Toolkit for Identification and Quantification of Mercury Releases

Guideline
for Inventory Level 3

Supplementing the Reference Report and Guideline for Inventory Level 2

Version 1

February 2023

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Citation: UNEP, 2023. Toolkit for Identification and Quantification of Mercury Sources, Guideline for Inventory Level 3, Version 1, UNEP Chemicals and Health Branch, Geneva, Switzerland.

This Toolkit for Inventory Level 3 is a part of the seventh version of the Toolkit. The Toolkit will be further developed and updated as appropriate.

Funding
The work to develop the Inventory Level 3 guideline and calculation spreadsheet has been funded by the Government of Sweden.

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The Toolkit can be found on UNEP Chemicals and Health Branch's website:
https://www.unep.org/explore-topics/chemicals-waste/what-we-do/mercury/mercury-inventory-toolkit

Acknowledgements
The Toolkit was originally developed for UNEP by Jakob Maag (Ed., COWI, later UNITAR), Carsten Lassen, (COWI A/S) and Charles French. The guideline and spreadsheet for Inventory level 3 was developed by Jakob Maag, Carsten Lassen and Rodrigo Cruz-Lean (UNITAR). We wish to thank data owners for their contributions to the enrichment of this Toolkit.

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Introduction

Welcome to the Toolkit for identification and quantification of mercury releases - Inventory Level 3. The Inventory Level 3 (IL3) Toolkit elements include this guideline, an associated calculation spreadsheet in MS Excel format and a reporting template. This guideline describes how to work in the associated Toolkit Inventory Level 3 spreadsheet for calculation of estimates of mercury inputs, flows and emissions/releases and should be read along with the spreadsheet.

Important: this guideline is to be considered and used as a supplement to the toolkit "Reference Report and Guideline for Inventory Level 2" (in the following referred to as the Reference Report). As such, it shall be used in conjunction with the said Reference Report, and where relevant, also with other elements of the toolkit.

This guideline for Inventory Level 3 does therefore not describe all relevant aspects of the methodology, nor the database, but only the elements that are additional to the Reference Report. It is therefore recommended that the associated sections in the Reference Report be read along with the sections in this guideline.

Compared to Inventory Level 2 (IL2), Level 3 is slightly more complicated to work in, and more importantly, it requires more data. This guideline is intended for users that are already well acquainted with working in Inventory Level 2. Inventory Level 3 (IL3) can also be used by other users experienced in working with detailed environmental inventory development and/or mass flow analysis, also called substance flow assessment. In such cases, it is recommended to read the relevant sections of the Reference Report first. The separate Guideline for Inventory level 1 may also prove useful for first-time users, as it provides additional general and specific advice for data collection, etc.

The Reference Report gives additional guidance on inventory development and describes the background inventory principles and the mercury source categories in more detail. It also describes the Inventory Level 2 methodology[1].

We acknowledge that mercury inventory development is generally challenging, especially when it comes to getting hold of the needed data types for your country. We have made every effort to collect and organise the needed background information to pave the way for a resource-saving and efficient mercury inventory development for you.

[1] All the UNEP Mercury Toolkit documents can be found on UNEP's website: https://www.unep.org/explore-topics/chemicals-waste/what-we-do/mercury/mercury-inventory-toolkit

1.1 Who should choose Inventory Level 3?

IL3 gives clear benefits in terms of more usable and informative results. But it is also significantly more demanding to use. If these demands cannot be met, users may be better helped by using IL2 (or IL1).

The benefits of using IL3 are:

- Quantitative assessment of all key flows of mercury through society;
- Clear visual illustration of causal pathways for emissions and releases of mercury;
- Higher accuracy of the inventory/mass flow;
- Detailed account of sector-specific waste treatment;
- Built-in quantification of changes in accumulation;
- Built-in data checks;
- Transparent and adaptable calculations.

The extra demands and pitfalls when using IL3 are:

- Specialized skills and experience are needed (inventory development and MS Excel use);
- Bigger data collection efforts are needed;
- Without a dedicated data collection effort, IL3 may produce misleading (under-estimated) results;
- Users who cannot invest the needed expertise and efforts may be better helped by IL2.

2 Methodology of Inventory level 3

2.1 What is different from Inventory Level 2?

The differences between IL3 and Inventory IL2 are related to the following aspects, which are all further detailed below:

- In IL3, the mass balance principle is fully applied;
- Quantification of imports, exports and domestic input;
- Accumulation of mercury in society over time;
- Estimation methodology for municipal solid waste;
- Detailing of sector-specific treatment/disposal and the estimation methodology for hazardous waste;
- Mercury supply/demand check.

2.2 Full mass balance

While all levels of the Toolkit are based on the mass balance principle, some simplifications were made in IL1 and IL2. This was done to:

- Make the work simpler for users, and more importantly, to
- Enable the development of reasonable releases/emissions estimates in countries where significant data gaps could be anticipated.

In IL3, these simplifications were omitted, with the associated higher complexity for users and need for dedicated and detailed data collection to avoid under-estimations for the waste treatment-related releases/emissions.

The following figure illustrates the key differences in the use of the mass balance principle in IL2 and IL3.

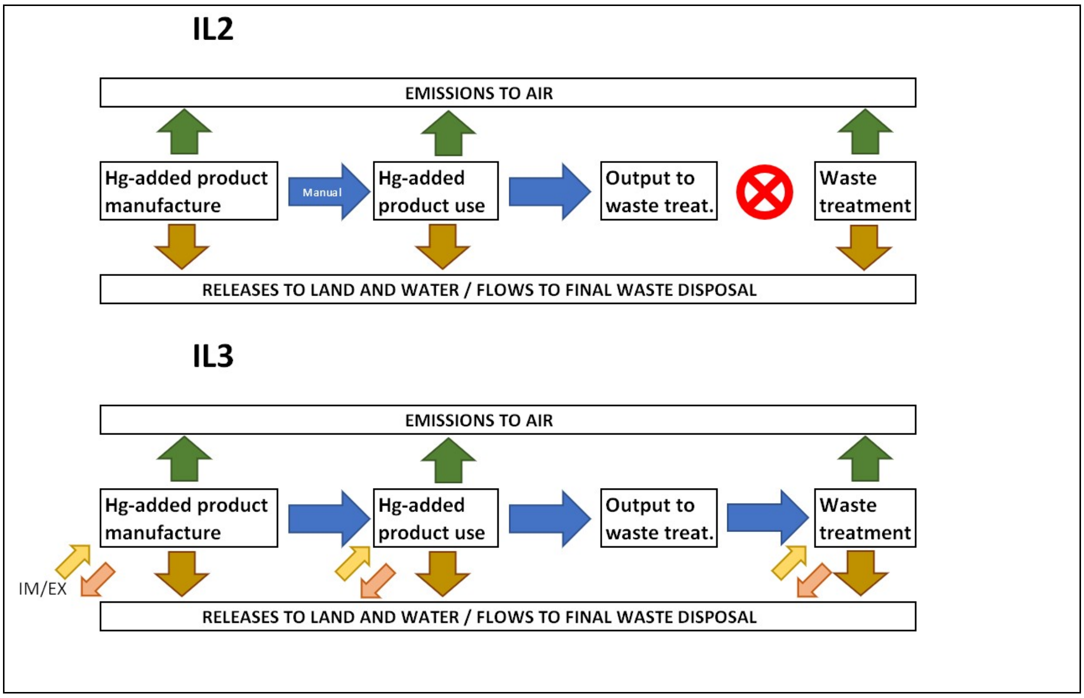

Figure 2-1 Key difference between Inventory Levels 2 and 3 (IM = import, EX = export)

As shown, IL2 does not use the outputs from products and processes to waste treatment as the basis for the estimation of mercury releases from waste treatment. Instead, realistic literature values for mercury concentrations in wastes are used. This is done to signal the importance of emissions and releases from the waste treatment phase, knowing that in many developing countries the quantification of products may be underestimated due to difficulties in getting the needed data.

In IL3, on the other hand, the flows of mercury are followed throughout, except for a few flows that are not in focus for exposure[2], and hence, policy-development. This also emphasizes how important it is to establish good coverage of all lifecycle phases in the data collection and analysis.

2.3 Quantification of imports, exports and domestic input

In IL3, imports, exports and inputs from domestic production are quantified individually, to allow for reporting each of these in the mass flow.

In IL2 (and IL1), the following formulas were used to derive the mercury input to the process in question:

1) Hg input = Activity Rate * Input Factor

2) Where, Activity Rate = import + production – export

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[2] Such as for example mercury traces in cement incorporated into buildings.

3) The Input Factor is typically the mercury concentration in a material or mercury content in a product.

This means that in IL2 we combined import, production and export data to calculate the total mercury input.

In a mass flow analysis, as IL3 is, you want to follow the mercury flow through society, and therefore you need to make separate quantification of mercury imports, exports and production contributions. Hence, the individual contributions are calculated separately, and only combined after, using the following formulas:

1) Hg in import = import rate * input factor$_{(import)}$

2) Hg in export = export rate * input factor$_{(export)}$

3) Hg in domestic production (of products or materials) = production rate * input factor$_{(production)}$

4) Input to sector = $Hg_{(import)} + Hg_{(production)} - Hg_{(export)}$

Or, in the case of estimation of releases/emissions from domestic production (because the production of exported products may also contribute to releases/emissions):

5) Input to sector = $Hg_{(import)} + Hg_{(production)}$

The spreadsheet is by default proposing identical input factors for import, export and input from domestic production. This is realistic in most cases and helps avoid further complication of the spreadsheet tabs. However, if, in the individual case, there are significant differences between these input factors, users are allowed to make alterations in the calculations, for example by entering an alternative input factor in the input calculations in question (in the yellow columns). When making alterations for sub-categories which are also listed in the Accumulation tab, remember to do the same changes in in the Accumulation tab.

Any alterations to the calculations must always be done explicitly with clear notes in the spreadsheet and explicit reporting in your inventory report, explaining in detail why and how the alterations were made. Detailed documentation can be placed in appendices to the report. Failure to provide such detailed explanations may be considered by readers as a flaw in the mass flow analysis.

2.4 Accumulation of mercury in society over time

Accumulation is the amount of the mercury that is at work in products and processes in society or in stockpiles not yet finally disposed off. This is important because much of the mercury releases/emissions are a result of mercury supply at the time of their original entry into the economy, not the present supply.

Today (2022), the total mercury amounts in for example spent products which are disposed off is typically larger than the current supply with new products. This is because mercury-added products are being phased out/down, notably after the entering into force of the Minamata Convention. This means that we cannot very well use current supply data to make estimates of current releases/emissions; it would under-estimate the releases/emissions. We have to – if feasible – use supply data reflecting former mercury supply, at least one average product life-time back in time.

And with lifetime, we mean functional time plus any hoarding time – the time from the product is taken out of service till it is disposed off. The functional time depends on the product type and its use; for example a mercury-filled fever thermometer may last for decades in a private home where it is used rarely (and if taken well care of), whereas it is used much more intensely in a hospital and hence would typically last only a few months or years before it is broken or otherwise replaced. The hoarding time is more difficult to predict, as it depends on things such as price of the product – high price may typically prolong the hoarding – user awareness of the product's/mercury's hazards, disposal options in the country, etc. For more details on this, see Section 4.1.

Accumulation is also mentioned in the Inventory Level 2 (IL2) methodol-ogy, but it was so far – for most products – up to the user to estimate relevant lifetimes and associated supply data. In Inventory Level 3, we have suggested relevant average lifetime estimates for each product (see Table 4-1). These can be replaced and reported by users if well-documented local data are available. The estimation of mercury supply one average lifetime ago is also operationalised in the IL3 spreadsheet, basically with similar calculations as for the current supply, but with the possibility to enter trade and production data representing the situation one average lifetime ago. These data may in some cases be available from previous inventories, or they can be collected from other sources for the IL3 estimations.

Comparing estimates for current supply (or input as we term it in the Toolkit) with estimates for the supply one lifetime back in time, enables the derivation of the so-called "Accumulation factor" (in the Accumula-tion tab of the spreadsheet), which then in turn is used in the relevant sub-category tabs to calculate current releases/emissions.

For additional details on the derivation and use of accumulation factors, see Section 4.1.

2.5 Estimations for municipal solid waste

As described above, in IL3 the total mercury input to municipal solid waste treatment (“general waste”) is calculated as the sum of outputs to municipal waste from the relevant products and process source categories[3].

The total amounts of municipal solid waste can be entered directly, with reference to the relevant data sources, or estimated through the use of relevant waste generation rates, preferably nationally derived.

The input of mercury to each individual municipal solid waste treatment type is then calculated by multiplying the total mercury input to municipal waste with the relative fraction of municipal solid waste that is treated with the treatment type in question.

If, for example, it is known from national statistics that all waste generated in the largest cities, equalling 40% - or 0.4 - of the total nationally generated municipal solid waste amounts, are disposed on engineered (lined and capped) landfills, the estimation of mercury input to disposal in engineered landfills would be:

Hg input (engineered landfills) = 0.4 * total mercury input to municipal waste treatment nationally = 0.4 * total mercury outputs to municipal waste from products and processes.

As explained above, this has the potential to more accurately estimate the mercury releases/emissions from municipal waste treatment, but it also makes a very good inventory coverage of the contributing products and process in the country necessary, in order to avoid under-estimations.

2.6 Detailing of sector-specific treatment/disposal and estimations for hazardous waste

To make a full mass flow assessment, as endeavoured in IL3, it is necessary to know the quantitative details of how hazardous waste is treated in the country. For this purpose, a new and more detailed approach was included in IL3[4].

Like for municipal solid waste, the detailing is based on a distribution of quantified mercury outputs to “Sector-specific waste treatment/disposal” on the relevant hazardous waste treatment techniques. However

[3] By comparison, in IL2, the inputs to municipal waste are calculated by multiplying waste amounts with relevant input factors representing mercury concentrations in the waste.

[4] For comparison, in IL2 outputs to all hazardous wastes treatments are quantified as outputs to ”Sector-specific treatment/disposal”, and users must themselves describe in their reporting the actual treatments applied and how mercury is distributed amongst them.

here, the distribution on treatment/disposal techniques is done by source sub-category, because the treatment methods applied normally depend closely on the characteristics of the specific type of waste treated.

The specifics of how this is done is described in Section 3.8, whereas the estimation of releases/emissions from hazardous waste treatment is explained in Section 3.10.

We note that what in IL2 and IL3 is termed "Sector-specific waste" is mostly hazardous waste of some kind (even if it may have varying mercury concentrations).

The new SectSpecWaste tab also provides the framework for a comparison of estimated mercury outputs to hazardous waste treatment with available recorded data from hazardous waste treatment companies/entities.

This comparison enables, to the extent recorded data are available, a quality check of the estimations made, and can – upon careful scrutiny – be used to adjust the mercury output calculations made for relevant product and process sub-categories.

2.7 Mercury supply/demand check

Also as a new feature in IL2, the IL3 spreadsheet introduces a mercury (Hg) "Hg-check" tab which enables a comparison of estimated mercury inputs to manufacturing and other processes using mercury metal and mercury compounds, respectively, with trade data for mercury and its compounds. The mercury inputs are estimated on the basis on data on any domestic production of mercury from dedicated mercury mining, from recovered mercury from other non-ferrous mining, as well as post-consumer mercury recycling.

This comparison enables a quality check of the estimations made, and can – upon careful scrutiny – be used to adjust the mercury input calculations made for mercury and mercury compound using industries.

The results in the tab can also be used to estimate relative contributions of mercury inputs to processes/manufacture from import and domestic sources.

More details of the use of the Hg-check tab are given in Section 4.2.

3 Specific information and advice to source categories

Due to the new additions and detailing of the mercury flow quantifications made in IL3, this section gives specific advice and data – where relevant – to each source sub-category. As mentioned previously, **this section does not give a stand-alone description of all aspects of the input and output estimations for the source sub-categories**, but only highlight the specificities of IL3, hence it is sought to make the text for each source sub-category concise. **The section must be read in conjunction with the Toolkit Reference Report's corresponding section on the source sub-category in question, where important explanations and data are given.**

3.1 General guidance

Collection of trade and production data

Statistics for registered import, export and production, are relatively easily available data that constitute significant elements of the data collection to be made.

The data sources may be international, such as UN Comtrade commodity trade database, the International Energy Agency's energy statistics database and the US Geological Survey Minerals Yearbooks. Or, they may be national or regional statistics. International databases have the advantage that they make use of both data supplied by the country in focus and other countries that have had trade with that country. This may in some cases secure higher quality data than national data. However, national trade data may be more detailed – have more specific commodity codes/grouping that can in some cases be helpful for inventory development. Production statistics are normally national or in some cases regional (for example in the European Union). In general, it is thus recommended to check both national and international statistics and compare or combine the data sets to describe the situation in the best possible way according to the inventory needs.

General advice and practical guidance for extracting data types needed in mercury inventory development from the UN Comtrade commodity trade database and the IEA energy statistics database is given in Appendices 1 and 2, respectively.

When using statistical data, it is important to use averages for several consecutive years because this will even out fluctuations caused by reporting delays (of the original data) and the fact that imports may happen in one year and the products in question may be sold (introduced to the market) over one or more years to the actual users[5].

[5] The year when the product is purchased by the end-user is in focus for the inventory.

