

REGIONAL STUDY ON

# MERCURY

WASTE MANAGEMENT IN THE ASEAN COUNTRIES



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# PREFACE

The Secretariat of Association of Southeast Asian Nations (ASEAN) commissioned a regional study on mercury waste management in the region to the Asian Institute of Technology, Regional Resource Centre for Asia-Pacific (AIT RRC.AP), in cooperation with the UN Environment. The study covers the current situation of mercury waste management in the region, which consists of the ten ASEAN Member States (AMS), namely Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Viet Nam. All AMS are Parties to the Basel Convention, however, AMS such as Brunei Darussalam, Lao PDR, Myanmar, and Thailand are not signatories to the Minamata Convention.

The result of the study is presented in this report, providing information on the current state of the mercury waste management systems in each AMS jurisdiction, which includes the regulatory framework, institutional framework, mercury waste management infrastructure and operations, as well as the information and control elements. In addition, it also provides information on the mercury management practices for selected activities, inventories of mercury and mercury waste, and AMS' input on the challenges, needs and opportunities implementing the ESM of mercury waste in the region.

The report is expected to serve as baseline information for consideration by the Association and its member states for decision-making in implementing environmentally sound management (ESM) of mercury waste as well as to the ASEAN Secretariat and other regional organisations for relevant programme development. It also identifies the current gaps of information and data on mercury management in the region.

The study relied on the secondary data available on the web and a set of questionnaires as the primary survey instrument. It was difficult to obtain the specific information needed for analysis in order to meet the objectives of the study. Although the questionnaire was expected to be the source of more reliable and updated information and data, AMS did not fully complete it. Generally, they also did not have the information and data on certain aspects of the mercury and mercury waste management in their jurisdictions. The unfavourable situation has made the study take a longer time than initially planned. Nevertheless, the author has tried to make all efforts to optimise the results of the study in order to make it more meaningful as per the objectives and purpose of the report.

The author would like to thank the AIT RRCAP and UNEP-IETC for trusting and providing support to the author in undertaking this interesting study, which is the first of its kind in the region. Appreciation is also extended to Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Myanmar, the Philippines, Thailand and Viet Nam for their efforts in responding to the questionnaire and their additional input during the Expert Review Meeting in August 2016 in Bangkok.

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# EXECUTIVE SUMMARY

In response to the decision made at the ASEAN Working Group on Multilateral Environmental Agreements (AWEGMEA) in Brunei in 2014, one of the three studies that was agreed upon, was the scoping study on Mercury Waste Management. The study takes into account the relevant provisions stipulated in the Minamata Convention on Mercury (MC) and other relevant multilateral environmental agreements, in particular the Basel Convention (BC). In line with these, the Asian Institute of Technology (AIT) through the Regional Resource Centre for Asia and the Pacific (RRC.AP), under the leadership of the UN Environment, is conducting studies and scientific assessments, and developing compendiums related to waste management, which are in line with the overall goal to provide support on national and local capacity for waste management. These studies will help ASEAN Secretariat to raise awareness and consensus among its member states on undertaking waste management, e-waste management, and mercury waste as a national priority.

The scoping study serves as a preliminary assessment of the current mercury waste management systems and practices in the ASEAN member states (AMS). It is aimed at identifying the current available sources of the relevant information, summarizing the essential information, and identifying gaps of information, challenges, needs and opportunities for further studies or actions.

The scoping study covers all AMS jurisdictions, while sector-wise, it focuses on Mercury in the Artisanal and Small-scale Gold Mining (ASGM); Mercury waste from the chemical manufacturing industry using the Chlor-Alkali process; as well as mercury in fluorescent lamps from industry and household sources. In terms of the Hazardous Waste Management (HWM) aspects under the BC Art. 4 and MC Art. 11, the study covers policies; legislative and regulatory framework; institutional framework; main sources/generators, waste prevention and minimization; handling, separation, collection, packaging and labelling, transportation, storage; treatment and disposal; and contaminated sites.

The secondary data related to the mercury waste management, that was used for the scoping study is limited to data available for the last five years only (2011-2015). A questionnaire was circulated to the ten selected AMS as the primary survey instrument, however, only six AMS returned the questionnaire, partially completed. The information and data acquired from the relevant web publications and the questionnaire were analysed and re-synthesised for developing the draft report of the study. The ASEAN member countries reviewed the draft report during the Expert Review Meeting on Waste Management in August 2016, held in Bangkok, Thailand. Comments received by the ASEAN member countries were taken into account in finalising the report.

The study aims to overview the adequacy of the regulatory framework for mercury waste management with regard to the existence of regulatory distinctions of mercury as a commodity and as waste, specific regulations for hazardous waste management, specific regulations for mercury waste or the inclusion of mercury in the hazardous waste management regulation, legal definitions of mercury waste, classifications and threshold limit for mercury waste, requirements for generators registration or identification, disposal facilities authorisation and inspection, as well transboundary movement requirements. In addition, the study also looks at the regulatory basis for mercury elimination, including reduction and phase-out of mercury mining and its uses in certain mercury-added products, as well as the regulatory aspect of mercury-contaminated sites management. National regulatory classification of mercury waste is also checked against the Basel Convention's classification system.

Based on the responses of the AMS to the questionnaire and other secondary data analysis, most AMS have a regulatory distinction of mercury as a commodity and as waste and have a specific regulation for hazardous waste management, in which mercury waste is included. The study has found that most AMS, except for Brunei and Cambodia, already have at least two main elements of the systems adequately in place, in particular the legal framework and institutional framework. Some AMS, such as Indonesia, Malaysia, Philippines and Thailand, also already have the other three elements of the system infrastructure (operational resource), operations/processes, education/information system and control, adequately in place.

It was found that all AMS have established an institutional framework with defined roles and responsibilities in undertaking the management of hazardous waste. Typically, the main responsibility for hazardous waste management is mandated by the state environmental authorities, e.g. Ministry of Environment. The other public service institutions involved, generally include the Trade/Commerce, Health, Mining & Energy and Customs Authorities. Some AMS have indicated that overlapping among the institutions has occurred and the interagency coordination was still poor. Nevertheless, at least two AMS, Thailand and Malaysia, have established a national coordination board for mercury or hazardous waste management, consisting of the relevant national authorities.

A few AMS have a number of licensed transporters, recyclers and TSD (treatment, storage and disposal) facilities for the ESM of hazardous waste. However, none have initiated mercury recycling. The few recyclers, especially for mercury-containing lamps (MCL) in Indonesia, Malaysia, Philippines and Thailand only dismantle or crush the MCL locally and export the crushed MCL to certain developed countries, such as Germany and Japan. Typically, mercury waste generators in member states, identify and manage their waste on-site with minimisation principles or by engaging licensed transporters and recycling or TSD service providers. The TSD facilities employ solidification/stabilisation processes and landfilling. In case local TSD facilities are unavailable, generators export the mercury waste to certain developed countries for recycling and or disposal in accordance with the transboundary movement (TBM) requirements.

Artisanal and small-scale gold mining (ASGM) activities in Southeast Asia have spread almost throughout the whole region, in particular in Cambodia, Indonesia, Myanmar, the Philippines, Thailand and Viet Nam. Most AMS have phased-out the use of mercury cells technology in their chlor-alkali production. In Thailand and Viet Nam mercury waste management practices in the industry were found to not be in accordance with regulatory requirements. Most AMS promote mercury elimination in mining and industrial processes, while a few AMS have already targeted phase-out for mercury in medical measuring devices production.

A few of the AMS have been found to have MCL industries, such as production or recycling facilities for waste MCL. Most AMS import the MCL, while Malaysia, Philippines, Singapore and Thailand have collection schemes for both institutional and household sources of waste MCL. Indonesia's MCL recycler serves industrial customers only and the waste MCL from the household source mostly goes to the municipal solid waste system as in the case of Viet Nam.

A few AMS have conducted mercury inventory using the UNEP Tool Kit. However, most AMS have not conducted a comprehensive inventory of mercury waste. Currently, the main supply of mercury in the region is from external sources. Most AMS did not provide data on mercury supply, uses and mercury waste management data. Malaysia and Philippines have better records or databases for mercury waste management. As only a few AMS have provided quantitative data, reliable mercury waste management data are scarcely available in the region. Although UN Comtrade maintains a huge database of the world commodity trade flows and quantities and retrievable by queries, it was difficult to distinguish mercury as waste from that of commodity on the database as the data are based on countries report and HS codes for commodity.

The most common challenges indicated by the majority of AMS include illegal trade of mercury related to ASGM, unavailability or inadequacy of infrastructure for mercury/hazardous waste management, operational problems, inadequate regulatory framework, expertise/resources and lack of inventory/data of mercury. As a result, improvement in the areas of education/training, control/enforcement, infrastructure development, regulatory framework, institutional capacity strengthening and inventory development are commonly identified as solutions. Furthermore, the study indicates that there are opportunities to develop or strengthen regional cooperation in the areas of education, institutional capacity, infrastructure development, inventories, economy as well as control or enforcement network.

Generally, the AMS have almost all of the main elements of waste management systems in place. However, some AMS still have weak elements, particularly the resource/infrastructure, operations and education/information. Even in the more advanced AMS, the adequacy levels of the system still vary. Regional cooperation is also still limited. The situation has not yet ensured that the ESM of mercury waste is well achieved.

In addition to individual AMS corrective and improvement actions to be taken, a regional strategy for the ESM of mercury waste may become a good platform, provided that it is thoroughly developed and implemented. Recommendations and considerations for the development of the regional strategy are provided in the full report.



# 1

## INTRODUCTION

### 1.1 BACKGROUND

The waste management issue is one of the prime issues on the national and international agenda due to its severe negative impacts on the environment, lack of resources to effectively manage waste, and loss of resources which could be saved and/or recovered through proper waste management based on the waste management hierarchy, circular economy and 3R (reduce, reuse and recycle) approach. Rapid increase in volume and types of solid waste and hazardous waste generation is becoming a burgeoning problem for national and local governments to ensure a sustainable management of waste. Waste management has a strong bearing on the quality of human life as well as that of flora and fauna. The adverse impacts of improper waste management are very serious and well known. Waste management also requires resources - both financial as well as sound technologies. In low-income countries, collection alone drains up to 80 - 90 percent of the municipal solid waste management budget.

It is necessary that the perspective on waste management will change, to be viewed not merely as a problem, but also as an opportunity, as waste represents lost resources. However, there are several challenges that need to be overcome, particularly in the developing countries. While the challenges may be difficult to overcome, in today's context, waste management also offers several exciting opportunities.

The Association of Southeast Asian Nations (ASEAN) Working Group on Multilateral Environmental Agreements (AWGMEA) at its meeting in Brunei in 2014 decided to conduct three scoping studies on waste management, e-waste management and mercury waste management. In line with the abovementioned decision, AIT, under the leadership of the United Nations Environment Programme, has conducted studies and scientific assessments, and developing compendiums related to waste management. These are in line with the overall goal to provide support on national and local capacity for waste management. The studies will help the ASEAN Secretariat to raise awareness and consensus among its member states on undertaking waste management, e-waste management, and mercury waste as a national priority.

This report provides the results of the regional study on mercury waste management as one of the abovementioned three studies. The study has taken into account relevant provisions stipulated in the Basel Convention and the Minamata Convention on Mercury as well as the Basel Convention Technical Guidelines for the Environmentally Sound Management (ESM) of Mercury Waste. The draft report of this study has been presented to UN Environment, the ASEAN Secretariat and the ASEAN member states (AMS) for their review and relevant comments/suggestions.

## 1.2 OBJECTIVES

The study basically serves as a preliminary assessment of the current mercury waste management systems and practices in the ASEAN member states. It is aimed at identifying the currently available sources of the relevant information, summarizing the essential information on the regional situation of mercury waste management, and identifying gaps of information, challenges, needs and opportunities for further studies or actions.

The results of the study will answer the questions whether or not mercury management in the Region has been adequately supported with adequate national management systems; whether or not a member state or more still need(s) assistance for developing or improving their management capacity in the ESM of mercury waste. In addition, the results of the study may answer the question whether or not a regional strategy needs to be developed and, if so, what aspects need to be considered in developing it.





## 1.3 SCOPE

The scope of this report includes mercury waste, particularly Y29 under the Basel Convention's classification of hazardous waste; mercury/hazardous waste management (HWM) aspects under Article 4 of the Basel Convention and Article 11 under the Minamata Convention. The management aspects of mercury waste as part of hazardous waste management covered under this study consist of policies; legislative and regulatory framework; institutional framework; infrastructure; operations; and education, authorisation and control. The mercury waste management operation that is under study, mainly consists of waste prevention and minimization; handling, separation, collection, packaging and labelling; transportation; treatment, storage and disposal (TSD); and contaminated sites.

Sector-wise, the study focuses on the artisanal & small-scale gold mining (ASGM); the chlor-alkali production using mercury cells technology as well as fluorescent (mercury-containing) lamps from industry and households.

Quantitative data were needed for analysis under this study and were collected as secondary data. The secondary data, related to the mercury waste management, that was collected and used for the study is limited to data available for the last five years (2011-2015) only.

Geographically, the study covers the entire ASEAN region. Currently, the ASEAN member states comprise Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Viet Nam.

## 1.4 METHODOLOGY AND SYSTEMS

Preparatory activity included identification of expected output of the study, development of study report structure and contents, identification of types of information and data to be collected, and identification of main sources of information/data at both regional and national levels. A survey questionnaire was circulated to 10 ASEAN member countries. Information and data collection included compilation of the currently available information and data, establishing initial contacts with the identified main source(s) of information/data, information and data collection from regional sources, information and data collection from national sources, and review on the collected information and data, as well as the detailed workplan was presented during the ASEAN meeting held in May 2016 in Bali, Indonesia. The ASEAN member countries reviewed the draft Mercury report during the Expert Review Meeting on Waste Management in August 2016 in Bangkok. Comments received by the ASEAN member countries were incorporated to generate the final report.

The study was conducted with the methodology as summarised hereunder.

1. Preparatory Activity
  1. Identification of expected output of the study
  2. Development of study report structure and contents
  3. Identification of types of information and data to be collected
  4. Identification of main sources of information/data at both regional and national levels
2. Information and Data Collection
  1. Compilation of the currently available information and data
  2. Establishing initial contacts with the identified main source(s) of information/data
  3. Information and data collection from regional sources
  4. Information and data collection from national sources with questionnaire
  5. Review on the collected information and data as well as the detailed workplan
3. Development of the First Draft Report
  1. Initial information and data analysis
  2. Draft report development
  3. Submission of the first draft report
  4. Review of the first draft report by AIT (and ASEAN countries)
  5. Collection of comments on the first draft report
4. Development of the Second Draft Report
  1. Review of comments on the first draft report
  2. Revision of the first draft report
  3. Submission of the second draft report
  4. Review of the second draft report by AIT (and ASEAN countries)
  5. Collection of comments on the second draft report
5. Development of the Final Report
  1. Review of comments on the second draft report
  2. Finalisation of the draft report
  3. Submission of the final report to AIT

# 2

## MERCURY WASTE MANAGEMENT SYSTEMS

This chapter provides information on the mercury waste management system in each of the ASEAN member states (AMS). The information on the management of mercury waste provided is either specific to or part of the general hazardous waste management system.

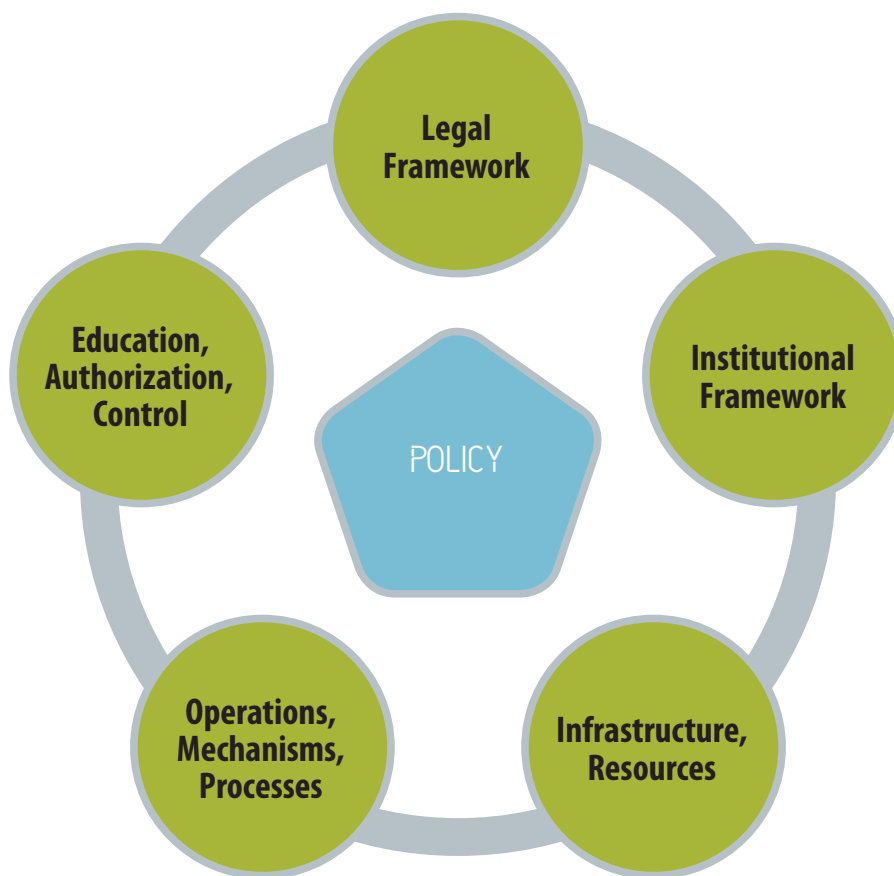
The study was conducted taking into account the principles of the environmentally sound management (ESM) of hazardous waste under the Basel Convention. The study also made use of the Basel Convention Technical Guidelines for the ESM of Mercury Waste which was just adopted by the Conference of the Parties at its meeting in 2015 as one of the main references for establishing the elements of the mercury waste management under review.

The Environmentally Sound Management (ESM) of Hazardous Waste is one of the pillars of the Basel Convention on the Control of Transboundary Movement of Hazardous Waste and their Disposal. Paragraphs 2 (a)-(e) and 2 (g) of Article 4 of the Basel Convention set out key provisions pertaining to Environmentally Sound Management (ESM) of hazardous waste, waste minimization, reduction of transboundary movement, and waste disposal practices that mitigate adverse effects on human health and the environment:

“Each Party shall take appropriate measures to:

1. Ensure that the generation of hazardous wastes and other wastes within it is reduced to a minimum, taking into account social, technological and economic aspects;
2. Ensure the availability of adequate disposal facilities, for ESM of hazardous wastes and other wastes, that shall be located, to the extent possible, within it, whatever the place of their disposal;
3. Ensure that persons involved in the management of hazardous wastes or other wastes within it take such steps as are necessary to prevent pollution due to hazardous wastes and other wastes arising from such management and, if such pollution occurs, to minimize the consequences thereof for human health and the environment;
4. Ensure that the transboundary movement of hazardous wastes and other wastes is reduced to the minimum consistent with the environmentally sound and efficient management of such wastes, and is conducted in a manner which will protect human health and the environment against the adverse effects which may result from such movement;
5. Not allow the export of hazardous wastes or other wastes to a State or group of States belonging to an economic and/or political integration organization that are Parties, particularly developing countries, which have prohibited by their legislation, all imports, or if it has reason to believe that the wastes in question will not be managed in an environmentally sound manner, according to criteria to be decided on by the Parties at their first meeting;
6. Prevent the import of hazardous wastes and other wastes if it has reason to believe that the wastes in question will not be managed in an environmentally sound manner.”

A hazardous waste management system generally comprises policies, regulatory framework, institutional framework or organisation, responsibilities, processes, procedures, practices and resources including infrastructure as well as evaluation and improvement measures as illustrated in figure 1. This chapter focuses on the brief description of the system, overview of the relevant regulatory and institutional frameworks as well as the existing infrastructure or services as essential technical resources for proper mercury/hazardous waste management in the Region.



**Figure 1 Hazardous Waste Management System used as parameters of analysis under this study**

A set of hazardous waste management system elements and parameters used as reference under the study are presented in Appendix I of this report, taking into account the Basel Convention’s principles of the ESM of hazardous waste as well as the Basel Convention Technical Guidelines for the ESM of Mercury Waste.

Until early September 2016, eight out of the ten AMS have responded to the questionnaire distributed in late June 2016. Those are Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Myanmar, the Philippines, Thailand and Viet Nam. Despite responding, some member states did not completely respond to all of the questions. Therefore, the needed information and data had to be acquired from the other sources, mostly web sources and member states’ presentation materials at the relevant workshop. The combined results of information and data collection are summarised in the following tables and or graphics.

### Regulatory framework

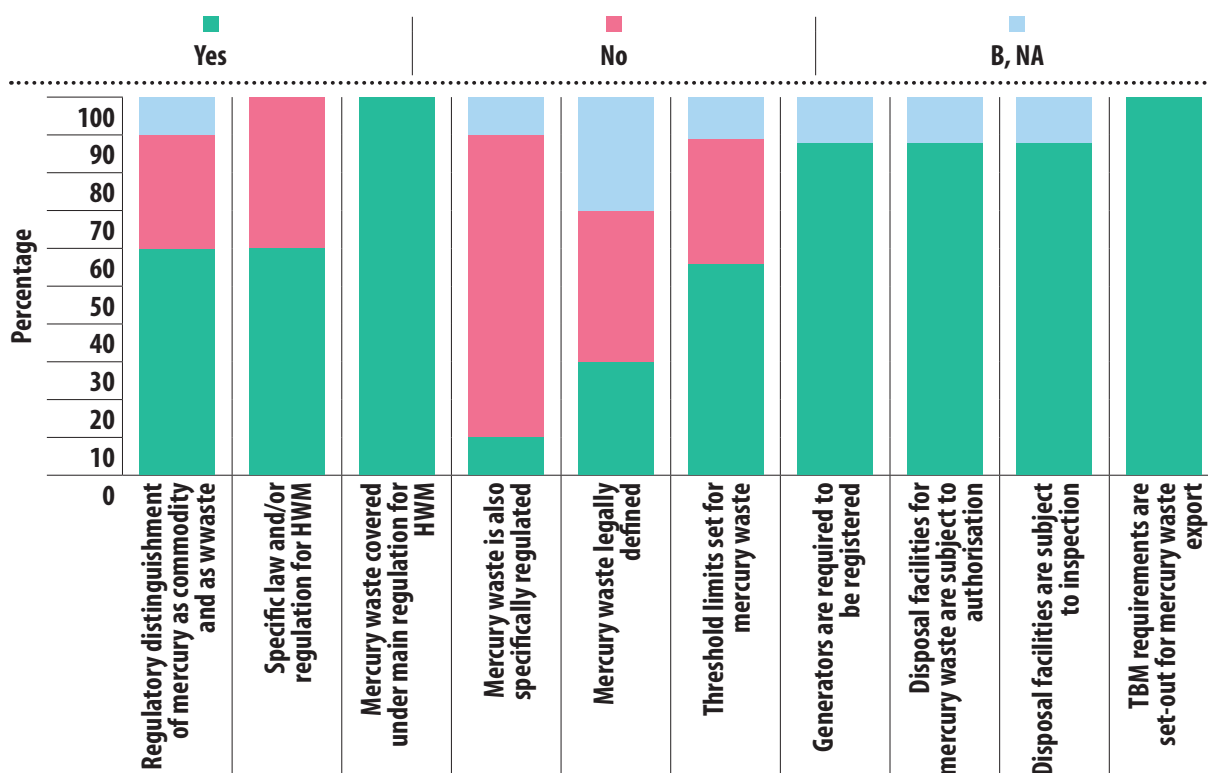
The current state of the main provisions of the regulatory framework of the AMS, against the regulatory framework parameters set-out under this study is presented in Table 1. The responding member states are identified with green colour. The responders were instructed to answer the questions under the “Legal Framework” section in the questionnaire with “Y” (yes) or “N” (no) or “NA” (not applicable). The blanks indicate that the responder left some questions unanswered. The same case applies to the information obtained from the sources other than the responses to the questionnaire. The results are indicated in Table 1 and Table 2.

**Table 1 Summary of results of information and data on the main elements of the regulatory framework in each member state**

Main Elements	BR	KH	ID	LA	MY	MM	PH	SG	TH	VN
Reg. distinction mercury vs. mercury waste	N	Y	Y		Y	N	Y	Y	Y	Y
HWM regulation	Y	N	Y	N	Y	N	Y	Y	N	Y
Mercury incl. in HWM Reg.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Mercury-specific waste reg.	N	N	N	N		N	Y	N	N	Y
Mercury waste legally defined	N	N		N		N	Y		Y	Y
Threshold limit for mercury waste	NA	Y	Y	N		N	Y	N	Y	Y
Generators to be registered	NA	NA	Y		Y	Y	Y	Y	Y	Y
TSDF subject to authorisation	NA	Y	Y		Y	NA	Y	Y	Y	Y
TSDF subject to inspection	NA	Y	Y		Y	NA	Y	Y	Y	Y
TBM requirements set-out	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

\* Member states who responded to the questionnaire are identified with green colour.

Figure 2 graphically illustrates the current state of the regulatory framework of the AMS based on the data presentation in Table 1 above. The figure shows that almost all of the member states already have the main elements of the regulatory framework for the ESM of mercury waste management, except for two elements. Those elements are specific regulations for mercury waste management and the legal definition of mercury waste. However, specific regulation for mercury is not necessary if the main regulation for hazardous waste management has adequately addressed the mercury waste hazards, characteristics and its sound management in order to protect human health and the environment (some member states may not have mercury-specific regulations, but, mercury is already included in the general hazardous waste regulatory framework).



**Figure 2** ASEAN member states' regulatory framework status based on the main parameters set-out under this study

Table 2 shows that fifty percent of the AMS legally require mercury use reduction and a few of them have set target dates for phasing-out mercury in mining/production and in certain activities/products. Mercury mining/production may not be relevant to those member states that have no mercury mining/production in their jurisdictions.

**Table 2** Summary of information and data collection on the regulatory framework with regard to mercury elimination, mercury waste classification and mercury-contaminated sites management

Main Elements	BR	KH	ID	LA	MY	MM	PH	SG	TH	VN
Mercury use reduction legally required	N	NA	NA	Y	Y	Y	Y		Y	N
Phase-out of mercury mining/production set-out	NA	NA	N	N	Y	NA	Y		N	N
Mercury phase-out in certain activities/products set-out	N	NA	Y	N		NA	Y		N	N
BC's waste classification and codes fully adopted	Y	N	N		Y	Y	N	Y	Y	Y

Main Elements	BR	KH	ID	LA	MY	MM	PH	SG	TH	VN
National classification and codes set-out		NA	Y		Y	N	Y			Y
Contaminated-sites management requirements	NA	NA	Y	N		Y			NA	
Clean-up criteria established		NA	Y	N		Y			NA	

The Table also shows that sixty percent of the member states fully adopt the Basel Convention hazardous waste classification system. Four member states also have set-out their own national classification system for hazardous waste, including the mercury waste.

Two member states have confirmed that contaminated sites management is legally required and two member states have already established a set of criteria for contaminated sites clean-up accomplishment.

#### Institutional Framework

Most member states assign their national environmental authorities with the overall environmental management responsibility, including the management of hazardous waste, which also covers the mercury waste management. In addition, under their institutional framework, the member states have defined specific roles for the other national institutions in the mercury/hazardous waste management as indicated in Table 3.

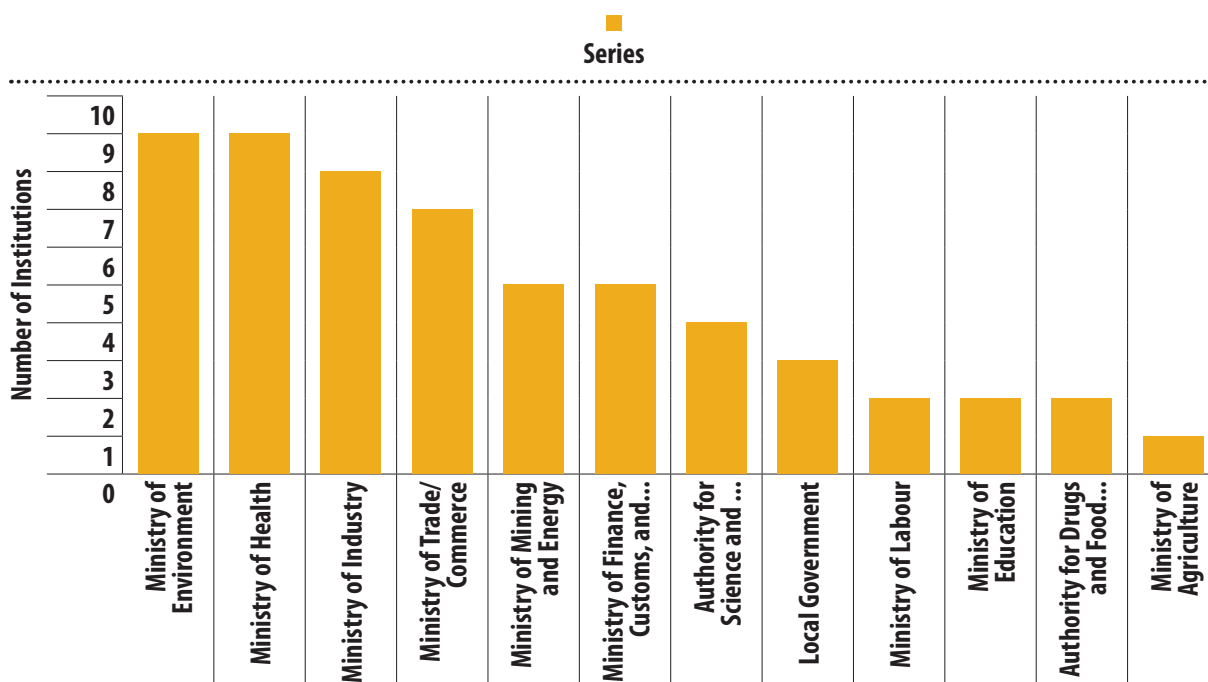
**Table 3 Institutional framework, national institutions which are involved in the management of mercury and mercury waste in each jurisdiction (indicated as “Y”)**

Institutions	BR	KH	ID	LA	MY	MM	PH	SG	TH	VN
Min. of Environment	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Min. of Industry	Y	Y	Y	Y	Y	Y	Y		Y	Y
Min. of Trade/Commerce		Y	Y	Y	Y	Y	Y			Y
Min. of Health	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Min. of Labour					Y		Y			
Min. of Agriculture		Y	Y							
Min. of Mines and Energy	Y	Y			Y	Y	Y			
Min. of Education	Y		Y				Y		Y	
Min. of Finance, Customs and Excise	Y	Y	Y	Y	Y	Y	Y			Y
Authority for Drugs and Food Control		Y	Y							
Authority for Science and Technology				Y		Y				Y
Local Government				Y			Y			Y



Each member state has a different configuration of the institutional framework. However, as shown in Figure 3, national authorities for environment, health, industry, trade/commerce, mining and energy, customs & excise, and science and technology are the ones most commonly involved in the mercury and mercury waste as well as for the other hazardous waste management.

