.39 – 8.11 (5.25)	0.119 – 0.406 (0.263)	-	-	-	2.267 – 7.708 (4.99)
Batteries	33.4	-	-	-	-	33.4
Biocides/pesticides	-	-	-	-	-	-
Paints	-	-	-	-	-	-
Pharmaceuticals	28.9	-	-	-	28.9	-
Cosmetics	-	-	-	-	-	-
Totals	**71.1 – 76.8 (73.9)**	**0.759 – 1.05 (0.903)**	**0.00015- 0.0015 (0.00083)**	**0.64**	**28.9**	**40.8 – 46.3 (43.6)**

8 Other intentional product/process uses

This category covers mercury uses in a range of other intentional products and uses (UNEP, 2023). The various sub-categories and the primary release pathways are summarised in Table 8-1, which has been copied directly from the UNEP Toolkit.

Table 8-1: Toolkit framework for category 6 – other intentional product/process uses

Toolkit Chapter	Sub-category	Air	Water	Land	Product	Waste/ residue	Main approach
5.6.1	Dental mercury amalgam fillings	x	**X**		**X**	**X**	OW
5.6.2	Manometers and gauges	x	**X**	x	**X**	**X**	OW
5.6.3	Laboratory chemicals and equipment	x	**X**		**X**	**X**	OW
5.6.4	Mercury use in religious rituals and folklore	**X**	**X**	**X**	**X**	**X**	OW
5.6.5	Miscellaneous product uses, mercury metal and other sources	**X**	**X**	**X**	**X**	**X**	OW

Notes: OW = National/overview approach;

X - Release pathway expected to be predominant for the sub-category;

x - Additional release pathways to be considered, depending on specific source and national situation.

8.1 Dental mercury amalgam fillings

Mercury is used in a range of dental amalgams which are used in restorative dentistry. Mercury typically comprises about 45 to 50% of these amalgams. The amount of amalgam used to fill a cavity depends on its size. Amalgam capsules are sold in different weights with the amount of mercury present corresponding to 400 mg, 600 mg, 800 mg and 1200mg. These amalgams are still used in New Zealand, although non-mercury alternatives are readily available and have largely replaced amalgam.

Only one company was identified as selling mercury amalgam restorative products in 2024. Product sales numbers combined with the amount of mercury in each sale item allowed the calculation of a total mercury input of 1.71 kg for 2024.

Input and output estimates

The output factors given in the Toolkit are 0.02 (2%) to air, 0.14 (14%) to water, 0.6 (60%) in products (ie, teeth), and 0.24 (24 %) to waste. The outputs to water and wastes may be modified if the dental surgeries are fitted with high efficiency amalgam filters, which can remove up to 95% of the mercury from the water outputs. However, it was noted in the 2012 Inventory Report that these are not widely used in New Zealand, with about 50% of dentists using basic filter systems and the remainder having no filtration at all. The limited quantities of wastes collected by the filters are either disposed to landfill, recycled or exported but no specific data is available on the quantities of dental wastes that are recycled or exported.

The mercury input and output estimates for mercury dental amalgam are shown in Table 8-2. The figure shown for product represents an annual addition to the existing stocks of mercury in the teeth of most New Zealanders, which have not been assessed. Similarly, the figure shown for wastes does not include any amounts removed during filling replacement or tooth extraction, which would be very difficult to determine.

Table 8-2: Input and output estimates for mercury dental amalgam

Source	Activity, kg/yr	Mercury content, %	Annual Mercury Inputs, kg/yr	Annual Mercury Outputs, kg/yr			
				Air	Water	Product	Waste
Dental amalgam, 2012	320	47%	150	3	21	90	36
Dental amalgam, 2016	79.4	47%	37.3	0.75	5.22	22.38	8.95
Dental amalgam, 2020	47.5	100%	47.5	0.95	6.65	28.50	11.40
Dental amalgam, 2024	1.71	100%	1.71	0.034	0.239	1.026	0.410

Note. For the 2012 and 2016 Inventory Reports the total weight of amalgam sold was combined with the average concentration of mercury to give an annual mercury input. For the 2020 and 2024 estimates the concentration of mercury in individual products was assigned to specific product numbers and summed, hence the use of 100% for mercury content.

Certainty assessment

Activity data: HIGH (because it is based on supplier estimates)

Input estimates: HIGH (because the mercury content of the products is known)

Output estimates: LOW (because they are based on the Toolkit default factors).

8.2 Manometers and gauges

The most common uses of mercury in this sub-category are in blood pressure devices (sphygmomanometers) and in barometers. However, mercury may also be used for pressure (or vacuum) measurement in a range of industrial and laboratory applications (UNEP, 2023). Electronic models have by and large superceded mercury sphygmomanometers.

The sole medical equipment supplier of sphygmomanometers in 2024 sold one unit in 2024.

Input and output estimates

The Toolkit indicates that each sphygmomanometer contains 80 g of mercury on average. Consequently the annual mercury inputs will be 0.080 kg mercury allocated to the product output category.

8.3 Laboratory chemicals and equipment

Mercury is used in laboratories in instruments, reagents, preservatives, and catalysts. Some of this mercury is released to air, primarily through lab vents. However, most of the mercury may be released in wastewater or disposed of as hazardous or municipal wastes (UNEP 2023).

The five major laboratory supply companies were contacted for details of 2024 sales of mercury and mercury containing products. There were no sales of elemental mercury but there were sales of mercury containing compounds totalling 1.641 kg expressed as mercury.

Input and output estimates

The Toolkit does not provide any specific output factors for this category and notes that this is highly dependent on the waste management practices of individual laboratories. The feedback received from some of the New Zealand laboratories and universities in 2012 indicated that the bulk of the wastes are taken away by waste contractors. On that basis it has been assumed (through familiarity with laboratory practices) that only 5% of the inputs are discharged to air and 10% to wastewater, with the remainder going to wastes.

The mercury input and output estimates for laboratory chemicals are shown in Table 8-3.

Table 8-3: Input and output estimates for laboratory chemicals

Source	Annual Mercury Inputs, kg/yr	Annual Mercury Outputs, kg/yr		
		Air	Water	Waste
Annual sales, 2012	55	2.75	5.5	46.8
Annual sales, 2016	4.77	0.24	0.48	4.05
Annual sales, 2020	2.84	0.14	0.28	2.42
Annual sales 2024	1.64	0.082	0.164	1.40

Certainty assessment

Activity data: not relevant

Input estimates: MEDIUM (because they are based on partial survey responses)

Output estimates: LOW (because they are based on the assumed output factors).

8.4 Mercury use in religious rituals and folklore medicine

According to the Toolkit, mercury is used in certain cultural and religious practices, such as some Latin American and Afro-Caribbean communities, in the USA, Mexico, and probably elsewhere. Uses include carrying it in a sealed pouch or in a pocket as an amulet, sprinkling mercury on floors of homes or automobiles, burning it in candles, and mixing it with perfumes (UNEP, 2023). These products are prohibited by legislation in New Zealand. (Office of the Minister for the Environment, 2020)

8.5 Miscellaneous product uses and other sources

The only other possible use considered for this category was explosives. Mercury fulminate has been used as an explosive in the past, but it is believed that this use was phased out about 50 or more years ago. Three explosives distributors were contacted for the 2012 Inventory Report and they all confirmed that there was no longer any mercury in any of their products. There is no reason to believe that this situation will be any different for 2024

8.6 Summary for this category

The estimated inputs and outputs for the other intentional product/process uses are summarised in Table 8-4.

Table 8-4: Summary of inputs and outputs for other intentional product/process uses for 2024

Category	Mercury Inputs, kg/year	Mercury Outputs, kg/yr				
		Air	Water	Land	Product	Waste
Dental mercury amalgam fillings	1.71	0.034	0.24	-	1.03	0.41
Manometers and gauges	0.075	-	-	-	0.075	-
Laboratory chemicals and equipment	1.64	0.082	0.16	-	-	1.40
Mercury use in religious rituals and folklore	-	-	-	-	-	-
Miscellaneous product uses, mercury metal, other sources	-	-	-	-	-	-
Totals	**3.43**	**0.116**	**0.40**	**-**	**1.11**	**1.81**

9 Production of recycled metals (secondary metal production)

This category covers mercury releases from the production of recycled metals, which is also referred to as secondary metal production (UNEP, 2023). The various sub-categories and the primary release pathways are summarised in Table 9-1, which has been copied directly from the UNEP Toolkit.

Table 9-1: Toolkit framework for category 7 –production of recycled metals (secondary metal production)

Toolkit Chapter	Sub-category	Air	Water	Land	Product	Waste/ residue	Main approach
5.2.1	Recycled mercury	X	X	X	X	X	PS
5.2.2	Ferrous metals (iron and steel)	X	x	x		x	PS
5.2.3	Other recycled metals	X	x	x		x	PS

Notes: PS = Point source by point source approach;

X - Release pathway expected to be predominant for the sub-category;

x - Additional release pathways to be considered, depending on specific source and national situation.