For Inventory Level 3, it is recommended to collect statistics data (import, export and production rates) as follows:

- Collect data for 5 years for the current input calculations, with your inventory base year being the last or next to last year.
  - If data are scattered – with no clear trend –, calculate the average of the last 3 years and use this as best approximation for the base year rate (import/export/production).
  - If there is a clear downward or upward trend in the data, calculate the average of the base year and the year before and use this average as use this as best approximation for the base year rate (import/export /production).
- Always display both the raw and processed data in your inventory report and mention which years you included in the averages used.
- Calculate a past reference year by subtraction the average product lifetime from the base year. Collect data for a 5-years period around this past reference year for the calculations of today's outputs to the waste streams and accumulation. If for example your base year is 2020, and the average product lifetime is estimated at 5 years, collect data for the period 2013-2017. For estimated product average lifetime, see Section 4.1 and the IL3 spreadsheet Accumulation tab .
  - Use the calculated average in the accumulation tab and report your raw and processed data in an appendix to your inventory report and provide a reference from the sections on the products in question to this appendix.

Remember also that statistics are based on data reported by people. As such they may have errors (wrong codes used or numbers mis-written) or be imprecise due to the reporters not being specific enough in their reporting (placing several products under one code, though more precise codes exist). If you observe clear outliers (that seem not only to be explainable fluctuations, discuss them in your report and consider to omit them in the used averages. Furthermore, trade statistics usually have some thresholds for quantities imported/exported below which companies do not have the obligation to report. Reporting errors and imprecisions are particularly important for products that are only traded in moderate quantities, which includes several of the mercury-added products.

When collecting data on amounts of products marketed nationally from national manufacturers (producers), make sure to check in advance what years you need data for to cover both current years and years around one average product/material lifetime ago. Start by asking about recent trends. See lifetimes and advice in Section 4.1.Subtraction of exported mercury

Subtraction of exported mercury is generally done in the use phase input calculations. This is because export may be from both national production and import, and because this enables the use of international trade data in the same set of calculations. Exceptions are made in a few cases (see details in Section 3.6), where use phase inputs are – for simplicity - calculated based on generic data such as population and electrification rate (instead of import rates, export rates and production rates). For these cases, any identified export needs to be subtracted in the production phase calculations, as detailed for these sub-categories in Section 3.6.

Alterations to the IL3 calculation spreadsheet

Confident users may make their own alterations to the calculation spreadsheet, **but only if this is explicitly noted in the spreadsheet itself, and it is explained in detail in the inventory report why and how it is done**. Making alterations in the spreadsheet requires a very good insight in the working of MS Excel. Before making changes in the calculations, **always examine carefully** the precedents and dependents of the cells in question e.g. by using the MS Excel formula tools. Due to its complexity, the IL3 spreadsheet is more intricately woven together than the IL2 spreadsheet.

The formulas in the IL3 spreadsheet are protected against accidental overwriting and deletion. If you need to change the formulas, after careful consideration, you can unlock the protection; it has no password. Make sure to leave it with no password, in case you re-protect it, to allow for review.

Output distribution factors for production sum up to 1

As all type of flows are quantified in IL3, this means that the sum of all output distribution factors should be 1 (meaning 100%). This is different from IL2, where outputs to products from some production processes are omitted to avoid double counting, and therefore the output distribution factors only sum up to the fraction of the mercury that is released/emitted. You will observe this if you compare output distribution factors between IL2 and IL3.

3.2 Fuels and energy production

This section refers to the Fuels tab in the IL3 spreadsheet.

For all fuels sub-categories, try to find reliable national energy statistics with the units needed in the Toolkit (see the IL3 spreadsheet in each case). You can also find the needed data for most countries in the International Energy Agency's, IEA's database, see how in Appendix 2, and convert the IEA data in (TJ unit) to Toolkit units using the IL3 spreadsheet's Unit conversion tab. Even if you find national energy data, it is recommended to compare it with the IEA data, as the latter has the quality of potentially having been validated through the use of several data sets.

No.	Sub-category and lifecycle phase	Import, production and export rates	Input calculations	Accumulation and output calculations
5.1.1	/Coal pre-processing (coal used in power plants)	This phase should include all coal used in the sub-category, whether imported, produced domestically or exported, as long as they are pre-treated in the country. The relevant treatment is coal wash that is sometimes but not always applied. Distribute coal amounts amongst key uses (power plants, industrial boilers, etc.) with specific data, or from general observations, such as energy supply or other. Note that the sum of all inputs from domestic production to the different coal uses should generally equal the	Note that using the standard input factors for coals will mean that export is counted as if coal wash (causing reduced Hg concentrations in the coal) has NOT taken place. If indeed coal wash has taken place, you can adjust the input factor for export directly in the corresponding cell in the "Calculated Hg EXPORT with product" column.	Distribute all coal inputs on output scenarios depending on the use or absence of coal wash (as this affects Hg concentrations and results in releases). Pre-treated coal to be exported also contributes to releases in the country. The (in) product output is assigned to coal uses (combustion).

No.	Sub-category and lifecycle phase	Import, production and export rates	Input calculations	Accumulation and output calculations
		sum of the import rate and the domestic production rate from the pretreatment step.		
	/Combustion		The mercury input with coal pre-processed in the country is automatically assigned to coal uses according to the domestic production rates entered for each coal use. If no production rates are entered, the total products output from pre-processing is automatically assigned to combustion of bituminous coal (a commonly used type).	
5.1.2	/Coal pre-processing (coal used in industrial boilers)	As for 5.1.1.		As for 5.1.1
	/Combustion		The mercury input with coal pre-processed in the country is automatically assigned to coal uses according to the domestic production rates entered for each coal use (actually "consumption from domestically pre-processed coal"). If no production rates are entered, the total products output from pre-treatment is automatically assigned to combustion of bituminous coal (a commonly used type).	

No.	**Sub-category and lifecycle phase**	**Import, production and export rates**	**Input calculations**	**Accumulation and output calculations**
5.1.3	Mineral oils - extraction, refining and use /Extraction	Relates only to oil extracted in the territory of the country.		Releases from the extraction process for oil that is later exported are included here, while the mercury present in the extracted and exported oil is included under oil refining (and combustion/use).
	/Refining	Domestic production rate need not be entered (see explanation in the cell to the right). The import and export rates refer to international trade of crude oil (as per the general approach in the Toolkit).	The input from domestically extracted oil is automatically derived from product output from the extraction phase.	
	/Use (all oil fractions)		The mercury input with oil refined in the country is automatically assigned to oil uses according to the domestic production rates (actually "consumption from domestically produced fuels") entered for each oil use. If no production rates are entered, the total products output from refining is automatically assigned to use of diesel for transport (a major use).	
5.1.4	Natural gas - extraction, refining and use		The mercury input with natural gas extracted and refined in the country is automatically assigned to gas uses according to the domestic production rates entered for each gas use. If	

No.	Sub-category and lifecycle phase	Import, production and export rates	Input calculations	Accumulation and output calculations
	/Use of gas		no production rates are entered, the total products output from extraction/refining is automatically assigned to use of pipeline quality gas (the dominant use).	
5.1.5	Use (direct) of oil shale and other fossil fuels		Both input factors and input formulas need to be added, depending on the unit applied.	
5.1.6	Charcoal combustion	If charcoal is domestically produced and the biomass volumes entered under burning include biomass used for charcoal production, charcoal rates should NOT be entered (as they will be covered under biomass burning). Imported charcoal is irrelevant because the mercury is assumed evaporated during charcoal production (in the exporting country).		
5.1.7	Geothermal power production	Geothermal power production may release/emit mercury naturally present in the underground.	Both input factor and input formula need to be added, depending on the unit applied.	

3.3 Primary (virgin) metal production

No.	Sub-category and lifecycle phase	Import, production and export rates	Input calculations	Accumulation and output calculations
5.2.1	Mercury (primary) extraction and initial processing	The data needed are the production and the mercury export numbers in Kg Hg/y	Calculations are based on an input factor taking into account that some mercury will be lost in the production process. Note that due to its special character, the inputs to society from dedicated mercury mining are calculated slightly differently than for most other sub-categories: Export is calculated in the production line itself. While the exported mercury amount does not constitute an input to society (in the country itself), the emissions and releases from the production of the exported mercury amounts do contribute to domestic input. The losses from emissions and releases are this deducted from the export amount calculated, while it is added to the calculated total current Hg input (see cell formulas for specifics).	The output to products equals the mercury feed into the society or exported from mercury primary extraction.
5.2.2	Gold (and silver) extraction with mercury amalgamation processes	Only the production of gold using mercury amalgamation shall be entered. This is typically ASGM miners. Note that some ASGM miners use cyanidation other methods that do not use mercury, and gold pro-	The calculated mercury inputs shall be considered imported unless there is clear evidence of domestic (formal or informal) mercury production, in which case, the input shall be distrib-	The outputs estimated are to be considered rough estimates due to the variability of the real-life output distribution factors. Field studies in the country are recommended to refine your mercury inventory for ASGM with

No.	Sub-category and lifecycle phase	Import, production and export rates	Input calculations	Accumulation and output calculations
		duced by these methods should not be included here (but under sub-category 5.2.6). Distribute the gold produced with mercury amalgamation based on national field observations on what estimated fractions of gold are produced with whole ore amalgamation vs. amalgamation of concentrates, and with vs. without retorts (that capture emitted mercury for reuse). For details, see the Toolkit Reference Report. These fractions can be hard to estimate precisely due to the often informal character of ASGM, but make your best estimates and be explicit about the data used and assumptions made, in your reporting.	uted on imports and domestic production based on mercury production and import data, see Section 4.2 and the IL3 spreadsheet's Hg-check tab.	the mercury amalgamation method. If the country has developed an ASGM National Action Plan under the Minamata Convention this may be consulted.
5.2.3, 5.2.4, 5.2.5	Zinc /copper /lead extraction and initial processing	The import, production and export rates are for the concentrates used in the production. In non-ferrous metal production, concentrates are often produced in the mining country, but may be traded/shipped to other countries for the actual smelting/extraction of the metal. Raw ores are less frequently traded between countries. Trade statistics usually report a total for ores and concentrates. If more specific information is not available,	As for other production processes in the Toolkit IL3 context, mercury inputs to the smelting process from nationally produced concentrates are calculated based on the product outputs from the concentration phase.	Since non-ferrous mining, when present in a country, are always significant mercury input sources, it is recommended to use reliable and well documented local input and output distribution factors, whenever available. Document the data used and assumptions made carefully and detailed in the inventory report. This is also the case for the so-called "heap leaching" method (mostly applied for copper production), which

No.	Sub-category and lifecycle phase	Import, production and export rates	Input calculations	Accumulation and output calculations
		it is recommended to assume that the traded quantities are all concentrates. The actual smelting /metal extraction is normally a significant source of mercury input to society, but some of the mercury may be withheld in special waste disposal facilities. The concentration phase may, as indicated above, take place elsewhere than the smelting /metal extraction. It is known that the concentration phase is a source of mercury releases, but data are so far very scarce for this process step, except for zinc production. For copper and lead, currently available data do not allow for the formation of metal-specific default input or output distribution factors for the concentration phase, yet the process is considered to be similar to that of zinc (and the metals are sometimes co-produced with zinc). Therefore the output distribution factors for zinc are suggested for copper and lead as well. Local data may be available that can increase the accuracy of the estimations, and such data should be used in the inventory wherever possible.		applies no roasting/smelting during the processing and may therefore have a different output distribution pattern. See important details of these source sub-categories in the Toolkit Reference Report.

No.	Sub-category and lifecycle phase	Import, production and export rates	Input calculations	Accumulation and output calculations
		Co-extraction of several non-ferrous metals from the same ore is often seen, and in such cases, assign the mercury input/output calculations to the metal that is produced in the highest quantities from the facility. Explain the specific of the operation/facility carefully and detailed in the inventory report.		
5.2.6	Gold extraction and initial processing by methods other than mercury amalgamation	Due to the high price of gold, it is often extracted directly from the ore with no pre-concentration, hence at or close to the ore extraction site. However, import and export rates for gold ore can be entered if specific data are available[6].		Since non-ferrous mining, when present in a country, are always mercury input sources, it is recommended to use reliable and well documented local input and output distribution factors, whenever available. Document the data used and assumptions made carefully and detailed in the inventory report. See important details on this source sub-categories in the Toolkit Reference Report.
5.2.7	Aluminium extraction and initial processing	Also here, the bauxite for alumina production can be traded internationally. However, it is more common that the alumina is traded internationally for the energy intensive aluminium production in countries		

[6] The Toolkit standard input factor is based on mercury concentrations in <u>ore</u>, So, in cases where gold <u>concentrates</u> are traded, make sure to convert the concentrate amounts to the equivalent ore amounts, or alternatively, use specific input factors for the concentrate.

No.	Sub-category and lifecycle phase	Import, production and export rates	Input calculations	Accumulation and output calculations
		where low-price electricity – such as hydro-power – is available. The key Hg inputs to society are believed to take place in the alumina production from bauxite phase. Data for the metal extraction phase are scarce, so if available, enter any local data and adapted calculations in the spreadsheet.		
5.2.9	Primary ferrous metal production	Only the production rate (t of pig iron produced/y) is to be entered, as the production is assumed based (primarily) on local ores and as final product exported to not include any mercury (due to the high temperatures applied).		
5.2.10	Use of sulphuric acid from non-ferrous mining	All non-ferrous metal production facilities with acid plants produce sulphuric acid (when sulphur is present in the ores). The acid production is thus an output from the non-ferrous smelting covered in sub-categories 5.2.3 - 5.2.5 and potentially 5.2.8. Only the import, production and export rates for sulphuric acid originating from non-ferrous metal production should be entered here. Seek advice from specialist	Note that the input factor applied may vary depending on both the production specifics and the acid quality sold. Some acid may be sold as low-grade technical quality which have in some cases been observed to have significant mercury concentrations. In case several acid qualities are sold/used in the country, a weighted average input factor can be used, or	The primary output from use of mercury-containing sulphuric acid is assumed to be water, unless/until more data are available.

No.	Sub-category and lifecycle phase	Import, production and export rates	Input calculations	Accumulation and output calculations
		to establish if there are other significant sulphuric acid sources on the market.	rows can be copied to make several sets of calculations.	

3.4 Other minerals and materials with mercury impurities

No.	Sub-category and lifecycle phase	Import, production and export rates	Input calculations	Accumulation and output calculations
5.3.1	Cement /clinker production	Clinker production is the only production phase which emits/releases Hg, hence only the production rate (t/y of cement produced from national clinker production) needs to be entered. Some countries do not have their own clinker production, but may have cement crushing and bagging operations that should not be included in this lifecycle phase. U.S Geological Survey publishes annual minerals year-books with information on minerals production for many countries at http://minerals.usgs.gov/minerals/pubs/country/index.html#pubs. In most cases, these reports also mention individual facilities and whether they have clinker production or not. It is however recommended to cross-check with national data sources – preferably the clinker production facilities themselves – , to confirm production data and also to get to know the energy mix and filter configurations applied. The Toolkit distinguishes between the two sub-types with or without (or with marginal) co-incineration of waste, as waste		Be careful to investigate what filter configuration is used in the individual clinker production facilities, and if the filter dust is recycled, as this influences the output distribution significantly. See the Toolkit Reference Report for details on the filter configurations normally used. As always in the Toolkit, make sure to distribute the total mercury inputs from the sub-type of clinker production in question (with/without waste) on the relevant output scenarios according to the production volumes of the clinker kilns that use each output scenario (filter configurations). Always use formulas with links to the inputs for the distribution, as this is more robust to changes in the mercury inputs (never enter the numbers manually).

No.	Sub-category and lifecycle phase	Import, production and export rates	Input calculations	Accumulation and output calculations
		used as fuel may affect the Hg input. Co-incineration with waste of less than 3% of the energy demand is considered “without co-incineration of waste” in the Toolkit. Make sure to enter your data in the right rows. In case of several clinker kilns in the country and different waste use, simply distribute production rates among the two sub-types using the respective production volumes in the years in question. Additionally, you need to know the fossil fuel mix used in the clinker kiln, as the fuels also contribute with varying Hg inputs. Here again, you distribute production rates among the fuel types using the respective production volumes in the years in question. If different fuels are used in the same kiln, reflect the fuel mix by distributing the production by fuel energy input ratio (the number that the facilities usually would have).		
	/Cement use	To complete the mass flow for cement, and because some of the mercury stays in the clinker or is added with purged filter dust to the cement, the use of cement is also included in IL3. The production rate needs not be entered, as the Hg input from domestic production is calculated in the clinker production phase and automatically linked to the use phase.		The products output is the constructions in which the cement is used. The Hg concentrations there are normally so low, that it has no/minor implications. Ultimately, the constructions will end up as reusable or disposed concrete waste or releases to land.
5.3.2	Pulp and paper production	The unit of the import and production rates is t/y biomass used in the production. Hence the export rate is irrelevant.		

No.	Sub-category and lifecycle phase	Import, production and export rates	Input calculations	Accumulation and output calculations
5.3.3-5.3.4		Any local data and formulas need to be entered depending on the units in question.		

3.5 Industrial process uses of mercury

This section relates to the Hg industry tab in the IL3 spreadsheet.