The specific roles of each national authority in the mercury and mercury waste management in each member state are described in the individual sections of this chapter.



**Figure 3** Common sectorial government institutions involved in the management of mercury and mercury waste

#### Infrastructure for HWM

The current results for the collection of information and data on the national infrastructure for hazardous waste management are presented in Table 4. The table may not reflect all available facilities in the region since some of the data were not provided by the member states, however, have been taken from several secondary data sources. The data presented may also not reflect the actual number of facilities that are capable of mercury recovery or mercury waste treatment and disposal.

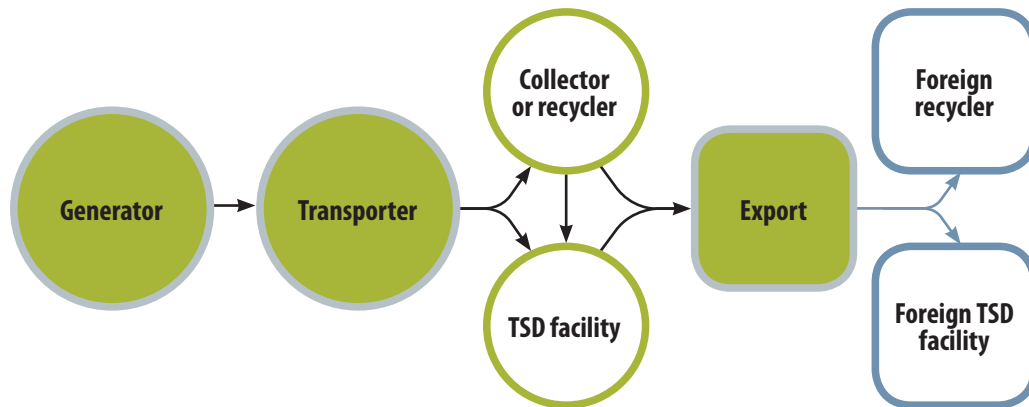
**Table 4 Hazardous waste management facilities constituting the national infrastructure for hazardous waste including mercury in each member state**

Type of Service	BR	KH	ID	LA	MY	MM	PH	SG	TH	VN
Transportation			1108				280			80
Collection			123					199		1
Recovery	0	0	236	0	333	0				
Treatment	0	0	21	0	43	1			8	76
Disposal	0	0	22	0	6	1	117	1	3	2

However, the data presented in the table above may provide the impression on the scarcity of adequate infrastructure for mercury waste management in the region.

#### Hazardous Waste Management Operations

Member states which already have relatively adequate hazardous waste management systems usually also have typical operations as graphically described in Figure 4.



**Figure 4 Hazardous waste management operations flow chart commonly found in the jurisdictions of the ASEAN member states that have all the hazardous waste management system elements in place**

Generators of hazardous waste, especially those who do not have their own hazardous waste management on-site facilities, engage commercial hazardous waste management service providers, which may consist of licensed collectors or recyclers or the Treatment, Storage and Disposal (TSD) facilities. Licensed commercial transporters may also have a role in the operations if the collectors, recyclers or the engaged TSD facilities do not provide transportation services. The generators shall make an agreement with the designated collectors, recyclers, or TSD facilities on the acceptance and the fee for the hazardous waste batch to be transferred for recycling or treatment and disposal. Upon agreement on the acceptance, price and the time of hazardous waste batch collection, an agreement with a transporter is then made on the transportation arrangement.

A hazardous waste batch may undergo recycling to recover the economically valuable materials in the waste matrix and the resulting waste or residue is ultimately sent to a TSD facility for proper treatment and disposal. The hazardous waste batch may also be sent directly to a TSD facility or be exported to another country for recycling or treatment and disposal in case the national recyclers or TSD facilities are not capable of handling certain hazardous waste streams. In such a case, the export is subject to the transboundary movement procedures under the Basel Convention framework.

The individual information by country is presented in the following sections and compiled from the member states' responses to the questionnaire and or other secondary data sources. Therefore, it is logical that some information on the situation of mercury/hazardous waste management in a member state which was obtained through other secondary sources, e.g. web publications, may not reflect the current one.

## 2.1 BRUNEI DARUSSALAM

Brunei is an energy-rich sultanate on the northern coast of Borneo in Southeast Asia. Brunei boasts a well-educated, largely English-speaking population; excellent infrastructure; and a stable government intent on attracting foreign investment. Crude oil and natural gas production account for approximately 65% of GDP and 95% of exports, with Japan as the primary export market.

Per capita GDP is among the highest in the world, and substantial income from overseas investment supplements income from domestic hydrocarbon production. Bruneian citizens do not pay personal income taxes, and the government provides free medical services and free education until the university level.

The Bruneian Government wants to diversify its economy away from hydrocarbon exports to other industries such as information and communications technology and halal manufacturing. Brunei's trade in 2016 is set to increase, following its regional economic integration in the ASEAN Economic Community, and the expected ratification of the Trans-Pacific Partnership trade agreement.

Currently, the main industrial sectors in Brunei comprise petroleum, petroleum refining, liquefied natural gas, construction, agriculture, and transportation. Brunei is a Party to the Basel Convention.

## 2.1.1 MERCURY/HAZARDOUS WASTE MANAGEMENT SYSTEM

Currently, the hazardous waste management system in Brunei is primarily supported with regulatory instrument and institutional instrument. Brunei stated that there were no proper facilities available at the time this report was written.

Brunei introduced its integrated waste management system at the Second Meeting of Regional 3R Forum as illustrated in figure 5.<sup>1</sup>

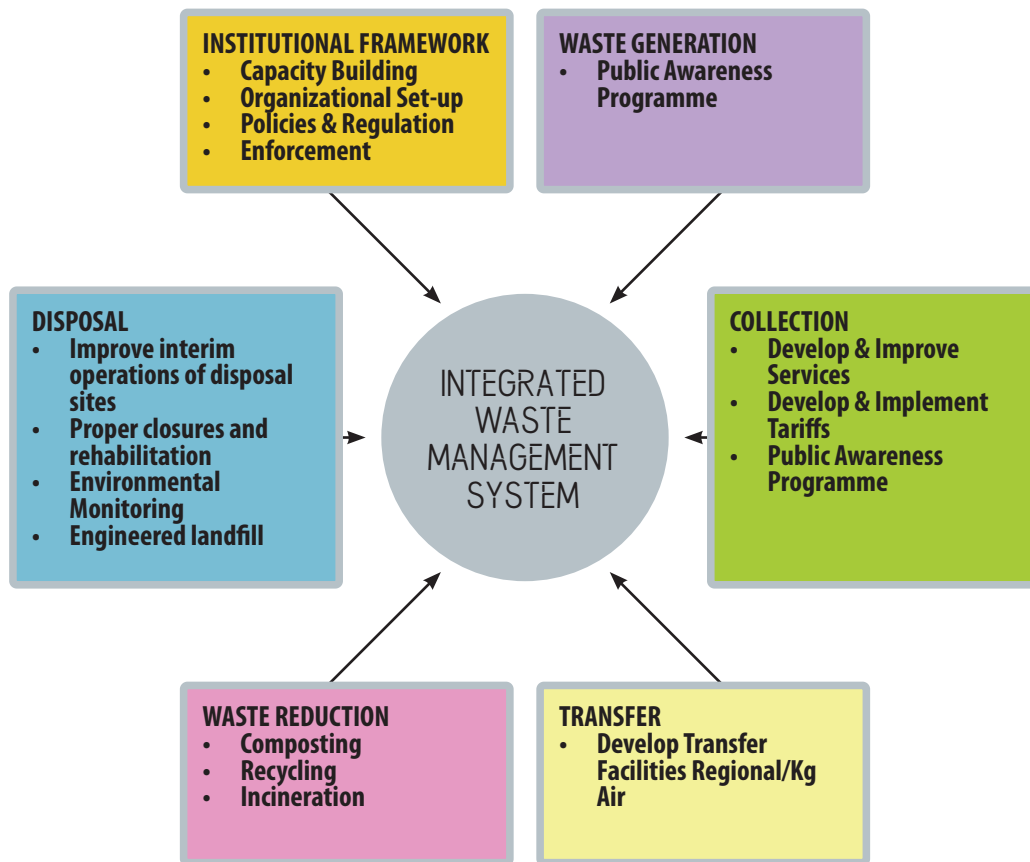


Figure 5 Brunei's integrated waste management system

<sup>1</sup> Hj Mohd Rozan Dato Paduka Hj Yunos and others (2010).

## 2.1.2 LEGAL FRAMEWORK

### 2.1.2.1 MAIN PROVISIONS

Currently there is no dedicated law in Brunei Darussalam regarding hazardous waste or mercury waste management. Few guidelines such as Pollution Control Guidelines on Industrial Development and Draft Environmental Order are in their final stages with the Attorney General, deals on the surface with it. The management of the hazardous waste is based only on the Poison Act Regulation (Ministry of Health).

However, Brunei regulates hazardous waste control for import, export and transit with its Hazardous Waste Order of 2013. The Order was established only for transboundary movements of hazardous waste in accordance to the Basel Convention obligations to Parties. Mercury waste is not specifically regulated, but is covered under the Order as part of the general hazardous waste. Brunei has no regulatory distinction of mercury as commodity or as waste.

#### Definition of mercury waste

There is no legal definition of mercury waste in Brunei. However, Brunei fully adopts the Basel Convention's categorisation and classification of hazardous waste.

#### Registration of generators

Registration of hazardous waste generators is not applicable in Brunei.

#### Authorization and inspection of disposal facilities

There is no recovery, treatment nor disposal facilities operating in Brunei. Therefore, no inspection is required. Hazardous waste is mainly exported by the generators themselves, while, there are no hazardous waste importers in existence, since the importation of hazardous waste is prohibited in Brunei.

#### Transboundary movement requirements

The transboundary movement requirements are provided under the Hazardous Waste (Control of Import, Export and Transit) Order, 2013 in order to meet the Basel Convention obligations.

### 2.1.2.2 MERCURY ELIMINATION

Reduction of mercury use is not legally required in Brunei. Therefore, phase-out of mercury mining/production and mercury use in certain activities/products is also not yet set.

### 2.1.2.3 REGULATORY CLASSIFICATION OF MERCURY WASTE

Brunei fully adopts the hazardous waste classification system under the Basel Convention, including that for mercury waste as specified in Annex I and Annex VIII of the Convention.

### 2.1.2.4 MERCURY-CONTAMINATED SITES MANAGEMENT ASPECT

Brunei indicated that there is no legal basis for mercury-contaminated sites management at the moment.

## 2.1.2 INSTITUTIONAL FRAMEWORK

The Department of Environment, Parks and Recreation under the Ministry of Development is the main government institution responsible for environmental affairs. It is also the designated National Focal Point as well as the Competent Authority for the Basel Convention.

In addition, other government institutions are involved in the implementation of the hazardous waste management as listed hereunder.

- › Energy and Industry Department at the Prime Minister's Office, responsible for the management of the industry sector in the country
- › Royal Customs and Excise Department, Ministry of Finance, Border Control
- › Ministry of Health, Management of mercury-contained lab apparatus and medical devices
- › Ministry of Education, Management of mercury-contained lab apparatus used for educational purposes

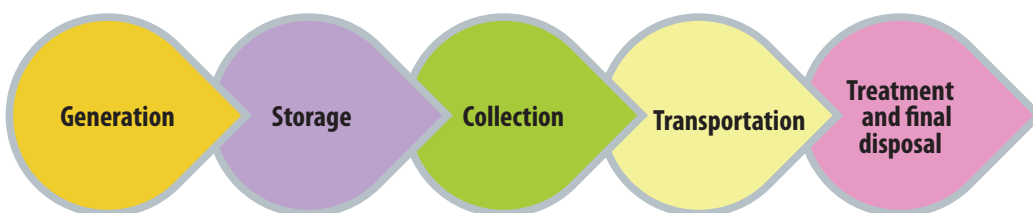
### 2.1.3 MERCURY/HAZARDOUS WASTE MANAGEMENT INFRASTRUCTURE/SERVICES

Based on Brunei's response to the questionnaire, at the present time there is no mercury waste recovery, treatment and disposal facility operating in Brunei.

In 2012 it was reported that Brunei does not have any appropriate facilities and sufficient skilled manpower for environmentally-sound disposal methods of hazardous waste. It was also reported that a feasibility study for the Development of a Treatment and Disposal of Hazardous Waste Centre, is currently being undertaken. The feasibility study would look at issues of how the toxic materials can be disposed of and how they can be capped, including how they can be controlled, in terms of their import into Brunei.<sup>2</sup>

### 2.1.4 OPERATIONS

Hazardous waste generators are required to treat and dispose of their waste in an environmentally sound manner. They may engage approved waste management service providers and properly record the storage and disposal of hazardous waste<sup>3</sup>, as illustrated in Figure 6.



**Figure 6** Brief presentation of the prescribed operations of hazardous waste management in Brunei Darussalam

<sup>2</sup> The Brunei Times (2012).

<sup>3</sup> Brunei's presentation at the Asian Network Regional Workshop (2009)

Industrial wastes generation are mainly from Brunei Shell Petroleum Industry (BSP), Brunei Liquefied Natural Gas Industry (BLNG) and New Brunei Methanol Industry. Basically, most of the waste which is generated, will be treated by companies themselves, however some chemical waste will be disposed of by exporting the chemical waste to other approved countries through Basel Convention procedures.<sup>4</sup>

## 2.2 CAMBODIA

Cambodia has experienced strong economic growth over the last decade; GDP grew at an average annual rate of over 8% between 2000 and 2010 and at least 7% since 2011. The tourism, garment, construction and real estate, and agriculture sectors accounted for the bulk of the growth. Around 600,000 people, the majority of whom are women, are employed in the garment and footwear sector. An additional 500,000 Cambodians are employed in the tourism sector, and a further 50,000 people in construction. Tourism has continued to grow rapidly with foreign arrivals exceeding 2 million per year since 2007 and reaching around 4.5 million visitors in 2014. Mining has also been attracting some investor interest and the government has touted opportunities for mining bauxite, gold, iron and gems.

Cambodia remains one of the poorest countries in Asia and long-term economic development remains a daunting challenge, inhibited by endemic corruption, limited human resources, high income inequality, and poor job prospects. As of 2012, approximately 2.66 million people live on less than \$1.20 per day, and 37% of Cambodian children under the age of 5 suffer from chronic malnutrition. More than 50% of the population is less than 25 years old. The population lacks education and productive skills, particularly in the impoverished countryside, which also lacks basic infrastructure.

The Cambodian Government has been working with bilateral and multilateral donors, including the Asian Development Bank, the World Bank and IMF, to address the country's many pressing needs; more than 30% of the government budget comes from donor assistance. A major economic challenge for Cambodia over the next decade will be fashioning an economic environment in which the private sector can create enough jobs to handle Cambodia's demographic imbalance.

The Industrial sector comprises tourism, garments, construction, rice milling, fishing, wood and wood products, rubber, cement, gem mining, textiles. Cambodia is a Party to the Basel Convention and a Signatory to the Minamata Convention.

### 2.2.1 MERCURY/HAZARDOUS WASTE MANAGEMENT SYSTEM

Cambodia already has legislations and regulations, national institutions, infrastructure, operational mechanisms, and an educational programme to support its policy on the hazardous waste management system. Detailed information on the abovementioned system elements is presented in the following sub-sections.

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4 Hj Md Zin Hj Yaakub (2014)

## 2.2.2 LEGAL FRAMEWORK

### 2.2.2.1 MAIN PROVISIONS

Cambodia's Law on Environmental Protection and Natural Resources Management implemented on December 24, 1996 by Ministry of Environment is relevant for toxic chemicals and hazardous waste management and protection of environmental quality. It prevents the environmental pollution through conducting environmental impact assessment for development projects and by monitoring chemicals and hazardous waste. It's mentioned in Article 6 (paragraph 1), 8, 12, and 13 of the Law.

The Law is further elaborated within its framework for hazardous waste management with its Sub-Decree on Solid Waste Management issued in 1999, in particular under Chapter 3. Article 11 of the Sub-Decree obliged the Ministry of Environment to establish guidelines on the management of hazardous waste to ensure the safe management. Mercury waste is not specifically regulated, but covered under the Sub-Decree as part of the general hazardous waste. Cambodia distinguishes mercury as a commodity from mercury as waste by regulation.

Sub-Decree No 37 (Articles 3, 15, 17, 20, 21, 24, 25, 26) on Solid Waste Management issued in April 27, 1999 by Ministry of Environment, Chemicals substances, stated that mercury (Hg) waste and its compound is hazardous waste, as specified in the Basel Convention and thus needs management by separation from household waste. Control of this hazardous waste and all activities related to hazardous waste generation and its disposal is governed under this legislation.

#### Definition of mercury waste

There is no legal definition of mercury waste in Cambodia. However, despite not fully adopting the Basel Convention's classification of hazardous waste, Cambodia has set a threshold limit value for mercury waste ( $\text{Hg} < 10 \text{ mg/kg}$ ).

#### Registration of generators

Registration of hazardous waste generators is not applicable in Cambodia. However, Art. 14 of the Sub-Decree requires that the owner of hazardous waste writes a quarterly report on his/her waste and forwards it to the Ministry of Environment. The report shall include the type and amount of the waste, temporary storage method, and treatment or elimination method.

#### Authorization and inspection of disposal facilities

Authorization and inspection of disposal facilities are required under the Sub-Decree on Solid Waste Management of 1999. Art. 17 and 19 of the Sub-Decree state that hazardous waste facilities are subject to a permit or approval from the Ministry of Environment.

#### Transboundary movement requirements

The transboundary movement requirements are provided under the Sub-Decree on Solid Waste Management of 1999 in order to meet the Basel Convention obligations.

- › Article 21 (Sub-Decree No 37, on Solid Waste Management): The importation of the hazardous waste from abroad into the Kingdom of Cambodia is strictly prohibited. The list of hazardous waste is completely based on the annex of the Basel Convention.
- › Article 20 (Sub-Decree No 37, on Solid Waste Management): The exportation of the hazardous waste from the Kingdom of Cambodia could be conducted on the basis of an agreement from the Ministry of Environment, an export license from the Ministry of Trade, and a permit from the



importing country. The exportation of the hazardous waste is consistent with the provisions and principles of the Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their Disposal, which was approved in 1989, and came into force on May 05, 1992.

#### 2.2.2.2 MERCURY ELIMINATION

Reduction of mercury use is not legally required in Cambodia. Therefore, phase-out of mercury mining/production and mercury use in certain activities/products is also not yet set.

#### 2.2.2.3 REGULATORY CLASSIFICATION OF MERCURY WASTE

Cambodia does not fully adopt the hazardous waste classification system under the Basel Convention, including that for mercury waste as specified in Annex I and Annex VIII of the Convention. However, it is also not clear if Cambodia has set its own national classification system.

#### 2.2.2.4 MERCURY-CONTAMINATED SITES MANAGEMENT ASPECT

Cambodia indicated that there is no legal basis for mercury-contaminated sites management at the moment.

### 2.2.3 INSTITUTIONAL FRAMEWORK

Governmental institutions participate in chemicals management according to their role and responsibility regulated by governmental ordinances. The governmental institutions fulfil their mandates in managing chemicals by building safety into the chemicals production processes, chemicals trade, and by ensuring the prevention and/or mitigation of impacts on people's health, especially user health, and protect the environment and biodiversity. The governmental ministries involved in chemical management process include:

- › Ministry of Commerce (Department of CAMCONTROL). Related to chemicals management, the Ministry of Commerce through the department of CAMCONTROL has the role and responsibility for controlling the quality and quantity of imported and exported goods and carrying out the repression of fraud related to product quality, except for pharmaceutical products, medical equipment, and cosmetics.
- › Ministry of Economy and Finance (Department of Customs). Related to the role and responsibility of the Ministry of Economic and Finance in managing chemicals and hazardous waste, the Department of Customs is the Ministry's agent in managing import-export regulated goods; to carry out prevention measures and confiscation of goods smuggled; control, monitor, and manage import-export regulated goods; address passenger's goods, foreign currency, valuable gem stones, jewels, cultural heritage, packages, and parcel postage for all kinds of transportation means.
- › Ministry of Environment. The Ministry of Environment cooperates with other governmental institutions, national and international organizations, non-governmental organizations, and private sectors. It is responsible for monitoring environmental quality (water, soil, and air), controlling environmental pollutants release, and participates in collecting, compiling, and managing data related to toxic and hazardous chemicals, and managing all kinds of waste in terms of a safe environment.

- › Ministry of Industry Mines and Energy. The Ministry of Industry, Mines and Energy is responsible for promoting development of industrial activities, and industrial chemicals production and use in terms of national industrial chemicals management. This Ministry also plays the important role to promote mineral exploration and exploitation activities, and hydropower development. Most importantly, the Ministry also has the obligation to develop the legislation, policy, and planning related to industrial aspects including industrial chemical management.
- › Ministry of Health. Related to chemicals management, the Ministry of Health is responsible for developing the overall health policy direction, regulation and legislation based on the governmental policy goals to improve health, managing the systems of pharmaceutical production, business and distribution of medical and paramedical equipment to all private and public units, and examining and following-up of food safety.
- › Ministry of Interior (National Authority for Controlling Drugs): Relative to the Ministry of Interior in managing chemicals, the Secretariat of National Authority for Drugs Control is responsible for gathering information and operational action against the cultivation of narcotic plants, their production, use, and distribution and the trade/trafficking of drugs. It facilitates drugs control activities in cooperation with other agencies in order to ensure effective and safe drugs control.

#### 2.2.4 MERCURY/HAZARDOUS WASTE MANAGEMENT INFRASTRUCTURE/SERVICES

There are no hazardous waste disposal facilities or recycling facilities available in Cambodia. There are two landfills, one, for solid household waste and a second one for certain special industrial wastes, arising mostly from the garment factory. The liquid hazardous wastes are treated by a number of industrial units, according to the national environmental standard. Ministry of Health is responsible for disposal of hospital waste by incineration.<sup>5</sup>

Based on its response to the questionnaire, Cambodia confirmed that at the present time there is no proper facility for mercury/hazardous waste management (transportation, recovery, treatment and disposal) operating in the country.

#### 2.2.5 OPERATIONS

Based on the recent information from Cambodia, currently, hazardous waste from the generators is directly transferred to a landfill designated for hazardous waste. There is no treatment of the hazardous waste prior to landfilling.

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5 Basel Convention (2006).

## 2.3 INDONESIA

Indonesia, officially the Republic of Indonesia, is an archipelago comprising some 17,508 islands. It has 33 provinces with over 238 million people, and is the world's fourth most populous country. Indonesia is a republic, with an elected legislature and president. The nation's capital city is Jakarta. The country shares land borders with Papua New Guinea, East Timor, and Malaysia. Other neighbouring countries include Singapore, Philippines, Australia, Palau, and the Indian territory of the Andaman and Nicobar Islands. Indonesia is a founding member of ASEAN and a member of the G-20 major economies. The Indonesian economy is the world's sixteenth largest by nominal GDP and fifteenth largest by purchasing power parity.

According to World Trade Organization data, Indonesia was the 27th biggest exporting country in the world in 2010, moving up three places from a year before. Indonesia's main export markets (2009) are Japan (17.28%), Singapore (11.29%), the United States (10.81%), and China (7.62%). The major suppliers of imports to Indonesia are Singapore (24.96%), China (12.52%), and Japan (8.92%). In 2005, Indonesia ran a trade surplus with export revenues of US\$83.64 billion and import expenditure of US\$62.02 billion. The country has extensive natural resources, including crude oil, natural gas, tin, copper, and gold. Indonesia's major imports include machinery and equipment, chemicals, fuels, and foodstuffs. And the country's major export commodities include oil and gas, electrical appliances, plywood, rubber, and textiles.

In an attempt to boost the domestic mineral processing industry and encourage exports of higher value-added mineral products, the Indonesian government implemented a ban on exports of unprocessed mineral ores in 2014.

Indonesia is a Party to the Basel Convention and a Signatory to the Minamata Convention. Since then, Indonesia has developed a National Action Plan under the Minamata Convention and is still to develop the required National Implementation Plan.

### 2.3.1 MERCURY/HAZARDOUS WASTE MANAGEMENT SYSTEM

Indonesia already has all elements of the hazardous waste management system in place. Despite being the first state which has an integrated TSD facility in the South-East Asian region, its infrastructure still lacks in mercury recycling and disposal facilities for high level mercury waste.

### 2.3.2 LEGAL FRAMEWORK

#### 2.3.2.1 MAIN PROVISIONS

The Indonesia's Law No. 32 of 2009 on the Protection and Management of the Living Environment is the umbrella law within the legal framework for the environmental management in Indonesia. The hazardous waste management is further elaborated within the framework with the government regulations. The latest revision of the regulation is currently stipulated under the Government Regulation No. 101 of 2014 on Management of Toxic and Hazardous Waste Substances (GR No. 101/2014).

In general, the GR No. 101/2014 regulates the management and disposal procedures for toxic and hazardous waste substances (“hazardous waste”), covering:

- › Method of identifying, reducing, storing, collecting, transporting, utilizing, processing, and hoarding hazardous wastes;
- › Procedures for dumping hazardous wastes into the open sea or land;
- › Risk mitigation and emergency responses to address environmental pollution caused by hazardous waste; and
- › Sanctions for non-compliance.

The 2014 Regulation is of relevance to producers, importers, exporters and managers of hazardous waste. The 2014 Regulation repeals and replaces the 1999 Regulation, and has been in force since 17 October 2014.<sup>6</sup>

#### Definition of mercury waste

Mercury waste is regulated as part of the general hazardous waste management under the Government Regulation No. 101 of 2014. Hazardous waste is generally defined under the Regulation as “any substance, energy, and/or other components which, due to their nature, concentration, and/or quantity, either directly or indirectly, can pollute and/or damage the environment, and/or endanger the environment, health, and viability of humans and other living creatures”. Despite no specific legal definition of mercury waste, mercury waste is listed in several entries on the List of Hazardous Waste as Appendix to the Regulation. The mercury waste codes and their descriptions as presented in the summary list below also indicate that the Regulation sets threshold limits for mercury waste.

#### Hazardous waste from non-specific sources

- › A105d - waste containing mercury and/or its compound(s) >10 ppm;
- › A110d - spent activated carbon containing A105d
- › B101d - waste containing mercury >0.3-10 ppm

#### Expired products, spill, off-spec products and packaging

- › A2057 - fulminic acid, its mercury salt or fulminic mercury (CAS 628-86-4)
- › A2078 - phenyl mercury acetate (CAS 62-38-4)
- › A2268 - mercury

#### Waste from general specific sources

- › A302-4 - equipment contaminated with mercury waste >10 ppm
- › A302-5 - spent activated carbon from processes using mercury cells
- › A302-7 - mercury sulphide
- › A302-9 - WWT sludge from mercury cells process
- › A302-10 - barium sulphate containing mercury (Hg) >10 ppm
- › A328-1 - mercury switch
- › A329-2 - fluorescent lamp
- › A337-4 - laboratory equipment containing heavy metals incl. mercury
- › A337-5 - Waste medical devices containing heavy metals, including mercury, cadmium, etc.

<sup>6</sup> Indonesia Legal Brief (2013)

### Registration of generators

The current Regulation does not explicitly require the Environmental Authority to develop and/or maintain registration of hazardous waste generators. However, all hazardous waste generators are obliged to notify the Authority on their hazardous waste generation and management. The HWM service providers are also required to apply for permits/licenses from the Environmental Authority and the Environmental Authorities are obliged to control and take necessary actions for any non-compliance occurrence. Hence, it implies that the Environmental Authorities are supposed to develop and maintain register of hazardous waste generators and the other actors.

### Authorization and inspection of disposal facilities

All HWM activities/facilities are subject to authorisation/permit. Control of disposal facilities are specified in Art. 238-240, GR 101/2014 (Art. 240 specifies inspection). It is further prescribed in the Decree of Minister of Environment No. 30/2009 regarding the Permit Procedure of Hazardous Waste and Investigation & Surveillance for Remediation of Contaminated Site by Hazardous Waste for Local Government.

### Transboundary movement requirements

Export is allowed if a generator is incapable of treatment and no proper facility is available domestically (Art. 123, GR No. 101/2014). The TBM requirements are specified in:

- > Art. 124, 101/2014 (export)
- > Art. 196-197, 101/2014 (transit)

#### 2.3.2.2 MERCURY ELIMINATION

Generators are obliged to reduce hazardous waste (Art. 10, GR No. 101/2014), hence, the obligation also covers the mercury waste. In the sectorial management, the Ministry of Energy and Mineral Resources has established a National Action Plan for elimination of mercury in the ASGM activities by 2018. In addition, the Ministry of Health has also conducted a program on reduction and elimination of mercury in medical devices during 2017 - 2018.

#### 2.3.2.3 NATIONAL REGULATORY CLASSIFICATION OF MERCURY WASTE

Indonesia does not fully adopt the hazardous waste classification system under the Basel Convention. However, it has its own national classification system as specified in Annex 1 of GR 101/2014. Table 5 presents the Basel Convention mercury waste codes and their corresponding codes under the Indonesia's national classification system.

**Table 5 Basel Convention Waste Classification and its Corresponding National Classification in Indonesia**

Mercury waste classification under the Basel Convention		Corresponding classification of mercury waste under your national law or regulation for mercury/hazardous waste management	
Code	Description	Code	Description
Y29	Mercury, mercury compounds	A105d	Any waste which is contaminated with and or contains mercury and or its compounds with concentration greater than 10 ppm.
		B101d	Any waste which is contaminated with and or contains mercury and or its compounds with concentration 0.3-10 ppm.
		A2268	Expired, spilled, off-spec mercury and used containers or packaging materials for mercury
		A302-7	Waste mercuric sulphide
A1010	Metal wastes and waste consisting of alloys of, a.o. mercury		
A1030	Wastes having as constituents or contaminants of, a.o. mercury; mercury compounds	A302-4	Waste equipment from chlor-alkali processes using mercury cell technology which is contaminated with mercury greater than 10 ppm
		A302-5	Waste activated carbon used in the production of chlorine, hydrogen, caustic soda using mercury cell technology.
		A337-5	Waste medical devices containing heavy metals, including mercury, cadmium, etc.
A1180	Mercury in waste electrical and electronic assemblies or scrap; mercury switches (Waste electrical and electronic assemblies or scrap containing components such as accumulators and other batteries included in list A, mercury-switches, glass from cathode-ray tubes and other activated glass and PCB capacitors, or contaminated with Annex I constituents (e.g., cadmium, mercury, lead, polychlorinated biphenyl) to an extent that they possess any of the characteristics contained in Annex III (note the related entry on list B B1110))		

#### 2.3.2.4 MERCURY-CONTAMINATED SITES MANAGEMENT ASPECT

Art. 203-205, GR 101/2014 is the legal basis for hazardous waste-contaminated sites management. The requirements are further elaborated under the Decree of the Minister of Environment No. 33/2009 on the Procedures for Hazardous Waste-Contaminated Sites (The Decree is currently under revision).

