UNEP

Toolkit for Identification and Quantification of Mercury Releases

**Guideline
for Inventory Level 1**

Version 1.3

April 2015

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This Toolkit for Inventory Level 1 represents the third version of this publication. It will be further developed and updated as appropriate.

The Toolkit can be found on UNEP Chemicals Branch's website:
http://www.unep.org/hazardoussubstances/Mercury/MercuryPublications/GuidanceTrainingMaterialToolkits/MercuryToolkit/tabid/4566/language/en-US/Default.aspx

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Introduction

Welcome to the Toolkit for identification and quantification of mercury releases - Inventory Level 1. The Toolkit consists of 6 separate documents:
- This Guideline for Inventory Level 1;
- An electronic spreadsheets for calculation of estimates of mercury inputs and releases on Inventory Level 1;
- Two templates for data collection letters;
- An Inventory Reporting Template; and
- A Toolkit Reference Report.

The Toolkit 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 Inventory Level 2 which gives guidance to performing more detailed and potentially more technically accurate mercury inventories.

This guideline works closely together with the Toolkit electronic Inventory Level 1 spreadsheet for calculation of estimates of mercury inputs and releases[1]. The guideline and the calculation spreadsheet bring you step by step through the development of your mercury inventory on Inventory Level 1. The design of Inventory Level 1 makes it simple to organise and calculate your first national mercury inventory. We acknowledge however that mercury inventory development is generally challenging, especially 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.

The Inventory Level 1 guideline and calculation spreadsheet is organised with the following steps:

Step 1: Getting started;
Step 2: Energy consumption and fuel production;
Step 3: Domestic production of metals and raw materials;
Step 4: Domestic production and processing with intentional mercury use;
Step 5: Waste treatment and recycling;
Step 6: General consumption of mercury in products, as metal mercury and as mercury containing substances;
Step 7: Crematoria and cemeteries;
Step 8: Miscellaneous mercury sources not quantified on Inventory Level 1;
Step 9: Reporting your inventory and
Step 10: Refining your inventory (optional).

Steps 2 through 7 provides brief descriptions of the mercury source categories included, the data types needed and ideas for where to search for data, and the main factors informing your decisions of whether to refine your inventory further for this category or not. Step 8 lists source categories which are not quantified via Inventory Level 1.

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[1] All the UNEP Mercury Toolkit documents can be found on UNEP's website:
http://www.unep.org/hazardoussubstances/Mercury/MercuryPublications/GuidanceTrainingMaterialToolkits/MercuryToolkit/tabid/4566/language/en-US/Default.aspx

Steps 1, 9 and 10 give you general guidance on performing and reporting your inventory.

Background
The UNEP Governing Council (GC) concluded in 2003 that there is sufficient evidence of significant global adverse impacts from mercury to warrant international action to protect human health and the environment from mercury and its compounds. The GC decided that national, regional and global actions should be initiated as soon as possible and urged all countries to adopt goals and take actions, as appropriate, to identify populations at risk and to reduce human-generated releases.

In response to the Governing Council's request, UNEP established a Mercury Programme to encourage all countries to adopt goals and take actions, as appropriate, to identify exposed populations, minimize exposures through outreach efforts, and reduce anthropogenic mercury releases. An important part of the UNEP Mercury Programme is to develop training materials, guidance documents and toolkits on a number of relevant topics that may be of use to Governments and others in their efforts to evaluate and address mercury pollution.

A certain level of knowledge is required to evaluate risks posed by mercury and to take appropriate action to reduce potential risks. This "Toolkit for identification and quantification of mercury releases" (Toolkit) assists countries to develop part of the required knowledge through the development of a mercury inventory that identifies sources of mercury releases in their country and quantify their releases.

A Pilot Draft version of the Toolkit was published by UNEP in November 2005, providing the initial version of what is now referred to as Inventory Level 2 and the "Toolkit Reference Report" in the current guideline document. Pilot tests in a number of countries have identified a need for further simplification of the Toolkit, thus the development of Inventory Level 1.

More reading on the Toolkit and mercury as a pollutant
For more information on the background for this Toolkit, see Section 1 and 2 of the Toolkit Reference Report. For more information on mercury release fundamentals, see Section 3 of the Toolkit Reference Report. Two other reports published by UNEP Chemicals, the Global Mercury Assessment[2], and the Global Mercury Assessment 2013: Sources, Emissions, Releases and Environmental Transport[3] give a deeper understanding of mercury pollution, its adverse effects, global release estimates and its global significance. These are useful for seeing your national release estimates in a global perspective.

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[2]

http://www.unep.org/hazardoussubstances/Mercury/Informationmaterials/ReportsandPublications/tabid/3593/Default.aspx

[3]

http://www.unep.org/hazardoussubstances/Mercury/Informationmaterials/ReportsandPublications/tabid/3593/Default.aspx

This revised Toolkit
The Toolkit suggests two levels of inventory development, a simplified and standardised methodology called Inventory Level 1, and a more detailed Inventory Level 2. This guideline describes a step by step procedure for Inventory Level 1. It also describes limitations of the Inventory Level 1 methodology and gives advice for situations where you may want to refine your inventory on Inventory Level 2. Finally this guideline provides advice for the reporting of your inventory. Besides providing background information, the Toolkit Reference Report describes Inventory Level 2.

Earlier users of the Toolkit will recognise Inventory Level 2 as the original methodology of the Pilot Draft version of the Toolkit published November 2005. As part of the current revision, the Toolkit has undergone certain revisions. Most importantly, default input and output distribution factors have been developed for more mercury release source categories than previously, making it simpler to use the Toolkit.

The MS Excel calculation spreadsheets were updated for Inventory Level 1 as part of the latest revision including updated default factors for some sources, improved estimation principles for selected consumer products, and improved design for more user friendliness.

The MS Excel calculation spreadsheets for Inventory Level 2 have also been revised with new default input factors for some source categories based on new knowledge of existing mercury release sources.

The mass balance principle, inputs and outputs
The mercury release calculations used in this Toolkit are based on the mass balance principle: All the mercury fed into the system (e.g. an industrial sector) with materials and fuels will come out again, either as releases to the environment or in some kind of product stream. In other words: "Sum of inputs = sum of outputs".

Inputs: Therefore we quantify the mercury inputs from the amount of mercury containing material fed into the system (called "**activity rate**"[4]) and general data on the mercury concentration in the feed material (called "**input factor**").

Outputs: The mercury releases from the system are calculated by distributing this mercury amount on the relevant release pathways based on available data on how the releases (or "outputs") are generally distributed in this sector. For calculating this distribution, we use general "**output distribution factors**".

On Inventory Level 1, these calculations are automatic, and are based on *default* input factors and *default* output distribution factors, which are already entered in the electronic calculation spreadsheet. So all you need to do is to enter the amount of material used or produced in each sector, as carefully described in the individual steps of this Guideline.

The generalised formula used in the calculations is:

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[4] For some source categories, other types of activity rates are used; see specific advice in the Steps in this guideline.

Estimated mercury release to pathway Y	= activity rate x input factor x output distribution factor for pathway Y

It is not crucial at this step to understand the above mentioned principles fully. Should you however desire a deeper understanding of the principles for the inventory calculations, read sections 3.1 and 4.1.1 in the Toolkit Reference Report, where several calculation examples are also shown.

The background for all default input factors and output distribution factors is also described in detail in the Toolkit Reference Report, in section 5. Appendix 1 to this guideline provides background information on how the default factors were implemented in Inventory Level 1.

Simplifications and limitations in the design of Inventory Level 1
Mercury concentrations in raw materials, fuels or products used vary depending on their type and origin and this naturally affects the amount of mercury being released. Production set-ups and pollution reduction equipment configurations may also influence the distribution of mercury releases among the release output pathways (air, water, land, waste, etc.). These factors are incorporated in the Toolkit. Simplification and standardisation of the inventory development was a priority in the Toolkit Inventory Level 1. The Inventory Level 1 is aimed at assisting developing countries and countries with economies in transition so the default factors need to reflect the input and release scenarios predominant in these countries. In Inventory Level 1, the Toolkit spreadsheet uses medium input and release factors (here called output distribution factors) for the calculation of the mercury inputs and releases, and presents the results as "standard estimates" with no uncertainty interval[5].These calculated "standard estimates" are simplified results of inputs and releases and may as such be above or below the actual inputs and releases in your country. These simplified results aim at providing a useful first insight into your country's situation on mercury inputs and releases. Generally, it may be useful to produce refined inventories at later stages, as the work with national management of mercury develops further.

Specifically, it is recommended to develop more detailed and refined inventories for targeted sectors or activities prior to launching any far reaching regulation or management procedures for these sectors or activities, preferably in cooperation with the relevant stakeholders.

For users who wish to reflect mercury management improvements in their inventory, which are not reflected on Inventory Level 1, the Toolkit Reference Report provides more detailed descriptions of the source categories, and release estimate calculations can be made in more detail in the Inventory Level 2 spreadsheet pages.

It should be noted that for some mercury source categories, the data available for developing the default factors have been very scarce, and some default factors are therefore associated with substantial uncertainty. In some cases where detailed mass balances have not been available, default output distribution factors were developed pre-

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[5] The Toolkit Reference Report provides additional documentation for default factors used in the calculation of the mercury inputs and releases.

liminarily based in expert assessment. In these cases the output distribution default factors are considered "signal values", which indicate a probable release distribution. As mentioned, the available data background for the default factors can be seen in the Toolkit Reference Report.

Each source-category section ("Step") in this guideline describes the limitations of Inventory Level 1 and lists the main factors which may influence the actual inputs and releases, including cases of more technically advanced source configurations, and cases with particularly uncertain default factors, including "signal values".

Users are invited to estimate mercury inputs and releases in such cases by using Inventory Level 2 procedures, and source specific data. Guidance for including Inventory Level 2 estimations in your inventory is introduced in Section 10 "Refining your inventory".

1   Step 1: Getting started

This guideline works closely in parallel with the Toolkit spreadsheets. You simply read Section 1 (this section) and open spreadsheet page Step 1 and fill in the information requested, using the advice given in this guideline. On Inventory Level 1, only the white cells are open for entering data in the spreadsheet. The coloured cells contain complex formulas without which the calculations will not work, and they are therefore protected and no changes can be made in them on Inventory Level 1[6]. When you have established an overview of your work in Step 1, simply proceed to Step 2 of the guideline and the spreadsheet to proceed with the inventory work.

1.1   Data collection

Data collection may take time, and once specific data are requested from data owners it may take time before responses are received. Therefore, it is recommended to start data collection early for all inventory steps, and not wait for data for one step before proceeding to the next inventory step. This also allows for coordination of data collection in cases where several data types are requested from the same sources of information (such as for example the national statistics bureau, or similar). The step by step procedure however makes it more simple to keep an overview of the data needed, and the data can be filled into the spreadsheet as they become available, which also provides an overview of current status of the inventory work at any time.

We recommend that while collecting data, you keep notes describing your contacts and the information they gave, for later reference in your work and for your reporting. Description of your data sources and the data they provided are a part of your reporting. See also reporting advice in Section 9.

As the inventory should aim at describing the mercury situation in (or around) a given year, try to get data for that same year from the different data sources. If some data types are not available for that year, data from other adjacent years can be used, or averages over several adjacent years, if this describes the situation better. Note the data year(s) for all data used, in your inventory report.

Data units are important
It is of paramount importance that you enter your activity rate data (production, consumption or use, as stated in spreadsheet) with the exact unit stated in the spreadsheet at the appropriate cell for each mercury source sub-category. Otherwise the spreadsheet will produce incorrect results.

This guideline gives some advice on units' conversion for some mercury source categories. For some mercury source categories, a simple conversion tool has been included as a separate sheet in the Inventory Level 1 calculation spreadsheet file. The Toolkit Reference Report also gives advice in some case in the relevant source sub-category description in section 5. Otherwise conversion of data have to be sought on the Internet or by help from relevant resource persons from universities, agencies, or similar.

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[6] If needed by advanced MS Excel users for corrections, the protected cells can be opened by entering the password "password" when prompted in the Windows dialogue.

1.2   Using the spreadsheet

Using the Toolkit calculation spreadsheet requires basic experience with using the spreadsheet programme MS Excel. On Inventory Level 1, procedures are however relatively simple, so please do not make limited Excel experience stop you in trying out the spreadsheet. MS Excel (of MS Office 2003 or newer) must be installed on your computer before the spreadsheet file can be opened. For instructions in the use of MS Excel use the Help functions of the programme or other user manuals.

The spreadsheet will use <u>the decimal point or decimal comma</u> according to your personal computer set-up (country selection). In this guideline and in the Toolkit Reference Report, decimal point is used. Make your choice of decimal separator in your inventory report, and assure consistency between text and data tables on this aspect.

We recommend saving your inventory spreadsheet file regularly throughout the working day to make sure new changes and additions are not lost.

As mentioned, the spreadsheet will not work correctly, if you enter data with another unit that stated in the spreadsheet at the appropriate cell for each mercury source sub-category.

1.3   Understanding the calculated results

Try opening the Inventory Level 1 calculation spreadsheet and open the page entitled "Step 2 Energy" by clicking on the page label with this title at the bottom of the screen window. You will first see a page as shown in Figure 1.

When you have entered "Y" to show that the source category in question is present in your country, and you have entered an input amount, say the annual consumption/use of diesel, gasoil, etc., the spreadsheet will automatically calculate the result types shown in the spreadsheet page. Remember, data can only be entered in the white cells.

As long as you have not entered Y, N or ? in column below "Source present? Y/N/?", the results columns say **"present ?"** to remind you to enter your indication of the presence of the source in the country. Once you have entered Y for "yes", and an amount in the "Annual consumption/production" column, the results appear in the results columns. As you may have noted in Figure 1, we have entered Y and a fictive amount of diesel oil (etc.) used annually, producing the fictive mercury release results shown to the right. Also shown, entering an N for no, gives the result "-", indicating that the mercury source is not present. Entering "?" gives "?" in the results cells to indicate that this knowledge is not yet established.