No.	Sub-category and lifecycle phase	Import, production and export rates	Input calculations	Accumulation and output calculations
5.4.1	Chlor-alkali production with mercury technology	The input is determined from the production of chlorine (CL_2) gas, and hence the only rate needed to enter is the domestic production rate for CL_2 based on mercury technology. See the Toolkit Reference Report and the Guideline for Inventory Level 1 for advice on data collection. Note that chlor-alkali can be – and is now increasingly being – produced with mercury-free technologies (the so-called membrane process is dominating). The Global Mercury Partnership area on chlor-alkali includes an overview of mercury-cell facilities globally, as well as other more recent documents that may inform the issue: https://www.unep.org/globalmercurypartnership/resources/report/global-estimate-	The mercury input to the process is the mercury used in the chlor-alkali production cells (whether imported or not). The spreadsheet assumes this is imported mercury, but if domestic mercury production is present in your country (virgin or recycled), you should reflect by changing the distribution between imported and domestically produced (or recycled) mercury in the input calculation cells. See guidance on distribution of mercury supplies in Section 4.2.	

No.	Sub-category and lifecycle phase	Import, production and export rates	Input calculations	Accumulation and output calculations
		global-mercury-cell-chlorine-capacity-global-inventory-updated. The IL3 spreadsheet includes a conversion factor, in the Unit conversion tab, that can be used in case on the alkali (NaOH or similar) is known.		
	/Use of chemicals produced with Hg cell tech.	To complete the mass flow for chlor-alkali, and because some of the mercury stays in the produced products, the use of the products produced in mercury-cell chlor-alkali plants is also included in IL3. As these chemicals can also be produced by other means, it is important to try to distinguish which volumes of the chemicals are produced with mercury cell technology. Again, the presence in the country of a mercury-cell chlor-alkali facility may give a hint of the significance. The Hg input with products from domestic mercury-cell chlor-alkali plants is calculated automatically, but production rates need to be entered to distribute this mercury input on the products in question.	If no production rate is entered, the mercury input from domestic production is automatically be allocated to NaOH (/KOH) from domestic production.	
5.4.4	Other production of chemicals	This sub-category also includes production of mercury compounds not accounted for elsewhere in IL3. Local data can be entered and the input and output calculations added by the user, depending on the units in question.		

No.	Sub-category and lifecycle phase	Import, production and export rates	Input calculations	Accumulation and output calculations
	and polymers with mercury			
5.4.5	Fire gilding (gold plating) with mercury amalgam	Data for mercury use for traditional fire gilding (gold plating) are scarce, and it is recommended to collect specific national data about the amounts of mercury used, if feasible. The pre-entered input and output factors are based on data from one country only (Nepal, see details in the Reference Report). The pre-entered input factor is based on mercury used per tonne of gilded (small) statues produced. But as the surface to weight ratio may be quite different for some other gilded products, it may in some cases be useful to use the alternative input factor, based on surface area, given in the Reference Report: 100 – 400 (250) g of mercury per m^2 of surface gilded (see that report for details). Using the alternative input factor would mean that the units and input calculations in the IL3 spreadsheet would need to be carefully changed accordingly. As some mercury usually stays (as an unintended trace pollutant) in the gilded surfaces, also the use and disposal phases are of relevance in the mass flow calculations. But be careful to only include products (objects) originally gold plated with use of mercury, as alternative non-mercury gilding methods are more common today, especially in industrialised countries. Traces of mercury are used in preservation	For the production step (the actual gilding of the products: statues, jewellery, cutlery or other), the mercury input is the mercury used in the manufacturing of products. By default, the spreadsheet assumes this to be imported mercury, but if domestic mercury production is present in your country (virgin or recycled), you should reflect this by changing the relative distribution between imported and domestically produced (or recycled) mercury in the input calculation cells in the production phase. See guidance on distribution of mercury supplies in Section 4.2.	To increase accuracy of the estimations, local data for output distribution factors should be collected and used whenever feasible. Note that accumulation may be of relevance in the use and disposal phase if fire gilding has been a dominating technique for gilding in the country. For this particular sub-category, this is however not operationalised in IL3, but can be accommodated by using older input rate data, if available.

No.	Sub-category and lifecycle phase	Import, production and export rates	Input calculations	Accumulation and output calculations
		and repair work to determine if the fire gilding method was originally used, and mercury should be readily detectable using XRF analysers or other mercury detection methods. In most cases, inventory developers may however need to rely on expert knowledge of the most common gilding method applied in the country.		

3.6 Products

General advice for products

The mercury input in the production phase is the mercury used in the manufacturing of products. The spreadsheet by default assumes this to be imported mercury, but if domestic mercury production is present in your country (virgin or recycled), you should reflect this by changing the relative distribution between imported and domestically produced (or recycled) mercury in the input calculation cells. See guidance on distribution of mercury supplies in Section 4.2.

As always when there are several output scenarios in the Toolkit's IL3, the calculated total input to a process or use shall be distributed on the relevant presented output scenarios. Use formulas for this, as they are more robust to changes. For products use and disposal, the output scenarios are about waste management schemes. Several schemes may be present in one country (for example rural vs. urban), so try to distribute the mercury inputs accordingly, reflecting what fraction of the total mercury output that enters the different waste management schemes listed.

Note that for most products, accumulation in society is a key factor influencing mercury releases/emissions, and it is highly recommended to devote efforts to investigate trends in the inputs of mercury over time for products. Accumulation is also important if there is no current mercury input with a particular product due to phase-outs. So, in such cases, do not ignore the accumulation and the associated data collection needs. Read more about accumulation and how you can handle it in IL3 in Section 4.1.

Products for which no specifics are given in the table below are to be calculated as other products with standard procedures.

No.	Sub-category and lifecycle phase	Import, production and export rates	Input calculations	Accumulation and output calculations
5.5.1	Thermometers with mercury /Production	The IL3 spreadsheet offers 2 different ways of estimating the mercury input and resulting emissions/releases: EITHER from data from the companies in question on their annual usage of mercury for the production, OR from records of the number of relevant product items produced in the country. This may be a help in data collection. ONLY ONE OF THESE METHODS SHOULD BE USED. Otherwise, the production would be counted double. If the overall Hg input method to production is used, try to estimate the distribution between imported and domestically produced mercury. See guidance on distribution of mercury supplies in Section 4.2.	The mercury input to the process is the mercury used in the manufacturing of products. If the detailed method for production input quantification is used, the spreadsheet assumes this is imported mercury, but if domestic mercury production is present in your country (virgin or recycled), you should reflect this by changing the relative distribution between imported and domestically produced (or recycled) mercury in the input calculation cells. See guidance on distribution of mercury supplies in Section 4.2.	
	/Use and disposal		If no production rates are entered (for the use phase), the mercury input from domestic production is automatically allocated to "Other glass Hg thermometers" a group expected to be dominant after Minamata restrictions have been widely implemented. To indicate another distribution, insert production rates for the relevant product types. If you do not have the exact production numbers, you can enter your best estimate of the	As always when there are several output scenarios in the Toolkit's IL3, the calculated total input to a process or use shall be distributed on the presented output scenarios. Use formulas

No.	Sub-category and lifecycle phase	Import, production and export rates	Input calculations	Accumulation and output calculations
			relative share amongst the product sub-types produced (for example 0.4 and 0.6 for a 40/60% distribution). Note that the trade statistics only indicate that the thermometers are liquid filled, so you need to obtain information on the fraction of the import (and export) that are mercury-filled from other sources. Note also that "pyrometers" are also thermometers (specialised for high temperatures) that may contain mercury.	for this, as they are more robust to changes. For products use and disposal, the output scenarios are about waste management schemes. Several schemes may be present in one country (for example rural vs. urban), so try to distribute the mercury inputs accordingly.
5.5.2	Electrical switches and relays with mercury /Production		The mercury input to the production phase is the mercury used in the manufacturing of products. See guidance on distribution of mercury supplies (import/domestic) in Section 4.2. In case production takes place in the country, and the production facility has indicated that they export part of their production, the corresponding mercury amount has to be entered in column O (unlike most products, where export is accounted for in the use phase). This is because, unlike most products, the inputs to use of the product are estimated based on generic calculations on the basis of population and electrification rate.	
	/Use and disposal	The only activity rates needed are the population in the country and the electrification rate (from the grid). Both can be found in	Due to the complexity in inventorying switches and relays with mercury (they usually exist as parts in other devices), the mercury input is suggested calculated based on the simplified method applied in Inventory	Output scenarios as for thermometers, see above.

No.	Sub-category and lifecycle phase	Import, production and export rates	Input calculations	Accumulation and output calculations
		the "Country data" tab or other sources can be used if detailed documentation is given in your inventory report.	Level 1. It is normally beyond the framework of a national inventory to make a more detailed estimation based on individual product sub-types. To avoid double counting, any input from national production is subtracted from the input to the use phase calculated in column N based on population data. Should the result in column become negative, this means there is export from domestic production to be accounted for by entering the mercury exported in the production phase in column O. This requires specific national data. Remember to make similar adjustments in the corresponding cells in the Accumulation tab, as relevant.	
5.5.3	Light sources with mercury /Production	The production rate is the amount of mercury used in the manufacture of the products. Try to estimate the distribution between imported and domestically produced mercury. See guidance on distribution of mercury supplies in Section 4.2.		
	/Use and disposal		If no production rates are entered (for the use phase), the mercury input from domestic production is automatically allocated to “Fluorescent tubes (double end)”, a dominant group. To indicate another distribution, enter production rates for the relevant product types (in the green cells). If you do not have the exact production	Output scenarios as for thermometers, see above.

No.	Sub-category and lifecycle phase	Import, production and export rates	Input calculations	Accumulation and output calculations
			numbers, you can enter your best estimate of the relative share amongst the product sub-types produced (for example 0.4 and 0.6 for a 40/60% distribution).	
5.5.4	Batteries with mercury /Production	The IL3 spreadsheet offers 2 different ways of estimating the mercury input and resulting emissions/releases: EITHER from data from the companies in question on their annual usage of mercury for the production, OR from records of the number of relevant product items produced in the country. This may be a help in data collection. ONLY ONE OF THESE METHODS SHOULD BE USED. Otherwise, the production would be counted double. If the overall Hg input method to production is used, try to estimate the distribution between imported and domestically produced mercury. See guidance on distribution of mercury supplies in Section 4.2. Note that that for alkaline batteries of other shapes than button cells, the default input factor is	The mercury input to the process is the mercury used in the manufacturing of products. If the detailed method for production input quantification is used, the spreadsheet assumes this is imported mercury, but if domestic mercury production is present in your country (virgin or recycled), you should reflect this by changing the relative distribution between imported and domestically produced (or recycled) mercury in the input calculation cells. See guidance on distribution of mercury supplies in Section 4.2. In IL3, the Hg concentration in non-button alkaline cells is assumed to be 0 based on observations for dominant brands. If you have local data indicating otherwise, feel free to insert it as input factor; show your documentation in your inventory report.	

No.	Sub-category and lifecycle phase	Import, production and export rates	Input calculations	Accumulation and output calculations
		now set as zero (0), as it is anticipated to be the common situation now. However, should you have data showing the presence of mercury in such batteries, the input factor should be changed. Remember to note such changes in your inventory report.		
	/Use and disposal		If no production rates are entered (for the use phase), the mercury input from domestic production is automatically allocated to "Silver oxide button cells" a group allowed under the Minamata Convention. To indicate another distribution, insert production rates for the relevant product types (in the use and disposal phase green cells). Again, if you do not have the exact numbers, you can enter the estimated relative distribution.	Output scenarios as for thermometers, see above.
5.5.5	Polyurethane with mercury catalysts /Production		The mercury input to the production phase is the mercury content of the mercury compounds used in the manufacturing of products. See guidance on distribution of mercury supplies (import/domestic) in Section 4.2. In case production takes place in the country, and the production facility has indicated that they export part of their production, the corresponding mercury amount has to be entered in column O (unlike most products, where export is accounted or in the use phase). This is because, unlike most products, the inputs to use of the	

No.	Sub-category and lifecycle phase	Import, production and export rates	Input calculations	Accumulation and output calculations
			product are estimated based on generic calculations using population and electrification data.	
	/Use and disposal	The only activity rates needed are the population in the country and the electrification rate (from the grid). Both can be found in the "Country data" tab or other sources can be used if detailed documentation is given in your inventory report.	Due to the complexity in inventorying of polyurethane use (it usually exists as polyurethane parts in other products), the mercury input is suggested calculated based on the simplified method applied in Inventory Level 1. It is normally beyond the framework of a national inventory to make a more detailed estimation based on individual product sub-types. To avoid double counting, any input from national production is subtracted from the input to the use phase calculated in column M based on population data. Should the result in column M become negative, this means there is export from domestic production to be accounted for by entering the mercury exported in the production phase in column O. This requires specific national data. Remember to make similar adjustments in the corresponding cells in the Accumulation tab, as relevant.	Output scenarios as for thermometers, see above, except that polyurethane is normally not separately collected and hence there are only two output scenarios.
5.5.6	Biocides and pesticides with mercury		As for other products above, except that for the use phase, local data need to be entered for the input factor and activity rates, and formulas introduced depending on the unit of the input data available.	
5.5.8	Pharmaceuticals for human and veterinary uses		As for other products above, except that for the use phase, local data need to be entered for the input factor and activity rates, and formulas introduced depending on the unit of the input data available.	

No.	Sub-category and lifecycle phase	Import, production and export rates	Input calculations	Accumulation and output calculations
			Note that this sub-category only include so-called allopathic medicines, whereas traditional local or so-called "alternative" mercury-added medicines are to be included under sub-category 5.6.4.	
5.5.9	Cosmetics and related products with mercury		As for other products. Input factors (mercury concentrations) may vary very considerably, so consult Internet resources to check the brands observed nationally or make measurements, if possible (see for example the Zero Mercury Working Group test overviews, including https://eeb.org/wp-content/uploads/2022/03/ZMWG-Skin-2022-Report-Final.pdf).	
5.6.1	Dental mercury-amalgam fillings /preparation of fillings	The only activity rates needed are the population in the country and the dental personnel density rate (personnel per 1000 inhabitants). Both can be found in the "Country data" tab or other sources can be used if detailed documentation is given in your inventory report.	Due to the complexity in inventorying dental amalgam fillings, the mercury input is suggested calculated based on the simplified method applied in Inventory Level 1. In case you have national statistics or similar good data sources, you can introduce your own calculations of the mercury input, also with the help of Reference Report data on typical Hg amounts per filling by size.	Output scenarios distinguish between presence or absence of high efficiency amalgam filters (so-called amalgam separators). Note that these are something else than the chair strainers most dentists have, that only retain large particles.
	/Use	No activity rate data need be entered as the "inputs" causing releases is the mercury already in the teeth. But please make sure	"Inputs" here are automatically calculated based on the output to "products", meaning in fillings made multiplied by the accumulation factor (indicating fillings made 5-15 years ago), as should be reflected in the Accumulation tab of the spreadsheet.	"Outputs" are calculated based on the current input with new fillings, times the accumulation factor (indicating fillings made 5-15 years ago), as should be reflected

No.	Sub-category and lifecycle phase	Import, production and export rates	Input calculations	Accumulation and output calculations
		to enter trends data in the Accumulation tab as amalgam use is in quick change globally.		in the Accumulation tab of the spreadsheet.
	/disposal	As for use.	"Inputs" are calculated based on the amounts of fillings made ("products"), times the accumulation factor (indicating fillings made 10-20 years ago), as should be reflected in the Accumulation tab of the spreadsheet.	"Outputs" are calculated based on the current input with new fillings, times the accumulation factor (indicating fillings made 10-20 years ago), as should be reflected in the Accumulation tab of the spreadsheet.
5.6.2	Manometers and gauges with mercury /Production	As for other products, the import and production rates entered are the amounts of mercury used in production.	The mercury input to the production phase is the mercury used in the manufacturing of products. See guidance on distribution of mercury supplies (import/domestic) in Section 4.2. In case production takes place in the country, and the production facility has indicated that they export part of their production, the corresponding mercury amount has to be entered in column O (unlike most products, where export is accounted or in the use phase). This is because, unlike most products, the inputs to use of the product are estimated based on generic calculations.	
5.6.2	Manometers and gauges with mercury /Use and disposal	Activity rates normally need to be collected from importers and any producers. Alternatively, rough estimates can be based on data collection at some major	In case there is national production of manometers, and domestic production rates are entered for "/Use+dis-	

No.	Sub-category and lifecycle phase	Import, production and export rates	Input calculations	Accumulation and output calculations
	of blood pressure gauges	hospitals and clinics, with the use of extrapolation to the national situation (hospital beds, clinic number/doctor number per clinic).	posal of medical blood pressure gauges", the total production input will – as a simplification - automatically be assigned to use+disposal blood pressure gauges	
	/Use and disposal of other manometers	The only activity rates needed are the population in the country and the electrification rate (from the grid – an indirect indicator of technical development). Both can be found in the "Country data" tab or other sources can be used if detailed documentation is given in your inventory report.	Due to the complexity in inventorying of mercury manometers use (it often exists as parts in other products), the mercury input is suggested calculated based on the simplified method applied in Inventory Level 1. It is normally beyond the framework of a national inventory to make a more detailed estimation based on individual product sub-types. In case a by-sub-product approach is desired, based on available very detailed national data, calculations need to be adapted very carefully (see IL2 for inspiration). In case there is national production of manometers, and no production rates are entered for blood pressure gauges above, the total production input will – as a simplification - automatically be assigned to "Other manometers" (with mercury). To avoid double counting, any input from national production is subtracted from the input to the use phase calculated in column M based on population data. Should the result in column M become negative, this means there is export from domestic production to be accounted for by entering the mercury exported in the production phase in column O. This requires specific national data. Remember to make similar adjustments	

No.	Sub-category and lifecycle phase	Import, production and export rates	Input calculations	Accumulation and output calculations
			in the corresponding cells in the Accumulation tab, as relevant.	
5.6.3	Laboratory chemicals and equipment with mercury /Production		The mercury input to the production phase is the mercury used in the manufacturing of products. See guidance on distribution of mercury supplies (import/domestic) in Section 4.2. In case production takes place in the country, and the production facility has indicated that they export part of their production, the corresponding mercury amount has to be entered in column O (unlike most products, where export is accounted or in the use phase). This is because, unlike most products, the inputs to <u>use</u> of the product are estimated based on generic calculations.	
5.6.3	Laboratory chemicals and equipment with mercury /Use and disposal	For both sub-groups of products covered, the only activity rates needed are the population in the country and the electrification rate (from the grid – an indirect indicator of technical development). Both can be found in the "Country data" tab or other sources can be used if detailed documentation is given in your inventory report.	In case there is national production of laboratory chemicals or equipment, the contribution from national production to the use phase is as a default equally distributed between chemicals and equipment, unless you adjust the formulas in column N to another distribution (changing the distribution factors from 0.5). To avoid double counting, any such input from national production is subtracted from the input to the use phase calculated in column M based on population data. Should the result in column M become negative, this means there is export from domestic production to be accounted for by entering the mercury exported in the production phase in column O. This requires spe-	

No.	Sub-category and lifecycle phase	Import, production and export rates	Input calculations	Accumulation and output calculations
			cific national data. Remember to make similar adjustments in the corresponding cells in the Accumulation tab, as relevant.	
5.6.4.1	Mercury use in traditional Asian medicines	Note carefully that the activity rates for use and disposal refer to ALL MEDICINES of the following types, and not only those known to contain mercury or its compounds: • Traditional Chinese medicines • Traditional Tibetan medicines • Indian Ayurvedic and Siddha medicines • Unani medicines The input factor is derived based on averages of mercury concentrations in all medicines of the relevant types, mercury-containing or not (this is an exception to the general principle of the Toolkit).		