The GR 101/2014 also sets a threshold value as criteria for the accomplishment of mercury-contaminated sites clean-up/remediation. The threshold value for remediation of contaminated soil is 0.3 mg/kg (dry weight basis) as specified in Attachment V of the GR No. 101/2014.

At the time this report was written, Indonesia had not yet developed a formal national plan for the mercury or any other hazardous waste-contaminated sites management. Nevertheless, the Ministry of Environment and Forestry, during a national survey in 2015 has identified 56 ASGM sites in 14 provinces. Those ASGM sites are considered identical with the mercury-contaminated sites.

### 2.3.3 INSTITUTIONAL FRAMEWORK

The Ministry of Environment and Forestry is the main government institution responsible for the environmental affairs in general. It is also the designated National Focal Point as well as the Competent Authority for the Basel Convention.

The Ministry also has specific roles in the management of mercury, e.g. coordination of the mercury and mercury wastes management; prevention and control of the emission and releases of mercury and mercury wastes into the environment; mercury-contaminated sites management; and notification and registration of mercury importation.

In addition, other government institutions are involved in the implementation of the hazardous waste management with regard to mercury and mercury waste as listed below.

- › Ministry of Industry, responsible for supervising the management of mercury in the industrial sector; implementation of BAT/BEP on reduction of mercury emissions in the industry; provides recommendation for permitting mercury import.
- › Ministry of Trade, responsible for regulating the importation and distribution of mercury; and prohibition of mercury use in gold extraction.
- › Ministry of Energy and Mineral Resources, responsible for implementing the elimination of the use of mercury in gold extraction; and supervising of the implementation of gold mining practices in ASGM.
- › Ministry of Health, responsible for conducting the management of mercury impacts on human health; and setting out and implementation of the phase-out of mercury-added products in the health sector.
- › Customs and Excise, Ministry of Finance, responsible for frontline control of illegal importation.
- › Agency for Technology Assessment and Application, responsible developing the non-mercury technology for gold processing.
- › Agency for Drugs and Food Control, responsible for monitoring and control of mercury contamination in food packaging and cosmetics; and regulate the level/limit of mercury as a contaminant in food.

### 2.3.4 MERCURY WASTE MANAGEMENT INFRASTRUCTURE/SERVICES

Indonesia has a comprehensive infrastructure available for hazardous waste management, including that for mercury waste, although with its own set of limitations. As of 2015, there are 1108 licensed transporters, 123 licensed collectors, 236 licensed recovery facilities, 21 licensed treatment facilities and 22 disposal facilities.

There is no specially-designated transporter for mercury waste. However, any transporter carrying mercury waste is closely monitored by the Ministry of Environment and Forestry.

Despite the relatively high number of hazardous waste recovery facilities operating in Indonesia, none of them are capable of mercury recovery. Among the hazardous waste treatment and disposal facilities, only one facility accepts mercury waste for treatment and disposal. However, the mercury waste from generators is accepted for on-site treatment and disposal there when the mercury concentration in waste is less than 260 ppm. In case the mercury concentration in the received waste matrix is greater than 260 ppm, the service provider exports the mercury waste for recovery and or disposal upon the authorisation/permission from the Competent Authority in accordance with the transboundary movement procedure.

### 2.3.5. OPERATIONS

Mercury waste is part of the general hazardous waste and, hence, the mercury waste is regulated under the same government regulation for hazardous waste management. Generators are supposed to manage it as hazardous waste. Generators are obliged to properly manage its hazardous waste in order to prevent the migration of hazardous waste to the environment by proper monitoring, handling, containerisation, labelling, or on-site storage for a limited time. If a generator is incapable of recovery, treatment, or disposal of its hazardous waste by itself, it is obliged to transfer it to a licensed treatment, storage and disposal facility. Indonesia prohibits the importation of hazardous waste, however, permits export of it, provided that there is no technology or commercial facility available and the Basel Convention requirements for the transboundary movements are met. All transportation of hazardous waste is accompanied by a manifest system.

## 2.4 LAO PEOPLE'S DEMOCRATIC REPUBLIC

The government of Lao PDR, one of the few remaining one-party communist states, began decentralizing control and encouraging private enterprise in 1986. Economic growth averaged 6% per year from 1988-2008 except during the short-lived drop caused by the Asian financial crisis that began in 1997. Lao PDR's growth has more recently been amongst the fastest in Asia and averaged nearly 8% per year for the last decade.

Nevertheless, Lao PDRs remains a country with an underdeveloped infrastructure, particularly in rural areas. It has a basic, but improving, road system, and limited external and internal land-line telecommunications. Electricity is available to 83% of the population. Agriculture, dominated by rice cultivation in lowland areas, accounts for about 25% of GDP and 73% of total employment.

Laos' economy is heavily dependent on capital-intensive natural resource exports. The economy has benefited from high-profile foreign direct investment in hydropower dams along the Mekong river, copper and gold mining, logging, and construction, although some projects in these industries have drawn criticism for their environmental impacts.

Lao PDR has gained Normal Trade Relations status with the US in 2004 and applied for Generalized System of Preferences trade benefits in 2013 after being admitted to the World Trade Organization



earlier that year. Lao PDR began a one-year chairmanship of ASEAN in January 2016. Currently, Lao PDR is in the process of implementing a value-added tax system. The government appears committed to raising the country's profile among foreign investors and has developed special economic zones replete with generous tax incentives, but a small labor pool remains an impediment to investment. Lao PDR also has ongoing problems with the business environment, including onerous registration requirements, a gap between legislation and implementation, and unclear or conflicting regulations.

The Industrial sector comprises mining (copper, tin, gold, gypsum); timber, electric power, agricultural processing, rubber, construction, garments, cement, and tourism.

Lao PDR is a Party to the Basel Convention.

## 2.4.1 MERCURY/HAZARDOUS WASTE MANAGEMENT SYSTEM

Lao PDR's hazardous waste management system mainly comprises legal and regulatory framework, institutional framework and education. The existing resources, infrastructure, and operations are in place for municipal solid waste management, but, not yet available for mercury as well for other hazardous waste.

## 2.4.2 LEGAL FRAMEWORK

### 2.4.1.1 MAIN PROVISIONS

Currently, there is no regulation specifically dedicated to waste management. However, the existing legal and regulatory framework for the environmental management already includes references to waste management, among others:

- › The National Constitution (1991, Art. 17): All Lao PDR citizens must protect the environment and natural resources: land, subterranean, forests, fauna, water resources and atmosphere;
- › The Environmental Protection Law (1999, Chapter 3, Art. 23 Prevention Measures and Pollution Control.) "All kinds of littering are forbidden. It is required to allocate waste disposal sites and to separate waste before its disposal. Technologies for waste treatment, recycling of waste into separate waste before its disposal. Technologies for waste treatment, recycling of waste into production, and reuse must be supported. It is forbidden to import, transport, and move any kind of hazardous waste through land, water and sky border of the Lao PDR.";
- › Industrial Waste Discharge Regulation (No.180/MIH) 1994;
- › Guidelines for Hospital Waste Management (1997);
- › Urban Development Administration Authority (UDAA), Existing community participation development in Urban Development Administration Authority of each province 1997;
- › Agreement on Waste Disposal Site Management, 2008;
- › Agreement on National Environmental Quality Standard, 2009;
- › EIA Decree, 2010.

Regulation for generation and disposal of Mercury waste:

Instruction on the Management of Hazardous Waste, No. 0744/MoNRE, dated 11 February 2015 by Ministry of Natural Resources and Environment, to prevent, control and reduce hazardous waste, the generator must do the following:

- › Hazardous waste generators from the industrial sector must prevent and reduce the quantity and risk of hazardous waste as much as possible by consuming non-toxic resources, clean technologies and the best eco-condition operations;
- › It is strictly prohibited to discharge hazardous waste into the environment, general waste landfills, sewer pipes, surface water, ground water or air;
- › It is strictly prohibited to burn waste in open areas;
- › Hazardous waste generators must be responsible for the preparation of environmentally friendly management, excluding hazardous waste from households.

Regulation on Storage, transportation, handling and disposal of hazardous mercury waste:

Instruction on the Management of Hazardous Waste, No. 0744/MoNRE, dated 11 February 2015 by Ministry of Natural Resources and Environment, regarding the transport, storage and handling of hazardous waste are as follows:

- › Hazardous waste must not be diluted or contaminated with other waste or substances while in keeping, or during transport and destruction;
- › Different types of hazardous waste with different treatment procedures must be kept separately without contamination.
- › Hazardous waste generated by both public and private sectors must be kept, labelled and transferred properly according to regulations;
- › Hazardous waste must be sent only to an entrepreneur who has the related ECC in consuming, recycling, keeping, transporting or final treatment;
- › An institute generator of hazardous waste has the right to destruct, recycle, or operate other actions in their place in cases where the operation has followed the regulations and/or is one of the plans insured in their EIA;
- › Hazardous waste generators must be responsible for all expenditure related to environmental safety management during the keeping and transportation of waste, until it has been sent to entrepreneurs who have environment certificates for treatment and destruction as issued in Appendix 3 of these instructions.

Regulation on Import Export and Possession of hazardous waste:

In Article 39 of the Environment Protection Law (Amended) issues:

- › Hazardous waste imports into Lao PDR are prohibited, excluding cases that have specific permission under Article 68 of the Environment Protection Law (Amended) issues.
- › It is prohibited to import, export, transit, sell, collect, consume, recycle or destruct hazardous waste in the area of Lao PDR without permission.
- › In the case of hazardous or other waste being imported for recycling or for use as fuel, official permission must be obtained from permitted agencies under the National Coordinator of the Basel Convention.

#### 2.4.1.2 MERCURY ELIMINATION

As mercury is part of toxic substances, its elimination is already covered under the Instruction on the Management of Hazardous Waste, No. 0744/MoNRE, dated 11 February 2015 by Ministry of Natural Resources and Environment, to prevent, control and reduce hazardous waste. Based on Lao PDR's response to the questionnaire, there is no target date on the phase-out of mercury in both mining and mercury-added products or industrial processes.

### 2.4.1.3 NATIONAL REGULATORY CLASSIFICATION OF MERCURY WASTE

Based on Lao PDR's response to the Questionnaire, no classification of mercury waste has been established.

### 2.4.1.4 MERCURY-CONTAMINATED SITES MANAGEMENT ASPECT

Currently, according to Lao PDR's response to the questionnaire, there is no regulation in existence in Lao PDR for mercury-contaminated sites management.

## 2.4.3 INSTITUTIONAL FRAMEWORK

Ministry of Natural Resources & Environment is directly involved in the planning and management of hazardous waste, along with the contribution from the Ministry of Health. Along with the Ministries there are a few national and regional infrastructures capable to have an impact on waste management in Lao PDR.

The institutional structure for environmental management in Lao PDR consists of:

- › National committees that guide inter-sectorial coordination among agencies.
- › Ministry of Natural Resources and Environment
- › Ministry of Public Works and Transport/ Urban Development Administration Authority
- › Ministry of Health
- › Ministry of Industry and Commerce
- › STEA (WREA) as the main manager, monitor and coordinator of environment matters at the national level, and other relevant ministries with the mandate to mitigate environment and social issues arising from their sectorial development activities.
- › Provincial and district entities that have developed responsibility for environmental protection at the local level.
- › Mass organizations which support the government in promoting participation and awareness.

Besides the institutions dealing with all affairs on environmental management, there are some organizations working on waste management in particular the public sector

- › Vientiane Urban Development Authority (VUDA)
- › Educational Institution

### 2.4.4 MERCURY/HAZARDOUS WASTE MANAGEMENT INFRASTRUCTURE/ SERVICES

There are two companies operating in solid waste management in Lao PDR:

1. Lao PDR Chaleon Recycling Center;
2. Vientiane Garbage company.

The two private companies buy recycled waste from small retailers and from households which collect their own waste to sell.

Sanitary landfills exist only in Vientiane and four secondary towns, including, Luang Prabang, Thakek, Savannakhet and Pakse. In Vientiane, hazardous waste is separated from the main disposal area inside

the landfill perimeter. In Luang Prabang, a special fenced-off area for hazardous waste disposal exists. Everywhere else, hazardous waste is mixed with the non-hazardous waste.<sup>7</sup>

## 2.4.5 OPERATIONS

Based on the recent information from Lao PDR, currently, hazardous waste from the generators is managed in the same way as the municipal solid waste. There is no proper facility available for the hazardous waste management.

## 2.5 MALAYSIA

Malaysia, a middle-income country, has transformed itself since the 1970s from a producer of raw materials into an emerging multi-sector economy. Exports - particularly for electronics, oil and gas, palm oil, and rubber - remain a significant driver of the economy. Gross exports of goods and services constitute more than 80% of GDP. The oil and gas sector supplied about 29% of government revenue in 2014. As an oil and gas exporter, Malaysia has previously profited from higher world energy prices, although the rising cost of domestic gasoline and diesel fuel, combined with sustained budget deficits, has forced Kuala Lumpur to begin to address fiscal shortfalls, through initial reductions in energy and sugar subsidies and the announcement of the 2015 implementation of a 6% goods and services tax.

Industrial sector comprises: Peninsular Malaysia - rubber and oil palm processing and manufacturing, petroleum and natural gas, light manufacturing, pharmaceuticals, medical technology, electronics and semiconductors, timber processing; Sabah - logging, petroleum and natural gas production;

Sarawak - agriculture processing, petroleum and natural gas production, logging.

Malaysia is a Party to the Basel Convention and a Signatory to the Minamata Convention.

### 2.5.1 MERCURY/HAZARDOUS WASTE MANAGEMENT SYSTEM

Malaysia already has the five hazardous waste management system elements in place.

### 2.5.2 LEGAL FRAMEWORK

#### 2.5.2.1 MAIN PROVISIONS

Department of Environment, Malaysia, is responsible to enforce the National legislative on Mercury Waste, Environmental Quality Act, 1974 and Environmental Quality (Scheduled Wastes) Regulations 2005. Hazardous waste is defined as any waste falling within the categories of waste listed in the First

7 ADB and UNEP (2012).

Schedule of the Environment Quality (Scheduled Wastes) Regulations 2005. List of mercury waste in First Schedule of Article 2 is listed in Table 6.

**Table 6** Types of mercury waste listed in Article

No	Code	Description
1	SW 103	Waste of batteries containing mercury
2	SW 104	Dust, slag, dross or ash containing mercury
3	SW 109	Waste containing mercury and its compound
4	SW 110	Waste from electrical and electronic assemblies containing components such as mercury switches or contaminated with mercury
5	SW 404	Pathogenic wastes, clinical wastes or quarantined materials

Source: DOE, Malaysia

The most important provisions for mercury waste management under the Environment Quality (Scheduled Wastes) Regulations 2005 are:

- > Control of the generation of waste by a notification system;
- > Licensing of hazardous waste facilities;
- > Treatment and disposal of hazardous wastes at prescribed premises; and
- > Implementation of the manifest system for tracking and controlling movement of waste.

#### Regulation on Import Export and Possession of hazardous waste

The policy described under the "Guidelines for the Classification of Used Electrical and Electronic Equipment in Malaysia", published by the Department of Environment (DOE) in 2008 states that Malaysia does not allow the importation of hazardous waste including e-waste into the country. However, Malaysia does allow importation of used electronic and electrical equipment into country for direct reuse, provided such equipment shall not be more than three years from the date of its manufacture.

Legislation responsible for the regulation of transboundary movement of hazardous waste includes:

- > Environmental Quality (Scheduled Waste) Regulations 1989, made under the Environmental Quality Act 1974 which regulate the generation, transportation and disposal of waste through a notification and licensing system for facilities. Now replaced with Environmental Quality (Scheduled Waste) Regulations 2005.
- > The Environmental Quality Act 1974 (EQA) was amended in 1996 to include specific and stringent provisions on the control of export, import and transit of scheduled waste in Section 34B. Penalties for illegal trafficking have also been increased up to RM 500,000.00 or five years' imprisonment or both. Under the new amendment of section of 34B, EQA in 2007, the maximum penalty against placing, deposit, etc., of scheduled waste is mandatory jail not exceeding 5 years and a fine not exceeding of RM 500,000.00.

To further support the implementation of the Basel Convention in Malaysia, the following Orders were formulated under the Customs Act 1967:

- › Customs (Prohibition of Export) Order 2008;
- › Customs (Prohibition of Import) Order 2008;

The orders are enforced by the Royal Customs Department, in cooperation with the DOE. Under these laws, the import / export of hazardous waste is prohibited, unless prior written approval is obtained from the DG of DOE, which is the designated Competent Authority and Focal Point for Malaysia.

### 2.5.2.2 MERCURY ELIMINATION

At the present time, there is no has been received information regarding the elimination of mercury in Malaysia. However, The Star Online (2016)<sup>8</sup>, reported that all government hospitals and facilities have been told by the Ministry of Health to stop acquiring medical equipment which contains mercury. The abovementioned instruction also applies to all hospitals, including universities and armed forces hospitals. The initiative was also in line with Malaysia becoming a signatory to the Minamata Convention.

### 2.5.2.3 NATIONAL REGULATORY CLASSIFICATION OF MERCURY WASTE

Malaysia has its own national classification system as specified in the First Schedule of the Environment Quality (Scheduled Waste) Regulations of 2005. Table 7 presents the Basel Convention mercury waste codes and their corresponding codes under the Malaysia's national classification system.

**Table 7** Basel Convention mercury waste codes and their corresponding codes under the Malaysia's national classification system

Mercury waste classification under the Basel Convention		Corresponding classification of mercury waste under your national law or regulation for mercury/hazardous waste management	
Code	Description	Code	Description
Y29	Mercury, mercury compound	SW 109	Waste containing mercury and its compound
A1010	Metal waste and waste consisting of alloys of, a.o. mercury	SW 104	Dust, slag, dross or ash containing mercury
A1030	Waste with constituents or contaminants of, a.o. mercury; mercury compounds	SW 404	Pathogenic waste, clinical waste or quarantined materials
		SW 103	Waste of batteries containing mercury
A1180	Mercury in waste electrical and electronic assemblies or scrap; mercury switches	SW 110	Waste from electrical and electronic assemblies containing components such as mercury switches or contaminated with mercury

Source: DOE, Malaysia

8 Singh, S. (April, 2016).

#### 2.5.2.4 MERCURY-CONTAMINATED SITES MANAGEMENT ASPECT

Section 24 - Restriction on pollution of the soil - of the Environmental Quality Act 1974 is the legal basis for mercury-contaminated sites management in Malaysia. Furthermore, Malaysia has set-out Contaminated Land Management and Control Guidelines (3 series), consisting of:

- › No. 1: Malaysian Recommended Site Screening Levels for Contaminated Land
- › No. 2: Assessing and Reporting Contaminated Sites
- › No. 3: Remediation of Contaminated Sites<sup>9</sup>

The Malaysian Recommended Site Screening Levels for Contaminated Land, in particular, for mercury and its compounds are presented in Table 8.<sup>10</sup>

**Table 8 Malaysian Recommended Site Screening Levels for Contaminated Land**

Contaminant		Screening Levels				
Parameter	CAS No.	Residential soil (10 <sup>-6</sup> ) mg/kg	Industrial Soil (10 <sup>-6</sup> ) mg/kg	Residential Air ug/m <sup>3</sup>	Industrial Air	Tap water (10 <sup>-6</sup> ) ug/L
Mercury Compounds						
Mercuric Chloride (and other mercury salts)	7487-94-7	23.0	350.0	0.3	1.3	5.7
Mercury (elemental)	7439-97-6	7.8	120.0			2.0
Phenylmercuric Acetate	62-38-4	4.9	66.0			1.6

Source: Doe, Malaysia

A regulation related to Contaminated Land Management has been drafted in order to cope with contaminated sites. Currently there are no identified contaminated sites with mercury and its compound.

### 2.5.3 INSTITUTIONAL FRAMEWORK

At the federal level, the Department of Environment (DOE), a department under the Ministry of Science, Technology and Environment (MOSTE), conducts environmental management regarding hazardous waste. In addition, other government institutions are also involved in hazardous waste management.

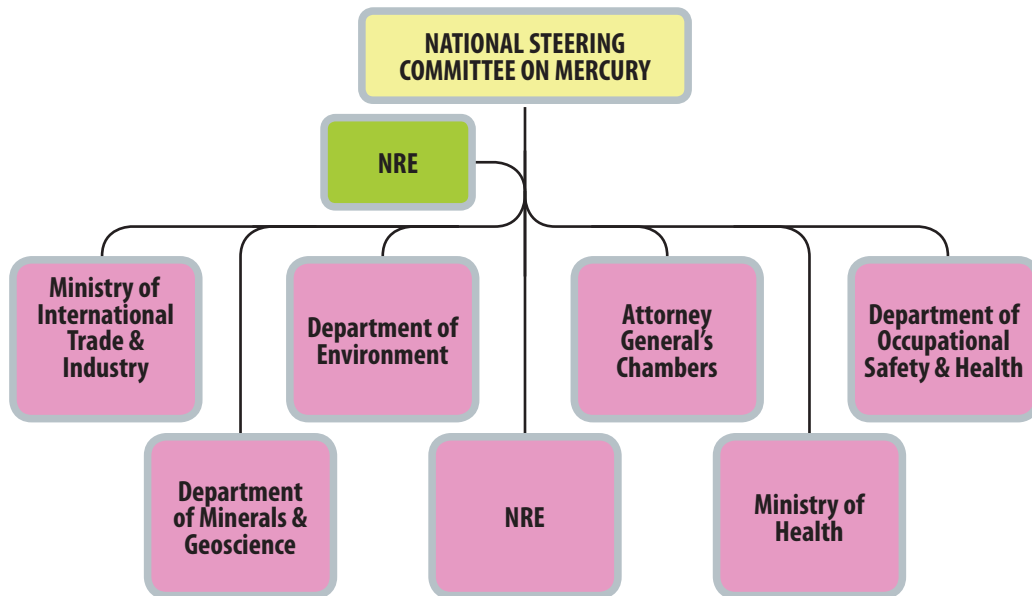
- › The Ministry of Housing and Local Government (MHLG) is responsible for the implementation of the waste management regulation (including the hazardous waste) at the local governmental level and thus has a key role in the preparation of waste management policies, strategies and plans.

<sup>9</sup> Sari, N. Ma. (2015).

<sup>10</sup> Ibid.

- › The Ministry of Urban Well Being, Housing & Local Government is also indirectly involved in hazardous waste management, as it is the governing organization for the domestic solid waste collection and treatment.

Malaysia has also established a NATIONAL STEERING COMMITTEE ON MERCURY in 2012, its organisation chart is presented in Figure 7.



**Figure 7** Malaysia's National Steering Committee on Mercury

Source: Norhazni Mat Sari, Mercury Wastes Management In Malaysia - Preliminary Analysis, Regional Workshop on the ESM of Mercury Waste, Osaka, December 2015

## 2.5.4 MERCURY/HAZARDOUS WASTE MANAGEMENT INFRASTRUCTURE/SERVICES

Malaysia has a number of facilities for hazardous waste, including at least 333 recovery facilities, 43 treatment facilities, as well as 39 incineration facilities and 6 secure landfills. However, the number of those capable of mercury waste recovery disposal and disposal is not yet identified.



## 2.5.5 OPERATIONS

Hazardous waste generators notify the DOE on the types and quantities of wastes generated. They are also required to reduce, to the maximum extent, practicable waste generation using the best practicable means. Waste must be kept in proper containers, properly labelled and stored in designated areas. Generators may also, recover and treat their waste on-site. In case the generators are unable to recover or treat and dispose of their own waste, they may transfer it via a licensed transporter to a recovery or TSD facility. Generators also monitor and ensure that the waste transported reaches the approved destination to keep an up-to-date inventory of waste generated, treated and disposed of.

Transporters have to apply for a license to transport waste from the DOE. Licenses are issued based on the type of waste. All HWM needs to conform to consignment note system:

- › Consignment Note manual
- › Online e-Scheduled Waste Information System (e-SWIS)

Malaysia stated its options for mercury waste management:

- › Recycle;
- › Take back scheme;
- › Recovery;
- › Extraction;
- › Solidification and Stabilization.<sup>11</sup>

## 2.6 MYANMAR

Since the transition to a civilian government in 2011, Myanmar has begun an economic overhaul, aimed at attracting foreign investment and reintegrating into the global economy. Economic reforms have included establishing a managed float of the Burmese kyat in 2012, re-writing the Foreign Investment Law in 2012 to allow more foreign investment participation, granting the Central Bank operational independence in July 2013, enacting a new Anti-corruption Law in September 2013, and granting licenses to nine foreign banks in 2014 and four more foreign banks in 2016.

The government's commitment to reform, and the subsequent easing of most Western sanctions, has led to accelerated growth in 2013 and 2014. In 2015, growth has slowed due to political uncertainty in the election year, summer floods, and external factors, including China's slowdown and lower commodity prices. Myanmar's abundant natural resources, young labor force, and proximity to Asia's dynamic economies have attracted foreign investment in the energy sector, garment industry, information technology, and food and beverages. Pledged foreign direct investment grew from \$4.1 billion in FY 2013 to \$8.1 billion in FY 2014.

Despite these improvements, living standards have not improved for the majority of the people residing in rural areas. Myanmar remains one of the poorest countries in Asia – approximately 26% of the country's 51 million people live in poverty. The previous government's isolationist policies and economic mismanagement have left Myanmar with poor infrastructure, endemic corruption,

<sup>11</sup> Sari, N. Ma. (2015).

underdeveloped human resources, and inadequate access to capital, which will require a major commitment to reverse. The Myanmar government has been slow to address impediments to economic development such as insecure land rights, a restrictive trade licensing system, an opaque revenue collection system, and an antiquated banking system. The newly elected government will likely focus on accelerating agricultural productivity and land reforms, modernizing and opening the financial sector, and improving fiscal management.

Industrial sector comprises agricultural processing; wood and wood products; copper, tin, tungsten, iron; cement, construction materials; pharmaceuticals; fertilizer; oil and natural gas; garments; jade and gems.

Myanmar is a Party to the Basel Convention.

## 2.6.1 MERCURY/HAZARDOUS WASTE MANAGEMENT SYSTEM

Currently, the mercury/hazardous waste management system in Myanmar is supported mainly with a legal framework and institutional framework. The other three elements still need to be developed or improved.

## 2.6.2 LEGAL FRAMEWORK

### 2.6.2.1 MAIN PROVISIONS

The Environmental Conservation Law is the main legislation governing environmental matters, including the waste management system of Myanmar. It consists of 14 Chapters and 42 Articles. The main objectives of this law are:

- > to implement the Myanmar National Environmental Policy;
- > to lay down the basic principles and give guidance for systematic integration of the matters of environmental conservation in the sustainable development process;
- > to emerge a healthy and clean environment and to conserve natural and cultural heritage;
- > to reclaim ecosystems as may be possible which are starting to degenerate and disappear;
- > to manage and implement for decrease and loss of natural resources and for enabling the sustainable use beneficially;
- > to implement for promoting public awareness and cooperation in educational programs;
- > to promote international, regional and bilateral cooperation; and
- > to cooperate with Government departments, organizations, international organizations, nongovernment organizations and individuals.

Other environmental laws are

- > Environmental Policy (1994)
- > Myanmar Agenda 21 (1997)
- > National Sustainable Development Strategy -NSDS (2009)
- > Environmental Conservation Rules (2014)
- > Procedures for Environmental Impact Assessment (2013,Drafted)
- > National Environmental Quality Standard (still ongoing process)
- > Environmental Quality Standard Guideline (still ongoing process)

At the time this report was written, there is no specific law or regulation dedicated for hazardous waste management in Myanmar. Hazardous waste is regulated under the Environmental Conservation Law and Rules, the Myanmar Agenda 21, and the NSDS. Mercury waste is also part of the general hazardous waste regulated under the Environmental Conservation Law and Rules. There are some sectorial laws and regulations covering the management of toxic chemicals and legislation such as the Factories Act (1951) and the Public Health Law (1972), which are related to management of hazardous waste.

The Factories Act contains provisions for the proper disposal of waste and effluents in factories; treatment of wastewater; regulations for health and cleanliness in factories, and the prevention of hazards. In addition, the Oilfields Act of 1918 also contains provisions to supervise the waste output from oil and natural gas exploration, which may relate to unintentional mercury waste generation and management.

The Myanmar Foreign Investment Law, 2012 has provisions to restrict or prohibit investment activities which affect public health, the environment and ecosystems, which produce toxic waste or which engage with toxic chemicals; duties of investors to conduct business in such a way as to avoid environmental damage, air and water pollution, in accordance with existing laws.

Currently there is no legal definition established for mercury. Hence, no threshold limit is also set for mercury waste.

Hazardous waste generators are required to be registered under the Myanmar Investment Law, the Special Economic Zone Law, and the Environmental Conservation Law and Rules. However, there is no proper facility for mercury disposal available at the present time.

Myanmar has just ratified the Basel Convention in 2015, therefore, it abides to the transboundary movement requirements under the Convention.

#### 2.6.2.2 MERCURY ELIMINATION

The reduction of mercury use is legally required under the Environmental Conservation Law and the industrial and health sectorial regulations. As there is no mercury mining in Myanmar, mercury mining and production phase-out is not applicable. The phase-out of mercury use in certain activities/products is also not applicable in Myanmar.

#### 2.6.2.3 NATIONAL REGULATORY CLASSIFICATION OF MERCURY WASTE

Myanmar stated that it fully adopts the mercury waste classification and codes under the Basel Convention's hazardous waste classification as specified in Annex VIII (List A) and does not establish its own classification system.

#### 2.6.2.4 MERCURY-CONTAMINATED SITES MANAGEMENT

At the time this report was written, Myanmar did not have information available on mercury-contaminated sites management.

### 2.6.3 INSTITUTIONAL FRAMEWORK

The Department of Environmental Conservation (DEC) is mandated to implement the National Environment Policy; to develop short, medium and long term strategies, frameworks, action plans for the integration of environmental conservation into the national development process; to manage natural resources conservation and sustainable utilization; to manage the pollution control on air, water, land including waste management; to cooperate with other government organizations, civil society, private and international organizations concerning the environmental management. Its mandates include the formulation of specific policies, laws and regulations; and the implementations of the programs on hazardous waste, including the mercury waste.

The Department of Industry regulates and monitors industrial development and operations. It also conducts research and disseminates the information on toxic chemicals and their effects.