Figure 1-1   *Example of an inventory spreadsheet page (Step 2 Energy).*

Source category / Energy consumption	Source present? Y/N/?	Annual consumption /production	Unit	Estimated Hg input, Kg Hg/y Standard estimate	Estimated Hg releases, standard estimates, Kg Hg/y Air	Water	Land	Impurity in products	General waste	Sector specific waste treatment /disposal	Cat. no.
Coal combustion in large power plants			t coal combusted/y	Present ?	Present ?	Present ?	Present ?	Present ?	Present ?	Present ?	5.1.1
Other coal uses			t coal used/y	Present ?	Present ?	Present ?	Present ?	Present ?	Present ?	Present ?	5.1.2
Combustion/use of petroleum coke and heavy oil			t oil product combusted/y	Present ?	Present ?	Present ?	Present ?	Present ?	Present ?	Present ?	5.1.3
Combustion/use of diesel, gasoil, petroleum, kerosene	Y	10.000.000	t oil product combusted/y	55	55,0	0,0	0,0	0,0	0,0	0,0	5.1.3
Biomass fired power and heat production			t biomass combusted/y (dry weight)	Present ?	Present ?	Present ?	Present ?	Present ?	Present ?	Present ?	5.1.6
Charcoal combustion			t charcoal combusted/y	Present ?	Present ?	Present ?	Present ?	Present ?	Present ?	Present ?	5.1.6
Fuel production											
Oil extraction	N		t crude oil produced/y	-	-	-	-	-	-	-	5.1.3
Oil refining	?		t oil refined/y	?	?	?	?	?	?	?	5.1.3
Extraction and processing of natural gas			Nm3 gas/y	Present ?	Present ?	Present ?	Present ?	Present ?	Present ?	Present ?	5.1.4

The result types for the different mercury releases and outputs are described in the table below for a better understanding. The same description is given in the inventory report template to save you from providing these descriptions to your readers.

Table 1-1   *Explanation to the types of results generated*

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

Calculation result type	Description
	example releases from: • Solid residues from flue gas cleaning on coal fired power plants used for gravel road construction; • Uncollected waste products dumped or buried informally; • Local un-confined releases from industry such as on site hazardous waste storage/burial; • Spreading of sewage sludge with mercury content on agricultural land (sludge used as fertilizer); • Application on land, seeds or seedlings of pesticides with mercury compounds.
By-products and impurities	By-products that contain mercury, which are sent back into the market and cannot be directly allocated to environmental releases, for example: • Gypsum wallboard produced from solid residues from flue gas cleaning on coal fired power plants; • Sulphuric acid produced from desulphurization of flue gas (flue gas cleaning) in non-ferrous metal plants with mercury trace concentrations; • Chlorine and sodium hydroxide produced with mercury-based chlor-alkali technology; with mercury trace concentrations; • Metal mercury or calomel as by-product from non-ferrous metal mining (high mercury concentrations).
General waste	General waste: Also called municipal waste in some countries. Typically household and institution waste where the waste undergoes a general treatment, such as incineration, landfilling or informal dumping. The mercury sources to waste are consumer products with intentional mercury content (batteries, thermometers, fluorescent tubes, etc.) as well as high volume waste like printed paper, plastic, etc., with small trace concentrations of mercury.
Sector specific waste treatment /disposal	Waste from industry and consumers which is collected and treated in separate systems, and in some cases recycled; for example. • Confined deposition of solid residues from flue gas cleaning on coal fired power plants on dedicated sites; • Hazardous industrial waste with high mercury content which is deposited in dedicated, safe sites; • Hazardous consumer waste with mercury content, mainly separately collected and safely treated batteries, thermometers, mercury switches, lost teeth with amalgam fillings etc; • Confined deposition of tailings and high volume rock/waste from extraction of non-ferrous metals.

The "Cat. no."(the category number) shows the section number in the Toolkit Reference Report, where more detailed information on the source sub-category is given.

1.4 Enter country data and contact details

Open the spreadsheet page entitled "Step 1 - Country data" by clicking on the page label with this title at the bottom of the screen window.

The first data you need to enter in step 1 of the Inventory Level 1 procedure are the general descriptive data listed in table 1-2 for your country, as well as the listed contact data types for your institution(s) responsible for inventory development.

Table 1-2   Data collection

Data types needed	Possible data sources and remarks
General population data Population Year and reference for population data	This number is needed for several of the calculations to function. For most countries, recent population data can be found by simply selecting your country from the drop-down list (see below). Otherwise, these data are available for most (or all) countries and areas in several international statistics available via the Internet, for example at the United Nations Statistics Divisions homepage at http://unstats.un.org/unsd/demographic/products/dyb/dyb2.htm
GDP (Gross Domestic product) Year and reference for GDP data	National Gross Domestic Product (GDP); a measure for the total national economic activity) can generally be found in national statistics. Otherwise, these data are available for most (or all) countries in several international statistics available via the Internet, for example the United Nations Statistics Divisions homepage at http://unstats.un.org/unsd/economic_main.htm
Main sectors in the economy of country (list)	Consult national country profiles, either from national sources or from international statistics available on the Internet.
Contact point responsible for inventory	Fill in relevant contact data.
Full name of institution	_
Contact person	_
E-mail address	_
Telephone number	_
Fax number	_
Website of institution	_

Estimates of mercury inputs and releases for some product types are, due to the complexity, calculated based on population number and electrification rate in the country in question. For dental amalgam, they are calculated from population and density of dental personnel. This is done based on authoritative data sources as described further in the Toolkit Reference Report sections of the relevant mercury uses.

To activate these calculations, you need to select your country in the part of Step 1 spreadsheet page shown below[7].

In case you make a mercury inventory for a country or area NOT specified in the list, select "other OECD country" or "other non-OECD country" as relevant, and enter the population number for the inventory area manually in cell B4.

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[7] If you do not select your country, the mercury use pattern will be considered similar to those developed countries where the default calculation factors were derived from. You should always enter your population number.

Figure 1-2   Selection of country in the spreadsheet's Step 1.

BACKGROUND DATA FOR DEFAULT CALCULATIONS FOR DENTAL AMALGAM AND CERTAIN PRODUCT TYPES			
Compulsory: Click cell below and select country from list	Population in 2010 (or as recent as available data allow; UNSD, 2012)	Dental personnel per 1000 inhabitants	Electrification rate, % of population with access to electricity
1-Click here to select country	0	0,000	0

2   Step 2: Energy fuels, consumption and production

Open the spreadsheet page entitled "Step 2 - Energy" by clicking on the page label with this title at the bottom of the screen window.

2.1   Mercury release sources

This inventory step covers the use of fossil fuels and plant matter (biomass) for production of electricity and heat. Fossil fuels and biomass naturally contain trace concentrations of mercury, and this mercury is released when the fuel is burned. Most of this mercury is released to the atmosphere, but some is captured by flue gas cleaning systems and ends up in residues from this system. Mercury concentrations in fuel vary depending on the fuel source and the fuel type. Large coal fired power plants are generally equipped with air pollution reduction equipment which retain parts of the mercury from flue gasses and transfer them to solid or wet residues. This is generally not the case for other coal uses. During extraction, refining and treatment of oil and natural gas, some of the mercury in the fuel may be released to the environment. Due to the enormous amounts of coal combusted annually, coal fired power plants is the single largest emitter globally of mercury to the atmosphere.

The source sub-categories included in this inventory step are shown in the table below along with category references to the relevant Toolkit Reference Report sections, in case you wish to read more about the source sub-categories.

Table 2-1   Source sub-categories covered, with reference to the Toolkit Reference Report sections.

Fuel consumption	Category reference
Coal combustion in large power plants (typically with thermal boiler effect above 300 MW)	5.1.1
Other coal uses (sum for all other uses)	5.1.2
Combustion/use of petroleum coke and heavy oil	5.1.3
Combustion/use of diesel, gasoil, petroleum, kerosene	5.1.3
Combustion/use of natural gas	5.1.4
Biomass fired power and heat production (wood, etc.)	5.1.6
Charcoal combustion	5.1.6
Fuel production	
Oil extraction	5.1.3
Oil refining	5.1.3
Extraction and processing of natural gas	5.1.4

Are these source types present in your country?
Start your inventory for these source types by investigating preliminarily if these source types are present in your country. Start with the background knowledge of yourself and your colleagues, and supplement as needed by contacting relevant ministries, agencies and resource persons in your country. This will also help you to identify the right contacts for later work on the inventory. Remember to ask all, if they

know of other contact persons who might have relevance for your inventory for these sectors.

Report your findings in the inventory spreadsheet by filling in column B with "Y" for source types present in your country, "N" for source types which you have proven are not present in the country, and "?" for source types for which you have no indications of their presence or absence. Be confident with entering your immediate findings first and adjust later as you get more information. We recommend that you continue to search for data for any source types you are not sure are present in your country, until you have confirmation of its presence or absence. Source types with cells in this column left blank will be indicated in the spreadsheet summaries.

2.2   Data collection

The data types you need for mercury input and release estimation and hints on where to seek them are given in the table below.

Table 2-2   Data collection

Source sub-category	Input data types and units	Possible data sources
Energy consumption		
Coal combustion in large power plants	Coal combusted, t/y	For many countries, fuel consumption and production data are provided on the International Energy Agency's statistics website at http://www.iea.org/stats/. Study the many tables carefully to find the right numbers, make sure they have the right units, and add up contributing numbers carefully. For guidance on which IEA numbers to use, see Appendix 3 to this guideline. Otherwise, contact your ministry of energy (or other ministry responsible for energy planning), or your national statistics bureau for these data. In some cases, it may be useful contacting individual power plants, etc. If possible, get advice for selecting the data from resource persons with knowledge of energy and fuels. If you need to convert energy units, EIA's unit converter may be useful (many other converters exist on the Internet also): http://www.iea.org/stats/unit.asp .
Other coal uses	Coal used, t/y	
Combustion/use of petroleum coke and heavy oil	Oil product combusted, t/y	
Combustion/use of diesel, gasoil, petroleum, kerosene	Oil product combusted, t/y	
Use of pipeline natural gas (consumer quality)	Gas used, Nm³/y	See advice above. Natural gas production data may be given as TJ (Terajoule), which can be converted to the unit needed in the Toolkit, Nm3 (normal cubic meters), by multiplying the TJ number with 25600 Nm3/TJ (an average gross calorific value of natural gas derived from http://www.iea.org/stats/docs/statistics_manual.pdf, p182) if no specific conversion values are available. If no details are available on the quality of the gas, consider it cleaned pipeline quality.
Use of raw or pre-cleaned natural gas	Gas used, Nm³/y	See advice above. If no details are available on the quality of the gas used, consider it cleaned pipeline quality.
Biomass fired power and heat production (wood, etc.)	Biomass combusted, t (dry weight)/y	See advice above. Your ministry responsible for forestry will likely have estimates of the annual consumption of

Source sub-category	Input data types and units	Possible data sources
Charcoal combustion	Charcoal combusted, t (dry weight)/y	wood and charcoal for combustion purposes. Otherwise consult the FAO Yearbooks of Forest Products (entry: Wood Fuel, Including Wood for Charcoal) at http://www.fao.org/forestry/statistics/80570/en/). Make sure you do not count the wood used for domestic production of charcoal twice. This means that under "Biomass fired power and heat production" you should ideally subtract the wood amounts used for charcoal production. If you have data for wood consumption for combustion and charcoal, and you do not import charcoal, you can enter the whole amount under "Biomass fired power and heat production ". If you import all your charcoal, you simply enter the consumption under "Charcoal combustion", and you need not worry about double-counting.
Fuel production		
Oil extraction	Crude oil produced, t/y	See advice above.
Oil refining	Crude oil refined, t/y	See advice above; refined crude oil amounts may be reported as "petroleum refineries" and "crude oil" usage.
Extraction and processing of natural gas	Gas produced, Nm³/y	See advice above.

In countries which do not have aggregated national fuel statistics, remember to include data from all sectors where fuel consumption is taking place, for example power stations, industry, transport, households, etc.

2.3   Key factors influencing mercury releases

On Inventory Level 1, the Toolkit spreadsheet uses medium input and output distribution factors for the calculation of the mercury inputs to a sector and releases to the environment from the same sector (see the introduction for more description). Actual inputs and releases in your country may be above or below the calculated standard estimates. The most important factors which can influence mercury inputs and mercury releases are the following:

- The mercury concentrations in the fuels used in your country (coal, oil, gas, biomass). Concentrations may vary considerably; see examples in the Toolkit Reference Report in the sections noted in the source sub-category table above. Representative national data for this input must be obtained from power plants, oil and gas companies, etc.

- In Inventory Level 1, the calculations are based on a general mix of coal types relevant for developing countries (see Appendix 1). Should you wish to make the calculations based on the specific coal mix used in your country, this can be done using the Inventory Level 2 calculation spreadsheet for this sector using local, documented factors or with default factors by coal type.

- The presence of advanced air pollution reduction systems on combustion facilities, which may retain in residues (wastes) some of the mercury otherwise emitted to the atmosphere. This may be the case for newer large power plants with flue gas desulphurisation and high efficiency particle filters (baghouses or other), but is generally not the case for other coal, oil, gas or biomass uses. For data on these issues, contact the power plants individually. On Inventory Level 1, large power plants are considered as with basic particle filters only, whereas other combustion sources are considered as with no flue gas release reduction devices.

- For oil and gas extraction, two mercury inputs may be present: Mercury naturally present in trace concentrations in the oil and gas, and in drilling fluids as a result of the mercury-containing mineral Barite which is commonly used.. On Inventory Level 1, only the trace concentrations in fuel are included in the inventory.

- Natural gas may be processed with or without dedicated mercury removal (retention) systems. On Inventory Level 1, default output distribution factors for extraction are estimated by assuming that 50% of the gas is processed without mercury removal and 50% with mercury removal.