No.	Sub-category and lifecycle phase	Import, production and export rates	Input calculations	Accumulation and output calculations
5.6.4.2	Mercury use in homeopathic medicines /Use and disposal	As explained in the Reference Report (see that), homeopathic remedies are marketed in a variety of different solution levels, called potencies, usually in the range of D5-D12. Some common examples are D6 (1 ppm dissolution), D9 and D12. The lowest D values have the highest concentrations of mercury. When collecting data for this product type (usually from producers and importers), you therefore need to ask for the input rates by remedy type (mercury compound used) and "D" value. The pre-entered input factors are based on D6 remedies (in which mercury or its compounds are used), and input factors for other D value remedies need therefore to be added, as relevant in the national situation. When a national overview of input rates (consumption) for the different remedy types and D values is established, it can be de-	As mentioned for the input factors, the presence of other D value remedies (than D6) in the national market means that similar input calculations for other D value remedies present (and significant) need to be added in separate rows.	

No.	Sub-category and lifecycle phase	Import, production and export rates	Input calculations	Accumulation and output calculations
		termined which D value remedies contribute with most mercury, and the input factors and input calculations can be added in the IL3 spreadsheet accordingly (omitting insignificant contributions).		
5.11	High-volume materials with trace Hg, disposed as general/municipal waste		With the aim of making a full mass balance, this sub-category was added in IL3. The calculations here are made based on municipal waste amounts treated in the country, so only input factors can be entered in the Products tab, if found needed based on well documented national data. For the waste amounts used in the calculation, see the Munic Waste tab, and Section **Error! Reference source not found.**). For details on background data for the default input factors, see below this table.	

*

Details regarding "High-volume materials with trace Hg, disposed as general/municipal waste"
As described in the IL2 Reference Report, mercury content in the general waste stream originates from three main groups: 1) intentionally used mercury in spent products and process waste; 2) natural mercury impurities in high-volume materials (plastics, tin cans, etc.) and minerals, and; 3) mercury as an anthropogenic trace pollutant in high-volume materials.

The Reference Report suggest a methodology where the total input of mercury for municipal solid waste treatment is estimated using a common input factor for all the waste. If more specific information on mercury content of municipal solid waste in the country is not available, a first estimate can be formed by using the provided default input factors in the range of 0.2 - 4 g Hg/metric ton waste (intermediate at 1 g Hg/metric ton waste). It is explained that the low-end input factor is expected to be relevant for a situation where substantial parts of the waste products with high mercury concentration (thermometers, batteries, dental amalgam wastes, switches etc.) have been sorted out of the waste for separate treatment.

In the IL3 mass flow methodology, the input to the municipal solid waste with mercury-added products is estimated separately for each category. It is considered that these estimates represent intentionally used mercury in spent products. The remaining part of the waste will consist of a combination of various high-volume materials with only trace concentrations of mercury.

According to a report on waste for the World Bank (Kaza et al., 2018), at an international level, the largest municipal solid waste category is food and green waste, making up 44% of global municipal solid waste, while dry recyclables (plastic, paper and cardboard, metal, and glass) account for another 38% of the waste. The composition of the municipal solid waste, however, varies considerably by income level (Table 3-1). The percentage of organic matter in waste decreases as income levels rise. For food and greens, the most pronounced difference is between the high-income level where food and greens account for 32%, while it for the three other levels account for 53-56%. For the four dry recyclables the total differs from 49% in high income countries to 16% in low income countries with the middle income countries at 29%.

Table 3-1 Municipal solid waste composition by income level (Kaza et al.*, 2018; mercury concentration levels are from various data sources cited in the Toolkit Reference Report, see text below).*

	Percentage of total				**Hg concentration levels**
Materials	**High income**	**Upper-middle income**	**Lower-middle income**	**Low income**	**g/t**
Food and green	32	54	53	56	0.007-0.5
Glass	5	4	3	1	<0.1 - 0.1 g/t
Metal	6	2	2	2	
Paper and cardboard	25	12	13	7	<0.1 - 0.2 g/t
Plastic	13	11	11	6	<0.1 - 0.2 g/t
Rubber and leather	4	1	<1	<1	
Wood	4	1	1	<1	0.002-0.07 g/t
Other	11	15	17	27	

The table above shows the average composition of the municipal solid waste, but this may not represent the composition of the waste directed to municipal solid waste incineration or waste deposition/landfilling, as some of the waste is recycled. The recycling rates vary considerably by income level, with the highest rates in high income countries where on average 29% of the municipal waste is recycled (Kaza et al., 2018). The rates for the three other income levels are more or less the same with average recycling rates of 4%, 6% and 4% in countries with upper-middle, lower-middle and low income levels, respectively (Kaza et al., 2018). For the high-income countries, the percentage represented by food and greens and "other" may be significantly higher in the waste incinerated or landfilled. In the other countries, the percentages of food and greens and "other" incinerated or landfilled may be slightly higher than indicated in the table.

The Reference Report provides examples of mercury content for various high-volume materials in the waste, including for some wood and vegetation materials. For the major high-volume materials, the following ranges are quoted from various data sources (on dry weight basis):

- Paper/Cardboard <0.1 - 0.2 g/t
- Plastics: <0.1 - 0.2 g/t
- Textiles: <0.1 - 0.1 g/t
- Glass: <0.1 - 0.1 g/t
- Wood: <0.1 g/t
- Fuel wood: 0.002-0.07 g/t
- Wood litter, straw, green vegetation, fir needles): 0.007-0.5 g/t
- Organic waste: <0.1 - 0.5 g/t

Dziok et al. (2022) identified concentrations in the same range[7].

As the concentrations for the high-volume materials are in the same range, and average values for most of the materials based on the available datasets are not significantly different, it is suggested to use one common input factor for all the high-volume materials.

If no indications are available on the mercury concentration in the high-volume materials of the municipal solid waste in the country (excluding mercury-added products), a first estimate can be formed by using the default input factors selected in Table 3-2 below (based on the data sets presented in Reference Report and this section) .

[7] Dziok, T., Bury, M. and Burmistrza, P. (2022): Mercury release from municipal solid waste in the thermal treatment process. Fuel 329, 125528.

Table 3-2 ***Preliminary*** *default input factors for mercury in the high-volume materials not accounted for by the mercury-added products.*

Material	Default input factors; g Hg/metric ton waste; low end - high end (intermediate)
Municipal solid waste (general "household" waste)	0.03 – 0.2 (0.1)

3.7 Municipal solid waste

As explained above, the mercury inputs to municipal solid waste treatment and wastewater treatment in IL3 are calculated based on the outputs from products and processes to general (municipal) waste and wastewater, respectively, combined with data for the fractions of waste (and wastewater) treated by each type of waste treatment methodology.

At the top of the IL3 spreadsheet tab, you need to enter the estimated total municipal solid waste amounts generated in the country. This may be from existing reporting, or it may be estimated based on waste amounts generated per capita, times the number of inhabitants in the country. Data for waste amounts generated per capita can often be found from existing national waste assessments, that may take into account any differences between rural and urban areas in the country.

Should you have problems finding appropriate waste generation rates data nationally – or should you wish to compare with independent data –, you can check the World Bank report "What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050" (Kaza et al, 2018)[8], which includes many examples – national and regional – of waste generation rates.

Additionally, you need data or estimates for the distribution of municipal solid waste (MSW) amounts on treatment types (in tonnes/y wet weight) as follows:

1. Part of national waste amounts incinerated in technical facilities
2. Part of national waste amounts burned in the open on landfills AND informally
3. Part of national waste amounts deposited safely in engineered facilities

[8] Available at https://openknowledge.worldbank.org/handle/10986/30317

4. Part of national waste amounts dumped in non-engineered sites (formal + informal)

Data for waste treated in technical and highly controlled facilities (type 1 and 3 in the list above) are often registered at the waste treatment facilities and reported nationally. The amounts of waste burned in the open (with no technical capturing of pollutants) and waste dumped in non-engineered waste dumps are often more challenging to quantify, and may need estimation as "the remainder" of total national waste generation numbers, in combination with field observations of the prevalence of open waste burning informally and on landfills. If no other data are available – or as a control of the nationally generated data – estimated amounts of waste burned openly and dumped by country can be found in the appendix to a paper from Wiedinmeyr at al. (2014)[9].

The Munic waste tab also includes pre-calculated mercury outputs to municipal waste from products and processes. These draw automatically on data calculated elsewhere in the IL3 spreadsheet, and you need not do anything with these calculations.

The sub-categories related to municipal waste treatment and wastewater treatment are grouped differently than in IL2, because of the mass flow focus in IL3. The sub-category numbers are however the same as in IL2.

No.	Sub-category and lifecycle phase	Import, production and export rates	Input calculations	Accumulation and output calculations
5.8.1	Incineration of municipal/general waste (in technical facilities)		Input calculations are done automatically, based on the principles and data described above the table.	As always when there are several output scenarios in the Toolkit's IL3, the calculated total input to a process or use shall be distributed on the presented output scenarios. Use formulas for this, as they are more robust to changes.
5.9.5	Waste water system/treatment		No data need to be entered here. The total output from products and relevant pro-	The fractions of the mercury inputs treated in waste water treatment plants, and –for fractions treated – by treatment method shall be entered in column J based on the relative share of waste water treated with the method (including no treatment). Use formulas for this, as they are more robust to changes.

[9] Wiedinmeyr C, Yokelson RJ, Gullet BK (2014): Global emissions of trace gases, particulate matter, and hazardous air pollutants from open burning of domestic waste. Environ. Sci. Technol., 48 (16), 9523–9530. Link: http://pubs.acs.org/doi/abs/10.1021/es502250z

No.	Sub-category and lifecycle phase	Import, production and export rates	Input calculations	Accumulation and output calculations
			cesses forms the basis for the calculations.	For example, in a country where 40% of the public waste water is treated in waste water treatment plants, the formula in cell J34 would be =0.4*G34. The waste water amounts treated are often publicly reported, whereas untreated waste water may be estimated using data for the proxy national water supply (omitting if possible, water supply for irrigation). Data on treatment types may be given from regulative requirements, national reporting, or can otherwise be collected from the treatment plants in question or estimated by relevant national experts.
5.8.4	Sewage sludge incineration	Enter the estimated fraction incinerated of sewage sludge produced nationally. Sewage sludge incineration is rare in developing countries, but may be applied in large cities.	Hg inputs are automatically calculated based on the entered fraction of sewage sludge incinerated, times the mercury output to sector-specific waste from waste water treatment.	
5.8.5	Sewage sludge disposal (in engineered sites)	Enter the estimated fraction disposed off in engineered sites of sewage sludge produced nationally. Note that sewage application to land is considered direct release to land (not engineered sites). The same is the case if the sludge is disposed off to non-engineered dumpsites/landfills.	Hg inputs are automatically calculated based the entered fraction of sewage sludge disposed off to engineered sites, times the mercury output to sector-specific	

No.	Sub-category and lifecycle phase	Import, production and export rates	Input calculations	Accumulation and output calculations
		Note that the sum of the fractions of sewage sludge incinerated and disposed off to engineered sites may not exceed 1 (often in developing countries it is (much) less than 1).	waste from waste water treatment.	

3.8 Sector-specific waste treatment

The SectSpecWaste tab is different from the standard source category tabs. This is because here, we sub-divide the outputs to Sector-specific waste from all product and process tabs, depending on how the waste is treated in the country. We also compare those estimates with information directly from waste treatment facilities/operators, as well as from waste shipment data.

Table 1: Distribution of "Sector-specific treatment/disposal" on management methods
This table links to the calculated outputs to Sector-specific waste from the process and products tabs, as well as relevant waste treatment sub-categories (column C).

In columns D – I, you need to enter the estimated relative distribution of the output to Sector-specific waste from each sub-categories in question. You enter the relative distribution factors here, and the factors used always should sum up to 1 (100%) for each sub-category (row). For example, if 60% of the ashes from coal-fired power plants are disposed to engineered sites, and 40% were used in road construction, you would enter “0.6” under “disposal to engineered sites” and “0.4” under “Dumping (non-engineered sites)”, as the latter may only temporarily be delaying further mercury releases.

Note that the distribution factors are default set at 1 – 100% – to dumping, the worst-case scenario, which for most countries is likely not the situation.

Table 1 provides input data for the calculation of mercury releases/emissions in the Haz waste tab, and the result summaries, except for inputs with imported waste and inputs to recycling of mercury which are taken from the tables deeper below. Note that the data entered in Table 2, and the analysis of these may signal that contributing sub-category data and output distribution factors may need adjustments; more about this below.

Table 2: Data collected from waste operators and waste statistics
Insert data on hazardous waste treatment from operators, statistics, etc. in Table 2 in the SectSpecWaste tab of the IL3 spreadsheet. Add rows in the table for any additional relevant mercury-bearing waste types for which data exist.

Input factors: To increase the usefulness of the table's results, preferably insert actual local measurements of mercury concentrations in the waste fractions, if available. If no representative and reliable local data are available, you can enter the relevant default input factors of the Toolkit.

The data in Table 2 are needed for the quantifications made in the spreadsheet for mercury-bearing waste that is imported for treatment/disposal in the country. Additionally, the data collected for Table 2 can be used to qualify the output estimations to "Sector-specific treatment/disposal" from the various product and process sub-categories ("Sector tabs").

If the calculated Hg input in Table 2 for "Hg in nationally generated waste treated /disposed" (column H) is very different from the total (or corresponding) Hg outputs for Sector-specific waste in Table 1 above, input data and output distribution factors in the sector tabs should be re-checked and, if needed, corrected or supplemented.

Based on the comparison between data in Table 1 and Table 2, you will hopefully be able to identify which specific source sub-categories need checking and adjustment. Remember that both input factors and output distribution factors pre-entered in the IL3 spreadsheet are default factors, which can be used if no local and well documented factors are available. Hence, if the data in Table 2 from waste operators and statistics are significantly different from the corresponding data in Table 1, it may indicate that the relevant input or output distribution factors in the sub-categories in question may need adjustment.

Sensitivity analyses can be a useful supplementary methodology to identify which sub-categories may need checking and adjustment.

If you indeed find that any input or output distribution factors in the sub-categories need adjustment, this should be done with much caution to avoid mistakes or misinterpretations. Always consult the data sections for the sub-categories in the Reference Report carefully. Also check this IL3 guideline, if additional data and methodology considerations are made for the sub-categories in IL3. Remember also that:

- Input factors should represent the average situation for the sub-category and country.
- All output distribution factors for a specific sub-category should always add up to 1 (100%).
- All deviations from default factors should always be documented carefully, explicitly and in detail in the inventory report, so that readers can understand why and how the changes were made.

Any significant differences between Table 1 and Table 2 for the sub-categories in question can be part of the documentation why pre-entered default factors were changed. Make sure to be very detailed in your explanations and include explicitly any quantitative data and calculations used in the checking and adjustment of default factors.