The Department of Health is mandated to promote public awareness and monitoring of human health. It also supports the national inventory and collects the information on the ASGM operation sites.

The Department of Mining is mandated to control the ASGM operations and conduct research on mercury alternatives. In addition, it supports the monitoring of human health and cooperates with the DEC

The Department of Customs is mandated to monitor and control the flow of commodities transferred to or from Myanmar. It cooperates with the other national agencies with regards to all international agreements to which Myanmar is a Party.

Department of Trade manages the permitting of export and import of goods.

City Development Committee (CDC) is responsible for the provisions of infrastructure, technology know how and cleaner operations.

### 2.6.4 MERCURY/HAZARDOUS WASTE MANAGEMENT INFRASTRUCTURE/ SERVICES

Myanmar's respondent indicated that currently there is no facility for mercury waste management available in Myanmar. However, a hazardous waste management service has just been constructed in Thilawa Special Industrial Zone in 2015 by DOWA Corporation.

### 2.6.5 OPERATIONS

At the present time, due to the unavailability of proper facilities for hazardous waste, hazardous waste is managed in the same way as ordinary municipal solid waste. All solid waste, including hazardous waste, is collected by the CDC's municipal solid waste unit and transported to a waste depot.

## 2.7 PHILIPPINES

The economy of the Philippines has been relatively resilient to global economic shocks due to less exposure to troubled international securities, lower dependence on exports, relatively resilient domestic consumption, large remittances from about 10 million overseas Filipino workers and migrants, and a rapidly expanding outsourcing industry. The current account balance has recorded consecutive surpluses since 2003, international reserves remain at comfortable levels, and the banking system is stable.

Although the economy has grown at a faster pace under the Aquino government, challenges to achieving more inclusive growth remain. The unemployment rate has declined somewhat in recent years but remains high, hovering at around 6.5%; underemployment is also high, ranging from 18% to 19% of the employed. At least 40% of the employed work is in the informal sector. Poverty afflicts about a quarter of the population. More than 60% of the poor reside in rural areas, a challenge to raising rural farm and non-farm incomes. The Aquino administration has been working to boost expenditures for education, health, transfers to the poor, and other social spending programs. Infrastructure remains underfunded and the government is relying on the private sector to help with major projects under its Public-Private Partnership program. Continued efforts are needed to improve governance, the judicial system, the regulatory environment, and the overall ease of doing business.

Notable achievements over the past year include the passage of laws that liberalised the entry of foreign banks into the country; partially relaxed the cabotage law by allowing foreign vessels to ply import and export cargo within the archipelago; and passage of anti-trust legislation. Substantial progress has also been made towards the passage of a Customs Tariff and Modernization Act to meet international standards and commitments, with strong prospects of enactment into law before President Aquino steps down from office. However, the Philippine Constitution and other laws restrict foreign ownership in important activities/sectors - such as land ownership and public utilities.

Industrial sector comprises electronics assembly, garments, footwear, pharmaceuticals, chemicals, wood products, food processing, petroleum refining, and fishing.

The Philippines are a Party to the Basel Convention and a Signatory to the Minamata Convention.

### 2.7.1 MERCURY/HAZARDOUS WASTE MANAGEMENT SYSTEM

The Philippines already has the five hazardous waste management system elements in place.

## 2.7.2 LEGAL FRAMEWORK

### 2.7.2.1 MAIN PROVISIONS

Three main legislatures working in the area of hazardous waste management are:

- › Republic Act 6969: Toxic Substances and Hazardous and Nuclear Waste Control Act of 1990;
- › DENR Administrative Order (DAO) 92-29 (Implementing Rules and Regulations of RA 6969);
- › DENR Administrative Order (DAO) 04-36 (Procedural Manual for Hazardous Waste Management).

The Philippines has regulatory distinction of mercury as commodity and as waste under the Republic Act (RA) 6969 (Toxic Substances and Hazardous and Nuclear Wastes Control Act) and its related DENR Administrative Orders (DAOs); DAO 1997-38 (Chemical Control Order for Mercury and Mercury Compounds); and DAO 2013-22 (Revised Procedures and Standards for the Management of Hazardous Wastes).

DAO 2013-22 (Revised Procedures and Standards for the Management of Hazardous Wastes) serves as the specific regulation established for hazardous waste management in the Philippines. It also covers and specifically regulates mercury waste.

Chapter 2, Table 2.1 (Classification of Hazardous Wastes) of DAO 2013-22 (Revised Procedures and Standards for the Management of Hazardous Wastes) serves as a basis for legal definition of mercury waste. It also specifies the threshold limit for mercury waste, which justifies the category D407 as mercury and mercury compounds, and includes all wastes with a total Hg concentration greater than 0.1 mg/L based on the analysis of an extract

Hazardous waste generators in the Philippines are required to be registered, as specified in Chapter 3 (Governing Rules and Regulations for Hazardous Waste Generators) of DAO 2013-22 (Revised Procedures and Standards for the Management of Hazardous Wastes). Chapter 5 of the same regulation specifies that hazardous waste facilities are subject to authorisation and inspection.

Transboundary movement requirements for mercury waste export are set-out in Chapter 10 (Import of Recyclable Materials Containing Hazardous Substances and Export of Hazardous Wastes) of the same regulation.

### 2.7.2.2 MERCURY ELIMINATION

Reduction of mercury use is legally required as specified in Section 7 of DAO 1997-38 (Chemical Control Order for Mercury and Mercury Compounds).

Section 11 (Measures to Improve Small-Scale Mining Activities) of Executive Order No. 79, series of 2012 (Institutionalizing and Implementing Reforms in the Philippine Mining Sector Providing Policies and Guidelines to Ensure Environmental Protection and Responsible Mining in the Utilization of Mineral Resources) serves as a basis for mercury phase-out in mining/production activities.

DOH Administrative Order No. 2008-0021 is the basis for Gradual Phase-Out of Mercury in all Philippine Healthcare Facilities and Institutions. It sets-out the timeframe for the phase-out of mercury in the following products:

- › Thermometers (December 2009)
- › Sphygmomanometers (December 2010)

The Administrative Order also leads to the development of Guidelines for setting up a proper temporary mercury storage area and Specific storage requirements and standards.<sup>12</sup>

### 2.7.2.3 NATIONAL REGULATORY CLASSIFICATION OF MERCURY WASTE

The Philippines has its own hazardous waste classification system as presented in Table 9.

**Table 9** Basel Convention Waste Classification and its Corresponding National Classification in the Philippines

Mercury waste classification under the Basel Convention		Corresponding classification of mercury waste under the national law or regulation for mercury/hazardous waste management	
Code	Description	Code	Description
Y29	Mercury, mercury compounds	D407	Mercury and mercury compounds - includes all waste with a total Hg concentration greater than 0.1 mg/L based on the analysis of an extract. These also include organomercury compounds.
A1010	Metal wastes and waste consisting of alloys of, a.o. mercury	D407	Mercury and mercury compounds - include all waste with a total Hg concentration greater than 0.1 mg/L based on the analysis of an extract. These also include organomercury compounds.
A1030	Waste with constituents or contaminants of, a.o. mercury; mercury compounds	D407	Mercury and mercury compounds - includes all waste with a total Hg concentration greater than 0.1 mg/L based on the analysis of an extract. These also include organomercury compounds.
A1180	Mercury in waste electrical and electronic assemblies or scrap; mercury switches	M506	Include all waste electrical and electronic equipment that contain hazardous components such as lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyls (PBBs) and polybrominated diphenyl ethers (PBDEs) that includes its peripherals i.e., ink cartridges, toners, etc.
		M507	Household hazardous waste such as paints, thinners, household batteries, lead-acid batteries, spray canisters and the like that are consolidated by Material Recovery Facilities (MRFs). These include waste from residential and commercial sources that comprise of consumer electronics, white goods (i.e. refrigerators, washing machines, air conditioners, etc.) batteries, oil and busted lamps.

Source: EMB/DENR, Philippines

### 2.7.2.4 CONTAMINATED-SITES MANAGEMENT

At the present time, the Philippines has not provided any information on mercury-contaminated sites management.

12 Ruiz, M. L. L. H (2015).

### 2.7.3 INSTITUTIONAL FRAMEWORK

The problems posed by hazardous wastes are beginning to be a priority concern for the new Philippine government, possibly due to the increasing number of transnational companies like the semiconductor industry, as well as local firms, which are generating waste considered hazardous to health and the environment. Steps are being done to define the regulatory and enforcement responsibilities of various government agencies. The Environmental Management Bureau (EMB), a policy making body of the Department of Environment and Natural Resources (DENR) is seeing that hazardous waste management is made an integral part of the industrial planning process. In the case of new industrial projects, environmental impact assessments are used to balance economic growth with ecological protection. Other activities of the EMB are geared towards providing baseline information that would eventually lead into the development of standards for hazardous waste management, environmental monitoring and the regulation of hazardous waste disposal.

The Department of Environment and Natural Resources is the executive department of the Philippine government responsible for governing and supervising the exploration, development, utilization, and conservation of the country's natural resources.

Environmental Management Bureau has a mission to protect, restore and enhance environmental quality towards good public health, environmental integrity and economic viability. To develop a nation empowered to protect its finite natural resources, attuned to the pursuit of sustainable development, for a clean and healthy environment that enhances the Filipino Quality of life for present and future generations. The main objectives of this Bureau are:

- > Ensure Attainment of an Environmental Quality that is conducive for present and future generations
- > Air, Water and Toxic and Hazardous Chemicals Management
- > Pursue Cooperation and Partnership
- > Environmental Impact Assessment System Implementation
- > Solid Waste Management
- > Secretariat assistance to the Pollution Adjudication Board
- > Environmental Compliance and Organizational Performance

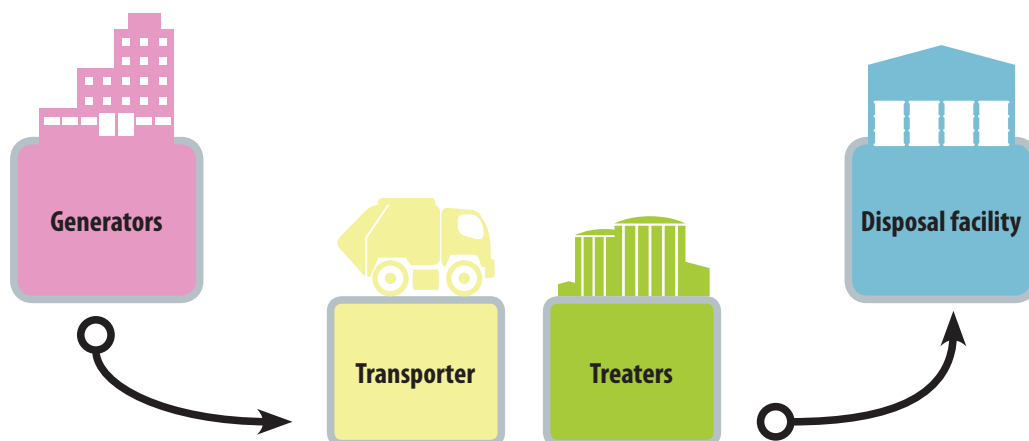
### 2.7.4 MERCURY/HAZARDOUS WASTE MANAGEMENT INFRASTRUCTURE/SERVICES

The Philippines has issued specific permits to the hazardous waste management facilities based on the waste streams the facilities are capable of. There are 116 transporters for D407, 97 transporters for M506 and 67 transporters for M57. In addition, 49 TSD facilities are registered to be capable of managing waste stream D407, 43 TSD facilities for M506 and 25 TSD facilities for M507.

### 2.7.5 OPERATIONS

Mercury waste management operations from the generation up to the disposal are briefly presented in the diagram in Figure 8.





**Figure 8** Simplified diagram of the hazardous waste operations in the Philippines

Source: EMB/DENR, Philippines

- › Mercury waste is considered hazardous wastes with waste number D407 or M506 or M507.
- › Generators, Transporters, and TSD facilities must register on-line at [www.philhazwastetracksys.com](http://www.philhazwastetracksys.com)
- › Transport of mercury waste from the facility of the generator to the TSD facility are covered by a Permit-to-Transport and accompanied by a manifest.
- › Export of mercury waste is covered by an export clearance and follows the notification procedure of the Basel Convention.<sup>13</sup>

Furthermore, the Philippines has provided detailed information on the hazardous waste management system and operations as an appendix to its response to the questionnaire as fully cited below.

Republic Act (RA) 6969, commonly known as the “Toxic Substances and Hazardous and Nuclear Waste Control Act of 1990”, was enacted to address the increasing generation of toxic and hazardous waste in the country. It has the main goal of ensuring that industrial economic growth is achieved in an environmentally sound manner.

RA 6969 directs the Department of Environment and Natural Resources (DENR) to establish rules, regulations, and programs for controlling chemical substances and hazardous wastes in the Philippines.

The Implementing Rules and Regulations (IRR) of RA 6969, Department Administrative Order No. 29 (DAO 92-29) was issued in 1992. This sets the guidelines, procedures and standards for the implementation of chemical management (Title II) and hazardous waste management (Title III) in the country. Title II provides for the regulation of all chemical substances that may pose a threat to public health and the environment whether through import, manufacture, sale, use, distribution, and disposal while Title III provides for the regulation of all hazardous wastes from generation, transport, storage, reuse/ recycling, treatment and disposal.

<sup>13</sup> Ruiz, M. L. L. H (2015).

In December 2013, DENR issued DAO 22, series of 2013, or the Revised Procedures and Standards for the Management of Hazardous Wastes (Revising DAO 2004-36).

The policy on hazardous waste states that the waste generator is responsible for the proper storage, treatment, and disposal of the hazardous waste they generate. The generator has the responsibility until the waste has been disposed of in an environmentally sound manner and is liable in case of spill or illegal disposal.

Hazardous waste generators are required to register with EMB and disclose the type and quantity of hazardous waste generated, submit Self-Monitoring Reports, designate a full-time Pollution Control Officer (PCO), have an emergency preparedness and response program to mitigate spills and accidents, communicate to its employees the hazards posed by the waste they are handling, adhere to the manifest system, and continue to own and be responsible for the waste until they have been rendered as recycled, treated or disposed of by EMB-registered TSD facilities.

Hazardous waste transporters are also required to register with EMB. They should have financial resources in the form of surety bond, insurance, etc. whose amount is commensurate to the identified risks and callable upon demand by EMB in case of spills or accidents during transport. They should have an emergency or contingency plan and equipped with the appropriate personal protective equipment (PPE). Movement of waste must be covered by a Permit-to-Transport (PTT) and the manifest system should be complied with.

TSD facilities are defined by DAO 13-22 as facilities where hazardous waste is transported, stored, treated, recycled, reprocessed or disposed of. TSD facilities are required to register with EMB, have an Environmental Compliance Certificate (ECC), Discharge Permit (DP), Permit-to-Operate (PTO) Air Pollution Source and Control Installations, PCO, emergency and contingency plan, financial resources in the form of the Environmental Guarantee Fund (EGF), surety bond, insurance, etc. in case of emergencies or spills; disclose their detailed waste acceptance criteria and procedure, process flow, storage management plan, and long-term plan; and comply with the manifest system.

For wastes which cannot be handled by local TSD facilities (such as mercury-containing healthcare devices), export is an option and allowed subject to compliance to RA 6969 requirements and the Basel Convention procedures.

## 2.8 SINGAPORE

Singapore has a highly developed and successful free-market economy. It enjoys a remarkably open and corruption-free environment, stable prices, and a per capita GDP higher than that of most developed countries. Unemployment is very low. The economy depends heavily on exports, particularly for consumer electronics, information technology products, medical and optical devices, pharmaceuticals, and on its vibrant transportation, business, and financial services sectors.

The economy contracted 0.6% in 2009 as a result of the global financial crisis, but has continued to grow since 2010 on the strength of renewed exports. Growth in 2014-15 was slower at under 3%, largely a result of soft demand for exports amid a sluggish global economy and weak growth in Singapore's manufacturing sector.

The government is attempting to restructure Singapore's economy by weaning its dependence on foreign labor, addressing weak productivity, and increasing Singaporean wages. Singapore has attracted major investments in pharmaceuticals and medical technology production and will continue efforts to strengthen its position as Southeast Asia's leading financial and high-tech hub. Singapore is a member of the 12-nation Trans-Pacific Partnership free trade negotiations, as well as the Regional Comprehensive Economic Partnership negotiations with the nine other ASEAN members plus Australia, China, India, Japan, South Korea, and New Zealand. In 2015, Singapore formed, with the other ASEAN members, the ASEAN Economic Community.

The industrial sector comprises electronics, chemicals, financial services, oil drilling equipment, petroleum refining, rubber processing and rubber products, processed food and beverages, ship repair, offshore platform construction, life sciences, entrepot trade.

Singapore is a Party to the Basel Convention and a Signatory to the Minamata Convention.

## 2.8.1 MERCURY/HAZARDOUS WASTE MANAGEMENT SYSTEM

Based on analysis of the information published on the National Environment Agency of Singapore, Singapore already has all hazardous waste management elements in place.

## 2.8.2 LEGAL FRAMEWORK

### 2.8.2.1 MAIN PROVISIONS

Based on analysis of the information on the NEA's website, Singapore has distinguished requirements for mercury as a commodity and as a waste. Mercury and its compounds are included on the List of Controlled Hazardous Substances (hazardous substances listed in the 2nd schedule of the Environmental Protection and Management Act (EPMA). Mercury compounds including inorganic mercury compounds, alkyl mercury compounds, alkyloxyalkyl and aryl mercury compounds, and other organic compounds of mercury are also regulated as part of the regulated hazardous substances under the Environmental Protection and Management (Hazardous Substances) Regulations.

The handling, transportation, treatment and disposal of toxic industrial waste in Singapore is controlled under the Environmental Public Health (Toxic Industrial Waste) Regulations 1988. The list of controlled toxic industrial wastes includes mercury waste and can be found in the Schedule of the regulations.<sup>14</sup>

Under the Toxic Industrial Waste Regulation, toxic industrial waste collectors who receives toxic industrial waste for storage, reprocessing, treatment and disposal are subject to authorisation. They are also subject to regular inspection. The transport of toxic industrial waste in quantities exceeding

<sup>14</sup> National Environment Agency, Singapore (n.d.).

those stipulated in the Schedule requires a transport approval. The prescribed quantity set for mercury waste is 0 kg.

Under the Hazardous Waste Act and its Regulations, any person who wishes to export, import or transit hazardous waste needs to obtain a permit from PCD. PCD has adopted the Prior Informed Consent (PIC) procedure of the Basel Convention in granting any permit for the export, import or transit of hazardous waste.

#### 2.8.2.2 MERCURY ELIMINATION

Singapore encourages minimisation on the use of hazardous substances including mercury. However, at the present time, there is no information obtained on the phase-out of mercury in mercury-added products. Mercury mining is not known to exist in Singapore.

#### 2.8.2.3 NATIONAL REGULATORY CLASSIFICATION OF MERCURY WASTE

The Toxic Industrial Waste Regulation includes four type of mercury waste as listed hereunder.

- > Effluents, residues or sludge containing mercury from chlor-alkali industry
- > Wastes containing mercury from equipment manufacturing involving the use of metal mercury
- > Spent catalysts from chemical processes containing mercury
- > Spent organo-mercury compounds

However, there is no classification code assigned to any of them.

#### 2.8.2.4 MERCURY-CONTAMINATED SITES MANAGEMENT

At the time this report was written, there was no information obtained on the legal aspect of mercury-contaminated sites management in Singapore.

### 2.8.3 INSTITUTIONAL FRAMEWORK

Formed on 1 July 2002, the National Environment Agency (NEA) is the leading public organisation responsible for improving and sustaining a clean and green environment in Singapore. The NEA develops and spearheads environmental initiatives and programmes through its partnership with the People, Public and Private sectors. It is committed to motivating every individual to take up environmental ownership and to care for the environment as a way of life.

The National Environment Agency (NEA) plays an important role in regulating hazardous substances in Singapore. Hazardous substances controlled by NEA are generally those that have mass-disaster potential, are highly toxic and pollutive, and/or generate toxic waste that can only be disposed of with greater difficulty.

NEA controls environmentally hazardous chemicals under The Environmental Protection and Management Act (EPMA), The Environmental Protection and Management (Hazardous Substances) Regulations and the Environmental Protection and Management (Ozone Depleting Substances) Regulations.

The Waste and Resource Management Department (WRMD) of NEA is to formulate policies to promote and spearhead waste minimisation in Singapore. WRMD develops, promotes and oversees

the implementation of programmes on waste minimisation and recycling. It also carries out studies to enhance waste recycling. Along with this, Pollution Control Department (PCD) is an institution responsible for dealing with waste management.

The following institutions provide technical assistance and training:

- > Singapore Environment Institute (SEI) (National Environment Agency).
- > National University of Singapore (NUS)
- > Nanyang Technological University (NTU)
- > Singapore Civil Defense Force (SCDF)

## 2.8.4 MERCURY/HAZARDOUS WASTE MANAGEMENT INFRASTRUCTURE/SERVICES

Based on the current List of Toxic Industrial Waste Collectors Licensed under the Environmental Public Health (Toxic Industrial Waste) Regulations, currently, there are three recovery facilities permitted to collect mercury waste.<sup>15</sup> The collectors are expected to confine the collected waste storage and treatment activities in approved premises and facilities.

There is one landfill in place in Singapore, which accepts treated hazardous waste residues such as incineration ash. The landfill is located off-shore and owned by NEA.

## 2.8.5 OPERATIONS

Information on the hazardous waste management operations in Singapore was obtained from its website<sup>16</sup> and partially cited in the following paragraphs.

The generator has to treat the wastes in an approved in-house waste treatment plant and dispose of the residues, if any, at the NEA sanitary landfill site. Alternatively, the generator is allowed to engage a licensed toxic industrial waste collector to collect the waste for treatment and disposal.

A toxic industrial waste collector is a person who receives toxic industrial wastes for storage, reprocessing, treatment and disposal. He has to obtain a license from PCD to collect specific toxic industrial wastes that are listed in his license and confine his wastes storage and treatment activities in approved premises and facilities.

Written transport approval from PCD is also required for the transportation of waste in quantities which exceed those specified in the TIWR. The responsibilities of the key persons in the transportation are clearly defined in the TIWR.

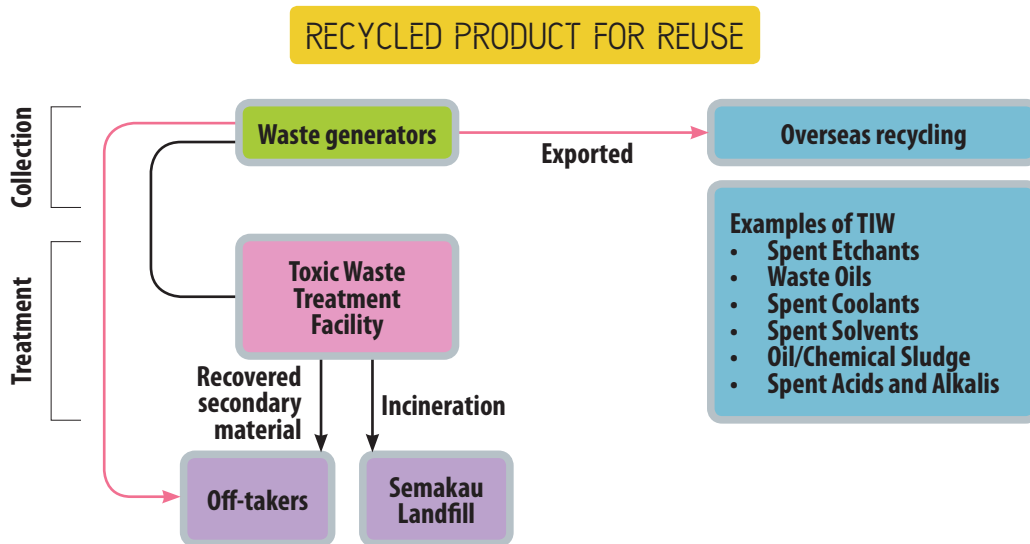
To prevent illegal dumping and disposal of toxic industrial waste, the movement of every consignment of waste from a generator through a carrier to a collector is tracked by means of an Internet-based electronic submission of consignment note system (known as the e-Tracking System).

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<sup>15</sup> National Environment Agency, Singapore (n.d.).

<sup>16</sup> National Environment Agency, Singapore (n.d.).

The toxic industrial (hazardous) waste management operations in Singapore are also presented in Figure 9, cited from another source.<sup>17</sup>



**Figure 9 Hazardous Waste Management Operations in Singapore**

Source: NEA Singapore

## 2.9 THAILAND

With a well-developed infrastructure, a free-enterprise economy, and generally pro-investment policies, Thailand historically has had a strong economy, but has experienced slow growth in 2013-15 as a result of domestic political turmoil and sluggish global demand, which curbed Thailand's traditionally strong exports - mostly electronics, agricultural commodities, automobiles and parts, and processed foods. Following the May 2014 coup d'état, tourism has decreased 6-7% but is beginning to recover. The Thai baht depreciated more than 8% during 2015.

Thailand faces labor shortages, and has attracted an estimated 2-4 million migrant workers from neighboring countries. The Thai Government in 2013 implemented a nationwide 300 baht (roughly \$10) per day minimum wage policy and deployed new tax reforms designed to lower rates on middle-income earners. The household debt to GDP ratio is over 80%.

<sup>17</sup> Chung, D. (2012).

The Industrial sector comprises tourism, textiles and garments, agricultural processing, beverages, tobacco, cement, light manufacturing such as jewellery and electric appliances, computers and parts, integrated circuits, furniture, plastics, automobiles and automotive parts, agricultural machinery, air conditioning and refrigeration, ceramics, aluminium, chemical, environmental management, glass, granite and marble, leather, machinery and metal work, petrochemical, petroleum refining, pharmaceuticals, printing, pulp and paper, rubber, sugar, rice, fishing, cassava, world's second-largest tungsten producer and third-largest tin producer.

Thailand is a Party to the Basel Convention.

## 2.9.1 MERCURY/HAZARDOUS WASTE MANAGEMENT SYSTEM

Thailand already has all hazardous waste management system elements in place.

## 2.9.2 LEGAL FRAMEWORK

### 2.9.2.1 MAIN ELEMENTS/PROVISIONS

Thailand has a regulatory distinction of mercury as a commodity and as a waste. Mercury as a commodity is regulated under the Notification of Ministry of Industry (B.E. 2556(2013)) on List of Hazardous Substances issued pursuant to Hazard Substances Act B.E. 2535(1992), it has determined that Mercury (Quick Silver; Hydragryum), Mercury (I) chloride, Mercury (II) oxide or calomel, Mercury (II) sulfide, Mercurous Chromate (Mercury Chromate), Mercury (II) Thiocyanate are hazardous substances type III. Its import, export, production, and possession must be registered and permitted by the Department of Industrial Works.

There is no specific law on hazardous waste management. However, the Notification of the Ministry of Industry (B.E. 2548(2005)), entitled "Disposal of Wastes or Unusable Materials" issued under the Factory Act. B.E. 2535(1992) prescribes that storage, transportation, handling, and disposal of hazardous waste must follow strict procedures for notification.

Mercury waste is also regulated under the Notification of the Ministry of Industry (B.E. 2548(2005)), entitled "Disposal of Wastes or Unusable Materials". It prescribes that "Wastes contaminated with mercury" shall be classified as "Hazardous Waste" when total mercury concentration in waste equals or exceeds 20 milligrams per kilogram and the extractable mercury concentration as determined by the Waste Extraction Test (WET), equals or exceeds 0.2 milligrams per liter.

The same Notification of the Ministry of Industry (B.E. 2548(2005)), entitled "Disposal of Wastes or Unusable Materials" also requires generators to be registered. It prescribes that waste generator shall have hazardous waste in possession within a factory no longer than 90 days. If the time in possession is longer than that prescribed, a waste generator shall ask permission from Department of Industrial Works.

Disposal facilities for mercury waste are subject to authorisation as prescribed under the Notification of the Ministry of Industry (B.E. 2548(2005)), which prescribes that Waste collector, transporter and disposer shall be approved from Department of Industrial Works as well as storage, transportation, handling, and disposal must follow strict procedure of the notification.

Disposal facilities are subject to inspection as required under the Notification of the Ministry of Industry (B.E. 2548(2005)), which prescribes that Waste disposer shall be approved by the Department of Industrial Works as well as submit an annual report to Department of Industrial Works regarding schematic of collection, detoxification, disposal, or landfill facility and monitoring point, Emergency plan, Mitigation report and environment impact assessment of the occurring emergency and pollutant monitoring (air water soil and groundwater)

Transboundary movement requirements are set-out for mercury waste export under the Notification of the Ministry of Industry (B.E. 2556(2013)), issued under the Hazardous Substances Act. B.E. 2535(1992), entitled "List of Hazardous Substances". List 5.2 chemical wastes has determined that Mercury wastes under the Basel Convention are hazardous substances type III as follows:

1. Metal wastes and Waste consisting of alloys of Mercury
2. Waste containing mercury-components
3. Electrical and electronic assemblies or Scrap [No Scrap from electric power generation] such as mercury-switches, cathode-ray, and activated glass etc.

Hazardous substances type III represents hazardous substance production, import, export or possession, which must be registered and permitted by the Department of Industrial Works.

#### 2.9.2.2 MERCURY ELIMINATION

Reduction of mercury use is legally required in Thailand:

- › Banned Pesticides and Biocides with mercury as well as Dry cell batteries containing mercury under Hazardous Substance Act B.E. 2535 (1992).
- › Limited mercury content in Fluorescent lamps under Industrial Product Standards Act, B.E. 2511 (1968), including in Cosmetics under Cosmetics Act B.E. 2559 (2016).

However, phasing-out of mercury use in other certain activities/products is not yet set. As there is no mercury mining in Thailand, phasing-out of mercury mining/production is not applicable.

#### 2.9.2.3 REGULATORY CLASSIFICATION OF MERCURY WASTE

Thailand fully adopts the hazardous waste classification system under the Basel Convention, including that for mercury waste as specified in Annex I and Annex VIII of the Convention.



#### 2.9.2.4 MERCURY-CONTAMINATED SITES MANAGEMENT

Thailand indicated that it does not have any mercury-contaminated sites. However, Thailand is well aware that the prevention of chemical substances spreading from contaminated sites is one of the key approaches to reduce the human health risk of chemical substances including mercury.

At the present, Thailand has already developed guidelines on managing contaminated sites from using and storage of chemical substances in factory and agriculture, including landfill and illegal dumping of hazardous waste. These guidelines provide a preliminary identification of contaminated sites, action plan for managing contaminated sites and validation of outcomes for managing contaminated sites.