9.1 Recycled mercury

Metallic mercury can be recovered from a variety of waste materials by distillation, or retorting. For the 2012 Inventory Report a single commercial mercury recycling operation was identified in Waihi, which was mainly concerned with metal recovery from dental, photographic and printing wastes however this company closed down in 2016.

The 2012 Inventory Report indicated that small quantities of mercury are occasionally picked up in local authority hazardous waste collection campaigns and some scrap metal dealers are also known to collect small quantities of mercury from old car bodies and home appliances. However, there is no cohesive data available on the overall mercury quantities. It is probable that most of the collected material is passed on to small-scale gold miners. Their release has already been accounted for in Section 3.4

9.2 Ferrous metals (secondary steel)

The closure of New Zealand's only secondary steel mill, Pacific Steel Ltd in South Auckland, in 2015 meant that there were no mercury inputs to New Zealand from this source category in 2024. Secondary steel processing will recommence in 2027 when the new arc furnace is commissioned at the New Zealand Steel Glenbrook plant.

9.3 Production of other recycled metals

This Toolkit sub-category covers the recycling of aluminium, zinc and other metals, but it is noted that very little is known about the mercury inputs and outputs for these activities. A similar situation applies in New Zealand.

For the 2012 Inventory Report, some survey data from the 2011 Dioxin Inventory for New Zealand (MfE, 2011) was used to estimate total mercury inputs of less than 0.6 kg/year for this source category. This estimate was not included in the 2012 inventory estimates because it was too low to be of any possible concern, and the same approach has been adopted here.

9.4 Summary for this category

There were no inputs or outputs for the metal recycling category in 2024.

10 Waste incineration

This category covers mercury releases from the incineration of different types of wastes (UNEP, 2023). The various sub-categories and the primary release pathways are summarised in Table 10-1, which has been copied directly from the UNEP Toolkit.

Table 10-1: Toolkit framework for category 8 – waste incineration

Toolkit Chapter	Sub-category	Air	Water	Land	Product	Waste/ residue	Main approach
5.8.1	Municipal waste incineration	X	x	x	x	X	PS
5.8.2	Hazardous waste incineration	X	x			X	PS
5.8.3	Medical waste incineration	X	x			X	PS
5.8.4	Sewage sludge incineration	X	X			X	PS
5.8.5	Informal waste incineration	X	X	X	X		PS

Notes: PS = Point source by point source approach;

X - Release pathway expected to be predominant for the sub-category;

x - Additional release pathways to be considered, depending on specific source and national situation.

10.1 Municipal waste incineration

There are no municipal waste incinerators operating in New Zealand.

10.2 Hazardous waste incineration

With the closure of the Corteva Agriscience agrichemical production and packaging site at Paritutu in New Plmouth, currently there are no high-temperature hazardous waste incinerators operating in New Zealand.

Corteva had ceased manufacturing operations from May 2021 and had removed all equipment and demolished most of the buildings by the close of 2022. In February 2023 Dow Chemical (NZ) Ltd took control of the site. (Taranaki Regional Council, 2025 and Tonkin and Taylor 2024)

Consequently there will have been no discharges of mercury from incinerator operations at the site in 2024.

10.3 Medical waste incineration

There is only one medical waste incinerator in New Zealand, at the Te Nikau Grey Hospital in Greymouth. Medical waste incineration was widely practised in the past, but has been phased out in favour of alternative methods, such as steam sterilisation (MfE, 2011).

The Grey Hospital incinerator is a diesel-fired, dual-chamber unit, with no add-on emission controls. In 2024 there was an estimated 162 tonnes of medical waste incinerated. (B. Woolhouse, Grey Hospital, pers comm, 2025). The incinerator emissions have never been tested for mercury.

The Toolkit recommends default input factors for medical waste of 8 – 40 g/tonne, and indicates that all of the mercury will be emitted to air on units with no emission control equipment. Applying these factors to the Te Nikau Grey Hospital incinerator indicates an annual input rate of 1.30 to 6.48 kg/year for 2024 (mean 3.89 kg/year). The outputs to air will be the same as the inputs.

Certainty assessment

Activity data: MEDIUM (because it was an operator estimate)

Input estimates: LOW (because it was based on the Toolkit default factor)

Output estimates: LOW (because the output distribution was based on the Toolkit default factors).

10.4 Sewage sludge incineration

There is one sewage sludge incinerator in New Zealand, operated by the Dunedin City Council at its wastewater treatment plant at Tahuna in Dunedin. The incinerator is a fluidised bed unit and is the only one in operation in Australasia. It uses 3.5 m^3 of sand as the fluidising medium and operates at a nominal combustion temperature of 830 °C. The residence time within the combustion zone is several seconds (Drew, S and Henderson, C, 2014). The exhaust gases are treated in a high-efficiency venturi scrubber, followed by a packed tower caustic scrubber. The gases are then passed through a bark biofilter which acts as a final scrubber, primarily for odour control (Dunedin City Council, 2012).

About 60% of daily sludge production at the treatment plant is incinerated. For the 2024 calendar year 5425 tonnes of solids were incinerated. This material was comprised of an average of 32.1% dry solids (A Paulino, Dunedin City Council, pers comm 2025). Consequently on a dry basis, 1,741 tonnes of waste water solids were incinerated.

The previous inventory used a mercury composition of 0.56 mg/kg for Dunedin (Green Island) biosolids. No more recent studies of the mercury content of biosolids have been done so this concentration will be used for the current study. On this basis multiplying dry sludge processed by mercury concentration gives an annual mercury input to the incinerator of 0.975 kg/year. The incinerator off-gases are tested annually for mercury, and the average mercury emission result for testing conducted in November 2024 indicates emissions of 0.377 kg/year (K2 Environmental, 2025). Given that some mercury will be removed in the venturi scrubber and packed tower caustic scrubber the result is consistent with the estimate based on biosolids composition. The incinerator off-gases are further treated by passing through the biofilter, and the tests on the latter shows that it captures more than 99% of the total mercury passing through it. It has been assumed that all of the mercury will be discharged via solid wastes, either in scrubber residues or in waste bark removed from the biofilter.

Certainty assessment

Activity data: HIGH (because it is based on monitored sludge quantities)

Input estimates: MEDIUM (because it was based on previous data for biosolids composition)

Output estimates: LOW (because the output distribution was based on indicative US information).

10.5 Informal incineration

This Toolkit category covers unregulated waste disposal practices such as backyard rubbish burning. The latest New Zealand dioxin inventory for 2024 (MfE, 2026) estimated that the quantity of domestic wastes burned annually in New Zealand was about 12,578 tonnes/year.

There is no data available on the mercury content of New Zealand municipal solid wastes. For the 2012 and 2016 inventories Toolkit default factors of 1 – 10 g/tonne were applied. For the most recent Toolkit revision a range of 0.2 – 4 g/tonne of waste with an intermediate value specified as 1g/ tonne of waste was recommended. As is discussed more fully in Section 11.1, the intermediate factor is seen as most appropriate for New Zealand.

Applying this to the annual waste quantities indicates an annual mercury input of 12.6 kg/yr. For the output calculations, it is assumed that all of the mercury is discharged to air.

Certainty assessment

Activity data: LOW (because it was based on a limited amount of historical survey data)

Input estimates: LOW (because it was based on the default Toolkit factors)

Output estimates: LOW (because the output distribution was assumed).

10.6 Other incineration

(Note: this is not a Toolkit category, but has been added to accommodate several other New Zealand incinerators).

The 2024 Dioxin Inventory (MfE, 2026) lists some other incineration sources in New Zealand, including 6 school incinerators, and 28 pet incinerators.

The estimated waste throughput for the school incinerators was only 6 tonnes/year, in total. The wastes burned in these units would have a similar composition to that burned in backyard rubbish fires, and would only add a further 0.1% to the estimated mercury inputs. Therefore, these sources have simply been added to the total informal waste incineration category.

The total estimated throughput for the pet cremators by the 2024 Dioxin Inventory (MfE, 2026) was about 510 tonnes/year, in 2024. The pet cremators are similar in design to crematoria and can be assessed using the same approach as described in section 12.1, but with adjustment for a lower mercury content. Some indication of the likely mercury level in pets and other animals is given by the following 2 publications. A study on a range of healthy US animals found no mercury in dog tissues at a detection limit of 0.0002 g/kilogram (Penumarthy *et al*, 1980). However, a report on a small dog suspected of suffering from mercury poisoning found concentrations of 0.003 mg/kg (Farrar *et al*, 1994). On the basis of these studies, a mercury concentration of 0.001 g/kg has been used for the input estimates, to give an annual mercury input of 0.51 kg/year. It has been assumed that all of the mercury outputs will be released to air.

Certainty assessment

Activity data: LOW (because it was based on a limited historical survey)

Input estimates: LOW (because it is an estimate based on limited scientific evidence)

Output estimates: MEDIUM (because the output distribution was assumed).

10.7 Summary for this category

The estimated inputs and outputs for waste incineration are summarised in Table 10-2.