Before initiating work on additional data collection for inventory refinement, we recommend reading relevant source description sections in the Toolkit Reference Report (see Table 2-1). If you can get representative national data from relevant source types on this issue, you can refine your inventory to Inventory Level 2 as described in Section 10. Details on default input and output distribution factors used on Inventory Level 1 which are differing from Inventory Level 2, are provided in Appendix 1; these details are useful for reference when refining your inventory on Inventory Level 2.

3   Step 3: Domestic production of metals and raw materials

Open the spreadsheet page entitled "Step3 - Metals-RawMat" by clicking on the page label with this title at the bottom of the screen window.

3.1   Mercury release sources

This step covers three groups of activities: 1) Industrial mining and primary processing of metals where the mercury source is trace concentrations in the ore material - also in ore for extraction of other metals than mercury; 2) small scale gold mining with mercury amalgamation, where mercury is added to extract the gold; and 3) industrial production of the large volume materials cement and paper.

The source sub-categories included in this inventory step are shown in the table below along with category references to the relevant Toolkit Reference Report sections, in case you wish to read more about the source sub-categories than described below.

Table 3-1   Source sub-categories covered, with reference to the Toolkit Reference Report sections.

Primary metal production (industrial)	Category reference
Mercury (primary) extraction and initial processing	5.2.1
Production of zinc from concentrates	5.2.3
Production of copper from concentrates	5.2.4
Production of lead from concentrates	5.2.5
Gold extraction by methods other than mercury amalgamation	5.2.6
Alumina production from bauxit (aluminium production)	5.2.7
Primary ferrous metal production (pig iron production)	5.2.9
Gold mining with mercury amalgamation	
Gold extraction with mercury amalgamation - without use of retorts	5.2.2
Gold extraction with mercury amalgamation - with use of retorts	5.2.2
Other high volume materials production with mercury releases	
Cement production	5.3.1
Pulp and paper production	5.3.2

Modern metal extraction
Not only primary mercury extraction, but also extraction and processing of other non-ferrous and ferrous metals may be potent sources of mercury releases. Non-ferrous metal extraction ranks as the third largest emitter of mercury to the atmosphere globally. Ore for extraction of zinc, lead, copper and other metals (mainly sulphide ore) contain trace amounts of mercury. In the process of extracting the desired metal from the ore, processes are used which release this mercury from the rock material. This mercury may evaporate and follow the gaseous streams in the extraction processes (in most cases) and/or follow wet (liquid) process streams, depending on the extraction technology used. Unless the mercury is captured by process steps dedicated to this purpose, major parts of it are likely released to the atmosphere, land and aquatic environments. Mercury retained in process steps for this purpose may be sold in the form

of metallic mercury or the inorganic mercury compound "calomel" (Hg2Cl2), for conversion to metal mercury elsewhere, or it may be stored or deposited as solid or sludgy residues, normally on-site. Marketing of recovered by-product mercury from extraction of non-ferrous metals accounts for a substantial part of the current global mercury supply. Besides these output pathways, part of the mercury input follows co-produced sulphuric acid at trace concentrations. Primary production of non-ferrous metals generally includes the following processes: Concentration of the ore to include only metal-rich particles (produced "concentrate"), oxidation (roasting, sintering or wet oxidation) of concentrate, production of the metal (by means of electrochemical or thermal processes), and refining of the metal. Several non-ferrous metals may be co-produced in the same facilities.

Artisanal and small scale gold mining (ASGM) with mercury amalgamation
Artisanal and small scale gold (and sometimes silver) mining with mercury amalgamation gives rise to substantial mercury releases on a global scale. Here, liquid metal mercury is added intentionally because it can dissolve gold present in the ore or concentrate, and the mix ("amalgam") can hereafter be separated from the rock material (called "tailings"), and the mercury can finally be heated off to produce the gold. Today, this ancient method is mainly used by "artisanal" and small-scale miners. When only the concentrate is amalgamated, the mercury consumption and releases are somewhat lower compared to whole ore amalgamation. In some cases so-called retorts are used to recover some of the mercury from the heating process for re-use. This reduces the mercury consumption and releases further. The Toolkit makes a distinction between gold produced with or without retorts.

Other high-volume materials production with mercury releases
This inventory step also includes the mercury release sub-categories cement production and pulp and paper production.

The raw materials used for the production of cement contains trace concentrations of mercury. The origin of this mercury is mercury naturally present in virgin raw materials and fossil fuels used (lime, coal, oil etc.) and other raw materials and alternative fuels, in which mercury content may be elevated compared to virgin materials, such as solid residues from other sectors; e.g. fly-ashes and gypsum from combustion of coal, and combustible wastes. In some cases, hazardous waste is incinerated (for destruction) in cement kilns and this may also contribute to mercury inputs. The use of waste products as feed materials may increase the total input of mercury to the cement production. The primary output pathways of mercury fed in with raw materials are released to the atmosphere, and through trace mercury levels in the produced cement. Mercury contributions from fossil fuels are deducted in the calculations here, because they are accounted for under the fossil fuel sub-categories.

The original mercury sources in pulp and paper production is the mercury present in trace concentrations in wood, as well as trace concentrations in fuels and chemicals (NaOH, H_2SO_4, Cl_2) used.

Are these source types present in your country?
Start your inventory for these source types by investigating preliminarily, if these source types are present in your country. Start with the background knowledge of yourself and your colleagues, and supplement as needed by contacting relevant minis-

tries, agencies and resource persons in your country. This will also help you identifying the right contacts for later work on the inventory. Remember to ask all, if they know of other contact persons who might have relevance for your inventory for these sectors.

Report your findings in the inventory spreadsheet by filling in column B with "Y" for source types present in your country, "N" for source types which you have proven are not present in the country, and "?" for source types for which you have no indications of their presence or absence. Be confident with entering your immediate findings first and adjust later as you get more information. We recommend that you continue to search for data for source types you are not sure are present in your country, until you have confirmation of its presence or absence. Source types with cells in this column left blank will be indicated in the spreadsheet summaries.

3.2 Data collection

The data types you need for mercury input and release estimation and hints on where to seek them are given in the table below.

Table 3-2   Data collection

Source sub-category	Input data types and units	Possible data sources
Primary metal production (industrial)		
Mercury (primary) extraction and initial processing	Mercury produced, t/y	Primary mercury mines are only operating in a few countries today. For data, contact the mining company or the ministry responsible for mining activities (ministry of mining, industry, natural resources, or other), or resource persons in universities, institutes
Production of zinc from concentrates	Concentrate used, t/y	For data, contact the mining company or the ministry responsible for mining activities (ministry of mining, industry, natural resources, or other), or resource persons in universities, institutes. As a beginning, or if you have no other data U.S Geological Survey publishes annual mineral yearbooks with information on minerals production for many countries at http://minerals.usgs.gov/minerals/pubs/country/index.html#pubs. In cases of co-production of zinc, copper and/or lead from the same concentrate, enter the amount of concentrate used annually in the spreadsheet under the metal produced in largest quantities and make a note on this in the inventory report. If different concentrates are used for different metals, enter annual data for each concentrate input. In case you cannot get data for amounts of concentrates used, but you have access to data for total production of raw zinc in the country, you can use the unit conversion sheet now featured in the Inventory Level 1 spreadsheet.
Production of copper from concentrates	Concentrate used, t/y	See advice above

Source sub-category	Input data types and units	Possible data sources
Production of lead from concentrates	Concentrate used, t/y	See advice above; also on data conversion.
Gold extraction by methods other than mercury amalgamation	Gold ore used, t/y	See advice above; also on data conversion.
Alumina production from bauxit (aluminium production)	Bauxit processed, t/y	For data, contact the mining company or the ministry responsible for mining activities (ministry of mining, industry, natural resources, or other), or resource persons in universities, institutes. The data conversion mentioned above is also available for raw aluminium production. See also advice for zinc above.
Primary ferrous metal production (pig iron production)	Pig iron produced, t/y	Production of pig iron (raw iron) may be found in national production statistics held at the ministry of industry or in the national statistics bureau; otherwise contact companies. Only pig iron production is deemed relevant for the mercury inventory in this Inventory Level 1. See also advice for zinc above.
Gold mining with mercury amalgamation		
Gold extraction with mercury amalgamation - without use of retort	Gold produced, kg/y	Production of gold may be found in national production statistics held at the ministry responsible for mining or in the national statistics bureau. If you have both large scale industrial and small scale gold mining in your country, you need to contact resource persons in ministries, universities or gold trading companies to make a (rough) estimate of the share of the national gold production from artisanal and small scale miners using the amalgamation method. Ask larger gold mining companies, if they also use mercury amalgamation. Studying statistics on import of mercury metal may give you a hint if large mercury amounts used in gold mining with amalgamation are imported (for example, if they are much larger than dental mercury use calculated in this Toolkit).

Ask gold mining resource persons if small scale miners generally use retorts (vapour hoods with mercury condensation), or not. Note that in 2012, these are not used widely, so a general use will be rare or a new development. If both of these techniques (retorts/no retorts) are used in parallel in the country, form a rough estimate of the share of gold used with each technique, or simply assume that all gold is produced with no retort. Report your data and assumptions clearly in your inventory report. |
Gold extraction with mercury amalgamation - with use of retorts	Gold produced, kg/y	
Other high volume materials production with mercury releases		
Cement production	Cement produced, t/y	Production data may be available in national production statistics, consult the national statistics department or the ministry of industry. Otherwise, contact the company or resource persons in universities, institutes. See also advice for zinc above.
Pulp and paper production (with own pulp production)	Biomass used for production, t/y	Contact the companies for information on their biomass consumption (principally wood).

New help for data collection

Note that, as a new feature of the Toolkit, templates for data collection letters for mining industry and cement/paper and pulp industry are available at UNEP's mercury Toolkit homepage
http://www.unep.org/hazardoussubstances/Mercury/MercuryPublications/GuidanceTrainingMaterialToolkits/MercuryToolkit/tabid/4566/language/en-US/Default.aspx.

3.3   Key factors influencing mercury releases

On Inventory Level 1, the Toolkit spreadsheet uses medium input and output distribution factors for the calculation of the mercury inputs to a sector and releases to the environment from the same sector (see the introduction for more description). Actual inputs and releases in your country may be above or below the calculated standard estimates. The most important factors which can influence mercury inputs and mercury releases are the following:

Industrial mining

- The mercury concentrations in the ores and concentrates actually used in your country. Concentrations may vary considerably; see examples in the Toolkit Reference Report in the sections noted in the source sub-category table above. For more detailed input data, contact the mining companies.

- The presence of technically advanced release reduction devices on smelter facilities, which may retain in filter residues (wastes) some of the mercury otherwise emitted to the atmosphere. Metal mercury is sometimes recovered from filter residues and sold on the market. The use of wet extraction processes instead of pyrometallic (heating) processes may have much lower air emissions, yet more of the mercury follows wastes, sludges and waste water discharges. For more detailed input data contact the mining companies.

Artisanal and small scale mining

- Mercury releases from small scale gold mining may vary significantly depending on local conditions and processing techniques. Refining the estimates may require substantial field research work, for advice see the relevant Toolkit Reference Report section (see section number in table 4.1). On Inventory Level 1, it is assumed for amalgamation without retorts that 50% of the gold is produced from amalgamated of whole ore, and the rest from amalgamation of concentrate only (using less mercury). Retorts are assumed used on concentrates only.

  If you cannot find data on gold production, estimates for mercury consumption for gold mining are available for many countries at www.mercurywatch.org. These data can be used in your mercury release quantification on Inventory Level 2.

Cement production

- If waste or chemical waste is combusted/used as fuel in cement kilns, the amount and type of waste may have significant influence on the mercury releases. Dust filters may be used, but generally they do not retain much mercury as the collected dust is often fed back into the process, and mercury, being on gas form at

these temperatures, may not be held back effectively. Contact the companies for a dialogue on mercury releases. On Inventory Level 1 half (50%) of the cement produced is assumed produced with co-incineration of waste and the remaining with no co-incineration of waste. In Inventory Level 1 basic particle filters are assumed used. Mercury contributions from fossil fuels are deducted in the calculations here, because they are accounted for under the fossil fuel sub-categories.

Before initiating work on additional data collection for inventory refinement, we recommend reading relevant source description sections in the Toolkit Reference Report (see Table 3-1). If you can get specific data on these issues, you can refine your inventory to Inventory Level 2 as described in Section 10. Details on default input and output distribution factors used on Inventory Level 1, which are differing from Inventory Level 2, are provided in Appendix 1; these details are useful for reference when refining your inventory on Inventory Level 2.

4   Step 4: Domestic production and processing with intentional mercury use

Open the spreadsheet page entitled "Step 4 - Industrial Hg use" by clicking on the page label with this title at the bottom of the screen window ("Hg" is the chemical designation for mercury).

4.1   Mercury release sources

This step covers two groups of activities: 1) Industrial production of chemicals, and 2) industrial production of mercury added products.

The source sub-categories included in this inventory step are shown in the table below along with category references to the relevant Toolkit Reference Report sections, in case you wish to read more about the source sub-categories than described below.

Table 4-1   Source sub-categories covered, with reference to the Toolkit Reference Report sections.

Production of chemicals and polymers	Category reference
Chlor-alkali production with mercury-cells	5.4.1
Vinyl chloride monomer (VCM) production with mercury catalyst	5.4.2
Acetaldehyde production with mercury catalyst	5.4.3
Production of products with mercury content	
Hg thermometers (medical, air, lab, industrial etc.)	5.5.1
Electrical switches and relays with mercury	5.5.2
Light sources with mercury (fluorescent, compact, others)	5.5.3
Batteries with mercury	5.5.4
Manometers and gauges with mercury	5.6.2
Biocides and pesticides with mercury	5.5.5
Paints with mercury	5.5.6
Skin lightening creams and soaps with mercury chemicals	5.5.7

Production of chemicals

Much of the chlorine (Cl_2 gas), caustic soda (NaOH) and potassium hydroxide (KOH) sold today is still produced in chlor-alkali production plants using mercury in an electrolytic process sometimes called the "mercury-cell" process. These large volume base chemicals are however also produced with other techniques (membrane process and diaphragm process), where mercury is not used. The share of national production capacity based on the mercury-cell process varies between countries, and is slowly decreasing seen in a global perspective. In many countries it has been agreed not to base new chlor-alkali facilities on the mercury-cell process, and in some countries/regions conversion/shut-down of mercury-cell facilities are planned or ongoing. Mercury is released to the environment with air emissions, water releases, in solid wastes, in production equipment and production buildings and to a minor degree in products (such as NaOH).