### 2.9.3 INSTITUTIONAL FRAMEWORK

Institutions involved in hazardous waste management are distributed into three administrative levels; national, provincial and local levels as illustrated in figure 10. At the national level, there are mainly four ministries involved with agencies under each of the ministries, to overlook the issue of solid waste management. However, under the Section 18 of the Public Health Act of 1992, the disposal of sewage and solid waste including hazardous waste, in the area of any local government is the power and duty of such local government.

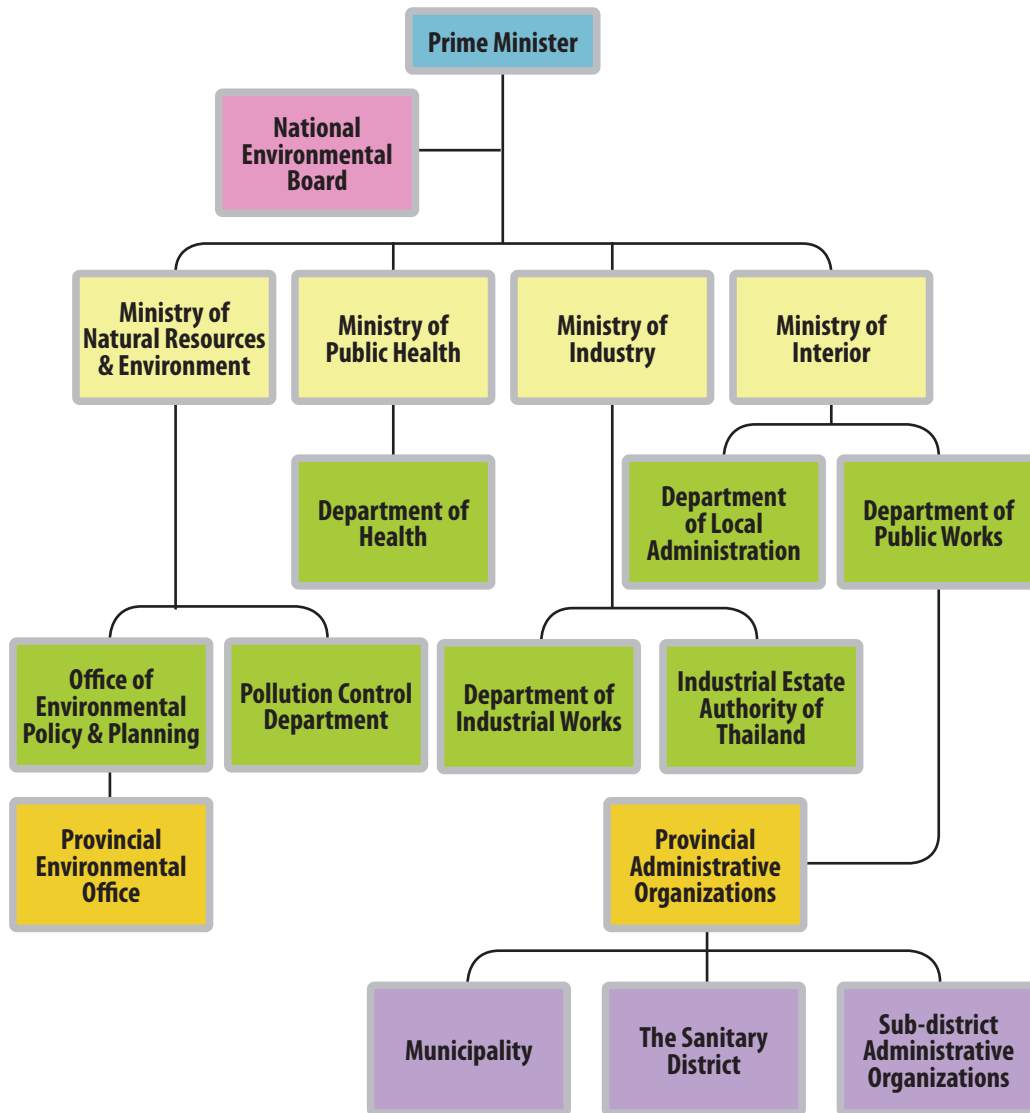
#### National Level

Although mainly four Ministries are directly involved in hazardous waste management, these ministries contribute in the management directly or indirectly.

- › Ministry of Natural Resources and Environment (MNRE),
- › Ministry of Science, Technology and Environment (MOSTE),
- › Ministry of Agriculture and Cooperatives.
- › Ministry of Public Health (MoP),
- › Ministry of Industry (MoIND), and
- › Ministry of Interior (MoINT).

#### The National Environment Board

This is one of the most important National bodies that contributes in the legislative and authoritative role in Hazardous waste management. The Board has the power and duty to submit policy and plan for enhancement and conservation of national environmental quality to the cabinet for approval and to give approval to the Environmental Quality Management Plan proposed by the Minister, as well as the Provincial Action Plan for environmental quality management. Furthermore, the Board can make recommendations to the cabinet in respect of financial, fiscal, taxation and investment promotion measures for the implementation of the policy and plan for the enhancement and conservation of national environmental quality. Additionally, it is in the position to propose, supervise and control amendments of law and action plans relating to the enhancement and conservation of environmental quality to the cabinet.



**Figure 10 Government Organization related to the hazardous waste management in Thailand**

Source: Converting Waste Plastics into Fuel - Report on Situation Analysis of Existing Solid Waste Management System for Bangkok Metropolitan Area, Institutional Framework - Bangkok Metropolitan Area (2009)

#### Ministry of Natural Resources and Environment

The ministry has been set up in 2002, following the Restructuring of Ministries, Bureaus and Departments Act of B.E. 2545 (2002). The responsible agencies for hazardous waste management within the Ministry of Natural Resources and Environment are the Pollution Control Department (PCD), Office of Natural Resources and Environmental Policy and Planning (ONEP), and the Department of Environmental Quality Promotion (DEQP).

### Ministry of Public Health

The Restructuring of Ministries, Bureaus and Departments Act of B.E. 2545 (2002) provides that the Ministry of Public Health has powers and responsibilities related to the promotion of health, as well as other official functions as provided by laws, which indicate that such functions are under the responsibility of the Ministry of Public Health.[1] Regarding SWM, the Department of Health (DOH) under the Ministry of Public Health is responsible for health care waste and infectious waste management.

### Ministry of Industry

Department of Industrial Works (DIW) and Industrial Estate Authority of Thailand (IEAT) under the Ministry of Industry are responsible for all hazardous waste generated from industries. DIW being the organization of the state that has the capability to supervise promote and support industrial business operation for its sustained development and acceptability to the international community. Its major responsibilities, include the supervision and coordination of industrial business operation activities by following the guidelines of environmental preservation, safety, hygiene and energy economization. Industrial Estate Authority of Thailand (IEAT), a state enterprise under the Ministry of Industry, is responsible for the development and establishment of industrial estates. The enterprise is to provide an environmental management system, along with industrial accident prevention and relief system.

### Ministry of Interior

The Ministry is given wide-ranging responsibilities over many aspects. For example, the Ministry has responsibility over local administrations. This indirectly affects the hazardous waste management at the local levels.<sup>18</sup>

### Provincial and Local Levels

At the provincial and local levels, the provincial administrative organizations (PAO), municipalities and Tambon (Sub-district) Administrative Organization (TAO) are primarily responsible for waste collection, transport, treatment, and disposal. These local governments can contract the private sector to undertake some of the services. During the last few years, the government has implemented the Decentralization Action Plan in order to transfer functions, budget, and personnel from the central government to nearly 8,000 local governments.

## 2.9.4 MERCURY/HAZARDOUS WASTE MANAGEMENT INFRASTRUCTURE/SERVICES

On its national report of 2014 to the Secretariat of the Basel Convention, Thailand listed eleven disposal facilities including three secure landfill and fifty-five recovery facilities were operating in the country. However, there was no clear indication on which facilities are capable of mercury waste.

## 2.9.5 OPERATIONS

Hazardous waste generators may store their waste up to 90 days without approval from DIW prior to transferring it to a licensed recycling or TSD facility. Upon agreement between the hazardous waste generator and a recycling or TSD facility, an appointed licensed transporter shall carry the hazardous

18 UNEP IETC (2009).

waste to the designated TSD facility and not possess it more than ten days. The transporter shall comply with the hazardous substance transportation regulation. The designated TSD facility shall only receive the hazardous waste types to be treated and stored or disposed of within its facilities according to its license/permit.

All hazardous waste management actors (generators, transporters and TSD facilities) shall be registered in the manifest system and keep up-to-date records of hazardous waste management practices and annually submit the records to DIW.

## 2.10 VIET NAM

Viet Nam is a densely populated developing country that has been transitioning from the rigidities of a centrally-planned economy since 1986. Agriculture's share of economic output has shrunk from about 25% in 2000 to 18% in 2014, while industry's share has increased from 36% to 38% in the same period. State-owned enterprises now account for only about 40% of GDP.

Vietnamese authorities have reaffirmed their commitment to economic modernization and a more open economy. Viet Nam joined the WTO in January 2007, which has promoted more competitive, export-driven industries. Viet Nam was one of 12-nations that concluded the Trans-Pacific Partnership free trade agreement negotiations in 2015.

Hanoi has oscillated between promoting growth and emphasizing macroeconomic stability in recent years. During 2015, Viet Nam's managed currency, the dong, depreciated by about 5%. Poverty has declined significantly, and Viet Nam is working to create jobs to meet the challenge of a labor force that is growing by more than one million people every year.

Viet Nam is trying to reform its economy by restructuring public investment, state-owned enterprises, and the banking sector, although Hanoi's progress in meeting its goals is lagging behind the proposed schedule. Viet Nam's economy continues to face challenges from an undercapitalized banking sector and nonperforming loans.

Industrial sector comprises food processing, garments, shoes, machine-building; mining, coal, steel; cement, chemical fertilizer, glass, tires, oil, and mobile phones.

Nam is a Party to the Basel Convention and a Signatory to the Minamata Convention.

### 2.10.1 MERCURY/HAZARDOUS WASTE MANAGEMENT SYSTEM

Viet Nam already has all hazardous waste management system elements in place.

## 2.10.2 LEGAL FRAMEWORK

### 2.10.2.1 MAIN PROVISIONS

Based on Viet Nam's response to the questionnaire, Viet Nam has no regulatory distinction of mercury as a commodity and as a waste. However, Nguyen (2015)<sup>19</sup>, mentioned the import of mercury as a chemical substance is regulated by Chemical Law.

Circular 36/2015/TT-BTNMT on Regulations for the management of hazardous waste is the specifically dedicated regulation for hazardous waste management. Mercury waste is covered under the main regulation for hazardous waste management.

QCVN 07: 2009/BTNMT National Technical Regulation on Hazardous Waste Thresholds has legally defined mercury waste. It sets the threshold limit for mercury waste:

- › Concentration lixiviation > 0,2 mg/l
- › Absolute concentrations basis > 4ppm

Circular 36/2015/TT-BTNMT on Regulations on the management of hazardous waste requires generators of hazardous waste to be registered. Disposal facilities for hazardous waste including mercury waste are also subject to authorisation and inspection under the same regulation.

#### Transboundary Movement Requirements

Viet Nam restricts the transit of hazardous wastes and other wastes. Law on Environmental Protection prohibits the transit of wastes (as defined by this Law, except for scrap materials). Decree No. 12/2006/ND-CP dated 23 January 2006 of the Government, providing guidelines on implementation of the Trade Law's regulations for international commodities buying and selling activities, stipulates that the temporary import for re-export of commodities (including waste) are subject to a permit from the Ministry of Trade. According to Viet Nam's response to the questionnaire, Circular 36/2015/TT-BTNMT on Regulations on the management of hazardous waste also set out transboundary movement requirements for export of hazardous waste, including mercury waste.

### 2.10.2.2 MERCURY ELIMINATION

Mercury-containing medical measuring devices (thermometer, sphygmomanometer) have been phased-out since 2012. The Ministry of Health is in charge of managing the phase-out implementation, including operation of public hospital system in Viet Nam (Decision No. 43/2007/QD-BYT). However, no action plan is in place.<sup>20</sup>

### 2.10.2.3 NATIONAL REGULATORY CLASSIFICATION OF MERCURY WASTE

Viet Nam fully adopts the mercury waste classification and codes under the Basel Convention's hazardous waste classification as specified in Annex VIII (List A). However, it has also established its own national regulatory classification of hazardous waste as presented in Table 0-9.

<sup>19</sup> Cuong, N. M. (2015).

<sup>20</sup> Ibid.

**Table 10 Mercury waste classification under the Basel Convention and its equivalent under the Viet Nam's national classification system**

Mercury waste classification under the Basel Convention		Corresponding classification of mercury waste under the national law or regulation for mercury/hazardous waste management	
Code	Description	Code	Description
Y29	Mercury, mercury compounds		
A1010	Metal waste and waste consisting of alloys of, a.o. mercury	01 01 03	Waste with hazardous components from iron ore processing
		01 02 01	Waste with hazardous components from ferrous metal ores processing
		19 06 01	Batteries, lead batteries waste
A1030	Waste with constituents or contaminants of, a.o. mercury; mercury compounds	01 01 03	Waste with hazardous components from iron ore processing
		01 06 01	Waste from refining and transportation of natural gas containing mercury
		02 07 03	Barium sulphate sludge with mercury
		15 01 01	Vehicles, trains, planes expired with the hazardous components or equipment, parts, delimited hazardous waste materials
		16 01 06	Fluorescent light bulbs and activated glass waste
A1180	Mercury in waste electrical and electronic assemblies or scrap; mercury switches (Waste electrical and electronic assemblies or scrap containing components such as accumulators and other batteries included on list A, mercury-switches, glass from cathode-ray tubes and other activated glass and PCB capacitors, or contaminated with Annex I constituents (e.g., cadmium, mercury, lead, polychlorinated biphenyl) to an extent that they possess any of the characteristics contained in Annex III (note the related entry on list B B1110))	19 02 05	Waste of equipment, machines, electronic components (except for electronic circuit that does not contain hazardous components)
		19 06 04	Electrolyte from batteries and accumulators waste

#### 2.10.2.4 MERCURY-CONTAMINATED SITES MANAGEMENT

There is no information obtained on the legal aspect of mercury-contaminated sites management in Viet Nam.

### 2.10.3 INSTITUTIONAL FRAMEWORK

The major state authority responsible for environmental affairs in Viet Nam is the Ministry of Natural Resources and Environment (MoNRE) with its three main administrative units assigned to undertake the state management of waste. Additionally, five other ministries and provincial People's Committees

(the local executive authorities organized in each province and city in Viet Nam ) are also directly involved in waste management activities. Some other ministries have specific roles to play in Solid Waste Management.<sup>21</sup>

#### Agencies at national level

- › Ministry of Natural Resources and Environment: a central agency in charge of environmental management and protection in Viet Nam . Its role in waste management is to issue guidelines, regulations, and standards on waste management in coordination with other ministries, compile annual and long-term waste management plans, formulate policies and strategies, plan and allocate budgets for research and development relating to waste treatment projects (specific task of Department of the Environment (DoE) – an administrative unit of MoNRE), and appraise and approve Environmental Impacts Assessment reports for waste treatment projects (specific task of Department of the Environmental Impacts Assessment and Appraisal - EIA Department), inspect the operation of waste treatment facilities, supervise waste management activities, raise public awareness, and approve recycling and treatment technologies (Viet Nam Environmental Protection Agency - VEPA). It is noteworthy that this ministry has just been recently formed in August 2002. Its precursor is the Ministry of Science, Technology and Environment (MOSTE). The former MOSTE was separated into two new ministries: Ministry of Natural Resources and Environment, and Ministry of Science and Technology.
- › Ministry of Construction (MOC): a central ministry with the highest authority in municipal solid waste management and landfill siting. Its responsibilities and jurisdiction in solid waste management is as follows:
  - » Formulating policy and legislation, planning and construction of solid waste facilities.
  - » Developing and managing plans for the construction of waste-related infrastructure nationally and provincially.
- › Ministry of Industry (MOI): with respect to waste management, this ministry deals mostly with industrial waste. Its responsibilities are to direct, inspect, supervise, and take measures to force businesses and establishments to strictly comply with regulations on industrial waste managements; and coordinate with waste disposal units in disposal of industrial waste (Directive No.199/TTg-1997).
- › Ministry of Health (MOH): have similar tasks as MOI, but MOH is involved in only hospital waste. Its responsibilities in terms of waste management are basically assessing the impacts of solid waste on human health, and inspecting and supervising hospital waste treatment activities (Directive No.199/TTg-1997).
- › Ministry of Planning and Investment (MPI): the most influential policy maker at the ministerial level due to its main task of proposing to the Government for approval of the overall national allocation of state budget. Regarding waste management, MPI together with the Ministry of Finance considers and provides funding and financial sources for other ministries, government agencies, and localities to implement waste management plans based on their annual and long-term waste management plans (Directive No.199/TTg1997). Furthermore, MPI in coordination with MOF also issues economic incentives to facilitate waste management activities.

<sup>21</sup> Viet, L. H. and others (2009).

- › Ministry of Finance (MOF): together with MPI allocates budgets for waste management activities. However, it focuses more specifically on financial and pricing issues (Directive No. 199-1997).
- › Ministry of Culture and Information (MCI): direct the dissemination and popularization of legal documents on waste management in order to raise awareness and responsibility of the public to environment protection (Directive No.199-1997).
- › Ministry of Transportation (MOT): its responsibilities are planning and managing infrastructure for air, land, railway and maritime transport nationally and provincially; overseeing the URENCOs.
- › Ministry of Science and Technology: Assess waste treatment technologies which are recently studied and applied for the first time in Viet Nam.

#### 2.10.4 MERCURY/HAZARDOUS WASTE MANAGEMENT INFRASTRUCTURE/ SERVICES

There are about 76 hazardous waste treatment companies in the country, however there are only two facilities (Tan Thuan Phong company in Hai Phong city and one in South) that can recycle and treat fluorescent lamps.

According to the most recent information from Viet Nam, during the last 3 years, a number of licenses were issued to applying companies for collection and disposal of CFL.

#### 2.10.5 OPERATIONS

Mercury and other hazardous waste generators are required to be registered. Hazardous waste collectors, transporters and disposers are also required to apply for a permit to operate.

Mercury-containing waste generated from industry are collected and treated according to the circular No. 36/2015/TT-BTNMT. Mercury-contaminated wastes generated from household are collected within the municipal solid waste collection scheme. URENCO is in charge of collection, treatment, and disposal of municipal solid waste.<sup>22</sup>

In general, solid waste is not sorted at the source or at the transfer points. More notably, regardless of the type of waste being collected – whether domestic, industrial, healthcare, hazardous or non-hazardous – it is all disposed of in the same landfill.<sup>23</sup>

<sup>22</sup> Cuong, N. M. (2015).

<sup>23</sup> Nguyen, T. (2006).



# 3

## MERCURY WASTE MANAGEMENT PRACTICES

This chapter provides some snapshots of the mercury/hazardous waste management practices in selected activities/sites in each of the ASEAN member states. The waste management practices being targeted are based on the following common elements of site waste management operations as listed hereunder.

- › Waste prevention and minimisation programme or plan
- › Extended Producer's Responsibility (EPR), e.g. take back scheme.
- › Waste generation monitoring and recording
- › Handling, separation, packaging, labelling, and temporary on-site storage
- › Collection and transportation for off-site recovery or disposal
- › Recovery operations (either on-site or off-site)
- › Treatment and final disposal (either on-site or off-site)
- › Safety & health protection
- › Emergency preparedness and response

- › Remediation of contaminated site
- › Export of mercury waste
- › Public awareness and participation

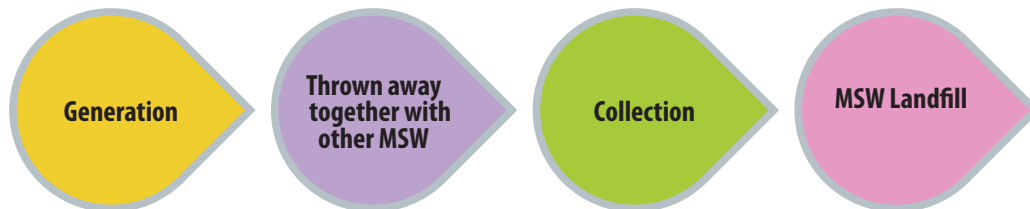
The selected activities are the ASGM, chlor-alkali plants using mercury cells and fluorescent lamps manufacturing and or recycling industry.

#### Mercury Waste Management Practices in Selected Activities/Sites

- › ASGM
- › Chlor-Alkali Industry
- › Fluorescent Lamps Industry
- › Households & Institutions' waste mercury-containing lamps (MCL)

## 3.1 BRUNEI DARUSSALAM

According to the most recent information from Brunei, currently, the generated mercury waste from the households is managed in the same way as the ordinary municipal waste, as indicated in Figure 11.



**Figure 11** Simplified diagram of the current waste mercury-products management practice in Brunei

Source: Brunei's response to the questionnaire

#### Possible disposal practices:

- › Direct disposal/no treatment/improper disposal
- › Co-disposal disposal with domestic waste
- › Incineration (Hospital)
- › Burying
- › Injection into abandoned wells
- › Recycling
- › Out of Country Disposal



## 3.2 CAMBODIA

By the time this report was finalised, the information on the mercury waste management practices in the selected activities in Cambodia was not yet available, as stated by the respondent. However, Cambodia has some activities or initiatives as on mercury management plans development listed below.

Cambodia has so far has undertaken a number of major activities supported under the fund through UNEP/ DTIE, such as the following:

- › Developed an Action Plan on the management of releasing of Mercury in Cambodia 2008-2010, and conducted primary inventory on mercury release in Cambodia
- › Developed Mercury waste Management Action Plan 2013-2017 and Technical Guideline on Environment Sound Management of Mercury Waste.
- › Developed of Strategic plan on Management of Mercury in Artisanal and small Scale Gold Mining 2012-2016.

The Objective of Action plans are:

- › Provide legal instrument to Ministry of Environment to lead and review existing regulations related to mercury and take action to develop in future, new regulations or national action plans specifically on mercury and its waste in cooperation with other concerned ministries, stakeholders, NGOs and private sectors.
- › Provide road map for Cambodia to consider reducing mercury release into environment or if possible eliminate mercury release or use in the country in the long term.
- › Strengthen capacity building institution and raise public awareness related to mercury and its harmful affect to human health and environment caused by mercury pollution activities.

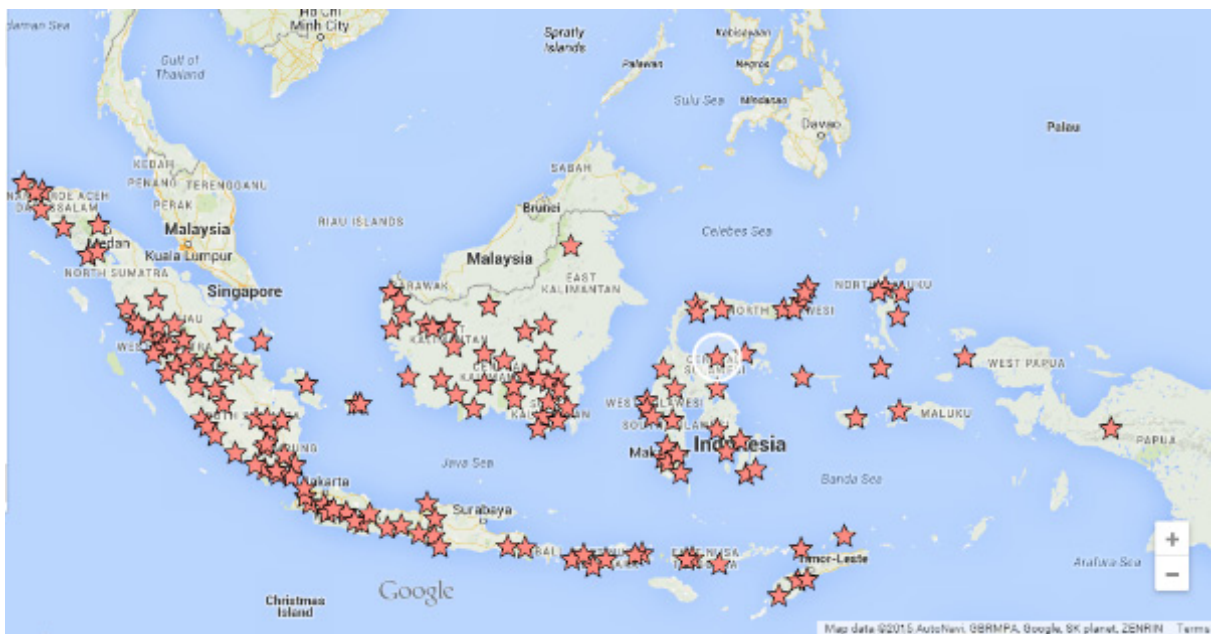
Key Components of Action plans:

- › Develop specific regulation/guidelines for major sources emission of mercury
- › Need full inventory on mercury
- › Mercury emission reduction
- › Mercury waste management approaches
- › Need to enhance capacity building institution and education/awareness raising
- › Mercury research program

## 3.3 INDONESIA

### 3.3.1 ARTISANAL/SMALL-SCALE GOLD MINING [ASGM]

The ASGM sites are widespread throughout Indonesia as depicted in figure 12. According to the Ministry of Energy and Mineral Resources of Indonesia the ASGM activity involves 184 districts in 30 provinces. The number might be an estimate, as the result of the Ministry of Environment and Forestry's national survey in 2015 has identified 56 ASGM sites in 14 provinces only (refer to Section 2.3.2.4.). The activity is known to be the largest consumer of elemental mercury for its quick traditional process. It also involves a large number of unskilled labourers, who do not have proper safety and health protection measures. Therefore, in addition to the scarcity of data of mercury uses, the activity has become the main focus of the study.



**Figure 12 ASGM Hot Spots in Indonesia**

Source: Ministry of Environment and Forestry, Indonesia

Mercury waste prevention and minimisation practices in the ASGM sector in Indonesia is not yet known or not yet assessed. The Indonesian Government has planned to formalize the activities as part of the National Action Plan for mercury elimination in the gold extraction process. In addition, on 27 November 2015, the government witnessed the "Declaration of Mercury-Free People's Mining in Indonesia signed by the representatives of people's mining (an ASGM association) from the 33 provinces of Indonesia

and the Chairperson and the Secretary General of the Association. The declaration is expected to lead the mercury phase-out in the ASGM in the near future.

Due to the nature of its operations being illegal ones, no record of proper practices of handling, separation, collection, packaging, labelling, transportation and storage is found at the moment. Based on observation on an ASGM site in the Province of Banten, Indonesia, the mercury-containing waste from the amalgamation process is discharged into some open on-site pits without hydraulic barrier. The mercury-containing sediment or sludge is sometimes recovered for further extraction of gold either on-site or off-site (third party). During observation, the rest of the sediment or sludge in the pits remained untreated.

### 3.3.2 MANUFACTURING INDUSTRY [CHLOR-ALKALI, LIGHTING EQUIPMENT]

There are several chlor-alkali process plants operating in Indonesia. According to a source person at the Ministry of Environment and Forestry, based on the data of 2015, there was one plant known to operate using mercury cell technology. Therefore, this study excludes the chlor-alkali industry in Indonesia.

### 3.3.3 FLUORESCENT LAMPS INDUSTRY

There are three light bulbs manufacturers operating in Indonesia. The major products of the lighting equipment manufacturing industry are, among others, fluorescent lamps in various sizes and capacities. 5-10 mg of mercury are used as conductor in each fluorescent lamp. The major market of the products is the domestic market, since the country itself is populated with over 230 million people.

A major producer of lighting equipment also operates a fluorescent lamps recycling in Indonesia. According to some resource persons, the recycling facility currently accepts waste fluorescent lamps from industrial sector only as pictured in Figure 13. Despite serving the industrial source only at the present time, the waste fluorescent lamps recycling facility is estimated to generate a significant amount of mercury waste.

Mercury waste is separated from other waste in order to prevent. The mercury waste is then contained in a proper container (usually in metal or plastic HDPE drums) in closed condition and labelled as hazardous waste according to its assigned code(s). As the case with the general hazardous waste, mercury waste is allowed to be stored on the generator's site for up to 90 days since its first accumulation in its container, prior to transportation to a designated treatment and disposal facility. Upon agreement with the designated collector or treatment and disposal facility on the price, the collector or the treatment and disposal facility picks-up the waste with its special transportation equipment for hazardous waste or is collected by another licensed transporter of hazardous waste. The transportation equipment is also placarded with the assigned symbol (toxic) and accompanied with a set of hazardous waste transportation manifests in accordance with the regulation for hazardous waste transportation. The hazardous waste collector may temporarily store the mercury waste at its site, but it eventually has to transfer the waste to a designated treatment and disposal facility. Upon arrival at the designated treatment and disposal facility, the mercury waste being shipped is verified against the specified characteristics and quantity prior to its placement at the facility's storage area.



.....  
**Figure 13 A CFL recycling installation at a manufacturer's site in Surabaya, Indonesia, 2013**

Source: [www.cfl-lamprecycling.com](http://www.cfl-lamprecycling.com)

### 3.3.4 HOUSEHOLDS & INSTITUTIONS [WASTE MCL]

The major mercury-added products used in households and institutional buildings are fluorescent lamps and batteries. But, most mercury-containing batteries have been discontinued a long time ago. Therefore, this scoping study focuses on the waste fluorescent lamps as a major mercury waste stream from the households and institutional buildings. Since the fluorescent lamps are replaced regularly, the resulting mercury waste generation is considered significant. It confirms the justification for the waste products to be selected as priority mercury waste type under this scoping study.

Due to its electrical energy efficiency, fluorescent lamps are still widely used in replace of the electrical energy-intensive incandescent lamps. However, since a few years ago, the even more energy-efficient Light-Emitted Diodes (LED) lamps have been commercially available so that some people have started using them. The price of the LED lamps is much higher than the fluorescent lamps. As the LED lamps have been eventually more affordable, the use of them has also been gradually increasing so that the decrease of fluorescent lamps use in households and institutional buildings is expected accordingly. Therefore, the generation of waste fluorescent lamps is also expected to decrease in the near future.

According to a representative of a major lighting equipment producer, the collection and recycling fee is already included in the price of fluorescent lamps. However, the collection and recycling of the waste products are not yet fully practiced in Indonesia. At the present time, the producer who operates the fluorescent lamps recycling facility does not provide collection service for households. As there is no formal waste segregation in the households, the used lamps go to the municipal waste collection system and no proper packaging, labelling, transportation and storage is being implemented.

#### Recovery operations

Up to the present time, there is no commercial mercury recovery operation ever found or reported in Indonesia. Therefore, excess mercury or waste with high mercury levels is exported for recovery.