Table 10-2: Summary of inputs and outputs for waste incineration for 2024

Category	Mercury Inputs, kg/year	Mercury Outputs, kg/yr				
		Air	Water	Land	Product	Waste
Municipal waste incineration	-	-	-	-	-	-
Hazardous waste incineration	-	-	-	-	-	-
Medical waste incineration	1.30 – 6.48 (3.89)	1.30 – 6.48 (3.89)	-	-	-	-
Sewage sludge incineration	0.975	-	-	-	-	0.975
Informal waste incineration	12.6	12.6	-	-	-	-
Other (pet incinerators)	0.51	0.51	-	-	-	-
Totals	**15.4 – 20.5 (18.0)**	**14.4 – 19.6 (17.0)**	**-**	**-**	**-**	**0.975**

11 Waste deposition/landfilling and wastewater treatment

This category covers mercury releases from the disposal of solid and liquid wastes by landfilling, dumping, or discharge to wastewater treatment systems (UNEP, 2023). The various sub-categories and the primary release pathways are summarised in Table 11-1, which has been copied directly from the UNEP Toolkit.

Information on the handling and disposal of mercury-containing wastes by specialist waste management companies will also be covered at the end of this section. This includes exporting for treatment and disposal in other countries.

Table 11-1: Toolkit framework for category 9 – waste deposition/landfilling and wastewater treatment

Toolkit Chapter	Sub-category	Air	Water	Land	Product	Waste/ residue	Main approach
5.9.1	Controlled landfills/deposits	x	x	**X**		**X**	OW
5.9.2	Diffuse deposition with some control	x	**X**	**X**		**X**	OW
5.9.3	Informal local disposal of industrial wastes	**X**	**X**	**X**			PS
5.9.4	Informal dumping of general waste	**X**	**X**	**X**			OW
5.9.5	Wastewater treatment systems	x	**X**	**X**		x	OW/PS

Notes: PS = Point source by point source approach; OW = National/overview approach;
X – Release pathway expected to be predominant for the sub-category;
x – Additional release pathways to be considered, depending on specific source and national situation.

One of the key points to recognise for this category is that the estimated inputs include the wastes that are generated by many of the sources discussed under previous categories. This means that there is inevitably some double accounting. However, the extent of this is not readily determined because the inputs are simply estimated using the default Toolkit factors

11.1 Controlled landfill/deposition

The mercury content in the general municipal waste stream can come from four main sources: 1) intentionally used mercury in spent products and process wastes; 2) mercury impurities in bulk materials (eg, paper, plastics, and metals); 3) mercury as an anthropogenic trace pollutant in bulk materials; and 4) trace levels of mercury contamination of food wastes. In New Zealand, most municipal solid wastes are disposed to controlled landfills.

The key requirements for quantifying the inputs and outputs for this source are the total quantities of waste disposed to landfill in each year, and the average mercury content of that waste. Information on tonnages of waste deposited in Class 1 landfills is available from waste statistics published by the Ministry for the Environment (MfE, 2025). From July 2023 to June 2024 3,228,248 tonnes were deposited, with 2,829,929 tonnes listed for July 2024 to June 2025. Averaging these quantities gives an estimated total quantity of 3,029,089 tonnes of waste for 2024. Whereas the previous Inventory noted an increasing trend in the rate of municipal waste disposal to landfill, the current prevailing trend is one of a decreasing rate. That this is occurring while population growth steadily increases suggests that newly introduced waste minimisation and elimination policies may be having an effect. For example, since Auckland Council introduced its kerbside food scraps collection service in April 2023, more than 30,0000 tonnes of food waste have been diverted from landfill. (Auckland Council, 2024)

The Class 1 landfill data only applies to commercial landfills accepting household waste, and does not include the waste disposed to cleanfill sites. However, there is no reason to expect significant levels of mercury contamination in cleanfill wastes, because mercury-containing wastes are usually excluded from these sites (eg, MfE, 2002). The wastes disposed at privately-owned waste facilities, such as those operated by the pulp and paper mills, Huntly Power Station, and the gold mine tailings dams, have already been addressed in other sections (when relevant).

The general composition of the New Zealand municipal waste stream is reasonably well characterised, but there is no information available on the mercury content of the wastes. In the absence of this data, the Toolkit factors have been used. For previous inventories default factors of 1 – 10 g/tonne of waste were recommended for estimating inputs. The most recent Toolkit revision issued in 2023 provides a range of 0.2 – 4 g/tonne of waste with an intermediate value specified as 1g/ tonne of waste. The low end input factor is expected to be relevant for a situation where substantial parts of waste products with high mercury concentrations (thermometers, batteries, dental amalgam wastes, switches etc.) have been sorted out of the waste for separate treatment. The high end input factor is expected to be relevant for situations where no such sorting takes place (UNEP, 2023). Some sorting of high mercury concentration products is likely to occur in New Zealand but there are still significant quantities of materials such as button batteries and LFL and CFL lights which are sent to landfill. Consequently, the intermediate input factor is seen as most appropriate for New Zealand.

Output distribution factors of 0.01 (1%) to air and 0.0001 (0.01%) to water, with the remainder of the inputs being regarded as disposal to a reservoir remain unchanged and have been applied here.

The mercury input and output calculations for controlled landfill are shown in Table 11-2 for the current study and previous inventories.

Table 11-2: Input and output estimates for controlled landfill

Source	Activity Rate, tonnes/yr	Mercury Content, g/tonne	Annual Inputs, kg/yr	Annual Mercury Outputs, kg/yr		
				Air	Water	Reservoir
Landfilling of wastes, 2012	2.5×10^6	1 – 10	2,500 – 25,000 (13,750)	25 – 250 (138)	0.25 – 2.5 (1.38)	2,475 – 24,748 (13,611)
Landfilling of wastes, 2016	3.41×10^6	1 – 10	3,410 – 34,100 (18,755)	34 – 341 (187.6)	0.34 – 3.41 (1.9)	3,375.6 – 33,756 (18,566)
Landfilling of wastes, 2020	3.45×10^6	1	3,450	34.5	0.345	3,415
Landfilling of wastes, 2024	3.03×10^6	1	3,029	30.29	0.303	2998

Certainty assessment

Activity data: HIGH (because it is based on national levy data)

Input estimates: LOW (because they are based on the default Toolkit input factors)

Output estimates: LOW (because they are based on the default Toolkit output factors).

11.2 Diffuse deposition, informal disposal and dumping

These 3 Toolkit sub-categories have not been assessed. The first, controlled diffuse deposition, relates to the use of industrial wastes in road and building foundations. It is not known whether this occurs to any extent within New

Zealand, although waste quantities of greater than about 0.5 tonnes would generally require a resource consent under the RMA.

Informal disposal also relates to industrial wastes, and especially those that may have been dumped in the past without any regulatory control. If this has occurred in New Zealand, the sites should show up in the list of hot-spots (ie. contaminated sites) discussed in section 13.

Finally, the informal dumping category relates to uncontrolled dumping of general wastes. There is almost certainly some uncontrolled dumping of solid wastes in New Zealand. However, no data is available on the likely extent of any of this.

11.3 Wastewater treatment systems

The most important factors determining releases of mercury from wastewater are the volumes of mercury-containing wastes that are discharged to the system and the concentration of mercury in those wastes. Mercury content in wastewater mainly originates from two source groups: 1) intentionally used mercury in products and processes (such as from dental amalgams, spillage from thermometers and other devices, and industrial discharges); and 2) atmospheric mercury washed out by precipitation and carried in stormwater entering sewers. As such, waste water treatment is an intermediate mercury release source where mercury inputs from original mercury contamination are treated and then re-distributed to water, land (through the application of sludge) and air (through sludge incineration). In addition some sludge is disposed to landfill (UNEP, 2023).

Currently there are 320 active municipal wastewater treatment plants in New Zealand (Taumata Arowai, 2025). There are 1,510,000 residential connections to these treatment plants which service about 79% of the population (Beca, GHD and Boffa Miskell, 2020). The remaining 21%, who live largely in rural areas, must treat their own household wastewater flows using an on-site wastewater management system (OWMS) such as a septic tank. An OWMS discharges treated wastewater effluent to a land application on the property such as a drainage field. Water NZ estimate there are about 270,000 OWMS in New Zealand (Water NZ, 2020).

The total volume of wastewater produced annually in New Zealand will be the sum of wastewater treated in wastewater treatment plants per annum and the volume of water discharged from OWMS annually.

Until 2022 Water New Zealand collated information on the volumes of liquid waste treated through New Zealand wastewater plants and this data was presented in a publicly available spreadsheet (Water NZ, 2022). Water NZ no longer maintains records of wastewater treatment plants. This role has fallen to the new Crown Entity the Water Services Authority – Taumatai Arowai who took on responsibility for the environmental performance of public wastewater networks in October 2023. Taumatai Arowai publish details such as the location of treatment plants, population serviced and administrative matters in its public register of wastewater networks – Hine korako – https://hinekorako.taumataaroiwai.govt.nz/publicregister/wastewater/. However it does not yet provide details of annual wastewater treatment volumes either there or in its annual performance reports (Taumata Arowai, 2025).