Add any other relevant mercury-bearing waste types for which data exist.

Table 3: Overview for recycled mercury
Data from this table are used in the Haz waste tab, and can be used in your assessment of sources for domestically used mercury. Remember to enter Hg amounts exported from recyclers. The table gives you a possibility to compare the two calculated estimates for amounts of mercury recycled from waste generated domestically, and to choose which of these estimates are to be used in dependent calculations. You do the latter by changing the reference in the blue cell, or if deemed relevant, you can enter a formula that makes use of both estimates (average or other). Always explain in your report why and how you did it (in details).

Table 4: Partial check versus data from national waste statistics
Also here, you enter waste amounts from statistics. If your estimations from Table 1 and Table 2 above differ significantly from the results in Table 4, you may wish to re-check your data. This table makes use of pre-entered default input factors from the Toolkit, and – while you can change them here in the blue cells – it is less relevant here, because you can use this table to assess how the results would have looked if you use the IL2 methodology for the same waste treatment source sub-categories.

Table 5: Waste trade registered in international trade statistics

Data for 4-6 digit HS codes can be found for most countries at https://comtrade.un.org/data/; see instruction for extraction of Comtrade data in Appendix 1.

Table 5 suggests the most relevant HS codes that should (if correctly reported) include some relevant Hg-bearing waste amounts imported or exported. While the HS codes are not sufficiently specific to the waste types of relevance here, they can be used to check the order of magnitude for relevant waste fractions. Note that regionally or nationally used HS codes with more digits may be more specific; make your own check of this in national statistics. Note also that if Basel Convention waste codes are used in the country, these may provide relevant data as well.

3.9 Crematoria and cemeteries/burial places

The methodology used for estimating mercury inputs and outputs from crematoria and cemeteries/burial places is the same as used in IL2. Note that the quantification of remaining mercury in the body at time of death is significantly influenced by the presence or absence of dental amalgam fillings (not forgetting that the diet and local exposures can also influence the remaining mercury concentrations). Hence, it is recommended to use the same moderation of input estimates used for dental amalgam in general, namely taking into account the density of dental personnel in the country, as an indirect measure of the dental care level. You do this by entering the dental personnel density per 1000 inhabitants in the country data tab in cell G13 (in the Crematoria+cem. tab). In case you have newer and significantly different national numbers for dental personnel density, you may use them, but this may introduce an extra uncertainty because the registration of dental personnel may be different from that used by the WHO for data in the Country data tab. Make sure to document the used numbers in your inventory report.

3.10 Hazardous waste treatment

Note that for most hazardous waste treatment methods, the quantities for input estimation are derived directly from the SectSpecWaste tab (where you can change the parameters used for the estimations).

No.	**Sub-category and lifecycle phase**	**Import, production and export rates**	**Input calculations**	**Accumulation and output calculations**
5.7.2	Production of recycled ferrous metals (iron and steel)	The activity rate data are – as for IL2 – the number of vehicles processed for recycling, whether these are imported for recycling in the country, are spent cars from the country itself, or are spent cars exported for recycling abroad. Other ferrous metal scrap recycled should not be included in the input estimation.		
5.7.3	Production of other recycled metals	Should you have data for mercury contents in other recycled materials than mercury recycling and ferrous metal recycling, you can enter data and relevant calculations depending on the units for the available data.		

*

4 Advice on other tabs in the spreadsheet

4.1 Accumulation of mercury in society

As described above in Section 2.4, mercury emissions and releases from all aspects of waste handling reflect the mercury inputs to the source sub-category one average product lifetime ago (also called lifespan). Hence, in times of changing mercury inputs, as currently, we need to collect data for previous mercury inputs, to enter these in the calculations. This is of primary interest for products, as wastes from processes are assumed to in general be formed in the same year as the process takes place[10].

The IL3 spreadsheet's Accumulation tab calculates the difference between current mercury input and the input one product average lifetime ago in the form of an accumulation factor. In the Products tab, the accumulation factor is in turn used to calculate the total output that is the basis for calculations of emissions, releases and waste flows.

First, we need to establish the approximate average lifetimes for products and materials are. Suggested average lifetimes based on literature search are given in Table 4-1. Should you yourself have national information that differs from the given suggestions, you may change the lifetimes used, provided you give clear and explicit documentation for such changes. Note that in the table, lifetimes within 1 year are noted as 0 years, meaning that products are disposed off the same year as they are brought on the national market from import or national production. For such products, you do not need to seek additional data on past mercury inputs.

For production processes the IL3 methodology as default assumes that the outputs balance the inputs of the base year. There may be specific cases that differ, but on average, it is our assessment, that this is in accordance with what can be observed.

The total life of the products from production to final disposal consists of three phases: 1) life on the shelf/stocks of distributers; 2) service life by the user of the products; 3) storage by the user before disposal. The service lifetime of the products is often described by the average technical lifetime, but in practice some product types are often disposed off before their technical end-of-life because they (or the products in which the Hg-containing components are used) are re-placed by newer models or other solutions (such as replacement of CFL by LED lamps). As a general tendency, the actual service life of many products are likely shorter in developed countries than in developing countries.

[10] Releases and emissions from contaminated sites (legacy mercury) is an exception to this, but these are not quantified in the standard Toolkit methodology, as local conditions are complex to quantify in this type of general standardized model.

Case studies from the European Environment Agency of four different electronic product groups show all have average actual lifetimes that are shorter than their designed lifetimes (EEA, 2020[11]). For television sets the actual lifetime is 7.3 years whereas the designed lifetime is 25 years. For smartphones, washing machines and vacuum cleaners the differences between actual and designated lifetimes are smaller, 0.2 years, 1.7 years and 2 years respectively.

An analysis of waste alkaline batteries collected in the Netherlands has shown that it can take up to 15 years from the date of purchase of the batteries to they appear in the waste stream, although batteries more than 10 years old account for less than one percent of the total, as seen in Figure 2 2. The collected number peaked 2 years after purchase and after 3 years, 58% of the batteries had been disposed off.

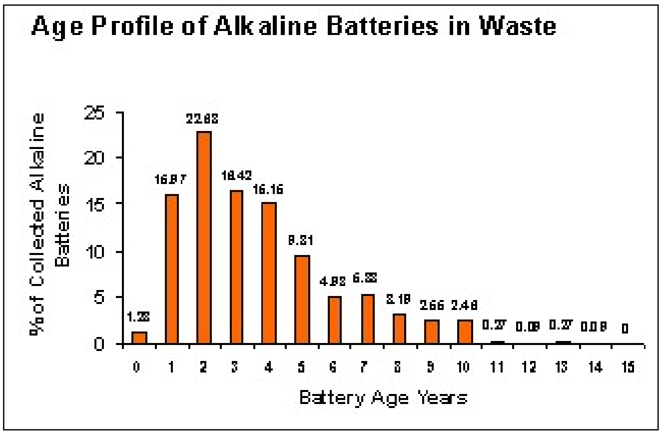


Figure 4-1 Age profile of alkaline batteries collected in the Netherlands (EPBA[12] 2008 as cited by Lassen et al., 2008)

Table 4-1 Default suggestions for average product and materials lifetimes (overleaf).

[11] EEA (2020): Europe's consumption in a circular economy: the benefits of longer-lasting electronics. European Environment Agency, Copenhagen.

[12] EPBA (2008): The website of European Portable Battery Association (document no longer available).

Sub-C	Source category	Average lifetime, y *1		Source of information
		Range *2	"Best estimate"	
5.5.1	**Thermometers with mercury**			
	Medical thermometers	1-10	3	1-2 months in hospitals (AGHTM, 2000 as cited by Maag et al.); 5 years by consumers (Barr, 2001)
	Ambient air thermometers	3-10	5	Thermometers: 5 years (Floyd et al., 2002); 5 years (Barr, 2001)
	Industrial and special thermometers	3-20	10	As above combined with expert assessment
	Other glass Hg thermometers	3-8	5	Thermometers: 5 years (Floyd et al., 2002); 5 years (Barr, 2001)
5.5.2	**Electrical switches and relays with mercury**	10-50	15	Switches in building walls: 30-50 years (IL2 Reference Report). Electrical and electronic equipment and cars: 15-20 years (IL2 Reference Report); In electronic equipment: 5-10 years (Floyd et al., 2002).
5.5.3	**Light sources with mercury**			
	Fluorescent tubes (double end)	4 – 10	5	5 years (Barr, 2001); 5 years (NJ MTF, 2002); 8-10 years (Skårup et al., 2003)
	Compact fluorescent lamp (CFL single end)	4 – 10	5	5 years (Barr, 2001); 5 years (NJ MTF, 2002); 8-10 years (Skårup et al., 2003)
	High-pressure mercury vapour	5-15	10	Expert estimate - the high-pressure mercury lamps have relatively long operating life
	High-pressure sodium lamps	5-15	10	As above
	UV light for tanning	4 - 8	5	The lifetime is assumed to be comparable to fluorescent tubes
	Metal halide lamps	5-15	10	Expert estimate - the metal halide lamps have relatively long operating life
5.5.4	**Batteries with mercury**			
	Mercury oxide (all sizes); also called mercury-zinc cells	2-10	5	Expert estimate. Mercury oxide cells have relatively long shelf life and service life, and therefore have some strategic uses (stocks).
	Zinc-air button cells	2-3	3	Expiry date 2 years (Panasonic, 2022)[*3]
	Alkaline button cells	2-4	3	Expiry date 3 years (Panasonic, 2022)
	Silver oxide button cells	2-3	3	2 years (Sathaiyan, 2013)[*4]; expiry date 2 years (Panasonic, 2022)
	Alkaline, other than button cell shapes	2-3	3	2-3 years (EPBA 2008 as cited by Lassen et al. 2008)
5.5.5	**Polyurethane with mercury catalysts**	5-20	10	Expert estimate. Polyurethane parts are used for many different applications and included in various products.
5.5.6	**Biocides and pesticides with mercury**	0-1	0	Expert estimate
5.5.7	**Paints with mercury**	0-1	0	The value takes into account possible shelf-life. Once applied, the half-life of mercury in water-based paints has been estimated to be about 1 year i.e. that half of the mercury content is released each year (NJMTF, 2002 as cited by Lassen et al., 2008). Assumed that no mercury is present when the paint is removed.
5.5.8	**Pharmaceuticals for human and veterinary uses**	0-1	0	Used either the year it is produced or the subsequent year

Sub-C	Source category	Average lifetime, y *1		Source of information
		Range *2	"Best estimate"	
5.5.9	**Cosmetics and related products with mercury**	0-1	0	Used either the year it is produced or the subsequent year
5.6.1	**Dental mercury-amalgam fillings**	10-20	15	See Reference Report for further references
5.6.2	**Manometers and gauges with mercury**			
	Manometers	10-20	15	Manometers: 10 years (Floyd et al., 2002); 20 year (ECHA, 2011)
	U-shaped manometers	10-20	15	Same as above
	Manometers for milking systems	10-20	15	Same as above
	Manometers and barometers used for measuring air pressure	10-20	15	Same as above
	Barometers	10-20	15	Same as above
	Environmental manometers	10-20	15	Same as above
	Pressure valves in district heating plants	20-40	30	Expert estimate. May be phased out. Liquid mercury was used for topping up, but a similar amount may be released to air while in use.
	Pressure gauges	10-20	15	Expert estimate
5.6.3	**Laboratory chemicals and equipment with mercury**			
	Laboratory chemicals	0-1	0	Mercury is used as consumable for the analysis i.e. disposed of same year as sold for the purpose
	Mercury drop electrode	0-1	0	Mercury is used as consumable for the analysis i.e. disposed of same year as sold for the purpose
	Porosimeters and pycnometers	0-1	0	Mercury is used as consumable for the analysis i.e. disposed of same year as sold for the purpose
	Blood gas analyser	5-15	10	Experts estimate assuming the average lifespan of measuring equipment is slightly higher than for consumer electronics
	Mercury electrodes (calomel)	5-15	10	Same as above
	Blood lead analyzer	5-15	10	Same as above
	Coulter counter	5-15	10	Same as above
	Sample collector for oil offshore	5-15	10	Same as above
	Electron microscope	5-15	10	Same as above
	Other measuring equipment (not further specified)	5-15	10	Same as above
	Centrifuges	5-15	10	Expert estimate
	Thermostats	15-25	20	Thermostats: 20 years (Barr, 2001)
	Mercury lamps for atomic absorption spectrophotometers and other equipment	4 - 8	5	Experts estimate assuming same lifespan as CLFs
	Overall average suggested for laboratory equipment		10	
5.6.4	**Mercury metal use in religious rituals and folklore medicine**	0-1	0	Experts estimate

Sub-C	Source category	Average lifetime, y *1		Source of information
		Range *2	"Best estimate"	
5.6.5	**Miscellaneous product uses, mercury metal uses, and other sources**			
	Infrared detection semiconductors	5-15	10	Experts estimate assuming the average lifespan of measuring equipment is slightly higher than for consumer electronics
	Bougie tubes and Cantor tubes	10-30	20	Expert estimate
	Educational uses	0-1	0	Mercury is used as consumable i.e. disposed of same year as sold for the purpose
	Gyroscopes with mercury	5-15	10	Experts estimate assuming the average lifespan of measuring equipment is slightly higher than for consumer electronics
	Vacuum pumps with mercury	5-15	10	Expert estimate
	Use of mercury as a refrigerant in certain cooling systems	5-15	10	Expert estimate
	Light houses (Marine navigation lights)	30-80	50	Expert estimate. Liquid mercury is frequently used for topping up but a similar amount is assumed to be released to air.
	Mercury in large bearings of rotating mechanic parts in for example older waste water treatment plants	20-50	30	Expert estimate. Liquid mercury may frequently be used for topping up but a similar amount is assumed to be released to air.
	Seam welding machines	20-50	30	At least 30 years (KemI 2004 as cited by Lassen et al., 2008)
	Tanning	?	0	Mercury is assumed evaporated over lifetime
	Pigments	5-20	10	Expert estimate. Hg pigments may be used for various products.
	Browning and etching steel	0	0	Mercury is assumed not present in products
	Certain colour photograph paper types	?	0	Information is missing
	Recoil softeners in rifles	5-50?	25?	Expert estimate; assuming Hg encapsulated
	Explosives (mercury-fulminate a.o.)	0-1	0	Mercury is consumed in explosion
	Fireworks	0-1	0	Mercury is used as consumable i.e. disposed of same year as sold for the purpose
	Executive toys	5-20	5	Expert estimate

Table notes:

*1 The average lifespan indicates the number of years from production/import to the products are discarded. An average lifespan of 0 years designates that the products are disposed of within one year after its production/import i.e. the quantities disposed of are calculated on the basis of production/import the same year. Likewise for mercury used as consumables, e.g. for laboratory analysis: A lifespan of 0 years designate that the mercury-containing waste is disposed of the same year as the mercury is sold for the purpose.

*2 The range represent the range on the average lifespan for the type of products and not the range of the lifespan of an individual product.

*3 Panasonic (2022): What does the expiry date on my coin battery mean? Accessed Oct. 2022 at: https://www.panasonic-batteries.com/en/faq/what-does-expiry-date-my-coin-battery-mean.

*4 Sathaiyan, N. (2014): Reclamation of mercury from used silver oxide watch batteries. Advances in Chemical Engineering and Science, 4(1), Article ID:41721.

Data collection

Collecting data for former mercury inputs is done exactly in the same way as collecting data for current inputs; see the relevant sub-sections under Section 3 for advice on data collection.

For products and materials with sufficiently specific HS codes, import and export data can be extracted concurrently with data on the current trade flows by broadening the years range; see Section 3 and Appendix 1.

When collecting data on amounts of products marketed nationally from national manufacturers (producers), make sure to check in advance what years you need data for to cover both current years and years around one average product/material lifetime ago. In case it is not possible to obtain exact data on the production oneone average product/material lifetime ago, it may be possible to estimate the amounts from semi-quantitate information on trends in production volume.

For input calculations making use of the electrification rate, the electrification rate one product lifetime ago can be entered in the in the Accumulation Tab. For short lifetimes, the electrification rate may be considered unchanged.

How the Accumulation tab works

As mentioned, the Accumulation tab calculates the difference between current mercury input and the input one product average lifetime ago in the form of an accumulation factor. In the Products tab, the accumulation factor is in turn used to calculate the total output that is the basis for calculations of emissions, releases and waste flows. The accumulation factor is calculated as follows:

Accumulation factor = (Hg input 1 lifetime ago) / (current Hg input)

This means that if the current mercury input with a certain product is identical to the input one lifetime ago for the same product type, the accumulation factor will be 1. If the mercury input has declined, the accumulation factor will be larger than 1, and conversely, if the input has increased, the accumulation factor will be smaller than 1 (between 0 and 1).

Note that in the IL3 spreadsheet's Accumulation tab, if you do not enter former activity rates, by default current mercury inputs are used in the Accumulation tab (green activity rate cells contain formulas referring to current input data entered). This means that unless you enter import, production and export rates from one average lifetime ago, no change in accumulation is assumed in the calculations.