VCM production with mercury compound catalysts is widespread in a few countries.

Acetaldehyde production with mercury compound catalysts is not common anymore, but may take place in a few countries.

Production of products with mercury added
A large number of traditional products make use of mercury's characteristics in their function. The major products groups in which mercury is added intentionally are thermometers, fluorescent light bulbs, some battery types, some traditional types of electrical switches, and traditional manometers and pressure gauges. The consumption of these products is declining in many countries because of mercury's adverse effects on health and environment, and because electronic equipment for the same purposes but with smart features has gained increasing shares of the market. Many glass thermometers are produced with alcohol liquid instead of mercury. A decline in consumption is not seen in all regions of the world, as the mercury added products are still cheaper, when waste and health expenses are not included. Mercury containing light sources (fluorescent and other discharge lamp types) is an exception, as their sales are rising due to their lower energy demand and the lack of sufficiently matured mercury-free low-energy alternatives. In some countries mercury containing latex paints (where mercury is a preservative), biocides/pesticides and skin lightening creams and soaps are also manufactured and used. Based on previous experience in USA and Europe, these mercury applications may give rise to substantial mercury consumption and releases.

The manufacture of mercury added products may give rise to mercury releases to air, waste water and production wastes. Publicly available mercury release data on such manufacture are scarce, and the estimation calculations here are based on a limited data base.

Are these source types present in your country?
Start your inventory for these source types by investigating preliminarily, if these source types are present in your country. Start with the background knowledge of yourself and your colleagues, and supplement as needed by contacting relevant ministries, agencies and resource persons in your country. This will also help you identifying the right contacts for later work on the inventory. Remember to ask all, if they know of other contact persons who might have relevance for your inventory for these sectors.

Report your findings in the inventory spreadsheet by filling in column B with "Y" for source types present in your country, "N" for source types which you have proven are not present in the country, and "?" for source types for which you have no indications of their presence or absence. Be confident with entering your immediate findings first and adjust later as you get more information. We recommend that you continue to search for data for source types you are not sure are present in your country, until you have confirmation of its presence or absence. Source types with cells in this column left blank will be indicated in the spreadsheet summaries.

4.2   Data collection

The data types you need for mercury input and release estimation and hints on where to seek them are given in the table below.

Table 4-2   *Data collection*

Source sub-category	Input data types and units	Possible data sources
Production of chemicals and polymers		
Chlor-alkali production with mercury-cells	Cl_2 produced, t/y	Production of chlorine (Cl_2) may be found in national production statistics held at the ministry of industry or in the national statistics bureau; otherwise contact companies. The share of chlorine production capacity based on mercury cells compared to total production capacity in a country is often known by industry associations, companies and resource persons. Production capacity can provide a reasonable estimate of the share of production produced with mercury cells. If not available in overview, production companies must be contacted individually to obtain production numbers based on mercury cells, and if possible mercury input and release data. Note that some companies producing rubber, PVC, vitamins and other chemicals may have their own internal chlor-alkali production plants for production of feedstock which is not sold externally. In such cases, the companies must be contacted to get data on their chlorine production and if possible their mercury input and release data.
VCM production with mercury catalyst	VCM produced, t/y	Production of VCM (vinyl chloride monomer) may be found in national production statistics held at the ministry of industry or in the national statistics bureau; otherwise contact companies. It may be needed to contact the companies to establish if mercury catalysts are used, or of the VCM is produced from other processes which do not use mercury. Note that some companies producing raw PVC plastic compound have their own internal VCM production plants for production of feedstock which is not sold externally. In such cases, the companies must be contacted to get data on their VCM production and if possible their mercury input and release data.
Acetaldehyde production with mercury catalyst	Acetaldehyde produced, t/y	See advice for VCM, the situation is similar for acetaldehyde.
Production of products with mercury content		
Hg thermometers (medical, air, lab, industrial etc.)	Mercury used for production, kg/y	Contact identified companies for production data and mercury input and release data.
Electrical switches and relays with mercury	Mercury used for production, kg/y	Contact identified companies for production data and mercury input and release data.
Light sources with mercury (fluorescent, compact, others)	Mercury used for production, kg/y	Contact identified companies for production data and mercury input and release data.

Source sub-category	Input data types and units	Possible data sources
Batteries with mercury	Mercury used for production, kg/y	Contact identified companies for production data and mercury input and release data.
Manometers and gauges with mercury	Mercury used for production, kg/y	Contact identified companies for production data and mercury input and release data.
Biocides and pesticides with mercury	Mercury used for production, kg/y	Contact identified companies for production data and mercury input and release data.
Paints with mercury	Mercury used for production, kg/y	Contact identified companies for production data and mercury input and release data.
Skin lightening creams and soaps with mercury chemicals	Mercury used for production, kg/y	See advice above; in case this sector is largely informal and perhaps not reported in statistics, etc., you may try to form a rough estimate of the likely annual consumption of such creams and soaps by visiting and interviewing a representative number of shops selling this type of products. Note that only some skin-lightening creams and soaps contain mercury compounds. The estimated national sales in metric tons may be multiplied with a medium mercury content of 30 kg Hg/t skin lightening cream or soap.

4.3   Key factors influencing mercury releases

On Inventory Level 1, the Toolkit spreadsheet uses medium input and output distribution factors for the calculation of the mercury inputs to a sector and releases to the environment from the same sector (see the introduction for more description). Actual inputs and releases in your country may be above or below the calculated standard estimates. The most important factors which can influence mercury inputs and mercury releases are the following:

- The production set-up and mercury management may vary considerably between facilities. For more detailed mercury input and release data contact the production companies. On Inventory Level 1, default output distribution factors based on limited data available for thermometers and batteries have been applied for all other product manufacturing facilities.

- Note that many chlor-alkali production facilities have difficulties in accounting for the fate of all mercury purchased. This is likely because other, not quantified losses take place, including fugitive emissions to air and absorption in production equipment and building materials at the facility. Ask therefore also for data on difference to balance with purchased mercury over the last few years. On Inventory Level 1, it is assumed that mercury unaccounted for is released (Inventory Level 2 output scenario "Hg unaccounted for is presented as releases" is used).

Before initiating work on additional data collection for inventory refinement, we recommend reading relevant source description sections in the Toolkit Reference Report (see Table 4-1). If you can get specific data on these issues, you can refine your inventory to Inventory Level 2 as described in Section 10. Details on default input and output distribution factors used on Inventory Level 1 which are differing from Inventory Level 2, are provided in Appendix 1; these details are useful for reference when refining your inventory on Inventory Level 2.

5 Step 5: Waste treatment and recycling

Open the spreadsheet page entitled "Step 5 - Waste treatment + recycling" by clicking on the page label with this title at the bottom of the screen window.

5.1 Mercury release sources

This step includes all types of waste treatment, landfilling, incineration, dumping, open burning and recycling activities.

The source sub-categories included in this inventory step are shown in the table below along with category references to the relevant Toolkit Reference Report sections, in case you wish to read more about the source sub-categories than described below.

Table 5-1 Source sub-categories covered with reference to the Toolkit Reference Report sections.

Recycling of metals	Category references
Production of recycled mercury ("secondary production")	5.7.1
Production of recycled ferrous metals (iron and steel)	5.7.2
Waste incineration	
Incineration of municipal/general waste	5.8.1
Incineration of hazardous waste	5.8.2
Incineration of medical waste	5.8.3
Sewage sludge incineration	5.8.4
Open fire waste burning (on landfills and informally)	5.8.5
Waste deposition/landfilling	
Controlled landfills/deposits	5.9.1
Informal dumping of general waste	5.9.4
Waste water treatment	5.9.5

General waste management set-up in the country
First, please answer the spreadsheets initial question in Step 5 on general waste management set-up:

	Y/N	
How much of the waste is collected and treated under controlled conditions?		Answer according to your best estimate (you may revise once you have more specific data)
Is more than 2/3 (two thirds; 67%) of the general waste collected and deposited on lined landfills or incineration with pollution abatement?		

This answer is used in the automatic calculation of releases in the spreadsheet, so it is needed for the spreadsheet to work properly. Your best estimate of the situation is

sufficient initially. If, during the further data collection on waste, you get indications that the actual situation may differ from what you initially thought, please change your answers accordingly. Once you have collected national data on general waste management, you can check the answer as follows and correct the answer if necessary:

Answer yes (y) to the question, if cells*:	$(C12+C19) > 0.67*(C12+C16+C19+C20)$
Answer no (n) to the question, if cells*:	$(C12+C19) <= 0.67*(C12+C16+C19+C20)$

* The C12, C 19, etc. refers to cell names in the spreadsheet page "Step5-Waste treatment + recycling".

Are these source types present in your country?
Thereafter, start your inventory for these source types by investigating preliminarily if the mentioned waste handling types and recycling activities are present in your country. Start with the background knowledge of yourself and your colleagues and supplement as needed by contacting relevant ministries, agencies and resource persons in your country. This will also help you identifying the right contacts for later work on the inventory. Remember to ask all if they know of other contact persons who might have relevance for your inventory for these sectors.

Report your findings in the inventory spreadsheet by filling in column B with "Y" for source types present in your country, "N" for source types which you have proven are not present in the country, and "?" for source types for which you have no indications of their presence or absence. Be confident with entering your immediate findings first and adjust later as you get more information. We recommend that you continue to search for data for source types you are not sure are present in your country, until you have confirmation of its presence or absence. Source types with cells in this column left blank will be indicated in the spreadsheet summaries.

5.2   Data collection

The data types you need for mercury input and release estimation and hints on where to seek them are given in the table below.

Table 5-2   Data collection

Source sub-category	Input data types and units	Possible data sources
Production of recycled mercury ("secondary production")	Mercury produced, kg/y	This may be reflected in some national production statistics, but generally it is needed to contact the recycling companies or consult resource persons with insight in the sector.
Production of recycled ferrous metals (iron and steel)	Number of vehicles recycled/y	See advice above;
Waste incineration		
Incineration of municipal/general waste	Waste incinerated, t/y	For these data, contact the ministry responsible for waste management. Some waste data may be available from existing studies, for example from national inventories for dioxins and furans (UNEP Toolkit), or from waste management planning activities. If aggregated national data does not exist, municipalities' departments for waste management or the waste management companies may have these data.
Incineration of hazardous waste	Waste incinerated, t/y	Incineration plants dedicated for hazardous waste are few, and may be identified through the ministry responsible for waste management. If they do not have data, identify and contact the waste management facilities. Hazardous waste may be incinerated along with general waste or in cement kilns (for destruction of hazardous properties). In such cases, contact facilities for data; see also cement sub-category in Section 3.
Incineration of medical waste	Waste incinerated, t/y	Two overall principles may be applied for controlled incineration of medical waste: Large scale facilities similar to hazardous waste incineration (see above), or small low-tech incineration chambers (focusing on sanitisation of the waste only) placed at individual hospitals. In the last case, the number of incinerators may be large, and data must be collected from the hospitals. Estimates can be formed by getting waste data and bed numbers from selected hospitals and extrapolate via the total number of hospital beds in the country (or similar). Report such assumptions and calculations in your inventory report.
Sewage sludge incineration	Waste incinerated, t/y	In some countries, sewage sludge is incinerated in dedicated facilities. The number of such facilities is likely low, and the most effective may be to contact the facilities individually. The ministry (or municipal departments) responsible for waste water treatment may be helpful in identifying relevant facilities.

Source sub-category	Input data types and units	Possible data sources
Open fire waste burning (on landfills and informally)	Waste burned, t/y	Open waste burning will generally be hard to quantify precisely, but as the mercury releases directly to the environment may be substantial, it is important to try and make a rough estimate for mercury release quantification. Some waste data may be available from existing studies, for example from national inventories for dioxins and furans (UNEP Toolkit), or from waste management planning activities. Otherwise try (maybe with help from resource persons) to estimate expected waste amounts generated per person in the country and compare to quantified waste amounts landfilled or incinerated under controlled conditions, and consider remaining waste amounts dumped and burned informally. Note that open burning of waste in municipal landfills is practised in many countries. This can be hard to estimate, but attempts can be made to interview personnel on selected major landfills on the applied practices and extrapolate to the national situation. Report your assumptions and calculations.
Waste deposition/landfilling		
Controlled landfills/deposits	Waste landfilled, t/y	See incineration of municipal/general waste above.
Informal dumping of general waste	Waste dumped, t/y	See open fire waste burning above.
Waste water treatment	Waste water, m^3/y	For these data, contact the ministry responsible for waste water management. Some waste data may be available from existing studies on waste water management planning activities. If aggregated national data does not exist, municipalities' departments for waste water management may have these data. You may use data from major city facilities and extrapolate to the whole population. Report such assumptions and calculations.

5.3   Key factors influencing mercury releases

On Inventory Level 1, the Toolkit spreadsheet uses medium input and output distribution factors for the calculation of the mercury inputs to a sector and releases to the environment from the same sector (see the introduction for more description). Actual inputs and releases in your country may be above or below the calculated standard estimates. The most important factors which can influence mercury inputs and mercury releases are the following:

- Mercury concentrations in waste. This can be found in representative waste samples by sorting surveys and chemical analyses. It should be noted that it is difficult to get representative samples because waste composition generally vary so much (therefore much waste from various locations must be sampled). In the Toolkit, releases from the waste handling categories are based on examples of mercury contents in waste in other countries for which such data have been available. This may differ from actual waste in your country due to differences in the consumption pattern of mercury added products and materials with trace concentrations of mercury such as paper, plastics, and other large volume wastes. For waste and waste water, the default input factors were derived from data from

developed countries only. You can make a simple test based on your Inventory Level 1 results, that will indicate if the default factors may over-estimate the mercury releases from waste and waste water treatment in your country. See Appendix 4 for more details.