In the absence of specific data on the volume of wastewater handled by New Zealand wastewater treatment plants, the 2024 volume has been estimated by applying a population growth factor of 1.07 to the volume of 497,162,000 m^3/year recorded for the 2020 Inventory to give 531,963,340 m^3/year.

For the purposes of this inventory people using OWMS are assumed to discharge wastewater at the same rate as individuals who are connected to a wastewater treatment plant. At June 2024 New Zealand's estimated population was 5,338,500 (Stats NZ, 2024) so the 21% of individuals not connected to a treatment plant number 1,121,085. Consequently OWMS are estimated to have discharged 141,402,450 m^3/year and therefore New Zealand's total wastewater production for 2024 was 673,365,790 m^3.

There is no information available on the average mercury content of the wastes entering New Zealand wastewater plants. The Toolkit recommends default factors of 0.5 – 10 µg/litre, and output factors of 0.5 (50%) to water, 0.2 (20%) to land[17], and 0.3 (30%) to waste. The latter two factors reflect the fact that some biosolids are disposed to land (including use in compost) and some are disposed to landfills, although the exact distribution for New Zealand is unknown.

The mercury input and output calculations for wastewater treatment plants are shown in Table 11-3.

Table 11-3: Input and output estimates for wastewater treatment plants

Source	Activity Rate, Litres/yr	Mercury Content, µg/L	Annual Inputs, kg/yr	Annual Mercury Outputs, kg/yr		
				Water	Land	Waste
Municipal WWTP, 2012	657×10^9	0.5 - 10	329 – 6,570 (3,449)	164 – 3,285 (1,725)	65.7 – 1,314 (690)	98.5 – 1,971 (1,035)
Municipal WWTP, 2016	555×10^9	0.5 - 10	277.5 – 5,550 (2,914)	138.7 – 2,775 (1,457)	55.5 – 1110 (583)	83.25 – 1,665 (874)
Municipal WWTP, 2020	629×10^9	0.5 - 10	315 – 6,290 (3304)	157 – 3,145 (1652)	62.9 – 1,258 (661)	94.4 – 1,887 (991)
Municipal WWTP, 2024	673×10^9	0.5 - 10	337 – 6734 (3535)	168 – 3367 (1768)	67.3– 1347 (707)	101 – 2020 (1061)

Certainty assessment

Activity data: MEDIUM (because it is based on past national data)

Input estimates: LOW (because they are based on the default Toolkit output factors)

Output estimates: LOW (because they are based on the default Toolkit output factors).

11.4 Specialist waste disposal services

This category is not specifically listed in the Toolkit, but has been included here for the purposes of providing additional information on some of the New Zealand management practices for mercury-containing wastes.

Waste exports and imports

Imports and exports of mercury-containing wastes require a permit under the *Imports and Exports (Restrictions) Act 1988*. These permits are issued by the Environmental Protection Authority and reported to the Basel Convention on Hazardous Wastes (Basel Convention, 2024). In 2024 there were records for two imports of mercury related waste materials classified under the Basel Convention as “fluorescent tubes containing mercury”. These involved quantities of 3.67 and 2.05 tonnes respectively.

Waste disposal services

In the 2012 Inventory Report it was noted that there were four companies providing hazardous waste treatment and disposal services in New Zealand. The information obtained from some of these companies indicated that they occasionally accept small quantities of mercury and mercury-containing wastes, especially from dentists, hospitals,

[17] The toolkit refers to the land disposal route as “sector specific” wastes.

schools, universities and laboratories. These are either passed on to other users or diluted and disposed to landfill or wastewater treatment plants. The situation is expected to be much the same for 2024.

11.5 Summary for this category

The estimated inputs and outputs for waste deposition/landfilling and wastewater treatment are summarised in Table 11-4.

Table 11-4: Summary of inputs and outputs for waste deposition/landfilling and wastewater treatment for 2024

Category	Mercury Inputs, kg/year	Mercury Outputs, kg/yr				
		Air	Water	Land	Waste	Reservoir
Controlled landfills	3,029	30.29	0.303	-	-	2998
Diffuse dumping	-	-	-	-	-	-
Informal - industrial wastes	-	-	-	-	-	-
Informal - general waste	-	-	-	-	-	-
Wastewater treatment	337 – 6734 (3535)	-	168 – 3367 (1768)	67.3 – 1347 (707)	101 – 2020 (1061)	-
Totals	**3366 – 9763 (6564)**	**30.3**	**168 – 3367 (1768)**	67.3 – 1347 (707)	101 – 2020 (1061)	**2998**

12 Crematoria and cemeteries

This category covers mercury releases from cremation and burial of human bodies (UNEP, 2023). The various sub-categories and the primary release pathways are summarised in Table 12-1.

Table 12-1: Toolkit framework for category 10 – crematoria and cemeteries

Toolkit Chapter	Sub-category	Air	Water	Land	Product	Waste/ residue	Main approach
5.2.1	Crematoria	X				X	OW
5.2.2	Cemeteries			X			OW

Notes: OW = National/overview approach;

X - Release pathway expected to be predominant for the sub-category;

x - Additional release pathways to be considered, depending on specific source and national situation.

12.1 Crematoria and cemeteries

Mercury releases from crematoria and cemeteries arise mainly from the mercury in dental amalgam fillings. In cremation, this is predominantly released to air, while in cemeteries it is released to land.

Annual data obtained from the Department of Internal Affairs (V Millar, pers comm, 2025) show that for 2024 there were 36,674 registered deaths. These deaths included 201 repatriations and 17 used for anatomical research. Of the remaining 36,456 deaths, 25, 429 or 70% of the total were cremated and 11,027 were buried.

No information has been found on the mercury content of New Zealanders, so the Toolkit default factors of 1 – 4 g/body have been used. The input and output estimates for cremation and cemeteries are shown in Table 12-2.

Table 12-2: Input and output estimates for cremation and cemeteries

Source	Activity Rate, deceased/yr	Mercury content, g/body	Annual Mercury Inputs, kg/yr	Annual Mercury Outputs, kg/yr	
				Air	Land
Cremation, 2012	19,053	1 – 4	19.1 – 76.2 (47.7)	19.1 – 76.2 (47.7)	-
Cremation, 2016	20,129	1 - 4	20.1 – 80.5 (50.3)	20.1 – 80.5 (50.3)	-
Cremation, 2020	22,073	1 - 4	22.1 – 88.3 (55.2)	22.1 – 88.3 (55.2)	
Cremation, 2024	25,429	1 - 4	25.4 – 102 (63.6)	25.4 – 102 (63.6)	
Cemeteries, 2012	11,046	1 - 4	11.0 – 44.2 (27.6)	-	11.0 – 44.2 (27.6)
Cemeteries, 2016	11,204	1 - 4	11.2 – 44.8 (28.0)		11.2 – 44.8 (28.0)
Cemeteries, 2020	10,639	1 - 4	10.6 – 42.6 (26.6)		10.6 – 42.6 (26.6)
Cemetries, 2024	11,027	1 - 4	11.0 – 44.1 (27.6)		11.0 – 44.1 (27.6)

Certainty assessment

Activity data: HIGH (because it was based on national data)

Input estimates: LOW (because it was based on the Toolkit default factors)

Output estimates: MEDIUM (because the air/land distribution is quite clear-cut. The only uncertainty is in the small amounts of mercury that may be present in crematoria ash).

12.2 Summary for this category

The estimated inputs and outputs for crematoria and cemeteries are summarised in Table 12-3.

Table 12-3: Summary of inputs and outputs for crematoria and cemeteries for 2024

Category	Mercury Inputs, kg/year	Mercury Outputs, kg/yr				
		Air	Water	Land	Product	Waste
Crematoria	25.4 – 101.7 (63.6)	25.4 – 101.7 (63.6)	-	-	-	-
Cemeteries	11.0 – 44.1 (27.6)	-	-	11.0 – 44.1 (27.6)	-	-
Totals	**36.5 – 146 (91.2)**	25.4 – 102 (63.6)	**-**	11.0 – 44.1 (27.6)	**-**	**-**

13 Potential hotspots

This category covers sites where previous land use activities may have caused contamination. Some of the types of sites where mercury might be an issue include the following:

- Historical gold and mercury mining sites
- Closed landfills
- Former agricultural sites, include pesticide manufacturing and storage, and market gardens/orchards
- Old industrial sites, such as tanneries, chlor-alkali plants, and battery manufacturers
- Government properties, including dental schools and defence bases
- Boat repair yards and slipways

For the 2012 Inventory contact was made with all Regional Councils and Unitary Authorities regarding their current knowledge of contaminated sites. Replies were received from 14 of these councils, with 10 indicating that they had no knowledge of any mercury-contaminated sites within their regions (other than sites where the mercury is simply an incidental, low level, contaminant). Other responses covered the following matters:

- A former mercury mine site in Northland is likely to be contaminated, though levels have not been confirmed.
- Both the Tasman and West Coast regions have old gold mining sites that may be contaminated with mercury.
- A power station site in Canterbury is known to be contaminated with mercury, but the extent of contamination has not been determined.
- Elevated mercury levels have been detected in many orchards and ex-mine sites, however generally not above the rural residential standard of 300mg/kg for inorganic mercury in soils. As an example, the Waikato Regional Council noted that at one highly contaminated former tailings dam (the Tui mine), the average concentration of mercury is less than 30mg/kg.