Note also, that in case current inputs are 0 (zero) due to phase-out of the product in question, the formulas used returns the accumulation factor ”0”. In order to avoid multiplying the activity rate data you have entered for one lifetime ago with “0”, by default (automatically) the activity rate data you have entered for one lifetime ago will be used in the mercury output calculations in the Products tab[13]. This is secured by the pre-entered formulas (so-called if sentences). This emphasises the need to enter former mercury activity rates in the Accumulation tab. These procedures secure, that the estimations of emissions, releases and flows with wastes from products use are based on the mercury amounts that are currently becoming waste.

4.2 Mercury-check with trade data

The Hg-check tab is designed to help compare trade statistics on metal mercury and mercury compounds with the mercury input estimates calculated using the IL3 spreadsheet.

The tab shows the conclusions in Tables 1 and 2, see them described deep below, but build on the data provided in the other tables which are hence described first.

Table 4 - Trade flows
Table 4 is meant for entering import and export data for metal mercury, mercury amalgams and other mercury compounds, so far as the available HS customs codes and data availability allow. As regards these codes, the relevant HS codes of 4 (summary codes) and 6 digits (detailed or semi-detailed), for which data are accessible for many countries are noted in the table. Note that some countries may have 8 or 10 digit HS codes that are more specific than the codes listed in Table 4. The 4 digit codes are only mentioned here because some countries may only have data for these, and not for the slightly more specific 6 digit codes. The amounts reported under 6 digit codes will always be included under the corresponding 4 digit codes, so, if available, use the 6 digit codes only.

The table allows you to enter trade data extracted from UN Comtrade (see Appendix 1) or from national statistics. In case 8 or 10 digit HS codes (or relevant codes from other systems) exist for your country, you can enter additional rows in the table. Enter data for the most recent three-year period which include the base year in Columns C-E and G-I, respectively. Average imports and exports are then automatically calculated in columns F and J, and the net import is calculated in column K.

For compounds, average mercury contents of the compounds can then be entered in column L, or – if no other information is available – the pre-entered values can be used; they are based on experience and some dominant compound types. If more specific data are available, use the

[13] In case the Hg input one lifetime ago was also 0 (zero), 0 outputs are anticipated in the calculations.

stoichiometric molecule formulas to calculate the mercury contents of the compound in question.

This in turn enables the calculation of roughly estimated mercury amounts imported and exported as compounds. Note that since the exact composition of the compounds are not known under these generic HS codes, the calculated mercury contents of the trade flows are only very roughly estimated, indicating an order of magnitude.

It is noted that indicative data on mercury compound import may in some cases be retrievable from Rotterdam PIC (prior informed consent) notifications recorded by the national competent authorities.

Table 3: Metal and compound mercury input estimated in the Toolkit
Table 3 summarised the estimated mercury metal and compounds inputs for processes, manufacture and direct uses estimated in the Toolkit calculations. Be aware that the overview does not include mercury incorporated in imported mercury-added products. Note that some entries are mixed metal/compound entries.

Tables 1 and 2: Overall balances for mercury metal and compounds
Tables 1 and 2 provide overview and comparisons between trade data from Table 4 and estimated data from Table 3. Tables 1 and 2 are built in a similar way; Table 1 indicates the overall mercury metal balance, whereas Table 2 indicates the overall mercury compounds balance. By way of example, we describe Table 1 below.

It should be kept in mind that reported trade data do not always reflect real imports and export exactly. This may be because of imprecision in the individual trade reporting, but more importantly, it may be due to illegal unreported imports and exports. For mercury compounds, a particular uncertainty is that the general HS trade codes are not specific to individual mercury compounds, so you will not know the exact mercury contents of the compounds traded; it will always be rough estimates only.

Note that for certain source sub-categories, some mercury inputs, as well as mercury outputs, may exist both in the form of mercury metal and mercury compounds. This is for example the case for mercury inputs to the society from non-ferrous metal extraction, from which mercury may be sold nationally and/or exported in the form of mercury compounds (often calomel) typically destined for metal mercury production elsewhere, or it may be sold already refined to the metal form from the original facility. Therefore, this input is mentioned both in the metal balance (Table 1) and the compounds balance (Table 2). In the relevant cells, a distribution factor is entered in the formulas; by default set as 100% metal mercury and 0% mercury compound. But you can change this factor quite easily to the distribution prevailing in your country, and this may be important in calibrating the national mercury balance that these tables endeavour to display.

The same applies for laboratory chemicals and equipment, only here the distribution is set by default to 80% metal and 20% compounds. Again, please try to adjust this distribution according to prevailing conditions in your country.

In the first part of the table, the estimated overall metal mercury sources to society are shown, dedicated mercury mining, by-product from other non-ferrous mining, post-consumer recycling from products and wastes, and import, the latter being from the trade data from Table 4 of the Hg-check tab. Export of metal mercury is also shown, but is deducted in the "Total estimated Hg metal input to society (excl. imported MAPs - mercury-added-products)". Note that metal mercury traded as incorporated inside mercury-added products is not included in the sum.

In the second part of Table 1, the estimated direct uses of metal mercury in processes and manufacturing nationally are shown and summarised.

The last line compares the total estimated metal mercury input to society with the calculated total metal mercury demand (total estimated uses). The result shown is the "Difference to balance". This balance should ideally be close to zero (0), and if it is not, the following questions should be considered, and if possible, investigated further:

1. Is the distribution of mercury input from non-ferrous metal extraction between metal mercury input and compound input in Tables 1 and 2 describing the actual situation in the country (is it sold as metal mercury or compound from the extraction facilities or domestic external recovery facilities)?

2. May there perhaps be significant un-reported imports, including potential illegal imports? Make also a double-check of reported of import data, preferably with other data sources. Sometimes national trade statistics and international trade data do not concur, for example because the international data maybe are double-checked versus exporting countries' data.

3. Does mercury recycling from products or recovery from mining take place that has not been captured in the data collection; formal or informal?

4. For major mercury demand (input) sub-categories estimated, are there errors in the activity rate data entered, or do the input factors deviate significantly from the applied default factors? If for example ASGM is taking place in the country, are the data for gold amounts produced with amalgamation sufficiently accurate?

Table 2 is built in a similar way as described above, and should be used in the same way, only, it focuses on the sources of mercury compound sources and uses. Due to the mentioned lack of specificity of the HS customs codes for mercury compounds the data on mercury chemical are more uncertain and in general it will be more difficult to explain any differences to the balance. In case a significant export of mercury compounds is recorded in the statistics it will be necessary to carefully assess whether this is due to export of mercury-containing residues from non-ferrous metal production or some production of mercury compounds takes place in the country.

General distribution of mercury input to production and processes
In cases where you do not have specific data on the specific sources of mercury input (import or national sources) to production/manufacturing facilities, Tables 1 and 2 can also guide you in estimating the relative input to national production processes of mercury and compounds, respectively, from the prevailing sources.

The upper part of Column D for each table shows the relative inputs in percent of the total. These percentages can be used as guiding points for the distribution of mercury inputs between import and domestic mercury sources for the individual production/manufacturing steps in the sub-categories (see also instructions for sub-categories in Section 3). To distinguish if the mercury input sources are metal mercury or mercury compounds in order to apply the correct set of percentages, follow the division shown in Tables 1 and 2 on sub-categories. For example, thermometers are manufactured using metal mercury, and the percentages should therefore be taken from Table 1. Conversely, batteries are manufactured using mercury compounds and the percentages should therefore be taken from Table 2.

Note that the percentage for import of mercury compounds (Table 2) may likely be more uncertain than for metal mercury, due to the mentioned lack of specificity of the HS customs codes for mercury compounds.

As indicated in the Report Template for IL3, the supply/demand overview tables should be shown in the inventory report, and the numbers displayed should be explained and discussed carefully.

4.3 Total summary tab

The TotalSumm tab is your working overview tab during your mass flow development. Here, you can get an overview of which sub-categories you have entered data for, and if some sub-results look strange and may need re-visiting.

The Total summary table is not suited for presentation in the body text of your report, but once the mass flow calculations are finalised, the total summary table should be shown in an appendix to your mass flow report (in horizontal format). Make sure to include the table notes into the appendix.

Annotations in the total summary tab
Some cells are coloured grey. These are generally of moderate relevance, but some have grey numbers in them, that are used in some contexts. The grey cells are not included in the sums at the bottom of the table.

Numbers in in pale yellow cells are also accounted for elsewhere in the table, and to avoid double counting, they are not included in the sums at the bottom of the table. They are however used in some contexts.

Consequently, the sums at the bottom of the table only include numbers from cells that are bright yellow. Forming and using simple sums of all data in a column would be erroneous and would lead to wrong conclusions.

Making your own alternative sums may be complicated due to the risk of double counting and is therefore not recommendable. In case you see an important need for making such alternative sums, please be very careful to avoid double counting.

4.4 Minamata Convention summary tab

The MCSumm tab makes use of the results from the TotalSumm tab, but the table is organised according to the Minamata Convention Articles, which may be of convenience in your Minamata Convention reporting. The rows pertaining to Articles 8, 11 and 9 are organised primarily according to Annex D emission sources, but include other stationary sources that may be of relevance for Article 9 on releases, as per Minamata Convention Guidance adopted at COP4. Several of these additional sources may also have relevance for Article 11 on waste.

4.5 Executive summary tab

The ExecSumm tab is meant for copying into the executive summary of your mass flow report. Due to the sub-division of sector-specific waste by treatment, it may be needed to show the table in horizontal page layout.

The ExecSumm tab includes all the data needed in the overview mercury flow chart.

4.6 Mercury flow overview chart

The FlowOVW tab gives a summarised overview of the mercury flow to, in and from the country. This chart is also meant to be copied into the executive summary of your mass flow report.

The arrows' widths relate relatively, and automatically, to the sum of total current inputs to the country in question, giving a visual indication of key flows. The chart is based on complex custom-made functions, and it is therefore recommended NOT to try to make alterations to the chart inside the IL3 spreadsheet file. If desired, the chart can of course be re-designed externally to the master IL3 file, for example in a graphics illustration software. Add-in graph programmes to Microsoft Excel are available, but have not been tested as part of the development of IL3. We recommend working in a copy of the master IL3 file, if such options are explored, for keeping the master file intact.

It should be noted that the numbers in boxes represent inputs to the selected processes mentioned. Due to the overview character of the chart, some flows and inputs are not shown, and therefore in-flows, box-numbers and outflows shown for a box do not necessarily match.

4.7 Detailed mercury flow chart

The FlowDet tab generates a chart similar to the overview chart described above, but with additional details shown. The details shown are selected based on a prioritisation, and not all results are shown. This chart is meant for copying into the results section of your mass flow report.

The arrows in the IL3 spreadsheet are not automatically adapted to the results, but if desired, you can carefully adjust the arrow's widths or layout manually. Be very careful not to erase numbers, etc., as these include links to other cells and may be hard to re-establish.

While the FlowDet chart includes more details that the FlowOVW chart, the numbers in boxes represent only inputs to selected processes mentioned in the boxes. Due to the overview character of the chart, some inputs are as mentioned not shown, and therefore in-flows, box-numbers and outflows shown for a box do not necessarily match.

5 Abbreviations and acronyms

%	percent;
*	multiplied by;
/	divided by;
/y	per year;
<	less than;
ASGM	
CFL	
g	gram;
Hg	
HS	
IEA	
IL1, IL2, IL3	
kg	kilogram;
LED	
m	meter;
MAP	
metric ton	1000 kg;
MS	
Releases	In the Toolkit, the term "releases" covers both emissions and releases the way these words are used in the Minamata Convention on Mercury.
t	tonne (= metric ton = 1000 kg);
TJ	Terajoule
UN	United Nations;
UN Environment	United Nations Environment Programme;

UNEP	United Nations Environment Programme (old designation used for historical reference here);
US	United States of America;
WHO	World Health Organization;

Appendix 1 - Guidance in the use of the UN Comtrade database available on the Internet

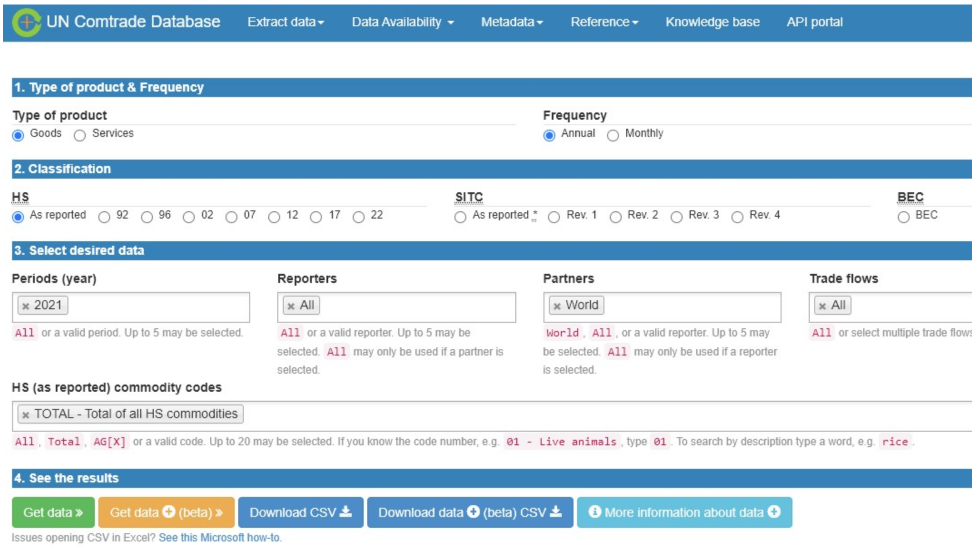
The UN Comtrade database
In cases where national statistics for import and export of products cannot be made available for mercury inventory work, the UN Comtrade database can be used to get import and export data for certain product types. The UN Comtrade database does however not include data on national production, so this element of the national supply cannot be covered via this database and need to be described with data collected nationally. In cases where it has been positively verified that production of the type products in question does not take place in the country, the annual net import (import minus export) of a product will be equal to the annual national supply.

It is emphasised that the UN Comtrade database does not cover all the data types needed to make a mercury inventory for the product in question, and generally it is needed to collect additional data nationally.

This is particularly the case for product types where the UN Comtrade statistics do not cover exactly the mercury containing product in question. For example, the "Harmonised System" (HS) customs codes reported (among others) by UN Comtrade have an entry on thermometers designated "Thermometers & pyrometers, not combined with other instr., liquid-filled, for direct reading [HS as reported code 902511] ", which cover all liquid-filled thermometers. But as the thermometers may be filled with several types of liquids: ethanol, mercury, or – more rarely – a gallium/indium/tin mixture, only some of these thermometers are of interest for our mercury inventory. For such products, it is recommended to contact a few large importers, and ask them about their assessment of the distribution of products in the category on mercury-containing versus non-mercury products. Look for advice on the relevant product types below and in other section of this guideline, or if needed in the relevant section of the Toolkit Reference Report.

More mercury-specific HS 10-digit customs codes were suggested under the Minamata Convention in 2021 for product types targeted in the Convention, see below. But it must be expected that it may take a number of years before the new codes find general use. Note also that the UN Comtrade database currently only displays 6 digit codes, whereas national statistics may display relevant 8, 9 or 10 digit codes; please make sure to search carefully for relevant products in your national trade statistics databases.

Data search in UN Comtrade
The UN Comtrade data search page can be found at https://comtrade.un.org/data/. The initial search picture looks like below (extract as seen June, 2022;).Should the display be different from this when you visit the page, try to find the same entry fields from the homepage https://comtrade.un.org:

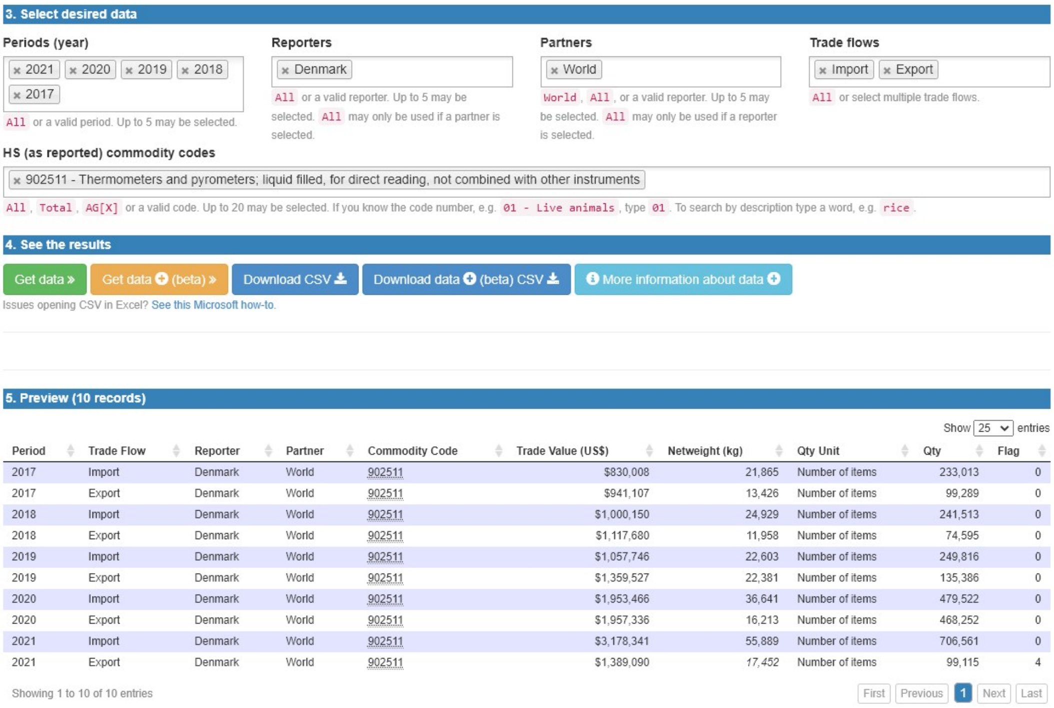


To find the import of a product type, for example thermometers, enter the following:

- “Type of product”: Select “Goods”
- “Frequency”: Select “Annual”.
- “Classification”: Select “HS”, “As reported”
(If you do not find the desired products, you may wish to try the “SITC” and “BEC” options, but be careful to check if the codes match specifically what you look for).
- “Periods”: Enter the last 5 years
(if you search is done in the first half of the current year, omit the latest year – data may not yet be reported).
- “Reporters”: Delete the pre-entered “All” by clicking the “x” before “All” and enter your own country name.
- “Partners”: Keep the pre-entered “World” (or select “World”).
- "Trade flows": Delete the pre-entered “All” and enter "import" and export (we do not need the other two options for our inventory).
- " HS (as reported) commodity codes": Delete the pre-entered “TOTAL—Total of all HS commodities”. Write a search word you think will cover the product type; in our example, write "thermometer", and select the code number and name you wish to get data for in the automatically generated list; get advice on search words and relevant code numbers in the table below in this appendix. You can easily enter all the relevant product codes at the same time. If you get an error message, reduce the number of products and try again.