- Flue gas cleaning systems of waste incineration and metal recycling facilities. Release reduction device systems exist, which retain substantial parts of the mercury in the flue gas in filter residues (wastes) and water discharges (of wet flue gas cleaning systems). In Inventory Level 1, only particle filters retaining moderate fractions of the mercury are assumed used. Data on release reduction devices must be collected from individual facilities or from resource persons with detailed overview of the national situation.

- General waste water treatment set-up. This will affect the output distribution among the relevant environmental media. Is the water treated before discharge to the environment, and if so, is it treated mechanically only or does it include more advanced biological treatment, and how is the produced sludge managed. On Inventory Level 1, mechanical treatment with minor mercury retention in sludge is assumed, and sludge is assumed landfilled with general waste.

Before initiating work on additional data collection for inventory refinement, we recommend reading relevant source description sections in the Toolkit Reference Report (see Table 5-1). If you can get specific data on these issues, you can refine your inventory to Inventory Level 2 as described in Section 10. Details on default input and output distribution factors used on Inventory Level 1 which are differing from Inventory Level 2, are provided in Appendix 1; these details are useful for reference when refining your inventory on Inventory Level 2.

6   Step 6: General consumption of mercury in products, as metal mercury and as mercury containing substances

6.1   Mercury release sources

This step includes national consumption of a vide variety of consumer products (such as thermometers and fluorescent light bulbs), and product where mercury must be added for its function (such as dental amalgam and manometers). The included products may be produced domestically, but may also be imported, and therefore needs to be quantified separately. National annual consumption is defined as:

Consumption = production + import - export   (in the same year)

The source sub-categories included in this inventory step are shown in Table 6-1 along with category references to the relevant Toolkit Reference Report sections, in case you wish to read more about the source sub-categories than described below.

Releases from mercury added products are significant in many countries and are thus important to quantify. Generally, most of the releases from products occur in the disposal phase of the products' life-cycle. Many of these products are used in large numbers by private consumers. They are therefore spread all over the country and may break during use, end up in waste, or simply be thrown away. Management solutions such as product marketing restrictions, separate waste collection of mercury added products and/or providing alternatives may be important to reduce these releases. As a basis for decision-making, releases from the disposal phase of mercury-added products are calculated individually in the Toolkit to indicate the relative importance of the various product categories. To avoid double counting with mercury release estimates for waste treatment, the releases from products are subtracted in the sums of total releases.

Note that for the spreadsheet calculations to work properly for several of these products, the number of inhabitants needs to be entered in Step 1, and the question on general waste management set-up in the country in Step 5 needs to be answered with "y" (for yes) or "n" as described under Step5.

For details on product types, see Table 6-2 further below.

Table 6-1   Source sub-categories covered with reference to the Toolkit Reference Report sections.

Use and disposal of products with mercury content	Category references
Dental amalgam fillings ("silver" fillings)	5.6.1
Preparations of fillings at dentist clinics	
Use - from fillings already in the mouth	
Disposal (lost and extracted teeth)	
Thermometers:	5.5.1
Medical Hg thermometers	
Other glass Hg thermometers (air, laboratory, dairy, etc.)	
Engine control Hg thermometers and other large industrial/speciality Hg thermometers	
Electrical switches and relays with mercury	5.5.2
Light sources with mercury:	5.5.3
Fluorescent tubes (double end)	
Compact fluorescent lamp (CFL single end)	
Other Hg containing light sources	
Batteries with mercury:	5.5.4
Mercury oxide (button cells and other sizes); also called mercury-zinc cells	
Other button cells (zinc-air, alkaline button cells, silver-oxide)	
Other batteries with mercury (plain cylindrical alkaline, permanganate, etc.)	
Polyurethane (PU, PUR) produced with mercury catalyst	5.5.5.
Paints with mercury preservatives	5.5.7
Skin lightening creams and soaps with mercury chemicals	5.5.9
Medical blood pressure gauges (mercury sphygmomanometers)	5.6.2
Other manometers and gauges with mercury	5.6.2
Laboratory chemicals	5.6.3
Other laboratory and medical equipment with mercury (porosimetry, pycnometry, hanging drop electrodes = polarimetry, etc.)	5.6.3, 5.6.5

Are these source types present in your country?

Start your inventory for these source types by investigating preliminarily if these source types are present in your country. Start with the background knowledge of

yourself and your colleagues, and supplement as needed by contacting relevant ministries, agencies and resource persons in your country. This will also help you identifying the right contacts for later work on the inventory. Remember to ask all, if they know of other contact persons who might have relevance for your inventory for these sectors.

Report your findings in the inventory spreadsheet by filling in column B with "Y" for source types present in your country, "N" for source types which you have proven are not present in the country, and "?" for source types for which you have no indications of their presence or absence. Be confident with entering your immediate findings first and adjust later as you get more information. We recommend that you continue to search for data for source types you are not sure are present in your country, until you have confirmation of its presence or absence. Source types with cells in this column left blank will be indicated in the spreadsheet summaries.

6.2   Data collection

The data types you need for mercury input and release estimation and hints on where to seek them are given in the table below.

Table 6-2   Data collection

Source sub-category	Input data types and units	Possible data sources
Use and disposal of products with mercury content		
Dental amalgam fillings ("silver" fillings) Preparations of fillings at dentist clinics Use - from fillings already in the mouth Disposal (lost and extracted teeth)	Number of inhabitants	No need to enter data in this step; calculations are based on population and density of dental personnel from step 1. Amalgam filling usage is in the decline in some countries, partly due to rising awareness of mercury adverse environmental effects, partly because white filling materials are considered cosmetically preferable in some countries and customer segments. Amalgam is however still generally less expensive than most alternatives, though prices of alternatives are falling, and some dentist prefer amalgam; especially for complex fillings.
Thermometers:		
Medical Hg thermometers	Items sold/y	Consumption (or data for production, import and export) of glass thermometers with mercury may be found in the national statistics bureau, or at the ministry of commerce. Make sure to use only numbers for medical glass thermometers, as also electronic fever thermometers exist. If there is no distinction in the statistics, consult producers, importers or resource persons and try to estimate a rough distribution. If these sources do not have data, identify and ask producers and importers of thermometers of their estimate for the total national consumption. Otherwise contact selected hospitals to get information on their annual purchase of medical glass thermometers and number of beds and extrapolate to national level via total number of beds in country. Add expert estimate of privately owned thermometers, for example as related to the supply to hospitals (importers of producers may have the knowledge to make an estimate). Data on import and export (but not production) may be available for your country in the UN Comtrade database available at http://comtrade.un.org/db/default.aspx (see Appendix 2).
Other glass Hg thermometers (air, laboratory, dairy, etc.)	Items sold/y	See above; this group of thermometers normally contain several times more mercury per unit (2-40 g/piece) than medical thermometers, but may be less in number supplied annually.
Engine control Hg thermometers and other large industrial/speciality Hg thermometers	Items sold/y	These are specialty thermometers which are generally sold in lower numbers than glass thermometers, but can contain up to 200 g mercury/unit. They are used for ship engine control among others. For data, contact identified producers or users (for example shipyards).
Electrical switches and relays with mercury	Number of inhabitants	No need to enter data; is based on population and electrification data from step 1.
Light sources with mercury:		
Fluorescent tubes (double end)	Items sold/y	Consumption (or data for production, import and export) of these light sources with mercury may be found in the national statistics bureau, or

Source sub-category	Input data types and units	Possible data sources
Compact fluorescent lamp (CFL single end)	Items sold/y	at the ministry of commerce. Otherwise identify and contact producers or importers and for their estimate for the total national consumption. Data on import and export (but not production) may be available for your country in the UN Comtrade database available at http://comtrade.un.org/db/default.aspx (see Appendix 2).
Other Hg containing light sources (see guideline)	Items sold/y	See above. This group contains the following other types of mercury containing light sources which generally contain higher amounts of mercury: High pressure mercury vapour lamps (road and outdoor lighting, etc.); high-pressure sodium lamps (road and outdoor lighting, etc.); UV light for sun-tanning; and metal halide lamps. You only need to insert the total consumption of all these types.
Batteries with mercury:		
Mercury oxide (button cells and other sizes); also called mercury-zinc cells	Batteries sold/y	Mainly used for certain specialised purposes; very high mercury concentrations, but sold in lower numbers; for details see Toolkit Reference Report. Consumption (or data for production, import and export) of these light sources with mercury may be found in the national statistics bureau, or at the ministry of commerce. Otherwise contact identified producers or importers and for their estimate for the total national consumption.
Other button cells (zinc-air, alkaline button cells, silver-oxide)	Batteries sold/y	For consumption data see above. Covers all other button size cells than mercury oxide button cells. Button cells generally contain mercury to reduce risk of breakage. Data on import and export (but not production) may be available for your country in the UN Comtrade database available at http://comtrade.un.org/db/default.aspx (see Appendix 2).
Other batteries with mercury (plain cylindrical alkaline, permanganate, etc., see guideline)	Batteries sold/y	For consumption data see above. These plain type batteries are sold in the largest quantities. Global brands generally do not anymore contain mercury, but some regional or national brands do contain mercury adding up to potentially large amounts due to the high numbers sold. To distinguish which parts of the national sales of these plain battery types contain mercury, you need to contact importers and producers and ask them what share of the battery supply contains mercury. Data on import and export (but not production) may be available for your country in the UN Comtrade database available at http://comtrade.un.org/db/default.aspx (see Apendix 2).
Polyurethane (PU, PUR) produced with mercury catalyst	Number of inhabitants	No need to enter data; is based on population and electrification data from step 1.
Paints with mercury preservatives	Paint sold, t/y	Contact identified paint producers and importers and ask them, which nationally marketed paint types may contain mercury (to prolong shelf life of the paint or prevent microbial growth on the painted surface), and what amounts such paint types are sold in annually.
Skin lightening creams and soaps with mercury chemicals	Cream or soap sold, t/y	Contact identified producers and importers and ask them, which nationally marketed cosmetic types may contain mercury, and what amounts such product types are sold in annually. If this is not possible, make rough estimates of potential amounts based on surveys in a number of shops and extrapolation to national conditions. Report your assumptions and calculations.
Medical blood pressure gauges (mercury sphygmomanometers)	Items sold/y	Consumption (or data for production, import and export) of medical blood pressure gauges may be found in the national statistics bureau, or at the ministry of commerce. Try to distinguish from supply of electronic blood pressure gauges. Otherwise, it may be possible to get data from importers, or from a representative number of hospitals, medical clinics and medical doctors and extrapolate to estimated national totals (via number of beds and number of doctors, respectively).

Source sub-category	Input data types and units	Possible data sources
Other manometers and gauges with mercury	Number of inhabitants	No need to enter data; is based on population and electrification data from step 1.
Laboratory chemicals	Number of inhabitants	No need to enter data; is based on population and electrification data from step 1.
Other laboratory and medical equipment with mercury	Number of inhabitants	No need to enter data; is based on population and electrification data from step 1.

Unit conversion

For medical Hg thermometers, fluorescent tubes (double end) and compact fluorescent lamp (CFL single end) you can use the new unit conversion sheet now included in the Inventory Level 1 spreadsheet to convert consumption numbers from statistics given in weight (kg/year) to the unit "items sold" needed in the mercury quantification calculations. For other product types, you need to search for data conversion factors on the Internet, or at relevant companies or institutions.

6.3 Key factors influencing mercury releases

On Inventory Level 1, the Toolkit spreadsheet uses medium input and output distribution factors for the calculation of the mercury inputs to a sector and releases to the environment from the same sector (see the introduction for more description). Actual inputs and releases in your country may be above or below the calculated standard estimates. The most important factors which can influence mercury inputs and mercury releases are the following:

- Mercury amounts per unit (piece) of product. These are quite well established for most of these product types, the main challenge is therefore to collect good data on the national supply of each product type. This may be resource intensive, but with some research it is should be possible to establish usable consumption estimates. The contact to data suppliers is also a way of raising awareness of the mercury issue, and as such has dual purposes. For additional advice on data collection, see Section 4.4 of the Toolkit Reference Report.

- Calculated results for releases to "general waste" and "land" for most of the product groups are dependent on the answer in Step 5 to the question "More than 2/3 of the waste is collected and treated under public control?" (see Step 5). On Inventory Level 1, two fixed scenarios for informal waste treatment are applied, see appendix 1. The distribution of waste between informal and publicly controlled waste disposal/treatment in the country will influence the mercury output distribution from these products.

- In some countries, separate collection systems are established in which mercury containing waste is collected and treated as a separate waste stream which may be deposited on special, safe deposits, or from which mercury is recycled. This

may include products such as thermometers, batteries, and light sources, among others. Inventory Level 1 does not reflect such systems by default. To reflect them, additional data must be collected as described in Inventory Level 2.

- For dental amalgam, a relatively large mercury release source, the actual national consumption varies depending on dental service level and the prevalence of the mercury-free alternatives. In Inventory Level 1, a medium estimate based on examples from western countries is used. A closer study of the use of amalgam in the dental sector will cast light on these issues; for example by contacting dentist associations, dentist schools, relevant ministries, or if this does not produce results, via contact to a representative number of dentist and extrapolation to the national situation. Also, the use of high efficiency amalgam separators in the dental clinics' waste water system may retain much released mercury in wastes, which is otherwise released to water. On Inventory Level 1, it is assumed that only the less efficient dental chair filters/strainers are used in most clinics.