It was also confirmed that there are no contaminated sites specifically associated with the two chlor-alkali plants that were previously operated at the two North Island kraft pulp paper mills (see section 6.1). These plants were shut down in the 1980s and it is believed that the sludge and other residues were disposed to the companies' solid waste disposal facilities.

The above information has not been updated for the current work.

14 Summary and discussion

14.1 High level summary of mercury inputs and outputs

A summary of the mercury inputs and outputs for New Zealand, at the level of the main Toolkit source categories is given in Table 14-1.

Table 14-1. High level summary of mercury inputs and outputs for New Zealand, 2024

Category	Mercury Inputs, kg/year	Mercury Outputs, kg/yr				
		Air	Water	Land	Product	Waste
1. Extraction and use of fuels/energy sources	358 - 2734 (1546)	348 – 2494 (1421)	6.46 – 58.8 (32.6)	2.31 – 17.1 (9.70)	--	1.7 – 163 (82.4)
2. Primary (virgin) metal production	257 – 391 (324)	28.7 – 89.9 (59.3)	10.8 – 18.9 (14.8)	155 – 220 (188)	5.69	57.0
3. Production of minerals and materials with mercury impurities	138 – 154(146)	0.92 -2.27 (1.60)	-	137 – 151 (144)	0.394-0.973 (0.683)	-
4. Intentional use in industrial processes	-	-	-	-	-	-
5. Consumer products with intentional use of mercury	71.1 – 76.8 (73.9)	0.76 – 1.05 (0.90)	0.00015- 0.0015 (0.00083)	0.64	28.9	40.8 – 46.3 (43.6)
6. Other intentional products/processes	3.43	0.116	0.403	-	1.10	1.81
7. Production of recycled metals	-	-	-	-	-	-
8. Waste incineration	15.4 – 20.5 (18.0)	14.4 – 19.6 (17.0)	-	-	-	0.975
9. Waste deposit/landfill and wastewater treatment	3366 – 9763 (6564)	30.3	168.6 – 3367 (1768)	67.3 – 1347 (707)	-	101 – 2020 (1061)
10. Crematoria and cemeteries	36.5 – 146 (91.2)	25.4 – 102 (63.6)	-	11.0 – 44.1 (27.6)	-	-
Totals	**4,244 – 13,285 (8766)**	**447 – 2,736 (1,594)**	**186 – 3,445 (1,816)**	**373 – 1,780- (1,076)**	**36.0 – 36.6 (36.3)**	**203 – 2289 (1246)**

The relative proportion of the most significant categories to the total mercury input based on mid-range values is shown in Figure 14-1.

By far the greatest source of mercury inputs is for category 9, waste disposal. However, describing these as inputs is not really correct – they would be better considered as secondary or down-stream inputs, in that they are the result of many of the past and current outputs from all other categories, plus contributions from indirect sources, such as mercury in foods and in airborne dust. In addition, most of the mercury in the solid waste stream (2,998 kg) is simply placed into long-term storage (ie. controlled landfill), rather than being mobilised into the environment. This was assigned to a 'Reservoir' output category, which has not been included in the table (refer section 11.1 for further details). This explains why the sum of inputs is greater than the sum of outputs.

Apart from the waste category, the next highest input is the extraction and use of fuels and other energy sources, where the principal mercury source is geothermal energy.

The next highest input is primary metal production and, in particular gold and silver mining. In this case, the bulk of the inputs and outputs are associated with the extraction of very large volumes of ore, which contain very small amounts of mercury.

Below that, the most notable source categories are production of other minerals and materials with mercury impurities dominated by phosphate based fertilisers and consumer products with intentional use of mercury with significant contributions from batteries and animal vaccines.

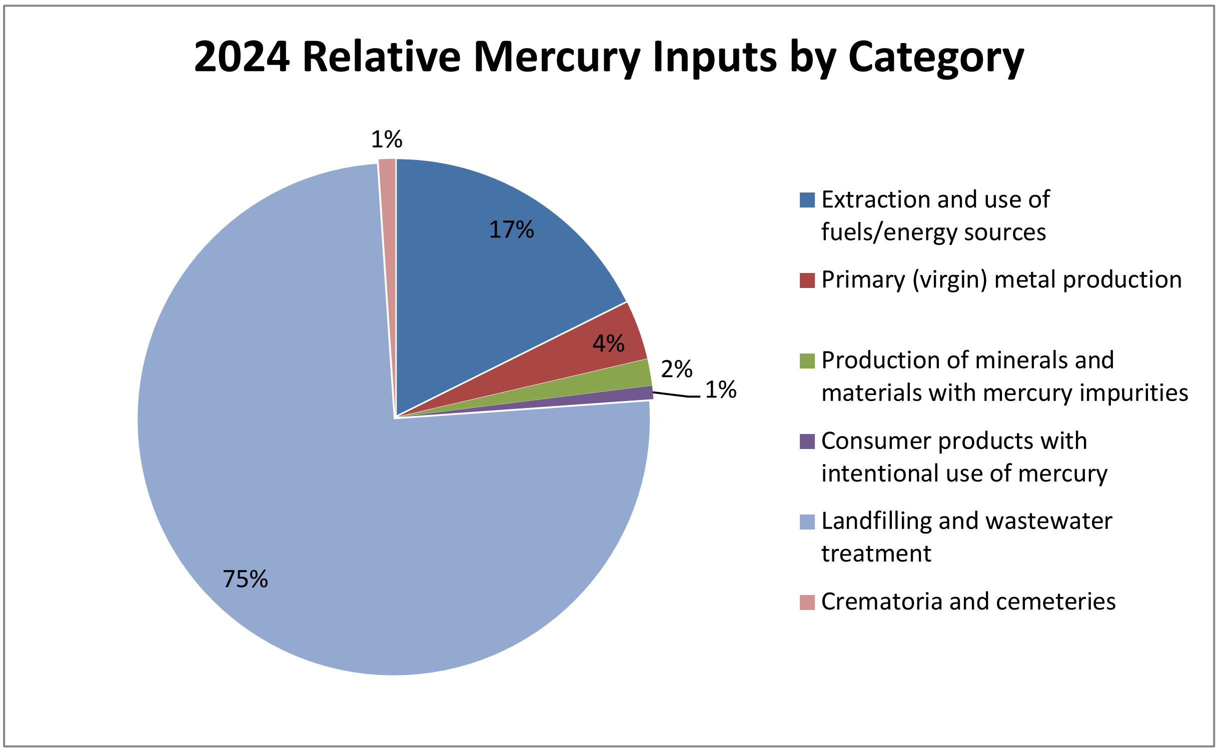

Figure 14-1: A comparison of the relative significance of major source categories of mercury for the New Zealand environment in 2024

14.2 Source by source summary of mercury inputs

A detailed source by source listing of all of the individual inputs and outputs for New Zealand sources is given in Table 14-2 at the end of this section. A relative ranking of the inputs from each of the sources is also illustrated in Figure 14-2 with the size of each bar giving a simple indication of the level of uncertainty associated with each estimate. It should be noted that mercury inputs are presented as a log scale in order to allow a clear visual ranking of the sources but it is emphasised that the relationship is not linear.