- Click the "Get data" button.

After a little while, the database returns with the data available for the choices you made. In the example with thermometers (and Denmark) it returned the following list:



Period	Trade Flow	Reporter	Partner	Commodity Code	Trade Value (US$)	Netweight (kg)	Qty Unit	Qty	Flag
2017	Import	Denmark	World	902511	$830,008	21,865	Number of items	233,013	0
2017	Export	Denmark	World	902511	$941,107	13,426	Number of items	99,289	0
2018	Import	Denmark	World	902511	$1,000,150	24,929	Number of items	241,513	0
2018	Export	Denmark	World	902511	$1,117,680	11,958	Number of items	74,595	0
2019	Import	Denmark	World	902511	$1,057,746	22,603	Number of items	249,816	0
2019	Export	Denmark	World	902511	$1,359,527	22,381	Number of items	135,386	0
2020	Import	Denmark	World	902511	$1,953,466	36,641	Number of items	479,522	0
2020	Export	Denmark	World	902511	$1,957,336	16,213	Number of items	468,252	0
2021	Import	Denmark	World	902511	$3,178,341	55,889	Number of items	706,561	0
2021	Export	Denmark	World	902511	$1,389,090	*17,452*	Number of items	99,115	4

Showing 1 to 10 of 10 entries   First Previous 1 Next Last

Now simply mark all relevant headings and data on your computer screen and copy them (Ctr C) to your spreadsheet for further data analysis. Observe that data may be displayed in several pages (see below the table displayed) and use “next” to display and copy all relevant data. It is easiest to copy the headings each time and then remove the heading rows in your won spreadsheet. Make sure you copy all relevant data and that they are pasted in a consistent and easily editable format.

When you hover your mouse cursor over the product code (here 902511) in the Comtrade results table, the name of the product code is displayed; you can use this when making your table on import/export data for your own calculations and for your inventory report. Adding the code name makes the table much more explicit and hence useful.

Once the data are copied to your spreadsheet (for example to an extra tap in your spreadsheet file), you can manipulate the data to calculate net imports (import minus export) and averages over 3 (or 5) years around your base year, depending on the need. Note that the data may in some cases display clear decreasing or increasing trends that you may wish to mirror in your inventory. If not, it is recommended to use averages over 3 years (or 5 years if the data are very scattered). Remember to write clearly in your report what the displayed data represent.

The data you use should preferably be in the unit stated in the Inventory spreadsheet, if available. In our example, we need imported number of items of thermometers. If the data are not available in the desired unit, you need to convert the trade data. For some product types, this can be done in the Toolkit spreadsheet's “Unit conversion” tab. For other, you may be able to derive conversion factors from similar data sets from 2-3 neighbouring countries, where data in all units are available, or from other Internet sources. Such conversion may of course introduce some uncertainty, but it is still better than having no data at all. Explain explicitly and with all relevant data how you made the conversion, in your inventory report.

Data for (at least) the following product/material groups can be sought with meaningful results in UN Comtrade. Note that new relevant customs codes may emerge, as mentioned above, but likely with 8 or 10 digits, not freely available at UN Comtrade (check with your national statistics bureau for such data).

Product/material name in Toolkit Inventory Level 1	Use this search word	Examples of product name(s) and code(s) in Comtrade (others may exist)	Remarks
Ore concentrates			
Zinc concentrates	Zinc concentrates	…Zinc ores and concentrates [HS as reported code 260800]	
Lead concentrates	Lead concentrates	…Lead ores and concentrates [HS as reported code 260700]	
Copper concentrates	Copper concentrates	… Copper ores and concentrates [HS as reported code 260300]	
Cement		… Portland cement, aluminous cement, slag cement, supersulphate cement and similar hydraulic cements, whether or not coloured or in the form of clinkers. [HS as reported code 2523]	This is generic category that includes both cement and cement clinker. Remember that in the Toolkit context, you only need data for national PRODUCTION based on nationally produced clinker. But trade data may help you establish such relevant amounts.
Cement	Cement	…White cement, whether or not artificially coloured [HS as reported code 252321] + …Other than white [HS as reported code 252329] + …Aluminous cement	Remember that in the Toolkit context, you only need data for national PRODUCTION data for CEMENT based on nationally produced clinker. But trade data may help you establish such relevant amounts.

Product/material name in Toolkit Inventory Level 1	**Use this search word**	**Examples of product name(s) and code(s) in Comtrade (others may exist)**	**Remarks**
		[HS as reported code 252330] + …Other hydraulic cements [HS as reported code 252390]	
Cement clinker	Cement clinker	…Cement clinkers [HS as reported code 252310]	While imported clinker is not relevant for our mercury inventory development, it may help derive the relevant production amounts, see note above.
Thermometers	thermo-mo- meter	….Thermometers & pyrometers, not combined with other instr., liquid-filled, for direct reading [HS as reported code 902511]	May include thermometers with other types of liquids, most likely alcohol-filled ambient air thermometers. You need to ask major importers about the likely fraction of mercury-filled thermometers.
Batteries	battery cell	…..Primary cells and primary batteries. [HS as reported code 8506]	This is a generic customs code that include all types of non-rechargeable batteries, including several without mercury
Other button cells (zinc-air, alkaline button cells, silver-oxide, mercuric oxide)		….Primary cells & primary batteries, air-zinc [HS as reported code 850660] + …Cells and batteries; primary, silver oxide [HS as reported code 850640] + Cells and batteries; primary, mercuric oxide [HS as reported code 850630]	Includes only part of the battery types in the Toolkit category, as there is no separate 6 digit HS code for button cell alkaline batteries (may be available in national 8 digit HS codes)
Other batteries [potentially] with mercury (plain cylindrical alkaline, permanganate)		… Manganese dioxide [HS as reported code 850610]	Most of these larger alkaline batteries are today likely without mercury, but this needs to be checked with battery importers and any national producers
Light sources with mercury	lamp		
Fluorescent tubes (double end) and Compact fluorescent lamp (CFL single end)		……Electric discharge lamps (excl. ultra-violet lamps), fluorescent, hot cathode [HS as reported code 853931]	For some countries, this 6 digit HS code may include both "Fluorescent tubes (double end)" and "Compact fluorescent lamp (CFL single end)", but not the distribution on the types; distribution on types must be based on data from

Product/material name in Toolkit Inventory Level 1	**Use this search word**	**Examples of product name(s) and code(s) in Comtrade (others may exist)**	**Remarks**
			importers. See also code 853939 below.
		…..Electric discharge lamps (excl. ul- tra-violet lamps; excl. of 853931 & 853932) [HS as reported code 853939]	Note that some countries use this code for compact fluorescent lamps (CFLs or "energy-savers"), so it must be analysed in conjunction with code 853931. If code 853939 has large imports, it may likely represent CFLs and can be incorporated as such in the inventory. Always make sure to report HS codes with the data displayed in your report.
		…..Ultra-violet/infra-red lamps [HS as reported code 853949]	Includes such mercury containing ultra- violet fluorescent lamps used for tanning beds as well as infra-red lamps which do not contain mercury. For some countries, a specific code is used for infra-red lamps, and these (non-mercury) lamps can then be deducted.
Other Hg containing light sources (see guideline)		…..Electric discharge lamps (excl. ul- tra-violet lamps), mercury/sodium va- pour lamps; metal halide lamps [HS as reported code 853932]	Includes some of the lamps with high mercury contents, but not all.
Other relevant product/material groups that can potentially be used for cross-checking of mercury inputs			
Metal mercury	Mercury	Mercury [HS as reported code 280540]	
Mercury compounds	Mercury compounds	…Inorganic or organic compounds of mercury, excluding amalgams, whether or not chemically defined [HS as reported code 2852] + …Inorganic or organic compounds of mercury, excluding amalgams, chemically defined [HS as reported code 285210] + …Inorganic or organic compounds of mercury; excluding amalgams, not chemically defined [HS as reported code 285290]	
Dental amalgams	Dental amalgams	….Pharmaceutical goods; dental cements and other dental fillings, bone reconstruction cements	There is no distinct code for mercury amalgam. This code

Product/material name in Toolkit Inventory Level 1	Use this search word	Examples of product name(s) and code(s) in Comtrade (others may exist)	Remarks
		[HS as reported code 300640]	may include other types of dental fillings
Gold (for all extraction techniques)	Gold	… Metals; gold, non-monetary, unwrought (but not powder) [HS as reported code 710812] + …Metals; gold, semi-manufactured [HS as reported code 710813]	This includes bars which for the purposes of marketing have a smooth surface and a hallmark. Grains of silver and its alloys are classified in this code, provided that they are not powdered. This codes exclude bars obtained by drawing or rolling.

HS customs codes proposed under the Minamata Convention (COP4.1)

The tables below list proposed statistical codes of more than six digits for mercury-added products listed in annex A to the Minamata Convention (codes based on the Harmonized System)[14]. These codes may, if promoted by Parties to that Convention, become available in the future in national – and perhaps international – trade statistics.

In the following table, the first column shows existing codes used by some parties and the second column provides proposed codes to distinguish mercury-added products from other products. The proposed codes and descriptions are shown in shaded cells.

Batteries

Existing code	*Proposed statistical codes*	*Description*
8506.10.10		Alkaline manganese dioxide primary cells
	8506.10.10.10	With added mercury
	8506.10.10.90	Others
8506.10.20		(Other) manganese dioxide primary cells
	8506.10.20.10	With added mercury
	8506.10.20.90	Others
8506.10.30		Manganese dioxide batteries
	8506.10.30.10	With added mercury
	8506.10.30.90	Others
8506.30.00		Mercuric oxide batteries
	8506.30.00.00	Mercuric oxide primary cells and batteries (excluding spent)
8506.40.10		Silver oxide primary cells with external volume less than or equal to 300 cm^3
	8506.40.10.10	With added mercury
	8506.40.10.11	Button batteries with mercury content less than 2% by weight

[14] Source: UNEP/MC/COP.4/27, dated 9 August 2021: Customs codes. Note by the secretariat.

	8506.40.10.90	Others
8506.40.90		(Other) silver oxide primary cells
	8506.40.90.10	With added mercury
	8506.40.90.90	Others
8506.60.10		Air-zinc primary cells (with external volume less than or equal to 300 cm^3)
	8506.60.10.10	With added mercury
	8506.60.10.11	Button batteries with mercury content less than 2% by weight
	8506.60.10.90	Others
8506.60.90		(Other) air-zinc batteries
	8506.60.90.10	With added mercury
	8506.60.90.90	Others
8506.80.01		Other primary cells and batteries
	8506.80.10.10	With added mercury
	8506.80.10.90	Others

Switches and relays

Existing code	*Proposed statistical codes*	*Description*
		Isolating switches and make-and-break switches, for a voltage exceeding 1,000 volts
8535.30.01		Make-and-break switches
	8535.30.01.10	With added mercury
	8535.30.01.90	Others
8535.30.13		Switches for rated current less than or equal to 1,600 amps, vacuum cut-off without actuating device (vacuum bottles or ampoules)
	8535.30.13.10	With added mercury
	8535.30.13.90	Others
8535.30.18		Disconnectors and switches for rated current less than or equal to 1,600 amps and others with automatic actuation device except for contacts immersed in liquid medium
	8535.30.18.10	With added mercury
	8535.30.18.90	Others
8535.30.19		Other disconnectors and switches for rated current less than or equal to 1,600 amps
	8535.30.90.10	With added mercury
	8535.30.90.90	Others
8535.30.27		Switches for rated current greater than 1,600 amps and others with non-automatic actuation device
	8535.30.27.10	With added mercury
	8535.30.27.90	Others
8535.30.28		Switches for rated current greater than 1,600 amps and others with automatic actuation device except for contacts immersed in liquid medium
	8535.30.28.10	With added mercury
	8535.30.28.90	Others
		Electrical apparatus for switching, protecting or making connections for a voltage exceeding 1,000 volts
8535.90.04		Starter relays
	8535.90.04.10	With added mercury
	8535.90.04.90	Others

Existing code	*Proposed statistical codes*	*Description*
8535.90.05		Thermal or induction relays
	8535.90.05.10	With added mercury
	8535.90.05.90	Others
8535.90.06		High sensitivity relays, with laminated core, inverting monopole, as exclusively designed for telephone equipment
	8535.90.06.10	With added mercury
	8535.90.06.90	Others
8535.90.13		Secondary electromagnetic relays, powered exclusively through current and / or voltage transformers
	8535.90.13.10	With added mercury
	8535.90.13.90	Others
8535.90.14		Automatic differential relays, up to 60 amps with differential protection up to 300 milliamps
	8535.90.14.10	With added mercury
	8535.90.14.90	Others
8535.90.22		Relays other than those included in subheadings 8535.90.04, 8535.90.05, 8535.90.06, 8535.90.13 and 8535.90.14.
	8535.90.22.10	With added mercury
	8535.90.22.90	Others
		Relays, for a voltage not exceeding 1,000 volts
	8536.40.00.10	With added mercury
	8536.40.00.90	Others
		Relays for a voltage not exceeding 60 volts
8536.41.01		For speakers
	8536.41.01.10	With added mercury
	8536.41.01.90	Others
8536.41.02		6- and 12-volt solenoids, for automotive starter motors
	8536.41.02.10	With added mercury
	8536.41.02.90	Others
8536.41.03		Thermal or induction
	8536.41.03.10	With added mercury
	8536.41.03.90	Others
8536.41.04		Certified for aircraft
	8536.41.04.10	With added mercury
	8536.41.04.90	Others
8536.41.05		High sensitivity, with laminated core, inverter monopole, designed and certified for telephone equipment
	8536.41.05.10	With added mercury
	8536.41.05.90	Others
8536.41.06		Electromagnetic secondaries, powered exclusively through current and / or voltage transformers
	8536.41.06.10	With added mercury
	8536.41.06.90	Others
8536.41.07		Automatic differential, up to 60 amps with differential protection up to 300 milliamps
	8536.41.07.10	With added mercury
	8536.41.07.90	Others
8536.41.08		Photoelectric relays
	8536.41.08.10	With added mercury

Existing code	*Proposed statistical codes*	*Description*
	8536.41.08.90	Others
8536.41.09		Directional indicators for manoeuvring indicator lights, for automotive use
	8536.41.09.10	With added mercury
	8536.41.09.90	Others
8536.41.10		For start-up functions, other than those included in section 8536.41.02
	8536.41.10.10	With added mercury
	8536.41.10.90	Others
8536.41.11		Manual or electrical reset multiple contact lockout auxiliary relays rated less than or equal to 60 amps
	8536.41.11.10	With added mercury
	8536.41.11.90	Others
8536.41.99		Other
	8536.41.99.10	With added mercury
	8536.41.99.90	Others
		Relays for a voltage greater than 60 volts and not exceeding 1,000 volts
8536.49.01		For start-up functions
	8536.49.01.10	With added mercury
	8536.49.01.90	Others
8536.49.02		Thermal or induction
	8536.49.02.10	With added mercury
	8536.49.02.90	Others
8536.49.03		Electromagnetic secondaries, powered exclusively through current and / or voltage transformers
	8536.49.03.10	With added mercury
	8536.49.03.90	Others
8536.49.04		Automatic differential, up to 60 amps with differential protection up to 300 milliamps
	8536.49.04.10	With added mercury
	8536.49.04.90	Others
8536.49.05		Multi-contact block auxiliary relays, manual or electrical reset, rated less than or equal to 60 amps and 480 volts maximum voltage
	8536.49.05.10	With added mercury
	8536.49.05.90	Others
8536.49.99		Other
	8536.49.99.10	With added mercury
	8536.49.99.90	Others
		Switches, for a voltage not exceeding 1,000 volts
8536.50.01		Switches other than those included in subheadings 8536.50.05, 8536.50.06, 8536.50.07, 8536.50.10, 8536.50.11 and 8536.50.15
	8536.50.01.10	With added mercury
	8536.50.01.90	Others
8536.50.05		Certified for aircraft
	8536.50.05.10	With added mercury
	8536.50.05.90	Others