- Also for the other product types quantified from national population numbers, the default factors are based on data from western countries and the actual national consumption may deviate from this. Refining these estimates however require quite resource-demanding investigations.

Before initiating work on additional data collection for inventory refinement, we recommend reading relevant source description sections in the Toolkit Reference Report (see Table 6-1). If you can get specific data on these issues, you can refine your inventory to Inventory Level 2 as described in Section 10. Details on default input and output distribution factors used on Inventory Level 1 which are differing from Inventory Level 2, are provided in Appendix 1; these details are useful for reference when refining your inventory on Inventory Level 2.

7   Step 7: Crematoria and cemeteries

7.1   Mercury release sources

This step includes mercury releases from the cremation and burial of human corpses. The main original mercury source is dental amalgam fillings, and mercury is present as fillings in remaining teeth and also in the body tissue at minor concentrations. At cremation, the mercury is released with the flue gas. At burial the mercury is released to the cemetery soil or immediate surroundings. In western countries crematoria are mainly larger central facilities. In some western countries, release reduction devices for mercury retention have recently been applied to reduce releases to the atmosphere, and crematoria may be among the largest mercury sources to the atmosphere nationally. In many countries cremation takes place in a large number of local facilities according to religious traditions, often in open air or with limited confinement of the cremation process. Some countries may use one of the process types almost solely, while other countries have a mix of cremations and burials, depending on religious faiths present and other traditions and trends.

The source sub-categories included in this inventory step are shown in the table below along with category references to the relevant Toolkit Reference Report sections, in case you wish to read more about the source sub-categories than described below.

Table 7-1   Source sub-categories covered with reference to the Toolkit Reference Report sections.

	Category references
Crematoria	5.10.1
Cemeteries	5.10.2

Are these source types present in your country?
Start your inventory for these source types by investigating preliminarily, if these source types are present in your country. Start with the background knowledge of yourself and your colleagues, and supplement as needed by contacting relevant ministries, agencies and resource persons in your country. This will also help you identifying the right contacts for later work on the inventory. Remember to ask all, if they know of other contact persons who might have relevance for your inventory for these sectors.

Report your findings in the inventory spreadsheet by filling in column B with "Y" for source types present in your country, "N" for source types which you have proven are not present in the country, and "?" for source types for which you have no indications of their presence or absence. Be confident with entering your immediate findings first and adjust later as you get more information. We recommend that you continue to search for data for source types you are not sure are present in your country, until you have confirmation of its presence or absence. Source types with cells in this column left blank will be indicated in the spreadsheet summaries.

7.2   Data collection

The data types you need for mercury input and release estimation and hints on where to seek them are given in the table below.

Table 7-2   Data collection

Source sub-category	Input data types and units	Possible data sources
Crematoria	Corpses cremated/y	Data on annual mortality are usually available in national population statistics, otherwise see the UN Statistics Divisions homepage http://unstats.un.org/unsd/demographic/products/dyb/dyb2007.htm. In countries using both cremation and burial, statistics may be available on the annual split between the two processes; if not try to form an estimate of the distribution via overviews of religious faiths in the country or via contact to resource persons in relevant ministries, or via offices of heads of religious societies predominant in the country.
Cemeteries	Corpses buried/y	

7.3   Key factors influencing mercury releases

On Inventory Level 1, the Toolkit spreadsheet uses medium input and output distribution factors for the calculation of the mercury inputs to a sector and releases to the environment from the same sector (see the introduction for more description). Actual inputs and releases in your country may be above or below the calculated standard estimates. The most important factors which can influence mercury inputs and mercury releases are the following:

- The average number of amalgam fillings present in people at their death. This may vary considerably and is depending on general dental service level and prevalence of amalgam fillings versus mercury-free alternatives. A closer study of the use of dental amalgam will cast light on these issues (see also Step 6). On Inventory Level 1, a medium estimate based on examples from western countries is used.

- The presence of mercury specific release reduction devices on crematoria. For data, contact responsible ministries, municipal offices or representative crematoria. In Inventory Level 1, no release reduction devices are assumed.

Before initiating work on additional data collection for inventory refinement, we recommend reading relevant source description sections in the Toolkit Reference Report (see Table 7-1). If you can get specific data on these issues, you can refine your inventory to Inventory Level 2 as described in Section 10. Details on default input and output distribution factors used on Inventory Level 1 which are differing from Inventory Level 2, are provided in Appendix 1; these details are useful for reference when refining your inventory on Inventory Level 2.

8   Step 8: Miscellaneous mercury sources not quantified on Inventory Level 1

The list in Table 8-1 shows additional mercury release source types, which are not quantified in Inventory Level 1.

Are these source types present in your country?
Consider, on a preliminary basis only, if the mentioned mercury release source types are present in your country. Use your background knowledge and that of your close colleagues. As for other sources, report your findings in the inventory spreadsheet by filling in column B with "Y" for source types present in your country, "N" for source types which you have proven are not present in the country, and "?" for source types for which you have no indications of their presence or absence. It is acceptable that you invest less time in investigating if these source types are present than generally for other, quantifiable sources.

The produced list can be used in prioritisation of any further or future work on the national mercury inventory. For some of these source types, detailed source description is available in the Toolkit Reference Report. For others, limited information may be available, and any contributions to the knowledge base from your country will be valuable for global mercury inventory work.

Table 8-1   Mercury release source types not covered on Inventory Level 1

Miscellaneous mercury release sources
Combustion of oil shale
Combustion of peat
Geothermal power production
Production of other recycled metals
Production of lime
Production of light weight aggregates (burnt clay nuts for building purposes)
Chloride and sodium hydroxide produced from mercury-cell technology
Polyurethane production with mercury catalysts
Seed dressing with mercury chemicals
Infra red detection semiconductors
Bougie tubes and Cantor tubes (medical)
Educational uses
Gyroscopes with mercury
Vacuum pumps with mercury
Mercury used in religious rituals (amulets and other uses)
Mercury used in traditional medicines (ayurvedic and others) and homeopathic medicine
Use of mercury as a refrigerant in certain cooling systems
Light houses (levelling bearings in marine navigation lights)
Mercury in large bearings of rotating mechanic parts in for example older waste water treatment plants
Tanning
Pigments
Products for browning and etching steel
Certain colour photograph paper types
Recoil softeners in rifles
Explosives (mercury-fulminate a.o.)
Fireworks
Executive toys

9   Step 9: Reporting your inventory

Use the Toolkit report template

Summaries of the results of your Level 1 Inventory can be seen in six spreadsheet summary pages in the calculation spreadsheet:

1   "Level 1 - ExecSummary" is an aggregated summary prepared for presentation in the executive summary of your inventory report;

2   "Level 1 - Charts" provides standardised charts for mercury inputs and each of the output pathways;

3   "Level 1 - Hg sources identified" it provides an automatically generated list of the mercury (= Hg) source category presence in your country which you have entered in previous inventory steps;

4   "Level 1 - Summary of Hg inputs" provides a summary of all calculated mercury input estimates from products, materials, etc.;

5   "Level 1 - Summary of releases" it provides a full summary of the calculated mercury release estimates, and

6   The last summary, named "Level 1 - Total summary" summarised all results; it is a good place to get an overview of your results during your inventory development.

For your convenience, and for attaining a standardised outline of mercury inventory reports developed with this Toolkit, we recommend using the report template which can be downloaded at the same website as this guideline (see front pages). The template is available in MS Word format, ready for entering your data and information, and in PDF format from which you can copy the outline, in case you do not have MS Word available.

Note that your final inventory spreadsheets comprises part of the documentation and reporting of your mercury inventory. Inventory Level 1 summary sheets are designed to be copied into the report document, and other spreadsheets are designed to be presented in an annex to your report. The report template indicates where to paste the copies of the Inventory Level 1 summary spreadsheet cells and where to place the appendix with all the detailed spreadsheet pages. Besides this, we recommend that the final spreadsheet file in MS Excel format is provided as a separate file along with the report file for reference.

Section 10 on refining your inventor on Inventory Level 2 describes how to incorporate selected Inventory Level 2 results in your report.

Decimal point or comma

The Toolkit spreadsheets will use the decimal point or decimal comma according to your personal computer set-up (country selection). In this guideline and in the Toolkit Reference Report, decimal point is used. Make your choice of decimal separator in

your inventory report, and assure consistency between text and data tables of your report on this aspect.

Keep notes and report your data origin
We recommend that while collecting data, you keep notes describing your contacts and the information they gave for later reference in your work and for background documentation of your reporting. This will also help you in preparing potential future updates of the mercury inventory. Description of your data sources and the data they provided are a part of your reporting. Note contact details, date and year contacted, data provided; see also the report template file.

Managing and reporting data uncertainty, approximations and data gaps
Most data from most sources are actually associated with uncertainty, smaller or larger, even if specific and detailed numbers are provided. Considering and discussing, as relevant, data uncertainty for obtained data in your inventory report is therefore seen as a strength and not as a weakness of the inventory work performed.

In the course of your inventory work, you may likely encounter source categories, where it is difficult to find the exact data types requested. This is a common phenomenon and in such cases, creative thinking in finding other related data types which can be used for an approximation is highly appreciated. Rather than omitting calculation of mercury inputs and releases for such a source category, it is recommended to use the best available approximations. <u>A value calculated and reported with uncertainty is normally a much better help in understanding the mercury situation than a missing value.</u> A basic and important principle is however to report explicitly which data you have used and how you made the approximations.

You may also likely encounter source categories, where it proves impossible to find the data types needed within the time and budget available for the inventory work. This is normal and should be reported explicitly in the inventory report. We recommend reporting it with the text on the mercury source category in question, and besides, major data gaps should be listed in the data gaps section by the end of the report.

Further inspiration on reporting principles is given in the Toolkit Reference Report's Section 4.5 (optional for inventories made on Inventory Level 1).

10 Step 10: Refining your inventory (optional)

As mentioned earlier, the Toolkit suggests two levels of inventory development, a simplified methodology called Inventory Level 1, and a more detailed Inventory Level 2. This guideline primarily describes Inventory Level 1, but this section provides basic guidance for refining your inventory work to Inventory Level 2, should you desire this for selected mercury source categories, or for your inventory as such.

Refining your inventory for selected categories

Besides providing background information, the Toolkit Reference Report describes Inventory Level 2 in detail. For performing Inventory Level 2 for selected source categories, it is recommended to start with reading the source category description section for the category in question. References to the relevant sections are given in the first tables of each of the previous inventory source category steps. This should give you a valuable insight in the fundamentals of the source category, including the original source of the mercury, a presentation of examples of mercury inputs and release patterns from literature, documentation for default factors used, and guidance for the source specific inventory work involved. Thereafter, it is recommended to read sections 2, 3 and 4 in the Reference Report, which describes the context and methodology of Inventory Level 2. Sub-sections 4.2 and 4.3 are not relevant, if you have completed the identification of sources present in your country in Inventory Level 1. Note that the sequence of steps and activities used in Inventory Level 2 and some subprinciples differ from those used in Inventory Level 1. This is because Inventory Level 1 has been designed to simplify the inventory work further than Level 2. The overall background principles are however the same.

You will observe that Inventory Level 2 demands more detailed data for most mercury source categories and that the procedures are more open, to allow for your selection of detailed approaches and your inclusion of national, specific data, which reflect the actual mercury situation for individual sources in your country.

The spreadsheet for Inventory Level 2 is provided as an open framework to facilitate your inventory calculations and provide possibility for making your own additions and changes in the calculations depending on your national and source-specific needs. The Inventory Level 2 spreadsheet pages are not self-explanatory, so it is very important to read the recommended sections of the Toolkit Reference Report and the spreadsheet page entitled "Level 2 - Introduction", before you start your work in the spreadsheet.

Insertion of Inventory Level2 results in Inventory Level 1 spreadsheet and report

If you have calculated inventory results for selected mercury source categories in Inventory Level 2, the results must be entered in the Inventory Level 1 spreadsheet to be included in the summary result tables and thus be easily incorporated in your reporting. Simply enter the input and release estimates generated in Inventory Level 2 in the corresponding cells in the Level 1spreadsheet page "Insert IL2 results"; see how it looks below. This is the only accepted way of incorporating Inventory Level 2 results in your Inventory Level 1 reporting, as it automatically takes care of neutralising double counting of results for waste categories and ensures adequate and correct summary table calculations.

Always document carefully and transparently the background for the Inventory Level 2 results introduced. This must be done in the notes column in the spreadsheet and with more detail in your inventory report. Make clear in your reporting that the input and release estimates for these specific mercury sources were calculated according to the Inventory level 2 methodology, and describe explicitly all data and sub-calculations made.

Note that for some source categories, the life cycle phases of the source category are grouped slightly differently in Inventory Level 1 to (facilitate data collection). In such cases the source category numbers in the spreadsheet page "Insert IL2 results" can be used for guidance.

For some source categories all life cycle phases are aggregated under one entry in Inventory Level 1, but they are split in life cycle phases in Level 2. In such cases, enter the sum up the calculated releases to the same output pathway (for example all releases to air). In case of difficulties, make explicit notes in the IL1 spreadsheet page "Insert IL2 results" and in your report, on how you summed up the numbers.

Source presence (y/n/?) must always be entered in the appropriate Step page in the Inventory Level 1 spreadsheet, also when Inventory Level 2 results are introduced and used.

Important: The spreadsheet page "Insert IL2 results" is to be used ONLY for inclusion of inventory results calculated in Inventory Level 2. Any insertion there will disrupt summary presentation of otherwise calculated Inventory Level 1 results for the same source categories, and care should thus be taken to not introduce erroneous or irrelevant data in the spreadsheet cells.

Figure 10-1   Extract of the Inventory Level 1 spreadsheet page " Insert IL2 results".