#### Treatment and final disposal

At Indonesia's only integrated treatment, storage and disposal (TSD) facility for hazardous waste, mercury waste is treated with the solidification/stabilisation (S/S) method and the resulting S/S product is disposed of in the on-site secure landfill. Mercury waste is accepted for on-site treatment and disposal when the mercury concentration in waste is less than 260 ppm. Based on the facility's operational criteria and schedule, the received and stored mercury waste then undergoes either on-site treatment and landfilling or exportation to a designated country for recovery.

#### Export

Under the new GR No. 101/2014, export of hazardous waste is allowed based on certain criteria. Mercury waste with mercury concentration greater than 260 ppm is exported for recovery or treatment. The export of the mercury and other hazardous waste is subject to the transboundary movement (TBM) procedure/protocol in accordance with the Basel Convention.

According to a resource person from the integrated facility for treatment and disposal of hazardous waste in Indonesia, during the period of 2012-2015, the facility as a licensed exporter has exported about 1000 tonnes of mercury waste to a developed country for mercury recovery. In early 2016, the Ministry of Environment and Forestry issued a permit to the facility to export waste elemental mercury and waste contaminated with mercury. The waste contaminated with mercury consists of filter waste, spent catalyst, sludge, solid waste, liquid waste and oil sludge.

#### Remediation of contaminated sites

Indonesia has initiated an effort in the identification of mercury and other hazardous waste-contaminated sites. Based on its survey in 2015, the Ministry of Environment and Forestry of Indonesia has identified 56 ASGM sites in 14 provinces. The data will be used as a basis for the mercury-contaminated sites and remediation planning. While the threshold value for remediation of contaminated soil is 0,3 mg/kg (dry weight basis) as specified in the Attachment V to the GR No. 101/2014 has been established, although the initiative has not been formally documented.

#### Safety and health

The general requirements for safety and health protection are stipulated in the Law No. 1/1970 which was revised in the Law No. 13/2003. However, specific requirements for the hazardous waste operations are specified in the decrees of the Head of BAPEDAL of 1995. The HWM operators are required to wear protective clothing, safety goggles, respiratory masks, hand gloves and other personal protective equipment. In practice, the requirements are not always met, especially in the informal and or illegal activities.

#### Emergency response system

The legal requirements for emergency response system was first specified for the Indonesia's first integrated treatment, storage and disposal (TSD) facility for hazardous waste management under an agreement between the Government and the developer of the Facility. Since then the Facility has set-up a comprehensive emergency response system, which has become a reference for the other activities involving hazardous waste. The basic requirements for an emergency response system are further legally strengthened in the GR No. 101/2014. Most multi-national or large companies operating in Indonesia have established an emergency response system, despite significant variations in the comprehensiveness and effectiveness.

#### Public awareness and participation

At the latest, since early 1990s there have been various activities conducted to promote the public awareness for the hazardous waste management issues, including mercury waste. The Government, academia, and NGOs have been actively involved in the activity. The Ministry of Environment and Forestry reported the most recent public awareness raising activity conducted on 26-27 November 2015, which was attended by 100 members of the association of people's mining of Indonesia (ASGM), representing the 33 provinces.

## 3.4 LAO PDR

By the time this report was written, there is no information on the mercury waste management practices in the selected activities in Lao PDR available as confirmed by respondent in the completed questionnaire.

## 3.5 MALAYSIA

### 3.5.1 ASGM

By the time this report was written, there is no information available on the ASGM activities in Malaysia.

### 3.5.2 CHLOR-ALKALI INDUSTRY

Based on the information presented by Mat Sari (2015), by the time this report was written, Chlor-Alkali production plants in Malaysia may have already been decommissioned.



### 3.5.3 FLUORESCENT LAMPS INDUSTRY

Currently, there is no information available on the fluorescent lamps industry in Malaysia.

#### Households & Institutions (waste MCL)

Fluorescent lamps collection for recycling has been initiated by both the government and the non-governmental organisation in Malaysia. At least, two sources provide a description of the initiatives.

A non-government organisation, the Malaysia International Commission on Illumination (MyCIE), has set-up a series of recycling initiatives since 2012. It started off with raising awareness on the importance of recycling compact fluorescent lightbulbs (CFL), fluorescent lamps (FL) and electronic waste (EW) in 2013 after receiving funding through the Small Grants Programme (SGP) from Global Environment Facility (GEF), which is administered by the United Nations Development Programme (UNDP). It also began by setting up collection bins for the light bulbs in residential and office areas. The bulbs collected were given to Kualiti Alam, the only recycling contractor that treated the bulbs. At the third stage, they hoped to be able to build an affordable facility as recycling centre that would eventually allow them to regularly recycle light bulbs.

In making the recycling centre a reality, MyCIE has been conducting the Electronics Waste, Compact Fluorescent Lamp and Fluorescent Lamp Recycling Programme for four years since June 15, 2015 to bring in sponsors. Activities such as conferences and dialogues are also planned to be held with interested parties throughout the programme.<sup>24</sup>

A summary report prepared by the Consortium Japan Fluorescent Lamp Recycling Co., Ltd. (JFR) and Kokusai Kogyo Co., Ltd. within the "Project Formulation Survey" under the Governmental Commission on the Projects for ODA Overseas Economic Cooperation in Fiscal Year 2013 reveals that a Feasibility Study on Promotion of the Fluorescent Lamp Recycling Plant in Thailand and Malaysia has been completed in March 2014.

The report also summarises the study teams finding as listed hereunder.

1. In some cases, waste fluorescent lamps are crushed by a machine, the crushed residues are then solidified by cement, and are finally disposed of at secure landfills. However, such cases are quite limited.
2. Most of waste fluorescent lamps are mixed with non-hazardous waste, treated and disposed. This leads to emit mercury into the environment. It is a requirement to show effective solutions for treating waste fluorescent lamps.
3. There is no plant equivalent to JFR's proposed level in both countries.<sup>25</sup>

The report also notes that those are said to be common issues. However, there no more information was obtained as a follow-up of the abovementioned feasibility study and the subsequent meetings with the government of Malaysia.

<sup>24</sup> MyCIE (August, 2015).

<sup>25</sup> Japan Fluorescent Lamp Recycling Co., Ltd. and Kokusai Kogyo Co., Ltd. (2014).

## 3.6 MYANMAR

### 3.6.1 ASGM

There is no information on the number and geographic distribution of ASGM sites in Myanmar available. However, Myanmar stated that the mercury waste management in ASGM is not implemented in accordance with legal requirements.

### 3.6.2 CHLOR-ALKALI INDUSTRY

Myanmar indicated that there is no chlor-alkali industry in existence in the country.

### 3.6.3 FLUORESCENT LAMPS INDUSTRY

Myanmar stated that there is no information on the fluorescent lamps industry at the present time.

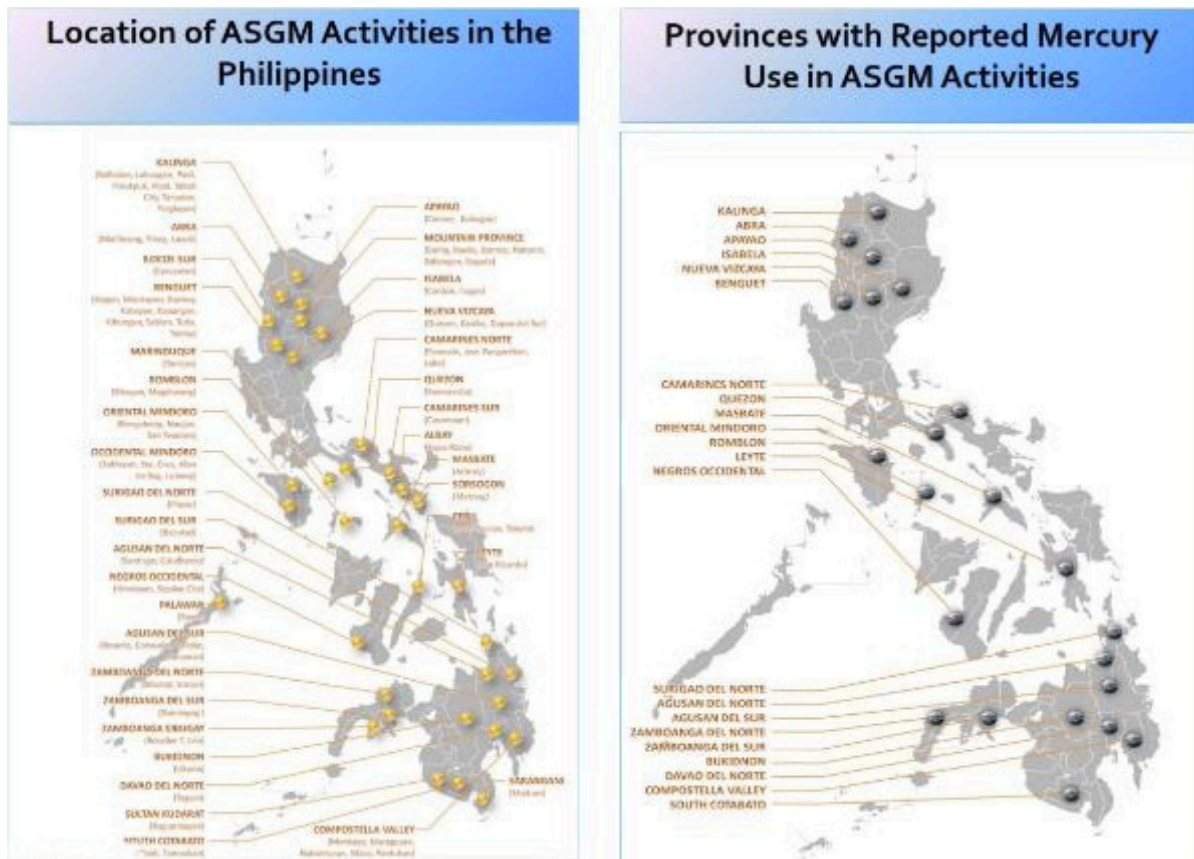
### 3.6.4 HOUSEHOLDS & INSTITUTIONS [WASTE MCL]

According to the most recent information from Myanmar, the generated mercury waste from households is managed in the same way as the ordinary municipal waste.

## 3.7 PHILIPPINES

### 3.7.1 ASGM

ASGM activities have been in existence in the Philippines for a long time. A number of ASGM sites are widely distributed throughout the country as indicated in the map in Figure 14.



**Figure 14 Geographic distribution of ASGM in the Philippines**

Source: Richard Gutierrez. Philippine National Action Plan on the Phaseout of Mercury in ASGM. Eastern and Southern Africa Regional Forum on Artisanal and Small Scale Gold Mining and the Minamata Convention on Mercury April 16-19, 2015 Dar Es Salaam, Tanzania.

During a regional workshop in Osaka, 2015, the Philippines' representative<sup>26</sup> presented one of the Country's initiatives/programs to improve the health and environment and artisanal gold mining communities in the Philippines by reducing mercury emissions. The program aims to:

- › Establish a formalized ASGM entity to facilitate the reduction of mercury.
- › Develop and deliver comprehensive health education, techniques, and technology training programs to reduce mercury in ASGM in the Philippines, including mercury surveillance program at the community level to prevent exposure among high risk populations.
- › Implement two replicable pilot projects with local and national stakeholders. Overall mercury use, emissions, and exposure are reduced at pilot sites.

26 Ruiz, M. L. L. H (2015).

- › Increase capacity for regional and sub-regional collaboration and coordination to manage and monitor mercury.

Based on the same source of information, the Philippines has also set-out priority goals, objectives and implementation strategies for ASGM to:

- › Effectively reduce mercury use in the ASGM sector;
- › Develop and implement coherent national policies and regulations;
- › Establish a legal and organized group of ASGM miners with a national constituency and representing the needs of the ASGM sector;
- › Build and strengthen institutional capacity of Provincial Mining Regulatory Boards (PMRBs), local government units (LGUs) and other ASGM support institutions;
- › Enhance cooperation and partnership of all levels among miners, industry sector, NGOs, Church, Academic institutions;
- › Develop and promote the safe handling and long term storage of excess mercury from the ASGM sector.

### 3.7.2 CHLOR-ALKALI

Mabuhay Vinyl Corporation (MVC) is the sole producer of caustic soda in the country. The mercury-cell process has been stopped production since 1993 and the facility was decommissioned in 2001.

### 3.7.3 FLUORESCENT LAMPS INDUSTRY

Philippines is a CFL importing country, with all imports for domestic use only. A recent estimate from the Philippine Lighting Industry Association (PLIA) is around 30 million CFLs in 2010.

Hazardous waste generators generating waste fluorescent lamps are governed by the requirements of DAO 2013-22.

### 3.7.4 HOUSEHOLDS & INSTITUTIONS [WASTE MCL]

During 2002 up to mid-2014, Philippines has generated approx. 60 tonnes of waste fluorescent lamps. Up to the present time the Philippines has exported uncrushed lamps for recycling at the Nomura Kohsan's mercury recycling facility in Japan. However, in 2014, with the support of the Ministry of Economy, Trade and Industry of Japan (METI), the company has established a new recycling scheme for the Philippines. It installed a lamp crusher in the Philippines, thus allowing lamps to be crushed locally. The crushed lamps are shipped to its facility in Japan.

Through this local pre-treatment process, the Company is be able to reduce the transportation fee, which in turn, cuts the cost of the whole recycling process. Moreover, by setting up a pre-treatment facility, the Company aims to raise awareness and increase the recycling rate in the Philippines.

By properly removing mercury from the waste, other materials from the waste product can be recycled.<sup>27</sup>

Department of Energy (DOE) is transforming the lighting industry market by promoting the use of energy-efficient lighting (EELs) products and recognizes that EELs such as fluorescent lamps contain mercury; thus DOE intends to:

- › Operationalize a Lamp Waste Management Facility (LWMF) that will recover mercury from lamp wastes
- › Implement an Extended Producer Responsibility (EPR) for lighting products

It is expected that the collaborative output will include:

- › Joint DENR-DOE Administrative Order on Lighting Industry Waste Management Guidelines<sup>28</sup>

## 3.8 SINGAPORE

### 3.8.1 ASGM

By the time this report was drafted, there was no information on the mercury waste management practices in ASGM activities in Singapore. However, it is known that there is no ASGM activity in Singapore.

### 3.8.2 CHLOR-ALKALI

By the time this report was drafted, there was no information on the mercury waste management practices in the chlor-alkali industry.

### 3.8.3 FLUORESCENT LAMPS INDUSTRY

There is no information available on fluorescent lamps production or recycling industry in Singapore.

### 3.8.4 HOUSEHOLDS & INSTITUTIONS [WASTE MCL]

As a measure for mercury waste minimisation, Singapore developed mercury controls in compact fluorescent lamps (CFL) for new import of CFL:

- › Mercury content exceeding 5 mg per hot cathode Compact Fluorescent Lamp (CFL)
- › Mercury content exceeding 10 mg per hot cathode linear/straight or circular fluorescent lamp.

<sup>27</sup> UNIDO (n.d.).

<sup>28</sup> Ruiz, M. L. L. H (2015).

These controls are implemented at the import stage. Fluorescent lamps containing mercury that exceed the above-stipulated limits are not allowed to be imported for local use and distribution after 1 July 2012. However, existing stocks of such lamps imported prior to 1 July 2012 will be allowed for sale until these stocks are depleted. Since fluorescent lamps are disposed of together with municipal waste at NEA's incineration facilities, controlling the amount of mercury present in the fluorescent lamps would help to minimise any release mercury into the environment.<sup>29</sup>

Based on information on the NEA's website, citizens are encouraged to recycle their waste fluorescent lamps with the voluntary lamp recycling programmes available in Singapore. At least one company has developed a partnership in the voluntary recycling programme in Singapore. Glass, metal, plastic is recovered from the fluorescent lamps. There was no information obtained on the management of mercury waste resulting from the MCL recycling.

## 3.9 THAILAND

### 3.9.1 ASGM

Thailand indicated that the mercury waste management elements as specified in the questionnaire were not implemented in the ASGM sector according to the legal requirements. Liquid mercury for gold extraction from ore is still used in certain remote areas in Thailand. However, the local administrative organizations and the relevant agencies are continuously promoting the building and strengthening of capacity on the safe handling to the involved communities.

### 3.9.2 CHLOR-ALKALI INDUSTRY

Currently there is no chlor-alkali production using the mercury cells technology operating in Thailand.

### 3.9.3 FLUORESCENT LAMPS INDUSTRY

There is only one MCL factory in Thailand, the Philips Electronics Thailand. However, in Thailand, fluorescent lamps market share in the general lighting market is estimated to drop to 28% in 2016, compared to 30% in 2015. Therefore, the company has shut down its only fluorescent bulb factory in Thailand by the third quarter of 2016.<sup>30</sup>

Once, the Toshiba company conducted a project on mercury-containing lamps recycling in Thailand. However, according to the respondent, it was a promotion project instead of a technology demonstration project and it has already been finished.

29 National Environment Agency, Singapore (n.d.).

30 LEDinside (2016).

Currently, the waste MCL collectors transferred the treated waste MCL to the municipal authorities of Bangkok and the vicinities. There are 3 landfills sites in the vicinity of Bangkok on which the municipal authorities disposed of the treated waste MCL.

### 3.9.4 HOUSEHOLDS & INSTITUTIONS [WASTE MCL]

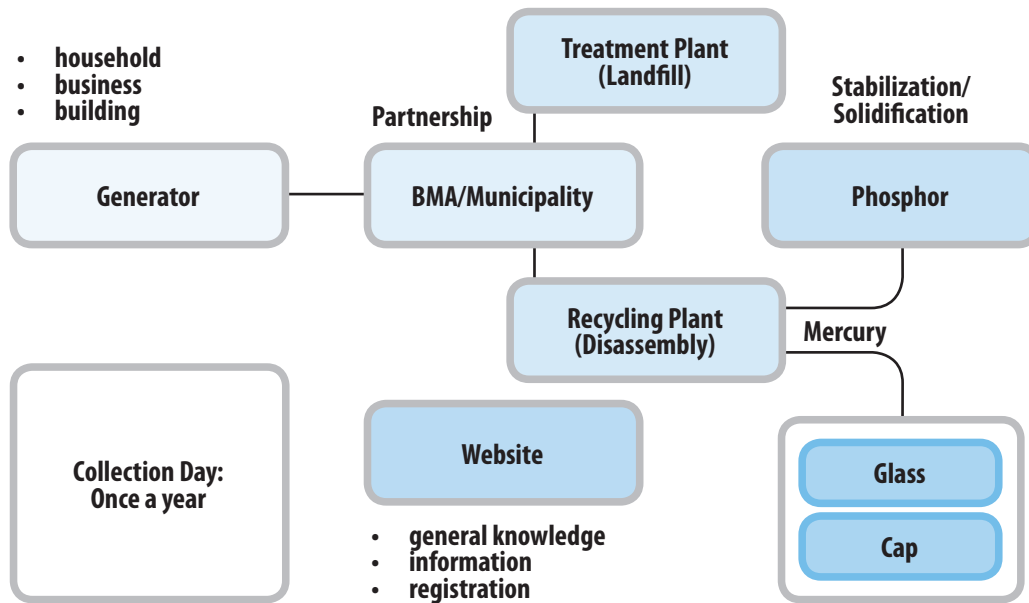
PCD, with cooperation of the Japanese government and JETRO, has established a pilot project on fluorescent lamp recycling in Thailand. The objectives of the project are to survey data and information of current amount and management system of waste fluorescent lamp, and to analyze the feasibility study of the fluorescent lamp recycling business in Thailand. Data and information received from the study will be used by PCD to lay out a guideline to promote a collection of waste fluorescent lamp from household and business establishments for further recycle or proper disposal. Nevertheless, currently Thailand does not have any specific laws and authorities that clearly control the management of municipal hazardous waste.

The study of the project showed that in 2004, the amount of waste fluorescent lamps in Thailand was approximately 41 million lamps, of which 70% was straight lamps and the others were circular and compact lamps. In the studied areas, covering Bangkok Metropolitan Area (BMA), Nonthaburi, Pathumthani, Nakornpathom, Samutprakarn and Samutsakorn, it was found that about 14 million of waste fluorescent lamps were straight lamps or about 50% of waste straight lamps in the country.

Although BMA and many municipalities has launched a campaign to encourage the public to sort out hazardous waste from general waste, it is found that this campaign is not quite successful since people still discard hazardous waste with general waste. In addition, waste fluorescent lamp that is sorted and stored by some organizations is still left piled up in the building without sending to proper disposal or recycling facility.

Thailand's Pollution Control Department has introduced a guideline for waste fluorescent lamp management. The guideline is disseminated on its website.<sup>31</sup> A flowchart, presented in Figure 15, briefly depicts the guideline for the waste fluorescent lamp management mechanism.

31 Pollution Control Department (n.d.).



**Figure 15 Thailand's Guideline for Waste Fluorescent Lamp Management Scheme**

Source: pcd.go.th

## 3.10 VIET NAM

### 3.10.1 ASGM

Viet Nam indicated that there was no information on ASGM or mercury waste management in the ASGM sector at the moment.

### 3.10.2 CHLOR-ALKALI INDUSTRY

Viet Nam indicated that the mercury waste management elements as specified in the questionnaire were not implemented in the chlor-alkali industrial sector according to the legal requirements.



### 3.10.3 FLUORESCENT LAMPS INDUSTRY

Viet Nam indicated that the mercury waste management elements in the light bulbs production or recycling are partially implemented according to the legal requirements.

### 3.10.4 HOUSEHOLDS & INSTITUTIONS [WASTE MCL]

Currently, mercury-containing waste from the households e.g., compact fluorescent lamps (CFL) is collected by URENCO together with other waste, as mixed waste. Some of this waste might end up in a landfill. And although landfill leachate is monitored, it is not analysed for mercury.

Two hazardous waste treatment facilities (Tan Thuan Phong company in Hai Phong city and one in the South) can recycle and treat fluorescent lamps. The abovementioned facilities crush the waste lamps and then mix them with solidified waste and with cement to produce bricks.<sup>32</sup>

According to the most recent information from Viet Nam, during the last 3 years, a number of licenses were issued to companies for collection and disposal of CFL.

Do Tien Doan (2011) also described the waste fluorescent tube treatment in Viet Nam and its advantages and disadvantages as cited hereunder.<sup>33</sup>

Characteristics: Treatment system consists of a grinding device, cloth bag filter (fluorescent powder recovering), device of mercury vapor absorbability and exhaust fan.

Advantages: Reasonable investment cost, easy operation. Fluorescent powder and glass can be used as raw material in cement production or recycle clean glass.

Disadvantages: Absorption of mercury vapor in the tube creates new waste (mercury salt) and needs to be treated Solution: Desorption of the saturated absorbent to recover mercury and reuse the absorbent.

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<sup>32</sup> Cuong, N. M. (2015).

<sup>33</sup> Doan, D. T. (2011).

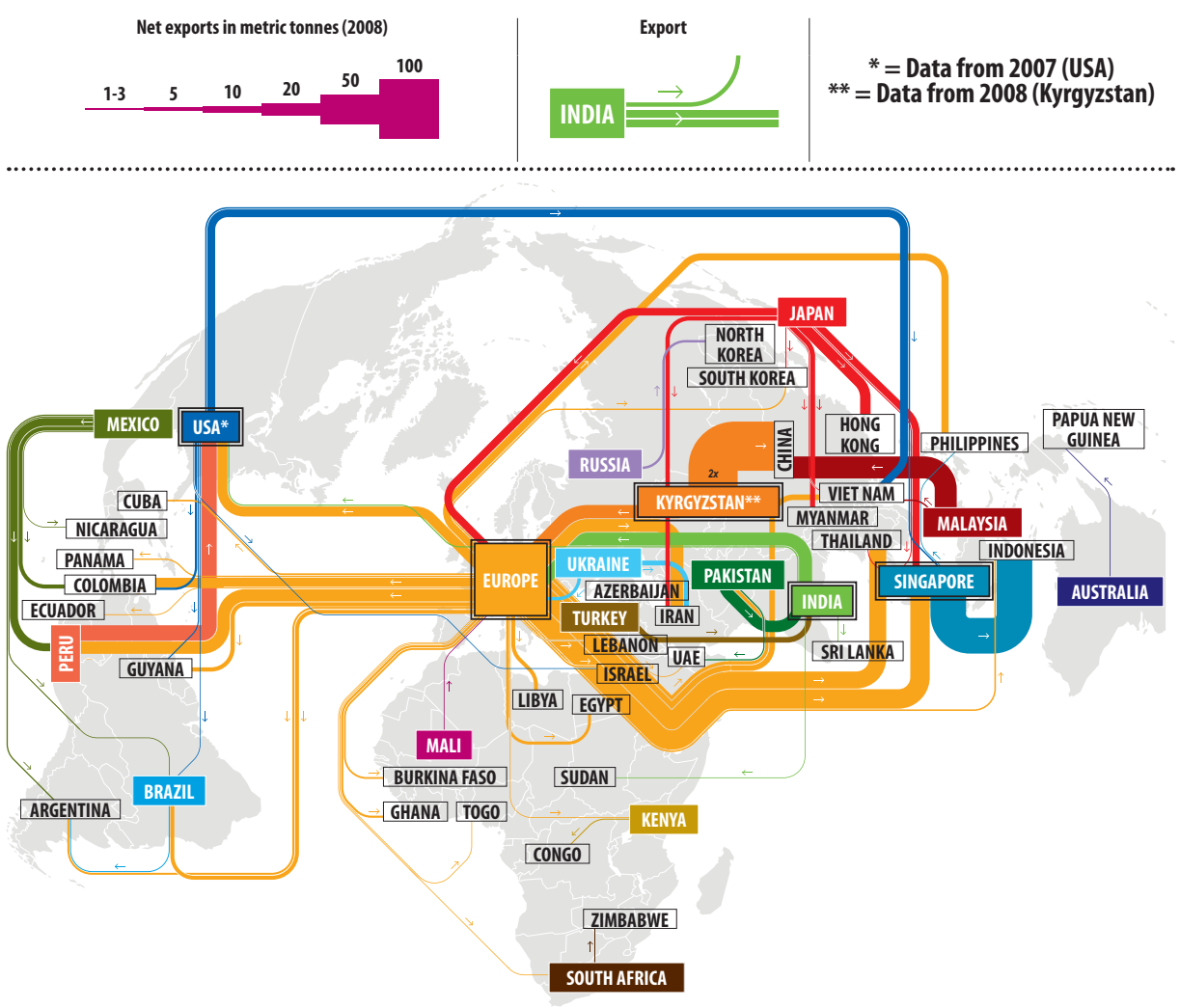
# 4

## INVENTORIES OF MERCURY & MERCURY WASTE

This chapter provides information on the inventories of mercury and mercury waste in each of the ASEAN member states with regard to:

- › Mercury Supply and Uses
- › Mercury Waste Sources and Generations
- › Mercury Waste Export
- › Material Flows
- › Existing Studies and Researches on Mercury and Mercury Waste

Many member states have not conducted inventory for both mercury and mercury waste, thus data is not always available. An overview of the overall situation in the region is presented in the succeeding paragraphs, while the information and data on the individual situations in each country are presented in the following sections.



**Figure 16 Zoinet Mercury Trade Map 2011**

Source: United Nations Comtrade, available at <http://comtrade.un.org>

The 2011 global mercury trade map released by Geneva-based ZOI Environmental Network identifies the Philippines as one of the main mercury trading centers in Asia. Indonesia, Thailand, China, Myanmar, Viet Nam, North and South Korea are also identified as the main trading centers in the region. Most of the elemental mercury entering these countries is generally coming from the European Union.<sup>34</sup> The abovementioned map is presented in Figure 16.

The largest mercury trade hub arising is Singapore. According to UN COMTRADE data, Singapore was the largest supplier of mercury to the global market in 2012. During 2011 and 2012, Singapore accounted for approximately 444 MT and 478 MT of global mercury exports respectively. Since Singapore imported larger quantities during this period, it is acting as a toxic supply center for private traders. The majority

34 Ban Toxics (n.d.).

of these exports are directed to countries engaged in ASGM, with Indonesia receiving over half the exports in both years, and substantial quantities also shipped to Guyana, Kenya, Peru, and Malaysia.<sup>35</sup>

Most countries import much more mercury than is actually needed for legal uses. The excess amount is sold in the black market for unsustainable practices such as in artisanal and small-scale gold mining or ASGM. An analysis of retrieved data from UN Comtrade on mercury import and export in the ASEAN member states during 2011-2015 (accessed 20.08.2016), indicates that a total of 1,541.19 tonnes of mercury was imported into the ASEAN during the abovementioned period of time. The total import of mercury by each ASEAN member state during 2011-2015 is presented in Figure 17 by the order of quantity.