Existing code	*Proposed statistical codes*	*Description*
8536.50.06		Switches, by pressure of liquids for level controls in washing machines for domestic use
	8536.50.06.10	With added mercury
	8536.50.06.90	Others
8536.50.07		Thermoelectric automatic switches for priming the discharge in fluorescent lamps or tubes
	8536.50.07.10	With added mercury
	8536.50.07.90	Others
8536.50.10		Switches designed and certified exclusively for radio or television, other than those included in section 8536.50.15
	8536.50.10.10	With added mercury
	8536.50.10.90	Others
8536.50.11		Loose or grouped switches, actuated by buttons, weighing up to 250 grams, or single or multiple push-button or keyboard switches, designed and certified exclusively for electronics, other than those included in section 8536.50.15
	8536.50.11.10	With added mercury
	8536.50.11.90	Others
8536.50.15		Dual, foot or pull-type light switches; start button; designed and certified exclusively for automotive use
	8536.50.15.10	With added mercury
	8536.50.15.90	Others

Thermostats[a]

HS reference	*Proposed statistical codes*	*Description*
9032.10.20		Electronic thermostats
9032.10.80		Other thermostats
	9032.10.80.10	Containing mercury
	9032.10.80.90	Others

Linear fluorescent lamps

Existing code	*Proposed statistical codes*	*Description*
		Fluorescent, hot cathode discharge lamps, other than ultraviolet lamps
8539.31.00.10		Linear fluorescent lamps (LFLs) for general lighting purposes
	8539.31.00.11	Triband phosphor less than 60 watts with a mercury content not exceeding 5 mg per lamp
	8539.31.00.12	Halophosphate phosphor less than 40 watts with a mercury content not exceeding 10 mg per lamp
8539.31.00.90		Other

Compact fluorescent lamps

Existing code	*Proposed statistical codes*	*Description*
8539.31.00		Discharge lamps, fluorescent and hot cathode

8539.31.10		Compact fluorescent lamps (CFLs) for general lighting purposes
	8539.31.10.10	CFLs less than 30 watts with a mercury content not exceeding 5 mg per lamp
	8539.31.10.90	Other CFLs

High-pressure mercury vapour lamps

Existing code	*Proposed statistical codes*	*Description*
8539.32.00		Mercury or sodium vapour lamps; metal halide lamps
	8539.32.00.10	High-pressure mercury vapour lamps for general lighting purposes

Cold cathode and external electrode fluorescent lamps

Existing code	*Proposed statistical codes*	*Description*
8539.39.00		Electrical discharge lamps, other than fluorescent (hot cathode), mercury or sodium vapour, metal halide or ultraviolet lamps
	8539.39.00.10	Cold cathode fluorescent lamps and external electrode fluorescent lamps (CCFL and EEFL) for electronic displays: short length (less than 500 mm) with mercury content no more than 3.5 mg per lamp
	8539.39.00.20	Cold cathode fluorescent lamps and external electrode fluorescent lamps (CCFL and EEFL) for electronic displays: medium length (greater than 500 mm and less than 1,500 mm) with mercury content no more than 5 mg per lamp
	8539.39.00.30	Cold cathode fluorescent lamps and external electrode fluorescent lamps (CCFL and EEFL) for electronic displays: long length (greater than 1,500 mm) with mercury content no more than 13 mg per lamp

Cosmetics

Existing code	*Proposed statistical codes*	*Description*
3304.10.01		Lip make-up preparations
	3304.10.01.10	With mercury content less than or equal to 1 ppm
	3304.10.01.20	With mercury content more than 1 ppm
3304.20.01		Eye make-up preparations
	3304.20.01.10	With mercury content less than or equal to 1 ppm
	3304.20.01.20	With mercury content more than 1 ppm and mercury is used as a preservative
	3304.20.01.30	With mercury content more than 1 ppm and mercury is not used as a preservative
3304.30.00		Manicure or pedicure preparations
	3304.30.00.10	With mercury content less than or equal to 1 ppm
	3304.30.00.20	With mercury content more than 1 ppm
3304.90.00		Other
	3304.90.00.10	With mercury content less than or equal to 1 ppm
	3304.90.00.20	With mercury content more than 1 ppm
3304.91.01		Powders, including compacts
	3304.91.01.10	With mercury content less than or equal to 1 ppm
	3304.91.01.20	With mercury content more than 1 ppm
3304.99.01		Skin creams
	3304.99.01.10	With mercury content less than or equal to 1 ppm
	3304.99.01.20	With mercury content more than 1 ppm

Existing code	*Proposed statistical codes*	*Description*
3304.99.99		Other
	3304.99.99.10	With mercury content less than or equal to 1 ppm
	3304.99.99.20	With mercury content more than 1 ppm
		Soap and organic surface-active products and preparations, in the form of bars, cakes, moulded pieces or shapes, and paper, wadding, felt and nonwovens, impregnated, coated or covered with soap or detergent
		For toilet use (including medicated products)
3401.11.01		Soaps for toilet use (incl. medicated)
	3401.11.01.10	With mercury content less than or equal to 1 ppm
	3401.11.01.20	With mercury content more than 1 ppm
3401.19.00		Other
	3401.19.00.10	With mercury content less than or equal to 1 ppm
	3401.19.00.20	With mercury content more than 1 ppm
3401.20.01		Soap in other forms
	3401.20.01.10	With mercury content less than or equal to 1 ppm
	3401.20.01.20	With mercury content more than 1 ppm
3401.30.01		Organic surface-active products and preparations for washing the skin, in the form of liquid or cream and put up for retail sale, whether or not containing soap
	3401.30.01.10	With mercury content less than or equal to 1 ppm
	3401.30.01.20	With mercury content more than 1 ppm

Pesticides, biocides and topical antiseptics

Existing code	*Proposed statistical codes*	*Description*
		Other medicaments consisting of mixed or unmixed products for therapeutic or prophylactic uses, for retail sale
3004.90.1000		Containing antigens or hyaluronic acid or its sodium salt
	3004.90.2000	[Topical antiseptics] containing mercury compounds
		Insecticides, rodenticides, fungicides, herbicides, anti-sprouting products and plant growth regulators, disinfectants and similar products
3808.50.01		Goods containing a range of substances as specified in Subheading Note 1 to Chapter 38, of which one is mercury compounds
3808.50.10		Specified goods containing any aromatic or modified aromatic pesticide
	3808.50.10.10	Containing mercury compounds
	3808.50.10.90	Not containing mercury compounds
3808.50.50		Other pesticides
	3808.50.50.10	Containing mercury compounds
	3808.50.50.90	Not containing mercury compounds
3808.91.00		Insecticides
	3808.91.00.10	Containing mercury compounds
	3808.91.00.90	Not containing mercury compounds
3808.92.00		Fungicides
	3808.92.00.10	Containing mercury compounds
	3808.92.00.90	Not containing mercury compounds

3808.93.00		Herbicides, anti-sprouting products and plant-growth regulators
	3808.93.00.10	Containing mercury compounds
	3808.93.00.90	Not containing mercury compounds
3808.99.00		Other
	3808.99.00.10	Containing mercury compounds
	3808.99.00.90	Not containing mercury compounds
	[To be considered][b]	Paints and varnishes to which a mercury compound has been added for its biocidal or fungicidal properties
3208.00		Paints and varnishes, including enamels and lacquers, based on synthetic polymers, dispersed or dissolved in a non-aqueous medium (excluding those based on polyesters and acrylic or vinyl polymers)
3209.00		Paints and varnishes, including enamels and lacquers, based on synthetic polymers or chemically modified natural polymers, dispersed or dissolved in an aqueous medium

Measuring devices

Existing code	*Proposed statistical codes*	*Description*
		Other instruments and appliances, including sphygmomanometers
9018.90.92		Devices for measuring blood pressure
	9018.90.92.10	Sphygmomanometers containing mercury
	9018.90.92.90	Other
9025.11.10		Clinical thermometers, liquid filled, for direct reading
	9025.11.10.10	Containing mercury
	9025.11.10.90	Other
9025.11.40		Liquid-filled thermometers, for direct reading, not combined with other instruments, other than clinical thermometers
	9025.11.40.10	Containing mercury
	9025.11.40.90	Other
9025.80.01		Other instruments, including barometers
	9025.80.01.10	Barometers containing mercury
	9025.80.01.90	Other
9025.80.02		Other instruments: hygrometers
	9025.80.02.10	Hygrometers containing mercury
	9025.80.02.90	Other
9026.20.10		Instruments and apparatus for pressure measurement or control, manometers
	9026.20.10.10	Manometers containing mercury
	9026.20.10.90	Other

Dental amalgam

Existing code	*Proposed statistical codes*	*Description*
2843.90.00		Amalgams of precious metals; etc.
	2843.90.00.10	Amalgams [containing mercury] of precious metals in capsule or other form for dental use
	2843.90.00.90	Other amalgams of precious metals
2853.90.00		Amalgams, other than amalgams of precious metals; etc.
2853.90.90		Other

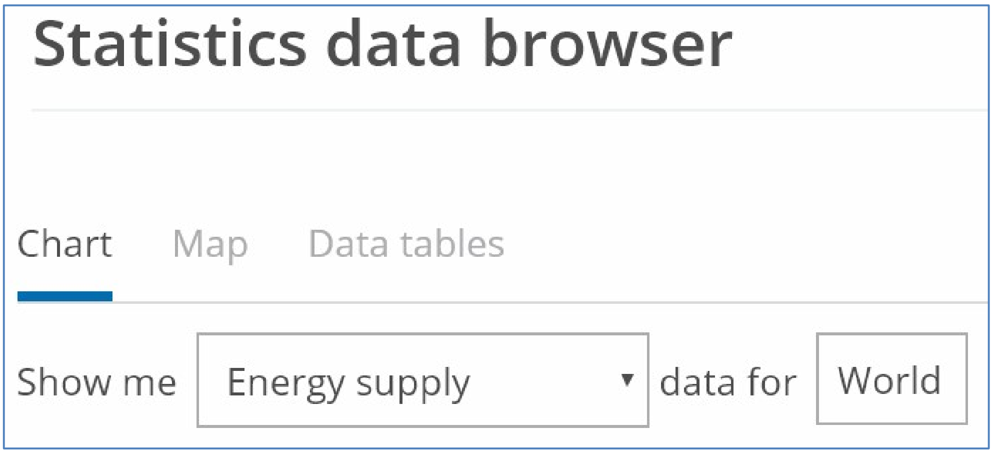
	2853.90.90.10	Amalgams [containing mercury], other than amalgams of precious metals, in capsule or other form for dental use
	2853.90.90.90	Other amalgams not containing precious metals

[a] Mercury-added thermostats used to control room temperature use a mercury-added switch to turn on and off heating and cooling equipment, and thus the switch is the sole mercury-added component of the product. Parties may therefore consider such thermostats to be included under the listing of switches and relays in annex A. On the other hand, other Parties may consider such products a measuring device, in which case parties may not consider such thermostats to be included in the products listed in annex A.

[b] Customs codes for paint and varnishes are subdivided into those using non-aqueous or aqueous medium, etc. Further information is needed on which types of products are likely to contain mercury compounds.

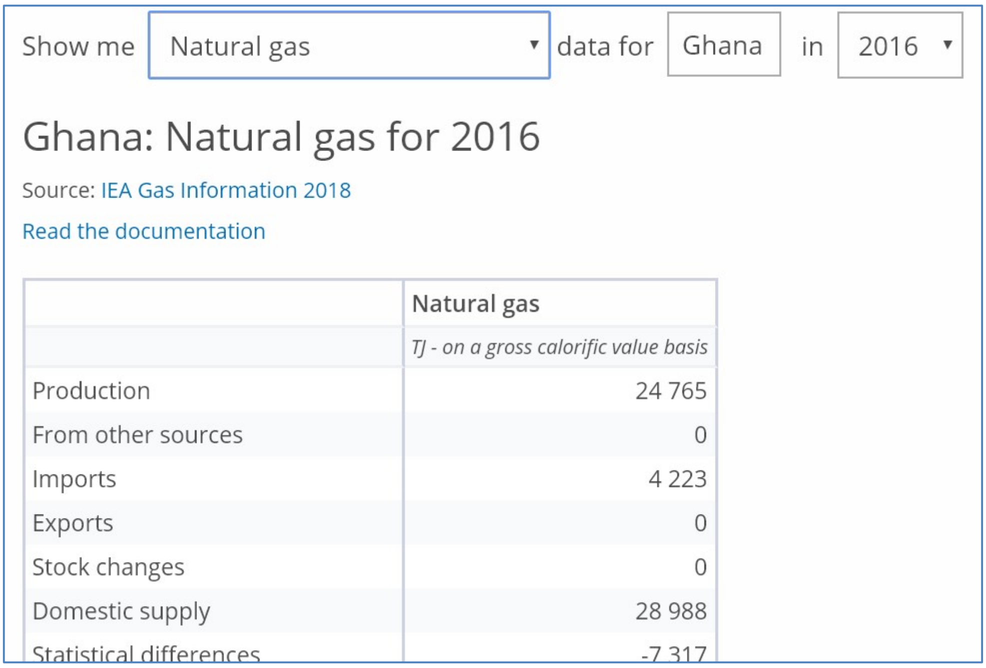
Appendix 2 - Guidance in the use of the IEA energy statistics database on the Internet

Country-specific data on fuel use can be found on the International Energy Agency's website on statistics. Go to the IEA site at www.iea.org. In the menu at the top, click “Statistics & Data”, you will see a search fields that can help you finding energy information about your country. Click on “Data tables”. In the “data for” field, enter your country name, in the “Show me” field, select the fuel type you are looking for from the drop-down menu.



In the “in” field, select the year you need data for (the base year of your inventory). The data are free under certain conditions. If you need it, the IEA has newer data than those displayed here, but they need to be purchased from another IEA site.

If I for example choose Ghana, natural gas and 2016, I get the data below (extract shown only). Make sure to check the units of the data given, and convert them as needed, using the Toolkit spreadsheets’ Unit conversion tab.


Show me Natural gas data for Ghana in 2016

Ghana: Natural gas for 2016

Source: IEA Gas Information 2018

Read the documentation

	Natural gas
	TJ - on a gross calorific value basis
Production	24 765
From other sources	0
Imports	4 223
Exports	0
Stock changes	0
Domestic supply	28 988
Statistical differences	-7 317

For mercury inventories done in the Toolkit, the IEA statistics have data for most countries on the following issues:

Toolkit fuel/energy entry (and unit used in Toolkit)	**Unit in IEA statistics (to be converted to Toolkit unit)**	**IEA data entries that should be included in your inventory**
Combustion of coal in large power plants (t coal com-busted/ y:	TJ (can be converted in the Toolkit's unit conversion tab)	Sum of consumption for Electricity plants and CHP plants for the coal types Anthracite + Other bituminous coal + Sub-bituminous coal + Lignite (+ coking coal if reported for these uses)
Other coal uses	TJ (can be converted in the Toolkit's unit conversion tab)	Sum of consumption for Heat plants, Other trans-formation, Industry, Transport, Residential, Agricul-ture/Forestry, Fishing, Other non-specified and Non-energy use for the coal types: Anthracite + Coking coal + Other bituminous coal + Sub-bitu-minous coal + Lignite + Patent fuel + BKB (brown coal briquettes)
Combustion/use of petroleum coke and heavy oil	TJ (can be converted in the Toolkit's unit conversion tab)	Domestic supply: Fuel oil (Toolkit sub-category "heavy fuel" only; petroleum coke consumption must be found elsewhere)
Combustion/use of diesel, gasoil, petroleum, kerosene and other light to medium fractions	TJ (can be converted in the Toolkit's unit conversion tab)	Domestic supply of Natural gas liquids + Naphtha + Liquefied petroleum gases + Motor gasoline + Aviation gasoline + Jet kerosene + Other kerosene + Gas/diesel

Oil extraction (t crude oil produced/y)	TJ (can be converted in the Toolkit's unit conversion tab)	Production, Crude oil
Oil refining (t crude oil refined/y)	TJ (can be converted in the Toolkit's unit conversion tab)	Oil refineries, Crude oil
Consumption of natural gas (Nm^3 used/y)	TJ (can be converted in the Toolkit's unit conversion tab)	Domestic supply
Production of natural gas (Nm^3 produced/y)	TJ (can be converted in the Toolkit's unit conversion tab)	Production
Biomass fired power and heat production (Biomass combusted, t (dry weight)/y)	TJ (can be converted in the Toolkit's unit conversion tab)	Primary solid biofuels (includes also other solid biofuels than wood). (Alternatively you may consult other sources for biomass data, for example the FAO Yearbooks of Forest Products (entry: Wood Fuel, Including Wood for Charcoal) at http://www.fao.org/forestry/statistics/80570/en/), which reports cubic meters wood consumption per year, but does not include other biomass fuels).
Charcoal combustion (Charcoal combusted, t (dry weight)/y)	Data for charcoal may be available in some cases, but need to be purchased.	Data specifically for charcoal may be available in some cases, but need to be purchased.

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