Source category	Source Category no.	Hg input Enter calculated Hg input in Kg Hg/y	Enter calculated Hg releases in Kg Hg/y					
			Air	Water	Land	By-products and impurities	General waste	Sector specific waste treatment /disposal
Energy consumption								
Coal combustion in large power plants	5.1.1							
Other coal uses	5.1.2							
Combustion/use of petroleum coke and heavy oil	5.1.3							
Combustion/use of diesel, gasoil, petroleum, kerosene	5.1.3							
Use of raw or pre-cleaned natural gas	5.1.4							
Use of pipeline gas (consumer quality)	5.1.4							
Biomass fired power and heat production	5.1.6							
Charcoal combustion	5.1.6							
Fuel production								
Oil extraction	5.1.3							
Oil refining	5.1.3							
Extraction and processing of natural gas	5.1.4							
Primary metal production								
Mercury (primary) extraction and initial processing	5.2.1							

Performing your whole inventory on Inventory Level 2

In case you should decide to perform your whole inventory in Inventory Level 2, either as a choice for your first mercury inventory, or as a later follow-up activity for refining your initial Level 1 inventory, we recommend that you start by reading sections 1-4 (about 50 pages) of the Toolkit Reference Report, which describes the con-

text and methodology of Inventory Level 2. Thereafter it is recommended to read the individual source description sections as you need them during the course of your inventory work. Most likely, not all source categories are relevant for your country.

As mentioned above, the spreadsheet for Inventory Level 2 is provided as an open framework to facilitate your inventory calculations and provide possibility for making your own additions and changes in the calculations depending on your national and source-specific needs. The Inventory Level 2 spreadsheet pages are not self-explanatory, so it is very important to read the recommended sections of the Toolkit Reference Report and the spreadsheet page entitled "Level 2 - Introduction", before you start your work in the spreadsheet.

11   Abbreviations and acronyms

%	percent;
*	multiplied by;
/	divided by;
/y	per year;
<	less than;
>	greater than;
°C	degree Celsius (centigrade);
APC	Air pollution control;
ESP	Electrostatic precipitator; equipment used to reduce emissions of certain pollutants from combustion flue gases;
EU	European Union. Starting May 1st, 2004, the European Union has 25 member states (Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxemburg, Malta, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, The Netherlands, United Kingdom), establishing an area of more than 4 million square kms with a population of approximately 460 mil-lion inhabitants; later expanded with two additional member states to 27;
FF	Fabric filter; filter type used to capture particulate matter (here: from combustion flue gases);
g	gram;
kg	kilogram;
m	meter;
metric ton	1000 kg;
mg	milligram (10^{-3} gram);
MW	Megawatt;
OECD	Organization for Economic Cooperation and Development;
PM	Particulate material; particulate matter;

PS	Particle scrubber; equipment designed to reduce emissions of particles from combustion flue gases
PVC	Polyvinylchloride;
t	tonne (= metric ton = 1000kg);
UN	United Nations;
UNEP	United Nations Environment Programme;
USA	United States of America;
VCM	Vinylchloride monomer;
WHO	World Health Organization;

Appendix 1 - Notes to calculation spreadsheet for Inventory Level 1

For users wishing to refine their inventories on Inventory Level 2: This note provides details of the relationship between Inventory Level 1 and Inventory Level 2 as regards default input and output distribution factors and input/output scenarios.

General remark: As mentioned elsewhere in this guideline, some choices of default factors are made by the authors to simplify the inventory development in Level 1. The default factors selected are made with the aim of reflecting the conditions in developing countries and countries in economical transition. The notes here only pertain to such specific choices made for Inventory Level 1. In many other cases, the general default factors are used, and if nothing else is mentioned below, mid of range input factors and standard output distribution factors are used. The ranges of default input factors and general output distribution factors, as well as the Inventory Level 2 scenarios referred to, can be seen in the Toolkit Reference Report (or in overview in the Inventory Level 2 spreadsheet).

Step 2: Energy consumption and fuel production

Coal combustion in large power plants: An output scenario based on a coal mix of 1/3 bituminous, 1/3 sub-bituminous and 1/3 lignite, all assumed to be in the output scenario "Particulate matter simple APC: ESP/PS/CYC". The default input factor is based on a medium value of 0.15 g Hg/t coal combusted. The output distribution factors for this mix are for air: 0.88 and sector specific treatment/disposal: 0.12.

Other coal use: An output scenario based <u>combustion</u> of a coal mix of 1/3 bituminous, 1/3 sub-bituminous and 1/3 lignite, all assumed with no air pollution controls. The default input factor is based on a medium conglomerate value of 0.13 g Hg/t coal combusted. Coke production is here included in "other coal use".

Combustion/use of petroleum coke and heavy oil: The default input factor is based on a value of 55 mg Hg/ton heavy petroleum product. The output scenario "All uses without emission control" is used for determination of the default output distribution factors.

Combustion/use of diesel, gasoil, petroleum, kerosene: The default input factor is based on a medium value of 5.5 mg Hg/ton light distillate petroleum product. The output scenario "All uses without emission control" is used for determination of the default output distribution factors.

Use of natural gas: The default input factor for pipeline natural gas is based on a medium value of 0.2 μg Hg/Nm3 gas. The default input factor for raw or pre-cleaned natural gas is based on a medium value of 100 μg Hg/Nm3 gas.

Biomass fired power and heat production: On the basis of wide data range on mercury in biomass a default input factor of 0.03 g Hg/t biomass burned is applied (dry weight basis).

Charcoal production: On the basis of wide range of data on mercury in biomass a default input factor of 0.12 g Hg/t produced charcoal is applied considering that 4 metric tons of biomass is used for production of 1 metric tons of charcoal.

Extraction and refining of oil: The default input factor is based on a value of 3,4 mg Hg/ton crude oil.

Extraction and processing of natural gas: The default input factors are based on a medium value of the unprocessed gas of 100 µg Hg/Nm3 gas. Default output distribution factors are estimated by assuming that 50% of the gas is processed in accordance with the output scenario "Gas processing without mercury removal" and 50% in accordance with "Gas processing with mercury removal".

Step 3: Domestic production of metals and raw materials

Production of zinc from concentrates: An intermediate mercury concentration in concentrates of 65 g/metric ton is used on Inventory Level 1. The output scenario "Smelters with wet gas cleaning and acid plant" is used for determination of the default output distribution factors based on an assessment of the industry globally. For some countries, less efficient filter configurations are however used and this should be a focus in any follow-up inventory work. Actual filter configurations present in a country can be mirrored by using Inventory Level 2 for this sector.

Production of copper from concentrates: An intermediate mercury concentration in concentrates of 30 g/metric ton is used on Inventory Level 1. The output scenario "Smelters with wet gas cleaning and acid plant" is used for determination of the default output distribution factors based on an assessment of the industry globally. For some countries, less efficient filter configurations are however used and this should be a focus in any follow-up inventory work. Actual filter configurations present in a country can be mirrored by using Inventory Level 2 for this sector.

Production of lead from concentrates: An intermediate mercury concentration in concentrates of 30 g/metric ton is used on Inventory Level 1. The output scenario "Smelters with wet gas cleaning and acid plant" is used for determination of the default output distribution factors based on an assessment of the industry globally. For some countries, less efficient filter configurations are however used and this should be a focus in any follow-up inventory work. Actual filter configurations present in a country can be mirrored by using Inventory Level 2 for this sector.

Gold extraction by methods other than mercury amalgamation: A medium mercury concentration in ore of 15 g/metric ton is assumed on Inventory Level 1.

Gold extraction with mercury amalgamation: For the Scenario "without use of retort": The gold quantities produced are distributed 50:50 on the two categories in 5.2.2. "/From whole ore" and "/From concentrate" thereby obtaining an medium factor for the processes. For the scenario "with retorts", the amalgamation is assumed done on concentrates only.

Aluminium production: The default input factor for production of alumina is based on a medium value of 0.5 g Hg/t bauxite used for the production.

Cement production: The quantities of cement produced are distributed 50:50% between the two categories "/without co-incineration of waste" and "/with co-incineration of waste". A mixed output scenario of 50% with "No filters" and 50% "Simple particle control (ESP / PS / FF)" with dust recycling is used for determination of the default output distribution factors. The mix produces the following resulting output distribution factors (unitless shares of mercury inputs):

Air	Water	Land	Products	General waste	Sector specific treatment/disposal
0,75			0,25		

Pulp and paper production: On the basis of wide range of data on mercury in biomass a default input factor of 0.03 g Hg/t biomass used for production is applied (dry weight basis). No presence of flue gas release reduction devices is assumed on Inventory Level 1.

Step 4 – Domestic production and processing with intentional mercury use

Chlor/alkali production: Default input factor based on a medium value of 100 g Hg/t Cl2 produced. The output scenario "Hg unaccounted for is presented as releases" is used for determination of the default output distribution factors.

Production of products with mercury content: If nothing else is indicated in the toolkit, the following default output distribution factors based on limited data available for thermometers and batteries have been applied for all production of processes, except battery production, on Inventory Level 1: Air (0.01), Water(0.005), Land (0.1), Impurity in products (0), General waste (0.1) Sector specific treatment/disposal (0.01). For battery production, original Inventory Level 2 defaults are applied.

Acetaldehyde production with mercury catalyst: Default input and output distribution factors are identical to the factors for VCM production as no specific data on acetaldehyde production have been available.

Step 5- Waste treatment and recycling

Waste incineration: For all types of waste incineration the output scenario "PM (particulate matter) reduc, simple ESP, or similar" is used for determination of the default output distribution factors. A medium mercury content in waste of 5 g/t is assumed for all general waste.

Sewage sludge incineration: Based on examples from the literature cited in the Reference Report, a medium input factor of 2 g Hg/metric ton of sludge was used on Inventory Level 1.

Landfilling: A medium mercury content in waste of 5 g/t is assumed for all general waste. Available data are not sufficient to form input-correlated output distribution factors as generally used in this Toolkit. The Reference Report provide a summary of data on emissions to air and via leachate water. The limited data available indicate that mercury air emissions from landfills may be relatively modest compared to major mercury sources such as coal fired power plants, etc. To signal that landfills are a relevant mercury release source however, artificial output distribution factors were on Inventory Level 1 set as signal values as follows: To air: 0.01 of mercury in waste landfilled annually (meaning that 1 percent of the mercury landfilled is calculated as released to air during the entire life of the landfill; a realistic yet maybe underestimated fraction). To water (via leachate): 0.0001 of mercury in waste landfilled annually.

Informal dumping of general waste: A medium mercury content in waste of 5 g/t is assumed for all general waste on Inventory Level 1.

Production of recycled ferrous metals (iron and steel): A medium mercury content of 1 g per vehicle recycled is assumed on Inventory Level 1 to signal possible significance.

Waste water system/treatment: For waste water treatment the output scenario "Mechanical treatment only" is used for determination of the default output distribution factors. On Inventory Level 1, mechanical treatment with minor mercury retention in sludge is assumed.

Step 6 – Hg products and substances

Default output distribution factors for most of the product groups are dependent on the answer to the question "More than 2/3 of the waste is collected and treated under public control". If "Y" is answered, the scenario "(a1) No separate collection. Waste handl. controlled" is applied. If "No" is answered, the scenario " (a2) No separate collection. Informal waste handl. widespread" is applied.

Dental fillings: In the light of the adjusted approach described below, a default input factor was based on an input with new fillings of 0.2 g Hg per inhabitant per year mirroring the Danish situation in 2001, where mercury free fillings had a substantial market share, but mercury fillings were still used to some degree; a situation which has since become more prevalent globally. To adjust approximately for the frequency

of dental restoration in the country of interest, the calculated mercury input is further reduced with a factor describing the access to dental care in the country. The factor is calculated as the number of dental personnel per inhabitant, divided by the same number for Denmark (from which the adjusted default input factor was derived). The number of dental personnel per country was derived by the WHO in 2006. To reduce the vulnerability of the calculations to the possible reporting errors, all national dental personnel densities below the 20% percentile for non-OECD countries, were however calculated as equal to the same 20% percentile (see the Toolkit Reference Report for details and references). Default output distribution factors for disposal were based on the scenario: "In countries where only dental chair filters/strainers are used in most clinics".

Thermometers: Two categories of thermometers have been merged. The number of items of "Other glass Hg thermometers (air, laboratory, dairy, etc.)" is considered distributed 50:50% between "Ambient air thermometers" and "Other glass Hg thermometers".

Electrical switches and relays with mercury: Default input factor based on a medium value of 1.4 g Hg per inhabitant per year. To adjust approximately for the prevalence of "technical installations" in the country, the calculated mercury input is further reduced with the fraction of the population with access to electricity (electrification rate as derived by IEA, 2009; see the Toolkit Reference Report for more details).

Light sources with mercury: Three categories of light sources have been merged. The number of items of "Other Hg containing light sources" is equally distributed (1/3 to each) between the High-pressure sodium lamps, UV light for tanning and metal halide lamps.

Batteries with mercury: Three categories of batteries have been merged. The number of items of "Other button cells (zinc-air, alkaline button cells, silver-oxide)" is distributed equally (1/3 to each) between the zinc-air button cells, alkaline button cells and silver oxide button cells.

Polyurethane with mercury catalyst: Default input factor based on current consumption in the European Union. As described in the Reference Report, the EU consumption of mercury with catalysts in polyurethane in 2008 was 20-35 tonnes corresponding to 0.04-0.07 g Hg/inhabitant. Global estimates indicate a lower average. On this basis a default value of 0.03 g Hg per inhabitant per year is applied. To adjust approximately for the prevalence of "technical installations" in the country, the calculated mercury input is further reduced with the fraction of the population with access to electricity (electrification rate as derived by IEA, 2009. See the Toolkit Reference Report for more details). Polyurethane is not only used as part of technical installations, but electricity access was however selected as an indirect indicator of technological development relevant for this material.

Paint with mercury: Default input factor based on a medium value of 2.6 kg Hg/t paint

Skin lightening creams and soaps with mercury chemicals: Is included as representing the main use within the category "Cosmetics and related products with mercury". Default input factor based on a medium value of 30 kg Hg/t skin lightening cream or soap.