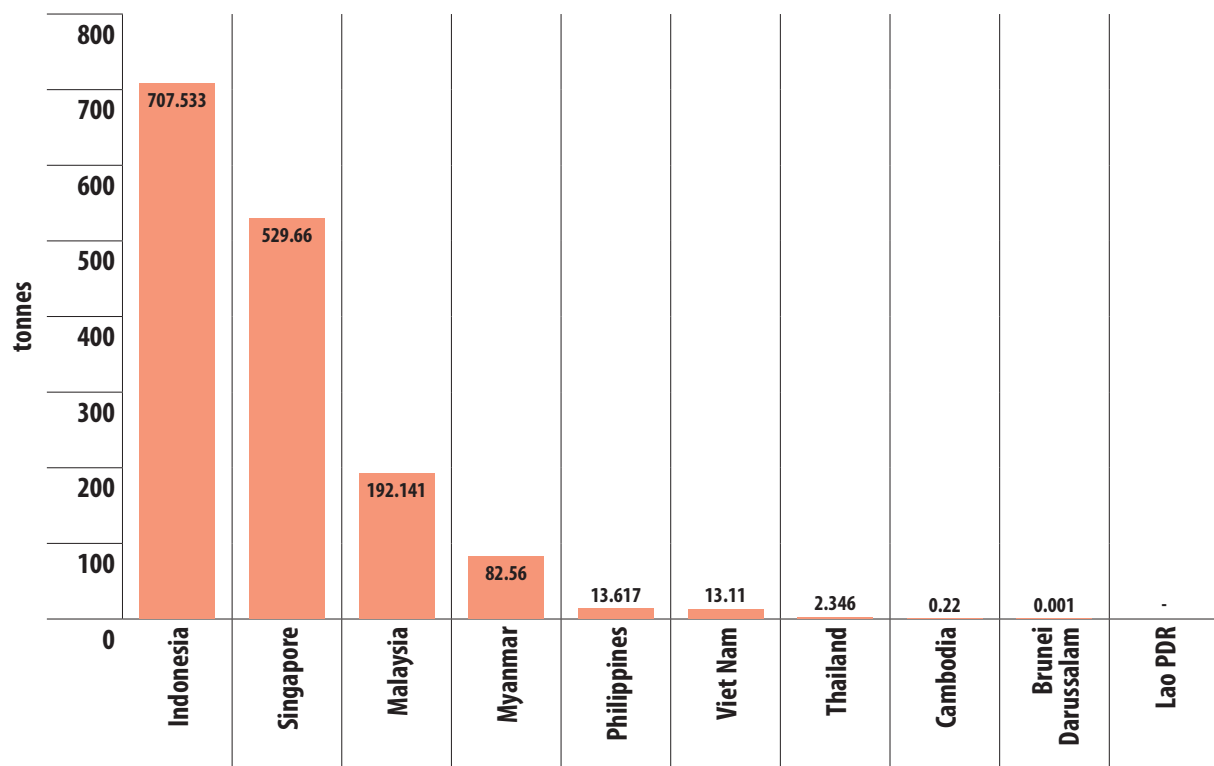
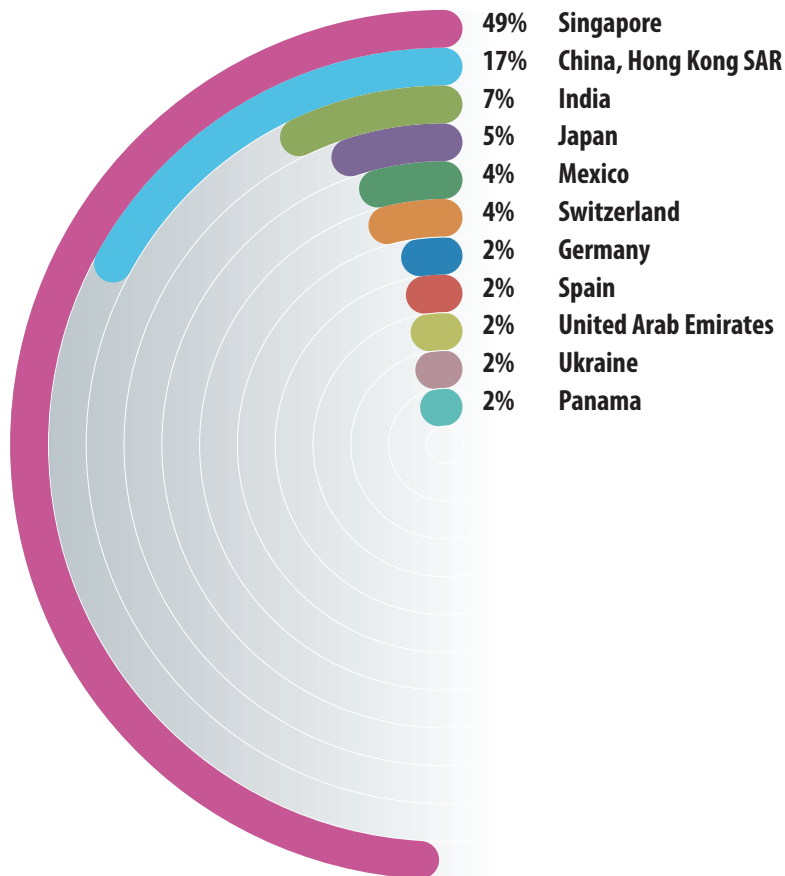


Figure 17 The total import of mercury by each ASEAN member state during 2011-2015

The countries of origin of mercury import in the region are graphically presented in Figure 18. On the contrary to the Ban Toxics' statement, that most of the elemental mercury entering some countries in the ASEAN region are generally coming from the European Union, the result of UN Comtrade data under this study, indicates that the five largest sources of mercury import in the region during the 2011-2015 period, as shown in Figure 19, are Singapore (one of the ten member states of ASEAN),

35 Gutierrez, R. and others (2013).

China, India, Japan and Mexico. It is now evident that the situation has changed recently, thus the European Union is no longer the largest supplier of mercury to the ASEAN region.



**Figure 18** Countries of origin of mercury import in the ASEAN region during 2011-2015 based on analysis of data retrieved from the UN Comtrade database

Source: UN Comtrade database

The total export of mercury from each ASEAN member state during 2011-2015 based on the analysis of data retrieved from the UN Comtrade database is presented in Figure 19.

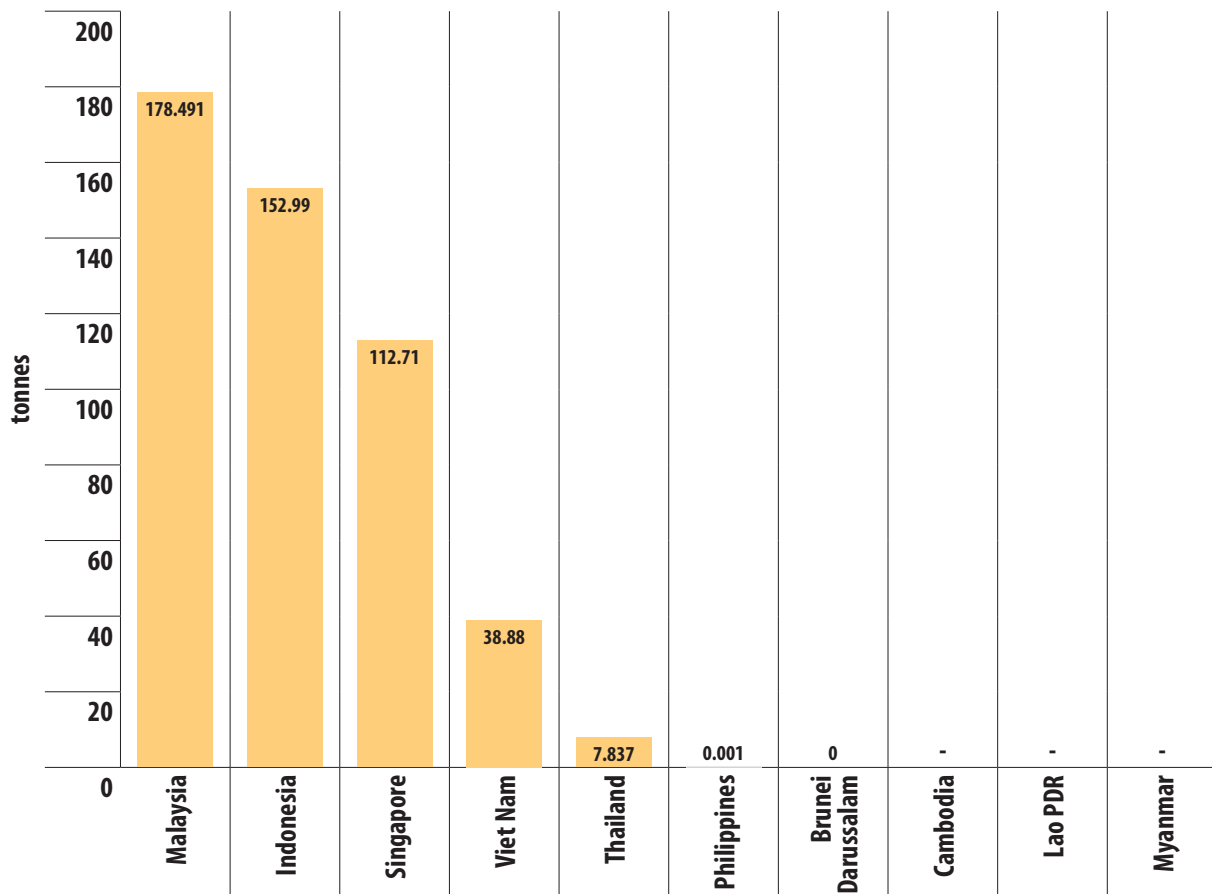
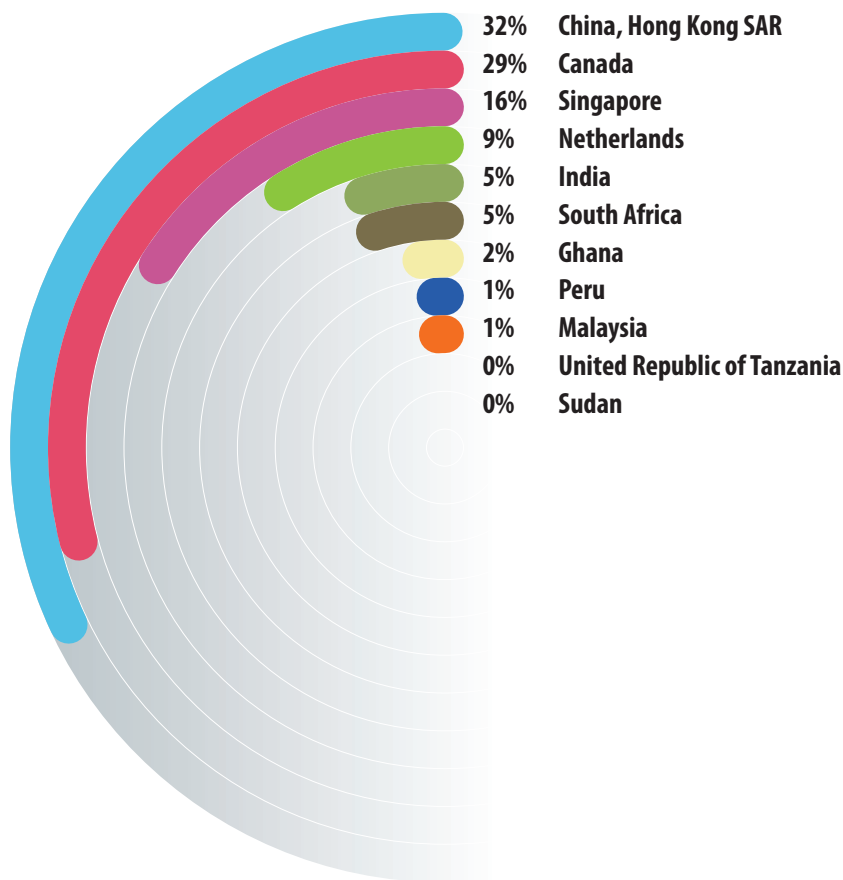


Figure 19 Total export of mercury by each ASEAN member state during 2011-2015

Source: UN Comtrade database

Another result of analysis of the same UN Comtrade data on mercury export from the ASEAN region during 2011-2015, indicates that a total of 490.91 tonnes of mercury were exported from the ASEAN region to various countries, including two of the ten ASEAN member states themselves. The countries of destination are ranked by quantities of mercury exported to them and presented graphically in Figure 20. It is shown that China holds the top of the rank (32%), followed by Canada 29%), Singapore (16%), Netherlands (9%), India (5%) and South Africa (5%) as the largest countries of destination. The rest of the destination countries, including Malaysia (one of the ten ASEAN member states), share less 1% or less of the total quantity.



**Figure 20 Countries of destination of mercury export from the ASEAN region during 2011-2015 based on analysis of data retrieved from the UN Comtrade database**

Source: UN Comtrade database

It is interesting to note that Singapore plays the role of a major - even the largest - supplier of mercury to the ASEAN region and at the same time plays the role of importer (country of destination of import) of mercury – the third largest importer - from the same region. The results of the analysis of mercury import-export in the region during 2011-2015 under this study have confirmed the statement of Richard Gutierrez (2013) cited above.

## 4.1 BRUNEI DARUSSALAM

### 4.1.1 MERCURY INVENTORIES

Brunei has not conducted any inventories of mercury nor mercury waste. Therefore, no data are available.

### 4.1.2 MERCURY SUPPLY AND USES

During the period of 2011-2015, UN Comtrade recorded an import of 1 kg mercury from Singapore in 2013 and 33 kg from Indonesia in 2015. There is no information on the use of the imported mercury.

### 4.1.3 MERCURY WASTE SOURCES, GENERATIONS

In Brunei, mercury waste is primarily generated from oil and gas exploration and production activities. However, there is no data on mercury waste sources and generation available at the present time.

### 4.1.4 MERCURY WASTE EXPORT

There is no data of mercury waste export during the period of 2011-2015.

## 4.2 CAMBODIA

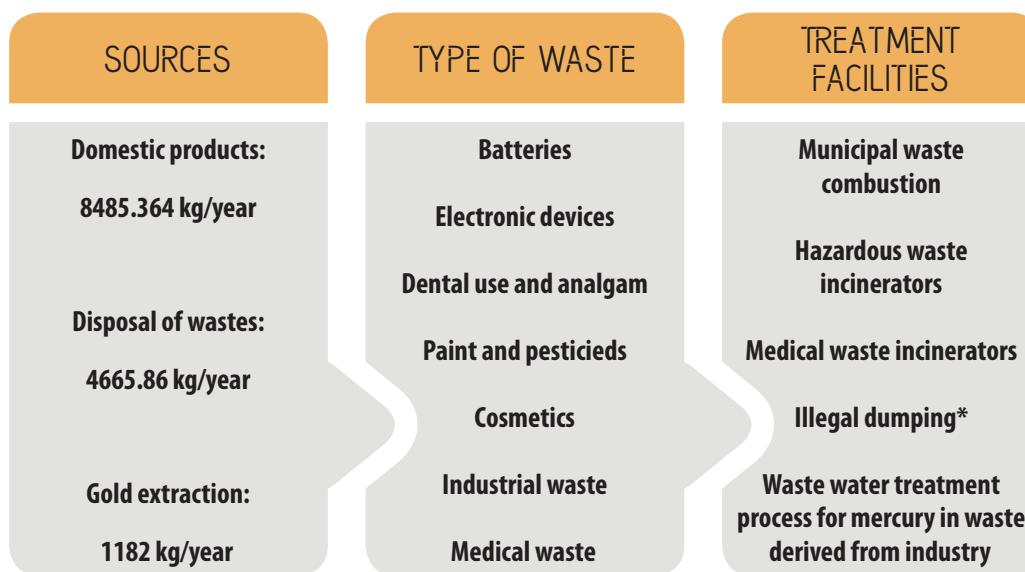
### 4.2.1 INVENTORIES

Cambodia has conducted a national inventory of mercury in 2007. The inventory aimed at establishing baseline information on mercury release sources, exposure routes and possible quantities released into the environment. As a preliminary inventory, it involved 12 provinces out of 24 provinces and municipalities first. The inventory report is available at both the UNEP Chemicals' website<sup>36</sup> and the AIT-RRCAP's website.<sup>37</sup>

36 [http://www.unep.org/chemicalsandwaste/Portals/9/Mercury/A\\_Inventories/Cambodia%20Mercury%20Invent%20Report.pdf](http://www.unep.org/chemicalsandwaste/Portals/9/Mercury/A_Inventories/Cambodia%20Mercury%20Invent%20Report.pdf)

37 <http://ekh.rrcap.ait.asia/?q=Cambodia%20Mercury%20Inventory%20Report>





**Figure 21 Cambodia's mercury material flow**

Source: Ministry of Environment, Cambodia

## 4.2.2 MERCURY SUPPLY AND USES

Cambodia does not produce mercury. It imports mercury from the neighboring countries.

During the period of 2011-2015, UN ComTrade recorded an import of 220 kg mercury from Thailand in 2011.

Mercury is used in ASGM in the rural areas and in certain industries, e.g. for cosmetics and domestic electronic products. The mercury supply for the ASGM activities may involve illegal importation.

## 4.2.3 MERCURY WASTE SOURCES AND GENERATIONS

Based on the result of Inventory in Cambodia, approximately 769 kg to 14845 kg of mercury is being released per year.

The main sources of mercury release are considered a high potential level as following:

- › Consumer products with intentional use: 8485.362 kg/year
- › Disposal of waste: 4665.56 kg/year
- › Gold extraction: 1182 kg/year

## 4.2.4 MERCURY WASTE EXPORT

At the time this report was written, there was no data on mercury waste export available.

## 4.3 INDONESIA

### 4.3.1 INVENTORIES

Indonesia monitors and summarizes the generated hazardous waste in the industrial sector based on their periodic reports. The industrial sector comprises the manufacturing industry, agro-industry, infrastructure and services, and oil and mining. According to information from some resource persons at the MoEF of Indonesia, a sectoral inventory of fluorescent lamps only was conducted in 2011. However, it was not well documented and the records were lost during the transition of the Ministry's restructuring. The Ministry has also developed an electronic/on-line system for hazardous waste management reporting which was recently launched in June 2016 as a trial. The system covers the main sectors of generators in Indonesia (Mining and Energy, Manufacturing, Agro-industry, Infrastructure & Services).

Indonesia has also developed a mercury material flow diagram as presented in the flow chart in Figure 22.

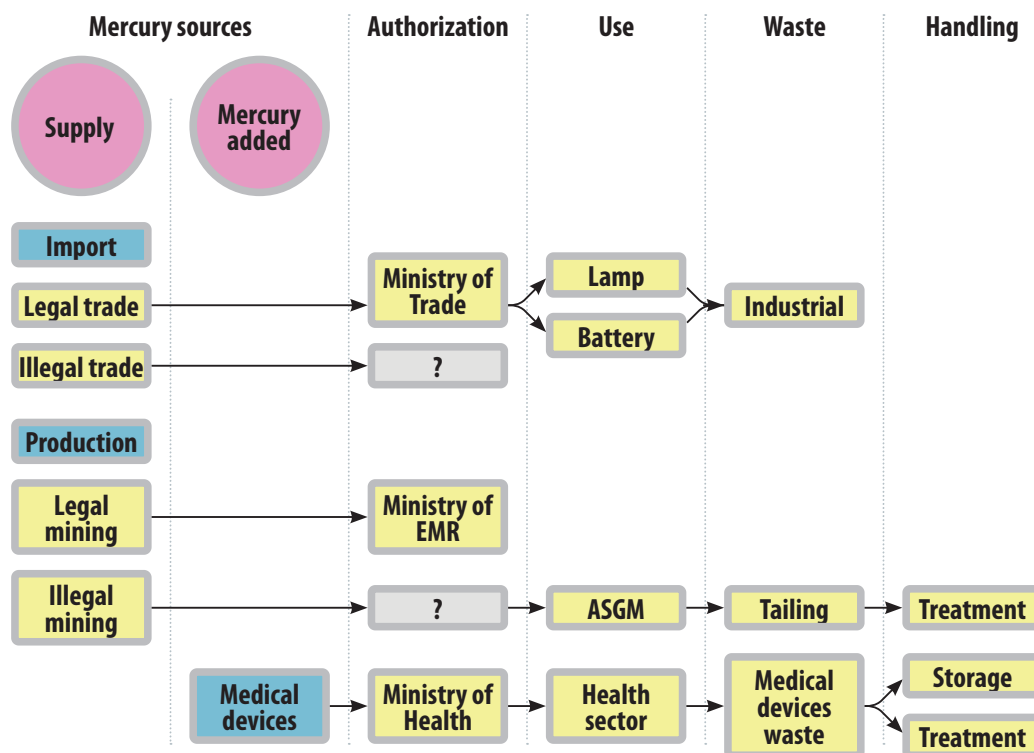


Figure 22 Mercury material flow in Indonesia

Source: Indonesia's draft response to the questionnaire, 2016

### 4.3.2 MERCURY SUPPLY AND USES

Mercury import is the legal source of mercury in Indonesia. According to the Ministry of Environment and Forestry - based on the Ministry of Trade's data it received - during the period of 2011-2015, about 1130 kg of mercury was imported for use in the lighting and power batteries industry. However, much larger quantities of mercury are found in the market for use in the ASGM sector and are suspected to be illegally imported – as illustrated in Table 11.

**Table 11 Data of mercury import**

Mercury Supply Source, Country of Origin	Quantity (metric tonne)					Sub-Total
	2011	2012	2013	2014	2015	
(Not specified)	0.552	0.040	0.040	0.500		1.132
Sub-Total	0.552	0.040	0.040	0.500		1.132

Source: Indonesia's MoEF, 2016

The MoEF of Indonesia noted that the import quantity of mercury as presented in the table above was for the mercury used in the light and battery industries. In fact, according to the same source at the MoEF of Indonesia, approximately 100 tonnes per year of mercury is used for ASGM activities in Indonesia, thus indicating that mercury may still be illegally entering Indonesia.

According to the Indonesian Ministry of Trade, the country imported slightly less than one metric tonnes of mercury in 2012 through two local companies, primarily for commercial manufacturing, including for the production of light bulbs and batteries, and for use in hospital equipment. According to United Nations trade statistics, however, 368 metric tonnes of mercury, about 810,000 pounds, was legally exported to Indonesia in 2012 from countries that included Singapore, the United States, Japan and Thailand.<sup>38</sup>

**Table 12 Data on mercury import in Indonesia**

Mercury Supply Source, Country of Origin	Quantity (tonne)					Sub-Total (tonne)
	2011	2012	2013	2014	2015	
Australia				1.550		1.55
Germany	0.002					0.002
Japan	0.962	0.554	0.425			1.941
Netherlands	2.504					2.504
Singapore	282.180	290.559	45.460	81.163		699.362
Spain	0.104					0.104
Thailand	0.034	2.036				2.07

38 Cochrane, J. (2014).

Mercury Supply Source, Country of Origin	Quantity (tonne)					Sub-Total (tonne)
	2011	2012	2013	2014	2015	
	285.786	293.149	45.885	82.713		707.533

Source: UN Comtrade, 2016

The data on mercury export to Indonesia during 2011-2015 retrieved from the UN Comtrade Database as presented in Table 12 confirmed the abovementioned statement that the actual import of mercury in Indonesia was much higher than the figures presented in Table 11. The table shows that during the abovementioned period Indonesia imported a total of 707.533 tonnes of mercury from various countries. But, almost 99% of the total quantity was imported from Singapore.

### 4.3.3 MERCURY WASTE SOURCES AND GENERATIONS

The major sources of mercury waste are oil and gas production, industrial processes, households and institutional buildings and the ASGM. The Ministry of Environment and Forestry of Indonesia provided data for the waste fluorescent lamps generation from the four main sectors - oil, gas and mining, agro-industry, manufacture and infrastructure (including the health care services) as presented in Table 13. There is no data for waste fluorescent lamps for households.

**Table 13** Data on waste fluorescent lamps generation from 4 industrial sectors in Indonesia

Main Source of Mercury Waste Generation (Fluorescent lamps only)	Quantity (metric tonne)				
	2011	2012	2013	2014	2015
Oil, Gas and Mining					7.78
Agro-industry					9.10
Manufacture					2.20
Infrastructure and Services (incl. Health Care Service)					858.87
Total					877.95

Source: Indonesia's MoEF

### 4.3.4 MERCURY WASTE EXPORT

The data on mercury waste export from Indonesia to the designated countries recorded during the 2011-2015 period are presented in Table 14.

The table shows that during the period of 2011-2015 Indonesia exported a total of 1 121.45 tonnes of mercury waste to Switzerland and the Netherlands. However, the actual export quantity during the period might be higher than that shown in the table, since the data for 2011-2013 were not available.

**Table 14 Data on mercury waste export from Indonesia**

Country of Destination (export) or Origin (import)	Quantity (metric tonne)					Sub-Total
	2011	2012	2013	2014	2015	
Switzerland					711.45	711.45
Netherlands				410		410
				410	711.45	1121.45

Source: Indonesia's MoEF

## 4.4 LAO PDR

### 4.4.1 INVENTORIES

Based on its response to the questionnaire, Lao PDR has not yet conducted any inventories of mercury and mercury waste, this there is no related information nor data provided under this section.

### 4.4.2 MERCURY SUPPLY AND USES

No information available/provided.

### 4.4.3 MERCURY WASTE SOURCES AND GENERATIONS

No information available/provided.

### 4.4.4 MERCURY WASTE EXPORT

No information available/provided.

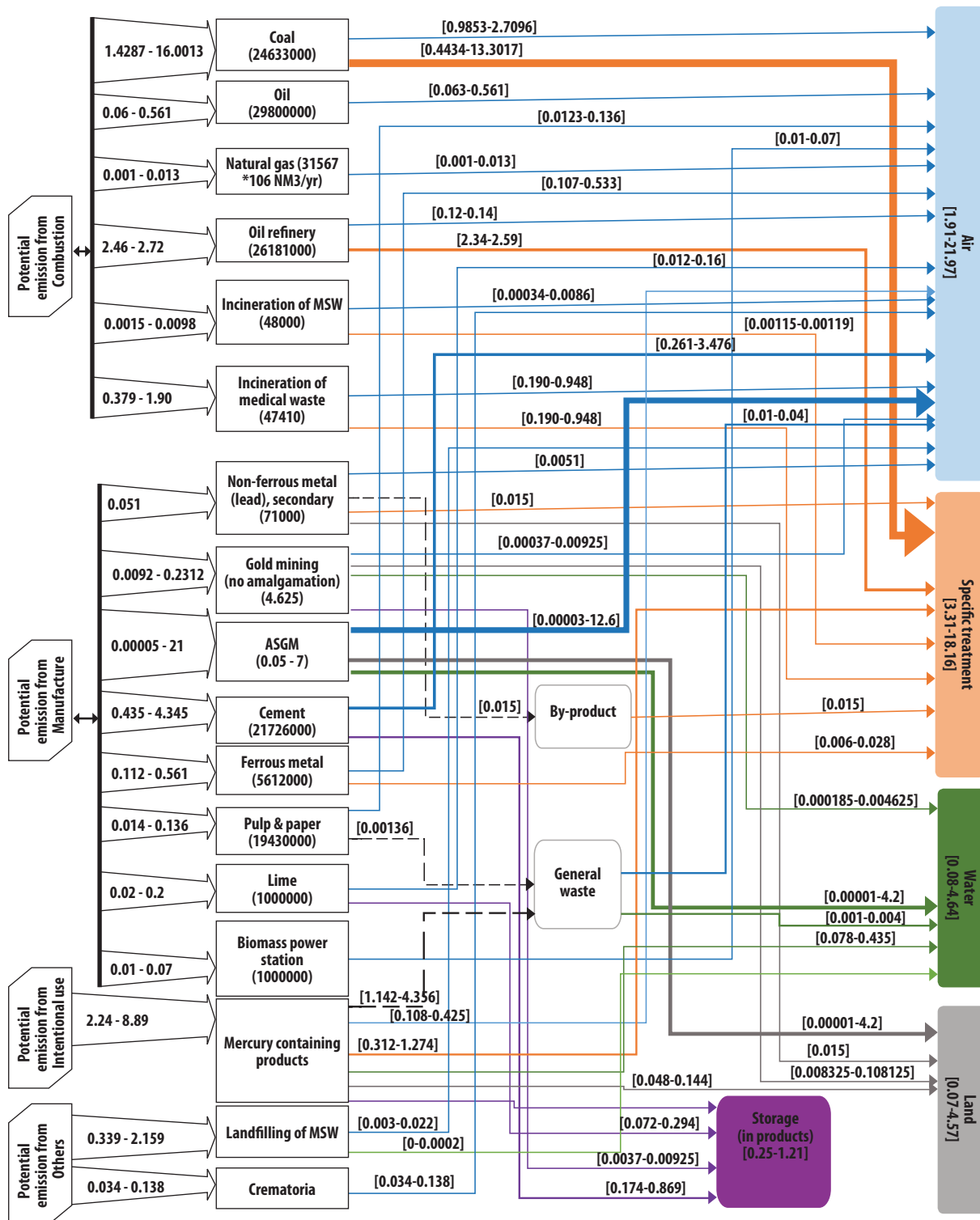


Figure 23 Substance flow of mercury emissions and releases in Malaysia in 2012

Source: Substance flow analysis of mercury in Malaysia. <http://www.sciencedirect.com/science/article/pii/S1309104215300805#bib31>

## 4.5 MALAYSIA

### 4.5.1 INVENTORIES

At the present time, there is no information on the inventory of mercury in Malaysia obtained. However, a study on substance flow analysis of mercury in Malaysia, which was considered a mercury emission inventory, was conducted in Malaysia. It used the measurement of the actual mercury emission in two solid waste incineration facilities (SWIF-a and SWIF-b) and a coal-fired power station in Malaysia. In addition to actual data on the range of mercury concentration emissions from the three point sources and an estimated total potential mercury emission in Malaysia in 2012, there is a graphical presentation of the substance flow of mercury emissions and releases, as presented in Figure 23.

### 4.5.2 MERCURY SUPPLY AND USES

Malaysia acquires mercury from foreign sources. The data on mercury exported to Malaysia from foreign countries retrieved from the UN Comtrade are presented in Table 15.

**Table 15 Data on Mercury import in Malaysia**

Mercury Supply Source, Country of Origin	Quantity (tonne)					Sub-Total
	2011	2012	2013	2014	2015	
Australia	3.120					3.12
Indonesia	4.025	6.150				10.175
China, HKS		77.604		24.150		101.754
India			0.063			0.063
Japan			0.005			0.005
Singapore	17.478	0.863	55.200	1.725		75.266
Thailand	0.006	0.120				0.126
United Arab Emirate		0.263				0.263
United Kingdom	0.151		1.215	0.003		1.369
Sub-total	24.78	85	56.483	25.878		192.141

Source: UN Comtrade, 2016

### 4.5.3 MERCURY WASTE SOURCES AND GENERATIONS

The main sources of mercury contamination in Malaysia are from batteries containing mercury or ash, waste containing mercury and its compound, waste from electrical and electronic assemblies containing components such as mercury switches or contaminated with mercury. Moreover, pathogenic wastes, clinical wastes or quarantined materials also form a major portion of mercury waste.

Mercury waste generation data which is available from two sources for the period of 2011-2014 in Malaysia are presented in Table 16.

**Table 16 Mercury waste generation in Malaysia during 2011-2014**

Mercury Supply Source, Country of Origin	Quantity (tonne)					Sub-Total
	2011	2012	2013	2014	2015	
Y29	434.18	698.27	25256.71	15840.00		42229.16
SW103	41,246.65	42,919.49	1,120.03	1,828.74		87,114.91
SW104	370,789.09	364,425.95	122,262.25	155,235.53		1,012,712.82
SW110	152,722.04	78,278.05	52,978.13	57,103.40		341,081.62
SW404	44,674.52	20,865.09	18,152.95	21,976.12		105,668.68
Sub-Total	609,432.3	506,488.58	194,513.36	236,143.79		1,546,578.03

Source: Y29 - Malaysia's National Report, Basel Convention. SW series - Environmental Quality Report 2009-2014, Department of Environment, Malaysia. Substance flow analysis of mercury in Malaysia, Science Direct, Available at: <http://www.sciencedirect.com/science/article/pii/S1309104215300805#bib31>

However, the mercury waste with the codes other than Y29 may not be entirely consisting of mercury or mercury compounds, as they may be mixed with other materials.

### 4.5.4 MERCURY WASTE EXPORT

No information obtained on mercury waste export.



## 4.6 MYANMAR

### 4.6.1 INVENTORIES

Myanmar has been conducting a sectoral inventory of mercury in cooperation with the Association of Science and Technology for Advanced Research Operation and Forest Resource Environmental Conservation and Development Association (FREDA). It is expected that the inventory will be completed in 2017.

### 4.6.2 MERCURY SUPPLY AND USES

Data on mercury import in Myanmar were obtained from the UN Comtrade database website, accessed in August 2016 and represented in Table 17.