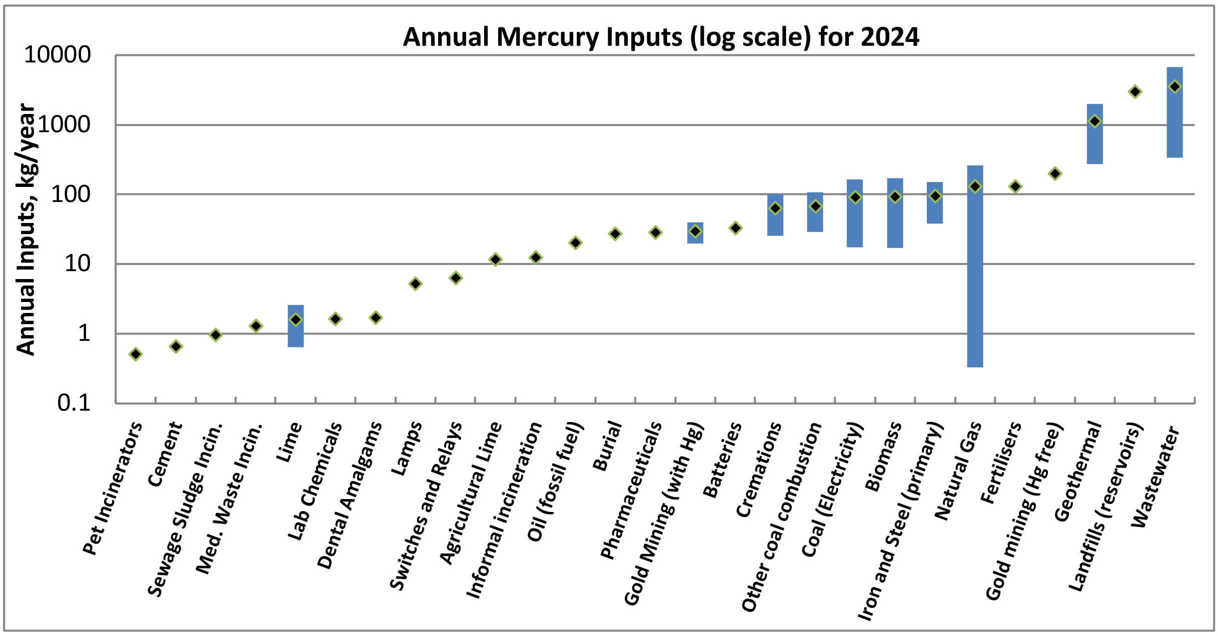

Figure 14-2: Ranking of mercury inputs by individual sources

As shown in the figure, the most significant input sources are waste water treatment and disposal, solid waste disposal (landfills), the extraction and utilisation of geothermal energy, gold and silver mining and phosphate fertiliser application. The extraction and processing of natural gas may also be a significant contributor but the uncertainties associated with the estimates for this source are very high, as indicated by the relative size of the error bar

14.3 Changes in mercury inputs since 2020

The estimated total input of mercury for New Zealand for 2024 is 8,766 kg which is 525 kg less than the 9,291 kg estimated for 2020.

Comparing 2024 mercury releases with those from 2020, the biggest mercury reduction in terms of weight for an individual source occurred for landfill deposition, which had a 2024 input 421 kg less than for 2020 based on a significant reduction of waste going to landfill. Gold mining not using mercury amalgamation also saw a significant reduction of 189 kg for 2024 which was due to a decrease in the mercury concentration of the Macraes mine ore. Other large reductions were observed for natural gas (59 kg) fertilisers (55 kg), dental amalgam (46 kg), batteries (30 kg) and coal combustion in boilers (19 kg). Natural gas, fertilisers, dental amalgam and coal combustion reductions all arose from reduced consumption of materials. The reduction for batteries was mostly due to the acceptance that cylindrical alkaline batteries are now mercury free.

Switches and relays had a reduction of 49 kg but this was due to a significant drop in the Toolkit input factor.

On the other hand some sources have seen significant increases in their mercury estimates. The estimated releases from wastewater were 231 kg higher for 2024 compared to 2020 mostly due to population increase. Geothermal power emissions were also 119 kg higher as a result of new geothermal power stations coming on-line increasing the consumption of geothermal stream.

It is worthwhile highlighting too where significant changes have occurred in terms of proportion.

Tables 14-2 and 14-3 show percentage reductions and increases for sources which have seen significant changes compared to 2020 levels.

Table 14-2: Sources Showing a Significant Relative Percentage Reduction in Mercury Releases

Source	Percentage Decrease
Dental amalgam	96
Cement	49
Batteries and Lamps	47
Gold mining without mercury amalgamation	46
Natural Gas	31
Phosphate Fertiliser	29
Coal Fired Boilers	21

The significant reductions in dental amalgam are due to continuing widespread adoption of alternative restorative dentistry compounds. Decreases associated with non-amalgamation gold mining and cement are not associated with reduction in production, rather they have arisen because of reductions in the estimated concentration of mercury in gold ore or emissions to air in the cement kiln process. These parameters will vary from year to year.

Natural gas, phosphate fertiliser and coal reductions result from decreases in consumption driven by reduced supply, farm economic factors and greenhouse gas emissions reduction strategies respectively.

The reduction for batteries and lamps results partly from a re-assignment of all alkaline cylinder batteries as mercury free coupled with a significant reduction in fluorescent lamp sales.

Table 14-3: Sources Showing a Significant Percentage Increase in Mercury Releases

Source	Percentage Increase
Medical waste incineration	108
Oil (fossil fuels)	18
Cremation	15
Geothermal	12

Compared to 2020, medical waste incineration mercury releases have increased because of an increase in the estimates of waste burnt. Cremation increases result partly from population increase but also an on-going trend favouring cremation over burial. Fossil fuel mercury releases have risen because there are more vehicles on the road and fuel consumption per vehicle has increased. Geothermal increases are due to more geothermal energy being used to generate electricity.

14.4 The Role of the Minamata Convention in Promoting New Zealand Initiatives for Controlling Release of Mercury

The objective of the Minamata Convention is to protect human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds. It aims to achieve this by controlling the supply and trade of mercury including controlling and setting limits on mercury added products and manufacturing processes in which mercury or mercury compounds are used including artisanal and small scale gold mining.

However Article 3 of the Minamata Convention specifically excludes the following from its control (UNEP, 2024):

Naturally occurring trace quantities of mercury or mercury compounds present in such products as non-mercury metals, ores or mineral products, including coal, or products derived from these materials, and unintentional trace quantities in chemical products.

Consequently it would seem that New Zealand's greatest opportunities for reducing its mercury releases under the Minamata umbrella are through controlling products to which mercury is deliberately added.

Article 4 of the Convention requires parties to take appropriate measures to stop the manufacture, import or export of mercury added products listed in part 1 of Annex A after the phase out date specified for these products (UNEP, 2024).

Mercury containing barometers, hygrometers, manometers, and sphygmomanometers have been prohibited since 2020 as have high pressure mercury vapour lamps for general lighting purposes.

All mercury containing battery types have been prohibited since 2025.

From 2027 all linear and non-linear fluorescent lamps will be prohibited following a staged removal programme since 2023 based on lamp coating material and mercury content.

Were New Zealand to ratify the Convention and decide that mercury emissions from small-scale gold mining amalgamation practices were not trivial, it would be obligated under Annex C requirements (UNEP, 2024) to adopt *strategies for managing trade and preventing the diversion of mercury and mercury compounds from both foreign and domestic sources to use in artisanal and small scale gold mining and processing*. This might mean assisting small scale gold miners to replace mercury amalgamation with alternatives that are less harmful for human health and the environment.

At the present time New Zealand has not ratified the Minamata Convention. Nonetheless as a signatory it has an obligation to refrain from acting in a way that would defeat the object and purpose of the Convention.

This means that the country needs to ensure that it has the correct regulations, and if necessary legislation, in place to enable proper control on items no longer allowed for manufacture, import or export under the Convention. Public education strategies are a necessary adjunct.

14.5 Summary of mercury outputs

The five charts given below provide summaries of the relative contributions (above 1%) from each source category to the various outputs to air, water, land, waste and in products. The key points to note from these charts are as follows:

- The outputs to air are dominated by fuel/energy use, especially geothermal. Other notable contributors, in decreasing order of significance are crematoria, primary metal production, waste disposal and waste incineration.
- The outputs to water are totally dominated by waste disposal, especially wastewater discharges. Extraction and use of fuels and primary metal production are the next most significant contributors.

- The outputs to land are dominated by waste disposal with primary metal production (largely gold mining), production of minerals with mercury impurities (largely phosphate fertilisers) and cemeteries also making significant contributions.
- The outputs to products are comprised mostly of consumer products with intentional use of mercury (largely pharmaceuticals) and production of primary metals.
- The outputs to waste feature waste disposal as the largest source with other notable contributions from extraction and use of fuels (dominated by gas extraction), primary metal production and consumer products with intentional use of mercury.