Medical blood pressure gauges (mercury sphygmomanometers): Included in the category "6.5.2. Manometers and gauges with mercury" but is here represented separately as data on the sale of blood pressure gauges may be more readily available. The input factor is based on a medium value of 80 g Hg/item. Outputs are assumed distributed as for medical thermometers.

Other manometers and gauges with mercury: Includes the remaining equipment within the category "6.5.2. Manometers and gauges with mercury". A default input factor is derived from European experience as described in the Reference Report to be approximately 0.005 g Hg per inhabitant per year. To adjust approximately for the prevalence of "technical installations" in the country, the calculated mercury input is further reduced with the fraction of the population with access to electricity (electrification rate as derived by IEA, 2009; see the Toolkit Reference Report for more details). Mercury outputs from the sector are assumed distributed as for medical thermometers.

Laboratory chemicals: Included in the category "5.6.3. Laboratory chemicals and equipment". The default input factor is based on current consumption in the European Union. As described in the Reference Report, the mercury input to pharmaceutical industry in 2008 in the European Union was 3-10 tonnes corresponding to 0.006-0.02 g Hg/inhabitant. On this basis a default input factor of 0.01 g Hg/inhabitant is applied. To adjust approximately for the prevalence of "technical installations" in the country, the calculated mercury input is further reduced with the fraction of the population with access to electricity (electrification rate as derived by IEA, 2009; see the Toolkit Reference Report for more details). As no data are available on mercury outputs from the sector, an equal output distribution on water, general waste and sector specific waste disposal/treatment (safe collection and treatment) is used to signal potential releases.

Other laboratory equipment: Includes the remaining equipment within the category "5.6.3. Laboratory chemicals and equipment". In the European Union the main mercury use for other laboratory equipment is mercury in analysis of pose size characteristics (porosimetry and pycnometry) and hanging drop electrodes. As described in the Reference Report, the EU27 use of mercury in laboratories for porosimetry and pycnometry in 2008 was estimated at 10-100 tonnes while the use of for hanging drop electrodes was estimated at 0.1-0.5 tonnes. Later information indicated that the actual consumption for porosimetry and pycnometry is most likely in the lower end, and 20 tonnes will be used as best estimate. On this basis a default value for other laboratory equipment is estimated at 0.04 g Hg/inhabitant. To adjust approximately for the prevalence of "technical installations" in the country, the calculated mercury input is further reduced with the fraction of the population with access to electricity (electrification rate as derived by IEA, 2009; see the Toolkit Reference Report for more details). As no data are available on mercury outputs from the sector, an equal output distribution on water, general waste and sector specific waste disposal/treatment (safe collection and treatment) is used to signal potential releases.

Level 1 summaries

Calculated input totals from waste related mercury sources: To avoid double counting of mercury inputs with waste products in the input total, only 10% of the mercury input to waste incineration sources, general waste deposition and informal dumping is included in the total for mercury inputs. These 10% represent approximately the mercury input to waste from materials which were not quantified individually in Inventory Level 1 of this Toolkit. These materials include such things as food wastes, paper, plastic, etc. which generally have very low mercury concentrations but very high volumes. The actual fraction of mercury from such materials, of the total inputs of mercury to waste, will vary between regions and very little data on this issue is available in the literature. Limited data from a Danish substance flow analysis (for 2001) for mercury indicate however, that this mercury fraction is small, in the range of some 2-20% of total mercury inputs to general waste.

Appendix 2 - 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 a rough idea of the net import of 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 need 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 UN Comtrade has 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 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 and other products. Look for advice on the relevant product types in the relevant section of this guideline, or if needed in the relevant section of Toolkit Reference Report.

Data search in UN Comtrade

The UN Comtrade data search page can be found at http://comtrade.un.org/db/. The initial search picture looks like below (extract as seen July, 2012;).Should the display be different from this when you visit the page, try to find the same entry fields on the page:

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

- "Show": Select "import" from the drop down menu.

- "of": Write a search word you think will cover the product type; in our example, write "thermometer" (without brackets).

- "in the year": Let the pre-selection "recent years" stay (or select a specific year from the drop down menu).

- "to": Select your country from the drop down menu.

- "from": Select "World" from the drop down menu.

- "in": Let the pre-selection "any" (classification) stay.

- Click the "Search" button.

After a little while, the database returns with the entries fitting the choices you made. In the example with thermometer import (to Slovenia) it returned the following list:

You tick off your choice of product groups in the small squares to the left of the product group title and click on the "View trade data" button. In the example, we tick off "Thermometers. liquid-filled", because we know these are the only ones of interest when we look for mercury thermometers (all mercury-containing thermometers make use of liquid mercury), Click "View trade data", and the following data list is displayed. The first time, you may be directed to a page called "Read me first (disclaimer)"; read it, tick of the box that you have read it in the bottom and click "continue", and the data list is displayed:

The data you use should preferably be in the unit stated in the Inventory Level 1 spreadsheet. In our example, we need imported number of items of thermometers. When you place your computer's cursor over the numbers under "Quantity unit", you will see which unit the "Trade quantity" data have. In our example it is "number of items", which is what we need.

It is recommended to click the link "Printable format" over the data table, as the view generated will show more details of the product group name. It looks like this:

You can now copy the data to your files for later entry in the Inventory Level 1 spreadsheet.

In some cases you may need to convert the unit from for example "Trade value" or better "NetWeight" with the help of typical value or typical total weight of the product type you seek data for. For medical Hg thermometers, fluorescent tubes (double end) and compact fluorescent lamp (CFL single end), converting can be done in the "Unit conversion" tab in the Inventory Level 1 spreadsheet. For others, typical value or weight needs to be found elsewhere, for example on the Internet, and reported in your inventory report with the data.

Data for (at least) the following product groups can be sought with meaningful results in UN Comtrade:

Product name Toolkit Inventory Level 1	Use this search word	Examples of product name(s) and code(s) in Comtrade (other may exist)	Remarks
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
Batteries	battery cell		
Other button cells (zinc-air, alkaline button cells, silver-oxide)		....Primary cells & primary batteries, air-zinc [HS as reported code 850660]	Includes only part of the battery types in the Toolkit category
Other batteries with mercury (plain cylindrical alkaline, permanganate, etc., see guideline)		.....Primary cells and primary batteries. [HS as reported code 8506] + Primary cells & primary batteries n.e.s. in 85.06 [HS as reported code 850680]	The sum of these two records should in principle include all primary batteries; including some without mercury. Air zinc batteries and lithium batteries can be subtracted, if reported for your country. See advice in Step 6.
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]	Includes 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 other data.
		.....Electric discharge lamps (excl. ultra-violet lamps; excl. of 8539.31 & 8539.32) [HS as reported code 853939]	
		.....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.
Other Hg containing light sources (see guideline)		.....Electric discharge lamps (excl. ultra-violet lamps), mercury/sodium vapour lamps; metal halide lamps [HS as reported code 853932]	Includes some of the lamps with high mercury contents, but not all.

Appendix 3 - 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. If you go to "Statistics" and there to "Statistics by country" (click the world map), you will find a search engine that can help you on finding energy information about your country.
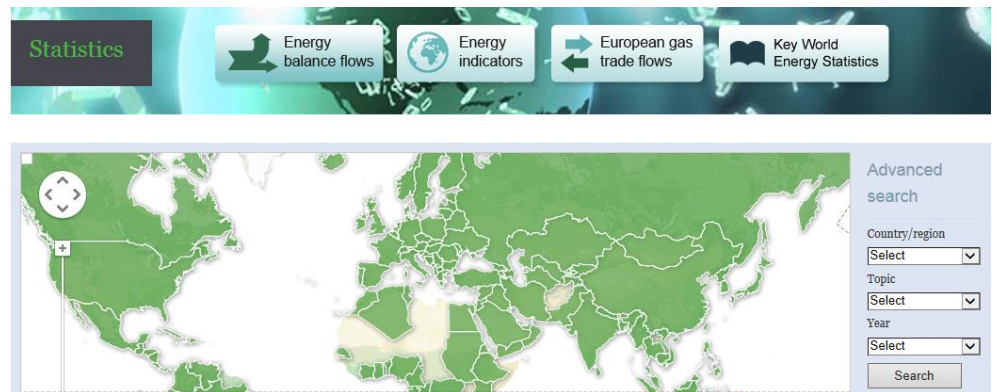
Select your country from the drop down list at the right, for example Australia, the topic you search data for, for example coal, and the year you need data for (the base year of your inventory). The data are free under certain conditions. If you need it, the IEA has newer data than those displayed here, but they need to be purchased from another IEA site (http://data.iea.org/ieastore/statslisting.asp).

If I for example choose Australia, coal and 2010, I get the data below (extract shown only). The data are given in kt per year, which mean kilo-tonnes or thousand metric tonnes, and in the Toolkit I need to enter them as t/y, so I need to multiply each number with 1000 and note that unit with my data.

Austria: Coal for 2010

Unit	Anthracite	Coking coal	Other bituminous coal	Sub-bituminous coal	Lignite	Patent fuel	Coke oven coke
	kt	kt	kt	kt	kt	kt	kt
Production	0	0	0	0	0	0	1391
From other sources	0	0	0	0	0	0	0
Imports	4	1907	1723	69	43	13	1252
Exports	0	0	-1	0	-8	0	-3
Stock changes	-2	-69	176	0	0	0	-83
Domestic supply	2	1838	1898	69	35	13	2557
Statistical differences	0	0	-3	0	0	0	0
Transformation	0	1838	1576	0	0	0	2206
Electricity plants	0	0	1396	0	0	0	0
CHP plants	0	0	180	0	0	0	0
Heat plants	0	0	0	0	0	0	0
Other transformation	0	1838	0	0	0	0	2206
Energy industry own use	0	0	144	0	0	0	54
Losses	0	0	0	0	0	0	0
Final consumption	2	0	175	69	35	13	297

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 combusted/ y:	Kilo-tonnes/year (= 1000 metric tons/year)	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	Kilo-tonnes/year (= 1000 metric tons/year)	Sum of consumption for Heat plants, Other transformation, Industry, Transport, Residential, Agriculture/Forestry, Fishing, Other non-specified and Non-energy use for the coal types: Anthracite + Coking coal + Other bituminous coal + Sub-bituminous coal + Lignite + Patent fuel + BKB (brown coal briquettes)
Combustion/use of petroleum coke and heavy oil	Kilo-tonnes/year (= 1000 metric tons/year)	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	Kilo-tonnes/year (= 1000 metric tons/year)	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)	Kilo-tonnes/year (= 1000 metric tons/year)	Production, Crude oil
Oil refining (t crude oil refined/y)	Kilo-tonnes/year (= 1000 metric tons/year)	Oil refineries, Crude oil
Consumption of natural gas (Nm³ used/y)	TJ (can be converted in the Toolkit's unit conversion tab)	Domestic supply
Production of natural gas (Nm³ 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 (needs to be converted to metric tons using typical primary energy content of the relevant fuels, see table note*)	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).
Charcoal combustion (Charcoal combusted, t (dry weight)/y)	Data for charcoal may be available in some cases, but need to be purchased.	Data for charcoal may be available in some cases, but need to be purchased.

Note: Typical value for 19 GJ/tonne oven dried biomass. Use the following formula to calculate the lower calorific value of wood: GJ/tonne = 19.2 - (0.2164*MC), where MC is the moisture content in percent of total weight. Freshly felled coniferous wood has a moisture content of be-tween 55 and 60%, one summer seasoning reduces the moisture content by 10 to 15%. Freshly felled ash has a low moisture content of between 35 and 40%, other hardwood species have moisture content between 45 and 50%. The moisture content of wood for energy is expressed as a percentage of total weight ac-cording to the following formula: (wet weight-dry weight)/wet weight*100= MC in %. Source: http://www.woodenergy.ie/frequentlyaskedquestions

Appendix 4 – Test of waste and waste water default input factors

In the Toolkit, default factors used for calculation of mercury releases from the waste handling categories are based on examples of mercury contents in waste and wastewater in countries for which such data have been available. This may differ from actual waste in your country, primarily due to differences in the consumption pattern of mercury-added products and intentional use of mercury in processes. The default input factors used in this Toolkit for waste and wastewater were derived from data from developed countries only. You can make a simple test based on your Inventory Level 1 results, that will indicate if the default input factors for general (municipal) waste treatment may over-estimate the mercury releases in your country.

Is the sum of the calculated INPUTS to all general waste sub-categories more than 2 times the sum of WASTE OUTPUTS from intentional mercury uses in products plus processes (and these are well covered in the inventory)? If so, please describe this in your inventory report (with sum numbers) and state that mercury flows to general waste sub-categories may be over-estimated, and that more detailed investigations may be needed on this issue.

In the IL1 spreadsheet the test is done as follows: Select the tab "Level 1-total summary", check if cells

$$(E60+E64+E66+E67) > 2*(J25+J26+\textstyle\sum(J31 \text{ to } J55)).$$

A similar test should be performed and discussed in the report for wastewater treatment: Is the sum of the calculated INPUTS to waste water treatment is more than 2 times larger than the sum of OUTPUTS TO WATER from intentional mercury uses in products plus processes (and these are well covered in the inventory)? If so, please describe this in your inventory report (with sum numbers) and state that mercury flows to waste water treatment may be over-estimated, and that more detailed investigations may be needed on this issue.

In the IL1 spreadsheet the test is done as follows: Select the tab "Level 1-ExecSummary", check if cell

$$B19 > 2*(D8+D10+D11+D12+D13+D14).$$

In the inventory report template, a suggestion for text discussing these issues is pre-entered. If the tests are negative, simply erase the proposed discussion text (see the report template).

These tests should not be understood as giving certain evidence that the default factors are overestimated, but they do give an indication of this. In principle, mercury flows to waste and wastewater from other sectors (without intentional mercury use) could also contribute, but they would more often not be contribute to the general waste/wastewater stream, but rather to sectors specific streams.

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