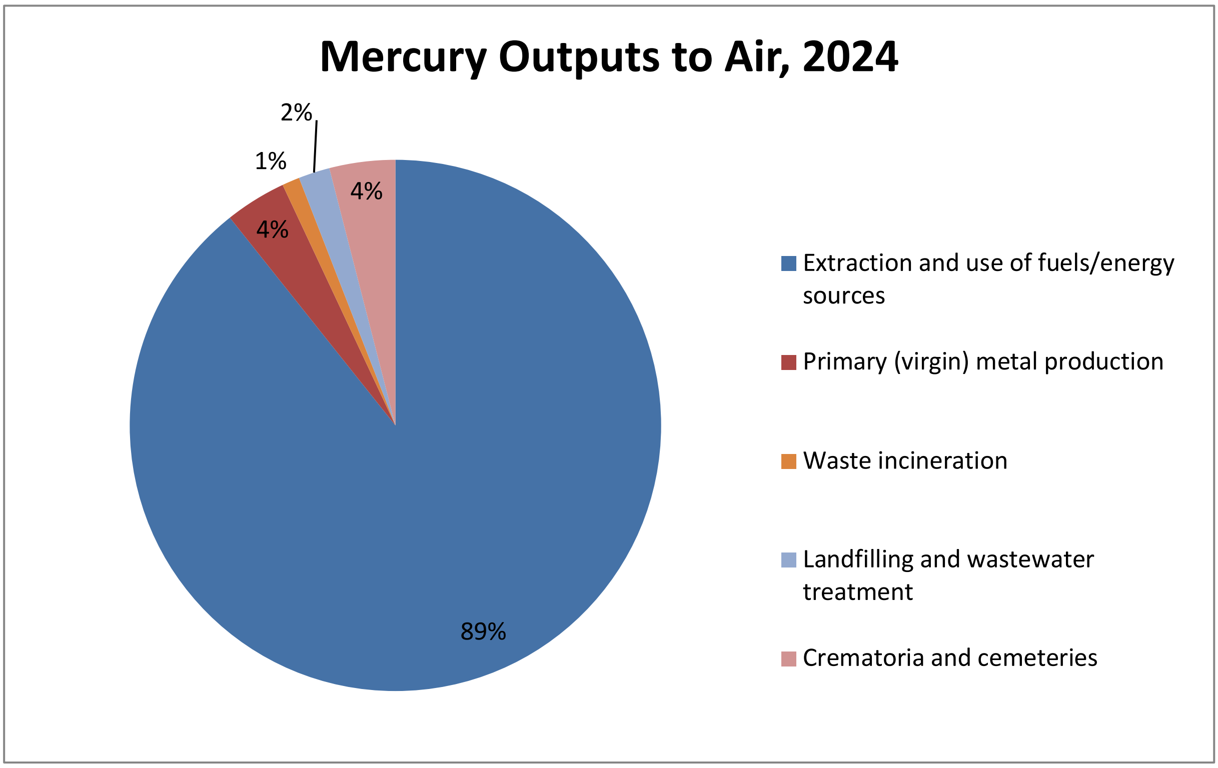

Figure 14-3: Relative mercury outputs to air, by source category

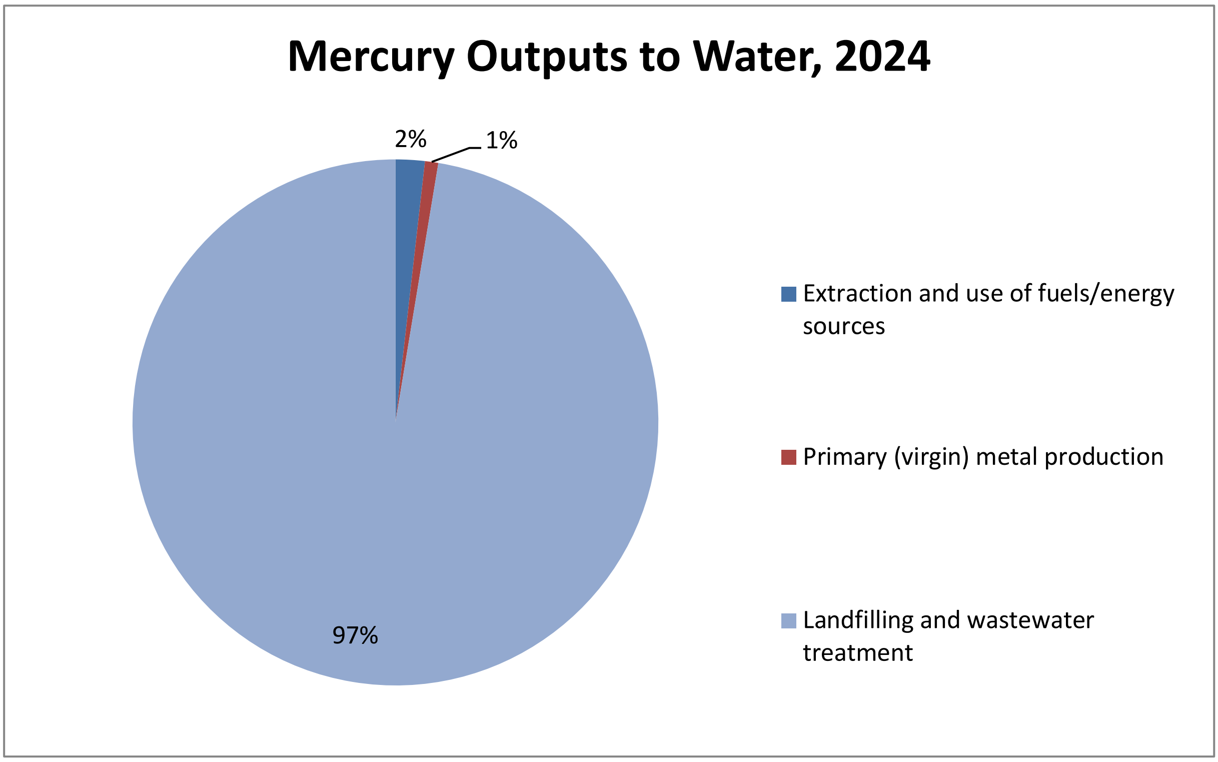

Figure 14-4: Relative mercury outputs to water, by source category

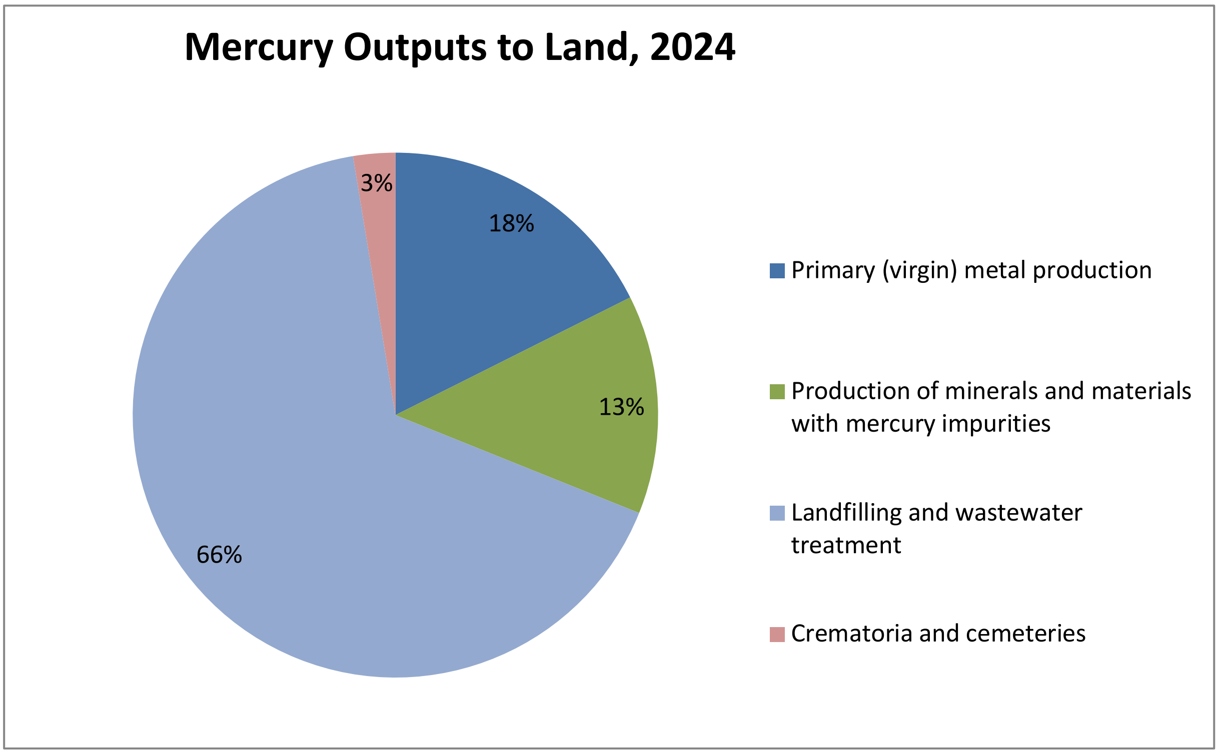

Figure 14-5: Relative mercury outputs to land, by source category

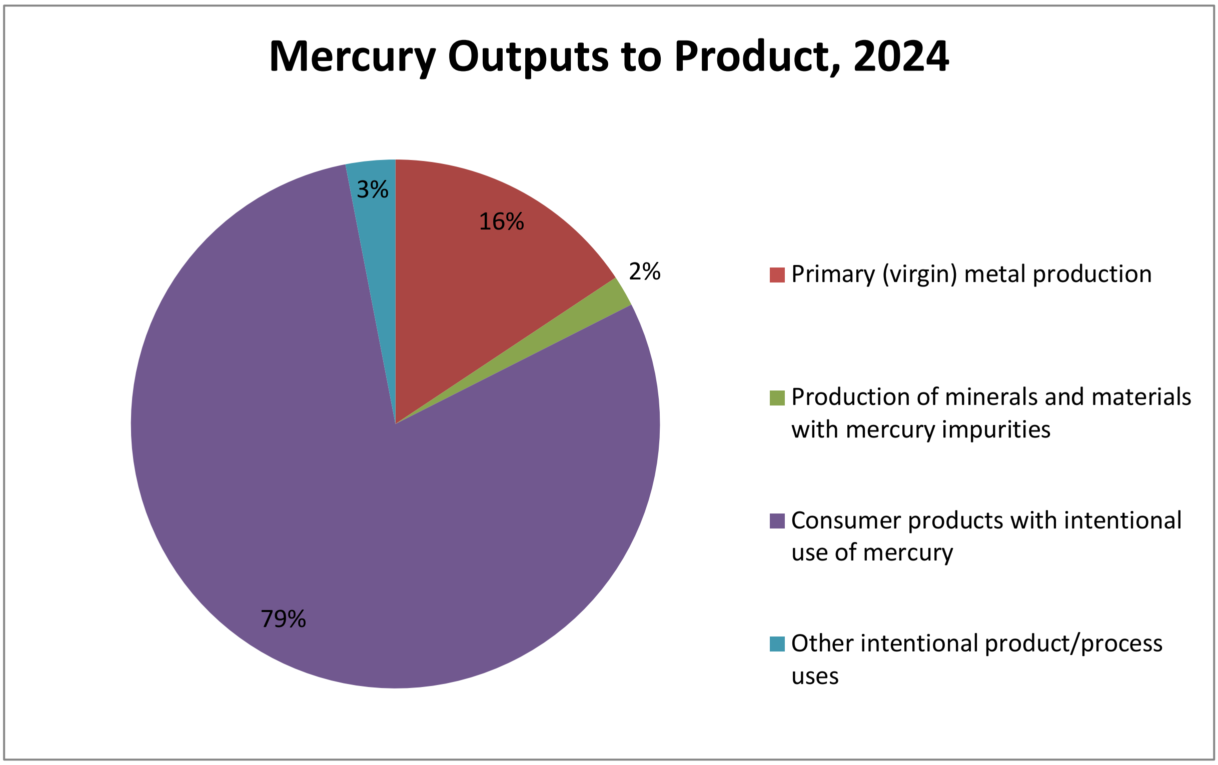

Figure 14-6: Relative mercury outputs to products, by source category

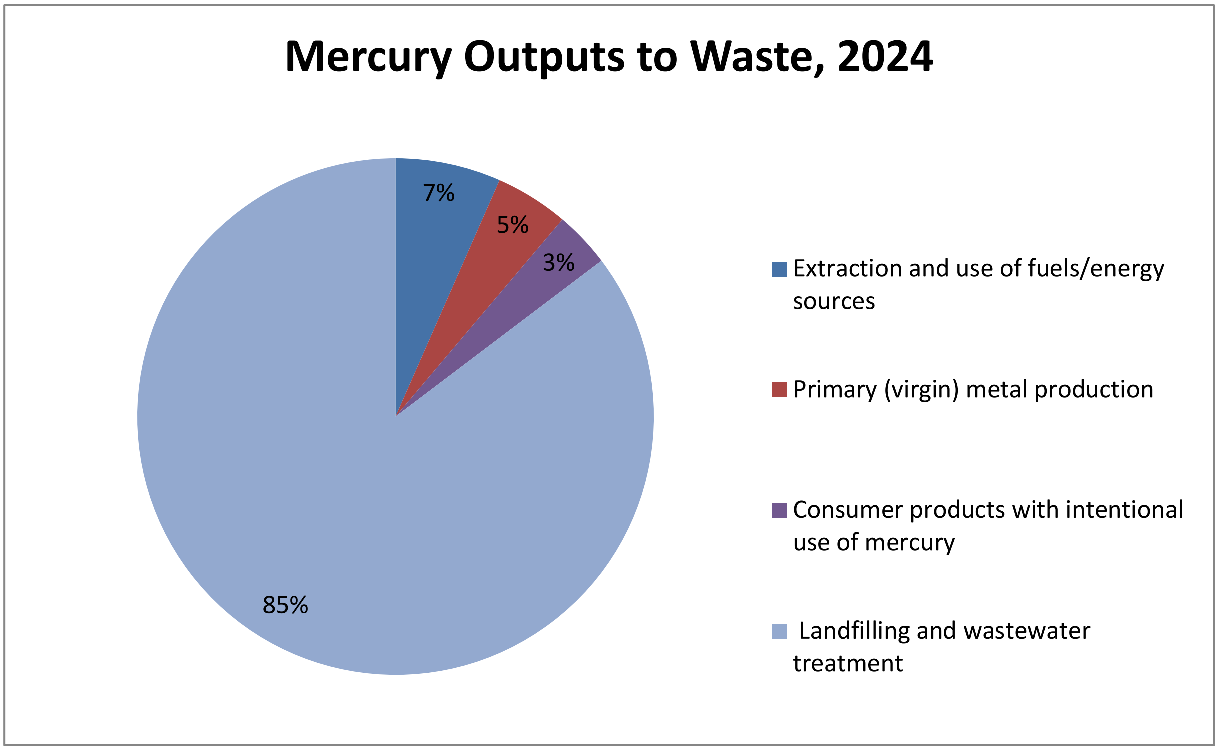

Figure 14-7: Relative mercury outputs to waste, by source category

Table 14-2: Detailed listing of mercury inputs and outputs*

Category	Mercury Inputs, kg/year	Mercury Outputs, kg/yr				
		Air	Water	Land	Product	Waste
Coal – large power plants	17.4 – 165 (91.4)	15.668 – 148.847 (82.3)	-	1.7 – 16.5 (9.1)	-	-
Other coal combustion	29.9 – 111.6 (70.7)	28.4 – 1036 (67.2)		-	-	1.5 – 5.6 (3.5)
Oil extraction, refining and use	20.4	19.8		0.57	-	-
Gas extraction, refining and use	0.33 – 262 (131)	0.065 – 52.4 (26.2)	0.065 – 52.4 (26.2)		-	0.198 – 157 (78.7)
Biomass fuel	17.0 – 170 (93.7)	17.0 – 170 (93.7)	-	-	-	-
Geothermal power	273 – 2004 (1138)	267 – 1997 (1132)	6.4	-	-	-
Gold & silver production, with mercury	20 – 40 (30)	4 - 8 (6)	8 – 16 (12)	8 – 16 (12)	-	-
Gold & silver production, without mercury	199	5.7	2.8	128	5.7	57.0
Ferrous metals production (iron & steel)	38.0 – 152 (95.1)	19.0 - 76.2 (47.6)		19.0 - 76.2 (47.6)	-	
Cement production	0.67	0.44	-	-	0.19	-
Lime production	0.64 – 2.57 (1.61)	0.45 -1.80 (1.13)	-	-	0.193 – 0.772 (0.483)	-
Phosphate fertiliser	132		-	132	-	-
Agricultural lime application	4.70 – 18.8 (11.8)	-	-	4.70 – 18.8 (11.8)	-	-
Thermometers with mercury	0.0005 – 0.005 (0.0028)	0.00005 – 0.0005 (0.00028)	0.00015 – 0.0015 (0.00083)	-	-	0.0003 – 0.003 (0.0017)
Electrical switches, contacts and relays with mercury	6.4	0.64	-	0.64	-	5.12
Light sources - lamps	2.4 – 8.1 (5.3)	0.12 – 0.41 (0.26)	-	-	-	2.3 – 7.7 (5.0)
Light sources - LCDs	-	-	-	-	-	-

Category	Mercury Inputs, kg/year	Mercury Outputs, kg/yr				
		Air	Water	Land	Product	Waste
Batteries containing mercury	33.4	-	-	-	-	33.4
Pharmaceuticals for human and veterinary uses	28.9	-	-	-	28.9	-
Dental mercury amalgam fillings	1.7	0.034	0.24	-	1.03	0.41
Manometers and gauges	0.080	-	-	-	0.080	-
Laboratory chemicals and equipment	1.64	0.082	0.16	-	-	1.40
Recycled mercury	-	-	-	-	-	-
Secondary ferrous metals (iron and steel)	-	-	-	-	-	0
Hazardous waste incineration	-	-	-	-	-	-
Medical waste incineration	1.3 – 6.5 (3.9)	1.3 – 6.5 (3.9)	-	-	-	-
Sewage sludge incineration	0.98	-	-	-	-	0.98
Informal waste incineration	12.6	12.6	-	-	-	-
Other (pet incinerators)	0.51	0.51	-	-	-	-
Controlled landfills/deposits	3,029	30.3	0.30	-	-	2998
Wastewater treatment systems	336.68 – 6733.66 (3535)	-	168.34 – 3366.8 (1768)	67.336 – 1346.73 (707)	-	101.00 – 2020.10 (1061)
Crematoria	25.4 – 102 (63.6)	25.4 – 102 (63.6)	-	-	-	-
Cemeteries	11.0 – 44.1 (27.6)	-	-	11.0 – 44.1 (27.6)	-	-
Totals, all sources	**4,244 – 13,285 (8766)**	**447 – 2,736 (1,594)**	**186 – 3,445 (1,816)**	**373 – 1,780- (1,076)**	**36.0 – 36.6 (36.3)**	**203 – 2289 (1246)**

* Landfill reservoir (2,998 kg) is not included in outputs here so total outputs will not equal total inputs. Also the totals in the table may not exactly equal the sum of displayed data, due to rounding)

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