**Table 17 Data on mercury import in Myanmar**

Mercury Supply Source, Country of Origin	Quantity (tonne)					Sub-Total
	2011	2012	2013	2014	2015	
India		0.100	0.550	1.910	27.040	29.6
Japan				0.690	10.867	11.557
Mexico	10.350		10.350	20.700		31.05
Singapore	2.484		10.350	0.005		10.355
Sub-Total	12.834	0.1	21.25	23.305	37.907	82.562

Source: UN Comtrade, 2016

The table shows that Myanmar imported a total of 85.562 tonnes of mercury during the period of 2011-2015. According to the data, the major mercury suppliers to Myanmar during the abovementioned period were Japan and Singapore. However, there is no information on the uses of the imported mercury in Myanmar.

### 4.6.3 MERCURY WASTE SOURCES AND GENERATIONS

The main source of mercury waste in Myanmar is the gold mining. According to Kachin Development Networking Group (2007), in Hugawng valley, concessions were sold to 8 selected companies and the number of main gold mining sites increased from 14 in 1994 to 31 sites in 2006. The number of active hydraulic and pit mines had exploded to approximately 100 by the end of 2006. This has resulted in an increase of mercury contamination due to ASGM.

Electronic goods containing mercury alloy or mercury compounds have no proper disposal method and hence pose a great threat to the environment. In addition to this, consumer products such as cosmetics and other products, along with the domestic electronic products also may contain mercury and are thus negatively affecting human health and environment.

#### 4.6.4 MERCURY WASTE EXPORT

There is no information available on mercury waste export as confirmed by Myanmar.

## 4.7 PHILIPPINES

### 4.7.1 INVENTORIES

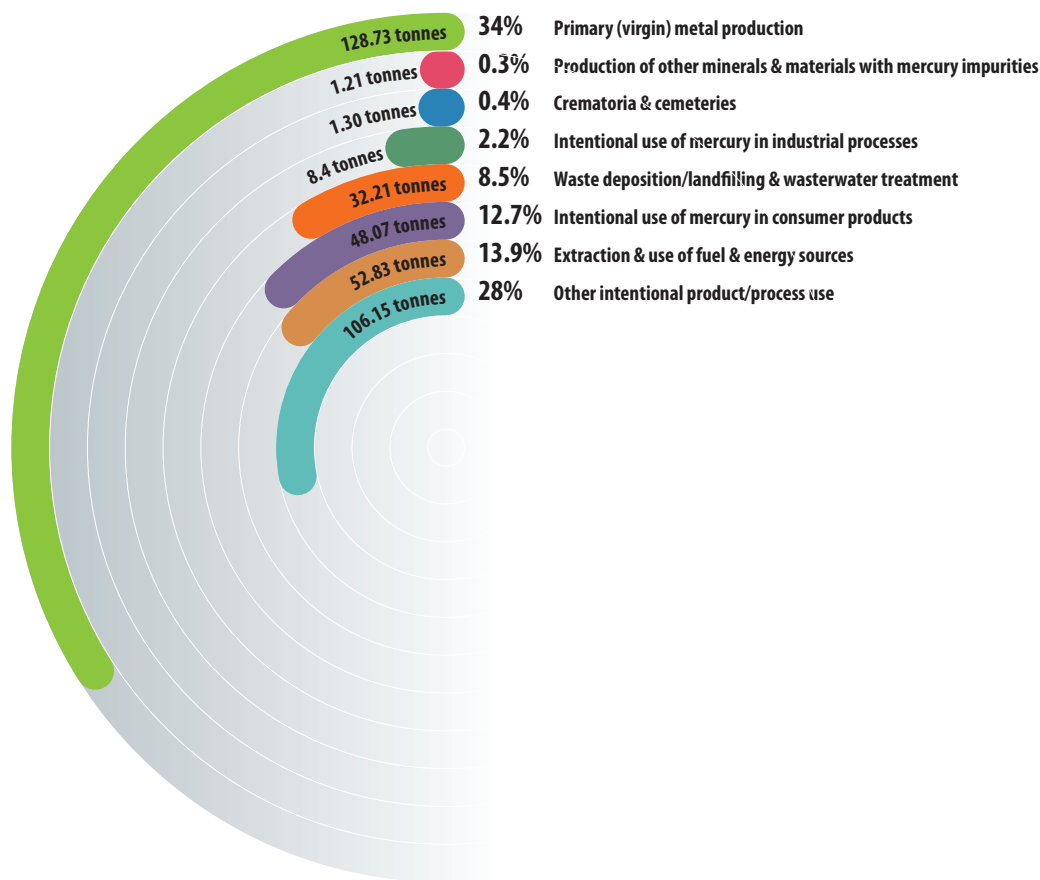
In 2008, EMB-DENR conducted a national inventory assessment for the identification and quantification of mercury releases in the country using the UNEP Inventory Toolkit. The inventory includes a list of the main and sub-category sources of mercury in the Philippines and the estimated annual releases from each source.

In 2008, the Environmental Management Bureau (EMB) of DENR conducted an inventory assessment for the identification and quantification of mercury releases in the country. The report includes a list of the main and sub-category sources of mercury in the Philippines and the estimated annual releases from each source. Using the UNEP Inventory Toolkit, an input factor is used to calculate for the estimated amount of mercury emissions to the environment.

The inventory revealed that approximately 378.89 tonnes of mercury and mercury-containing waste are released annually into various environmental media. Eight (8) main sources, comprising twenty-three (23) sub-categories, of mercury and mercury-containing waste were identified and their individual contributions are presented in Figure 24.

Top three (3) principal sub-categories releasing mercury in the Philippines are:

- > Primary Virgin Metal production - 65,927 kg Hg/year (32% of total releases) - ASGM;
- > Extraction and Use of Fuel and Energy Resources - 31,940 kg Hg/year (20% of total releases)
- > Other intentional use - products, e.g. thermometer, etc. - 29,471 kg Hg/year (20% of total releases)
- > Over-all mercury emissions are distributed mainly to air (45%), land (19%), water (18%) and the rest to general waste and others.



**Figure 24 Sources of mercury waste in Philippines**

Source: EMB/DENR, Philippines, 2008 data

## 4.7.2 MERCURY SUPPLY AND USES

In the Philippines, primary mercury was extracted from mines in the island province of Palawan from 1955 to 1976, with an annual estimated production of 140 tonnes. However, since its shutdown, the country's mercury supply now relies heavily on imports from the US, Spain, China, and Germany. Based on statistics from the United Nations Statistical Division-Commercial Trade (COMTRADE), the Philippines imported over 295,000 kilograms of mercury from 2000-2011, amounting to a total trade value of US\$ 4 million.<sup>39, 40</sup>

The quantities of mercury imported in the Philippines retrieved from UN Comtrade during the period specified under the scope of this study (2011-2015) are presented in Table 18.

39 Philippines' response to the questionnaire

40 Ban Toxics (n.d.).

**Table 18 Data on mercury import in the Philippines**

Mercury Supply Source, Country of Origin	Quantity (tonne)					Sub-Total
	2011	2012	2013	2014	2015	
China, HKS	11.213	1.725				12.938
Japan			0.045	0.030	0.045	0.12
Korea, Republic			0.414			0.414
Malaysia			0.136			0.136
Singapore		3.450			0.007	0.007
Switzerland					0.001	0.001
Thailand		0.001				0.001
Sub-Total	11.213	5.176	0.595	0.03	0.053	13.617

Source: UN Comtrade, 2016

Under Section 7 of DAO 1997-38 CCO for Mercury and Mercury Compounds, the use of mercury and mercury compounds is strictly limited to the following end-users:

- › Chlor-alkali plants
- › Mining and metallurgical industries
- › Electrical apparatus (lamps, arc rectifiers, battery cells, and others)
- › Industrial and control instruments
- › Pharmaceutical
- › Paint manufacturing
- › Pulp and paper manufacturing
- › Dental amalgam
- › Industrial catalyst
- › Pesticides (fungicide) production or formulation

### 4.7.3 MERCURY WASTE SOURCES AND GENERATIONS

The EMB-DENR makes use of its national reporting system for hazardous waste management as a basis for the national inventories of hazardous waste including mercury waste. The EMB's regional offices collect reports from the EMB-registered hazardous waste generators and submit the compiled reports to EMB-DENR. The data of mercury waste total annual generation by waste stream codes during 2012-2014 are presented in the Table 19.

**Table 19 Mercury waste generation data for 2011-2015 period**

	Main Source of Mercury Waste Generation	Quantity (metric tonne)				
		2011	2012	2013	2014	2015
EMB-registered hazardous waste generators (Industrial and non-industrial)	D407		1,993	2,988	614,595	
	M506				70	
	M507				111	

Source: Philippines' response to the questionnaire, 2016

#### 4.7.4 MERCURY WASTE EXPORT

During the period of 2011-2015, the Philippines has exported mercury waste entirely in the form of mercury containing lamps. The details of data of the export as provided by the Philippines in its response to the questionnaire are presented in Table 20.

**Table 20 Philippines's mercury waste export data for 2011-2015**

Country of Destination (export) or Origin (import)	Quantity (tonne)					Sub-Total
	2011	2012	2013	2014	2015	
Japan (Mercury-containing lamps)	24	0	24	60		108
Germany (Mercury-containing lamps)			60			60
Sub-Total	24	0	84	60		168

Source: Philippines' response to the questionnaire, 2016

The table shows that during 2011-2015, the Philippines exported a total of 168 tonnes of mercury-containing lamps to Japan (108 tonnes) and Germany (60 tonnes).

## 4.8 SINGAPORE

### 4.8.1 INVENTORIES

There is no information available on inventories of mercury and mercury waste in Singapore.

### 4.8.2 MERCURY SUPPLY AND USES

The data of mercury import in Singapore were acquired from the UN Comtrade and presented in Table 21.

**Table 21** Data on mercury import in Singapore

Mercury Supply Source, Country of Origin	Quantity (tonne)					Sub-Total
	2011	2012	2013	2014	2015	
Belgium		0.001				0.001
China, Hong Kong SAR	87.630	44.145	26.336	3.450		161.561
France			0.001	0.004	0.140	0.145
Germany	39.766			0.005		0.005
India	84.000	0.100	0.150			84.25
Japan	20.355	12.420	14.334	10.350	5.175	62.634
Malaysia	1.000					1
Mexico	10.350	5.175		17.250		17.25
Switzerland		22.797	18.683	0.051	18.675	60.206
Netherlands	1.857					1.857
Panama	29.600					29.6
Spain	38.177					38.177
Thailand		3.952			2.553	2.553
Ukraine	12.076	8.901	11.098			32.075
UAE			37.170			37.17
UK			1.118			1.118
USA		0.058				0.058
Sub-Total	324.811	97.549	108.89	31.11	26.543	529.66

Source: UN Comtrade, 2016

The table shows that during the period of 2011-2015, Singapore imported a total of 529.66 tonnes of mercury from various countries around the world. The major countries of origin were China, India, Japan, Switzerland, Spain, UAE, Ukraine and Panama.

### 4.8.3 MERCURY WASTE SOURCES AND GENERATIONS

At the present time, there is no information provided on mercury waste sources and generations.

### 4.8.4 MERCURY WASTE EXPORT

At the time this report was written, there was no information on mercury waste export from Singapore. However, UN Comtrade recorded Singapore's export of mercury and the data for the period of 2011-2015 are presented in Table 22.

**Table 22 Data on mercury export from Singapore**

Country of Destination	Quantity (tonne)					Sub-Total
	2011	2012	2013	2014	2015	
China, Hong Kong SAR	36.225	3.450			20.584	60.259
Croatia	0.096					0.096
Ghana		8.625				8.625
India	1.755	0.200			8.453	10.408
Korea, Republic		0.001				0.001
Malaysia			1.725	1.725		3.45
Papua New Guinea	0.108	0.173				0.281
Peru				5.175		5.175
South Africa		3.450	5.583	8.889	5.175	23.097
Tanzania			1.117			1.117
Togo					0.197	0.197
Sub-Total	38.184	15.899	8.425	15.789	34.409	112.706

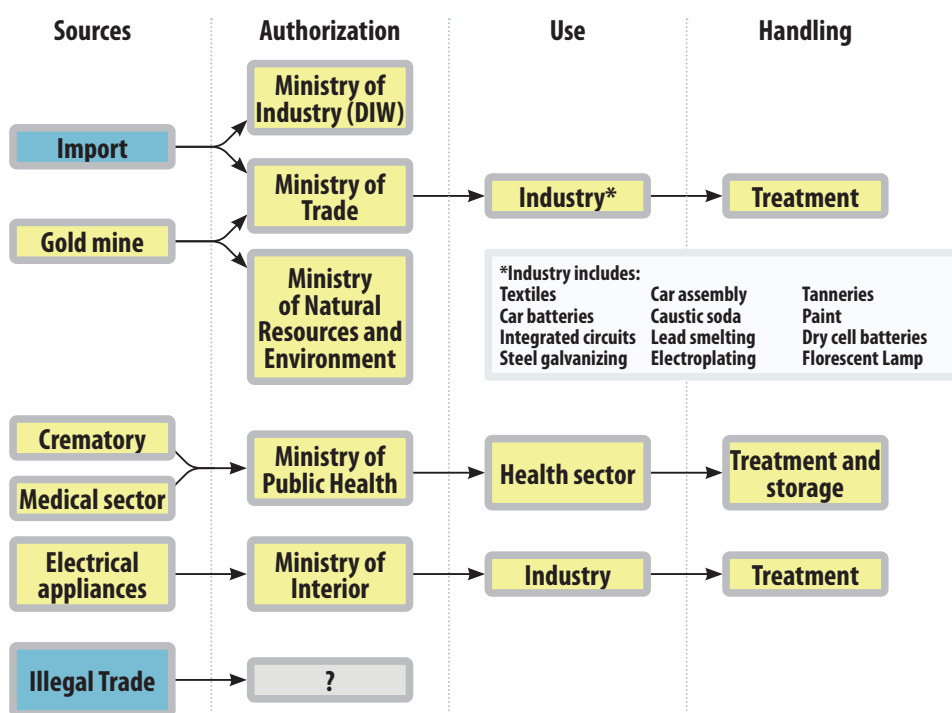
Source: UN Comtrade, 2016

Besides importing, during the same period of time (2011-2015), Singapore also exported a total of 112.706 tonnes of mercury to various countries around the world. The major country of destination is China, followed by South Africa, India and Ghana. In fact, during the same period of time, China and India were also the major suppliers of mercury to Singapore. There is no information on the reason for importing and exporting the same commodity with the same countries during the period of time. Meanwhile, the only country of destination of export from Singapore in the ASEAN region during the abovementioned period was Malaysia, to which Singapore exported a total of 3.45 tonnes of mercury.

## 4.9 THAILAND

### 4.9.1 INVENTORIES

In 2013 Thailand conducted a preliminary national inventory of mercury. The preliminary mercury inventory uses the estimation method of UNEP Toolkit for identification and quantification of mercury emissions and releases using the data of 2010.



**Figure 25 Mercury material flow in Thailand**

Source: Thailand's response to the questionnaire, 2016



## 4.9.2 MERCURY SUPPLY AND USES

The data of mercury import in Thailand as provided in its response to the questionnaire are presented in Table 23. The table shows that during the period 2011-2015, Thailand imported a total of 2.62 tonnes of mercury, mostly from Japan. The data are not much different from those obtained from UN Comtrade for the same period of time.

**Table 23** Data on mercury import in Thailand

Mercury Supply Source, Country of Origin	Quantity (tonne)					Sub-Total
	2011	2012	2013	2014	2015	
Germany	-	-	-	0.014	-	0.014
Japan	0.233	0.204	0.690	0.345	0.862	2.334
United States	0.053	0.179	0.040	-	-	0.272
Sub-Total	0.286	0.383	0.73	0.359	0.862	2.62

Source: Thailand's response to the questionnaire, 2016

## 4.9.3 MERCURY WASTE SOURCES AND GENERATIONS

There is no data on the annual mercury waste generation available for the period of 2011-2012 both in Thailand's latest national report under the Basel Convention framework or in the Thailand's response to the questionnaire. However, according to Rungraung (2015)<sup>41</sup>, in 2014, Thailand generated approximately 2.693 million tonnes of hazardous waste. Out of this, approximately 0.576 million tonnes of hazardous waste was generated from households sources. It was seen that the electroplating industry and the textile industry are the biggest polluters in the areas surrounding Bangkok, generating, respectively, about 84,000 tonnes of wastewater and 38,300 tonnes of sludge each year, which has mercury contamination. In addition to this, it was found that a good deal of hazardous waste in Samut Prakarn is generated by the tanning and chemical industries.

## 4.9.4 MERCURY WASTE EXPORT

**Table 24** Data on mercury waste export from Thailand

Country of Destination (export) or Origin (import)	Quantity (tonne)					Sub-Total
	2011	2012	2013	2014	2015	
Germany	217.38		491.00			708.38

Source: Thailand's response to the questionnaire, 2016

41 Rungraung, C. (2015).

## 4.10 VIET NAM

### 4.10.1 INVENTORIES

Viet Nam conducted a preliminary inventory of mercury in 2008 using the UNEP Tool Kit. However, according to the information received from a respondent, it was conducted in a very short time and with a very limited scope, thus the results are considered inappropriate for release.

At the time this report was written, Viet Nam had just started an inventory of mercury waste, thus no data are available yet. The results of the inventory may be shared later once they are ready.

### 4.10.2 MERCURY SUPPLY AND USES

The data of mercury import in Viet Nam were acquired from the UN Comtrade and are presented in Table 25.

**Table 25** Data on mercury import in Viet Nam

Mercury Supply Source, Country of Origin	Quantity (tonne)					Sub-Total
	2011	2012	2013	2014	2015	
Belgium	0	2.191		0.003		2.194
Germany			0.002			0.002
Japan	2.518		1.937	1.070	1.070	6.595
Malaysia	1.800					1.8
Thailand	0					0
USA	2.072					2.072
Other Asia				0.450		0.45
Sub-Total	6.39	2.191	1.939	1.523	1.07	13.113

Source: UN Comtrade, 2016

In Viet Nam mercury has been widely used in industrial production. Data on mercury uses in Viet Nam is presented in Table 26.<sup>42</sup>

42 Cuong, N. M (2015).

Table 26 Mercury uses in Viet Nam

TT	Sector	Capacity	Mercury Use	Regulation
1	Lighting equipment	~ 70 million LED	Use: 3,000kg liquid mercury and 64 mercury pellets; Disposal: 350,000 mg (from 40,000 broken bulbs)	- Circular 30/2011/TT-BCT on temporary regulation on allowed concentration of some harmful chemicals in electric and electronic products
2	ASGM	Estimated gold reserve of 300 tonnes to be mined, with current technology, the estimate of Hg will be 900 tonnes		
3	Healthcare	Dental: 151 – 5,000 g/year/hospital		

Source: Adapted from Nguyen Minh Cuong. Minamata Convention and Mercury Waste Management in Viet Nam. Joint Workshop: Regional Workshop on Environmentally Sound Management (ESM) of Mercury Waste and Regional Inception Workshop on Minamata Initial Assessment (MIA), Osaka, December 2015.

### 4.10.3 MERCURY WASTE SOURCES AND GENERATIONS

According to a research project carried out in factories/industries in Viet Nam, some mercury sources are found as below:

- > Coal power plants
- > Cement factories/plants
- > Steel plants
- > Other manufacturers: Oil refinery, thermometer, compact fluorescent lamp, dentistry, electric components, metallurgy, waste incinerator, e-waste, landfill, chemistry.

At the present time, there is no information on the mercury waste generation quantities provided.

### 4.10.4 MERCURY WASTE EXPORT

No information provided

## 4.11 MUNICIPAL WASTE AND ESTIMATED MERCURY EMISSIONS AND RELEASES

Various types of discarded mercury-added products in some developing countries go with the municipal solid waste to the sanitary landfills or open dumping sites. In such disposal sites, mercury may be released to the air, water and land. Solid waste landfilling, if the facility for it is constructed and operated properly, is a better method to prevent the mercury releases to the environment than the open dumping.

This section provides an idea of the relative quantities of the municipal solid waste in the ASEAN member states annually and the estimated mercury releases to the environment from the landfilled waste using the UNEP Toolkit for Mercury Inventory Level 1. The inventory of mercury releases is completely different from inventory of mercury waste.

The toolkit has prescribed formulas for estimating the mercury input to the landfill and its releases to the environment. The formula is quite simple, however the assumptions to be taken into account in using it are not that simple. Nevertheless, the Toolkit provides notes on the calculation spreadsheet for Inventory Level 1 in Appendix I, in order to let users have an understanding on the background of the prescribed formula for estimation. The note for mercury estimation in waste landfilling is cited hereunder.

“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 provides 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.”

In order to use the toolkit for estimating mercury releases to environment from municipal solid waste landfilling, users just need data on annual quantity of landfilled waste, e.g. in the ASEAN region. It, indeed, was difficult to find reliable data on annual quantities of municipal solid waste generation and the amount of landfilled portion in the ASEAN region completely. However, some available data on the annual quantity of the landfilled municipal waste in the ASEAN member states from various sources were obtained and presented in Table 27.

**Table 27 Annual quantity of solid waste landfilled in ASEAN member states and the data sources**

Countries	Waste Landfilled in tonnes	Sources
Brunei Darussalam	NA	
Cambodia	NA	
Indonesia	44,160,000 tonnes (69% of waste, 2014)	Ministry of Environment, Indonesia (2016). Available from: <a href="http://www.menlh.go.id/rangkaian-hlh-2015-dialog-penanganan-sampah-plastik/">http://www.menlh.go.id/rangkaian-hlh-2015-dialog-penanganan-sampah-plastik/</a>
Lao, PDR	71,175 tonnes (195 tonnes per day, only in Vientiane city, 2011)	Baseline survey on urban environment in the 3 cities in Lao PDR (2012), LPPE Newsletter, p.3. Available from: <a href="https://www.jica.go.jp/project/laos/008/news/environment/pdf/newsletter_02.pdf">https://www.jica.go.jp/project/laos/008/news/environment/pdf/newsletter_02.pdf</a>
Malaysia	5,110,000 tonnes (25,000 tonnes/day; 9,125,000 tonnes/year; 56% of total waste disposed, 2012)	Anwar Z (2015). Solid Waste Management in Malaysia, p.6, 12. Available from: <a href="https://prezi.com/qxvovdd4xkpr/solid-waste-management-in-malaysia/">https://prezi.com/qxvovdd4xkpr/solid-waste-management-in-malaysia/</a>
Myanmar	567,750 tonnes (1550 tonnes per day only in Yangon city, 2014)	IGES (2014). Present Situation of Solid Waste Management in Yangon City, p.4. Available from: <a href="http://pub.iges.or.jp/modules/envirolib/upload/4677/attach/Waste_management_in_Yangon-30_July.pdf">http://pub.iges.or.jp/modules/envirolib/upload/4677/attach/Waste_management_in_Yangon-30_July.pdf</a>
Philippines	NA	

Countries	Waste Landfilled in tonnes	Sources
Singapore	3,023,800 tonnes (7,673 kilo tonnes in total, 2015)	National Environment Agency (2016). Waste Statistics and Overall Recycling. Available from: <a href="http://www.nea.gov.sg/energy-waste/waste-management">http://www.nea.gov.sg/energy-waste/waste-management</a>
Thailand	21,910,000 tonnes (13,590,000 tonnes were appropriately disposed, 4,940,000 tonnes were residual, 2015)	Pollution Control Department (2015). Thailand State of Pollution Report 2015, p.75. Available from: <a href="http://www.pcd.go.th/public/Publications/en_print_report.cfm?task=en_report2558">http://www.pcd.go.th/public/Publications/en_print_report.cfm?task=en_report2558</a>
Vietnam	NA	

Source: UN Comtrade, 2016

The table shows that the data of annual quantities of landfilled waste in each of the ASEAN member state are not always consistently representing the total quantities at the national level, but, in some member states the data were related to the municipal level only, in some cases even just from a single municipality. However, as the toolkit actually is also a set of simplified calculations aimed at providing ideas on the pathways and quantitative figures of mercury released to the environment from various major sources and, hence, the importance of paying attention to the issue, the data are used anyway.

Based on the available data for each ASEAN member state, calculations using the toolkit for mercury releases inventory in the region have been performed. Specifically the set of calculations reference 5.9.1 of the toolkit for waste landfilling was used. The results are summarized and presented in Table 28.

**Table 28** Estimated mercury releases to the air, water and land resulting from the solid waste landfilling, using the UNEP Mercury Toolkit Level 1 (Reference 5.9.1., Controlled landfills/deposits)

Country	Annual Waste Landfilled [tonne/y]	Estimated Annual Hg Input [kg/y]	Estimated Hg releases, standard estimates [kg/y]		
			Air	Water	Land
Brunei Darussalam	NA				
Cambodia	NA				
Indonesia	44160000	220,800	2,208.0	22.1	0.0
Lao PDR	71175	356	3.6	0.0	0.0
Malaysia	9125000	45,625	456.3	4.6	0.0
Myanmar	567750	2,839	28.4	0.3	0.0
Philippines	NA				
Singapore	3023800	15,119	151.2	1.5	0.0
Thailand	21910000	109,550	1,095.5	11.0	0.0
Viet Nam	NA				
Total	78857725	394,289	3,943	39.5	0.0
Sub-Total	38.184	15.899	8.425	15.789	112.706

Source: UN Comtrade, 2016

The table shows a great variation of results due to the broad range of input variables. It should be noted that the results from Lao PDR and Myanmar do not represent the national level and data from three member states were even not available. Therefore, the showed results may not properly represent the entire ASEAN region.

The accuracy of the estimation of mercury releases greatly depends on the reliability of landfilled waste quantity data and the assumptions taken in the calculation. The solid waste composition and the state of the mercury waste entering the landfill as well as landfilling practices vary throughout the world and even within a country. For example, in countries where solid and hazardous waste management policies and regulations are strictly implemented, mercury and other hazardous waste may not be found in municipal solid waste. On the contrary, in countries with no policies and regulations for solid and hazardous waste management or no enforcement, the municipal solid waste streams may contain considerable quantities of mercury waste and other hazardous waste, e.g. discarded mercury-containing lamps. Another example, some municipal solid waste landfills in Thailand accept mercury waste after solidification/stabilization so that the mercury constituent in the waste matrix may not migrate easily to the environment. On the contrary, despite constructed and designated as sanitary landfills, some municipal waste landfills in some other countries were not operated properly. Not only is there no acceptance criteria for incoming waste that prevent hazardous materials entering the landfills, there was also no daily soil cover applied. Moreover, scavengers were even admitted to enter the landfills and burn the waste there in order to recover metal waste.

The different operations of the abovementioned landfill sites affect the occurrence and the quantities of mercury releases to the environment. The policies and regulations for solid and hazardous waste management as well as their enforcement affect the municipal waste composition, reducing the presence of mercury and other hazardous waste in the municipal solid waste matrix. Waste acceptance criteria for landfilling affect the presence and the level of mercury quantities in the landfill, reducing the risk of mercury and other hazardous substances migration from the landfill. Landfill construction and operations affect the pathway and quantities of mercury released to the environment. Hence, the assumptions taken into account in estimating mercury releases to the environment cannot be generalized for all countries even for those in the same region.

Taking the abovementioned aspects into consideration, the variations of the influencing factors are too broad. As a result, using the toolkit for Mercury Inventory Level 1 for estimating mercury releases into the environment in the ASEAN region may not be appropriate to achieve a certain level of accuracy. Using the Toolkit for Mercury Inventory Level 2 may be more appropriate. However, the latter requires more detailed information and data, which have to be assessed and prepared first.

It is recommended that in order to reach a satisfactory level of accuracy of estimation of mercury releases from the landfilled municipal solid waste in the ASEAN region, a thorough study or assessments on municipal solid waste needs to be performed first. The study should also include assessments of the existing landfills construction and operations, which may affect the assumptions for the pathways and quantities of mercury released.

# 5

## IDENTIFICATION OF CHALLENGES, NEEDS & OPPORTUNITIES FOR REGIONAL COOPERATION

This chapter presents the challenges faced by the ASEAN member states (AMS) in managing the mercury waste, ideas for solutions needed as well as the opportunities for regional cooperation. The information is mainly based on the responses of the AMS to the questionnaire. However, some AMS did not respond to the questionnaire and even some of those who responded did not complete this part of the questionnaire. Therefore, additional issues have also been identified based on other sources, e.g. presentations of the AMS on mercury at any relevant meetings conducted before the commencement of this study. Most of the presentations of the AMS published on the web are in the context of municipal waste management. Therefore, in order to ensure the relevance and up-to-date information, the other sources of information included are the AMS presentations only on mercury waste management.

Table 29 identifies the sources of information considered under this study on the challenges, needs and opportunities from each member state. Despite responding to the questionnaire, some member states (Lao, Thailand and Viet Nam) did not state their challenges, needs and opportunities. Hence, the information was taken from their presentations at the Regional Workshop on the ESM of Mercury Waste held in Osaka, 2015, except for Lao PDR, as it did not attend the workshop.

**Table 29 Sources of information on the challenges, needs and opportunities in the implementation of the ESM of mercury waste for each ASEAN member state**

Source of Information	ASEAN Member States									
	BR	KH	ID	LA	MY	MM	PH	SG	TH	VN
Questionnaire	X	X	X	X		X	X		X	X
RWS, Osaka 2015		X	X		X		X		X	X

During the Expert Review Meeting in Bangkok, additional input on the challenges, needs and opportunities were obtained from the participants, as listed below.

- > Even the government officers face a difficulty in identifying mercury waste.
- > There is no demonstration of mercury waste treatment technology in the region.

All of the challenges faced by the member states, the solutions needed and the areas of opportunity for regional cooperation were reviewed. Based on the review, the challenging issues, the solutions needed and the area of opportunity for regional cooperation were then grouped into several categories as presented in Table 30.

**Table 30 Categorisation of the identified challenges, needs and opportunities in the implementation of the ESM of mercury waste**

Category of Challenges, Needs and Opportunities in the ESM of Mercury Waste		
Challenging Issues	Solution Needed	Area of Opportunity for Regional Cooperation
Control deficiency	Control, enforcement	Control, enforcement
Expertise deficiency	Economic development	Economic development
Information deficiency	Education, training	Education, training
Infrastructure deficiency	Information network	Information network
Institutional capacity deficiency	Infrastructure development	Infrastructure development
Inventory deficiency	Institutional capacity building or improvement	
Illegal activities	Inventory development	
Legal aspect deficiency	Legal instruments development	
Operational aspect deficiency	Operational improvement	
Public awareness deficiency		
Tools deficiency		



The inputs from all AMS are compiled in Table 31. Some member states provided inputs on the challenges, but, did not specify the corresponding needs for solutions and opportunities for regional cooperation. Therefore, for the purpose of analysis, the writer has added the corresponding needs for solution and opportunities for regional cooperation (printed in brown in the table) based on simple professional judgement.

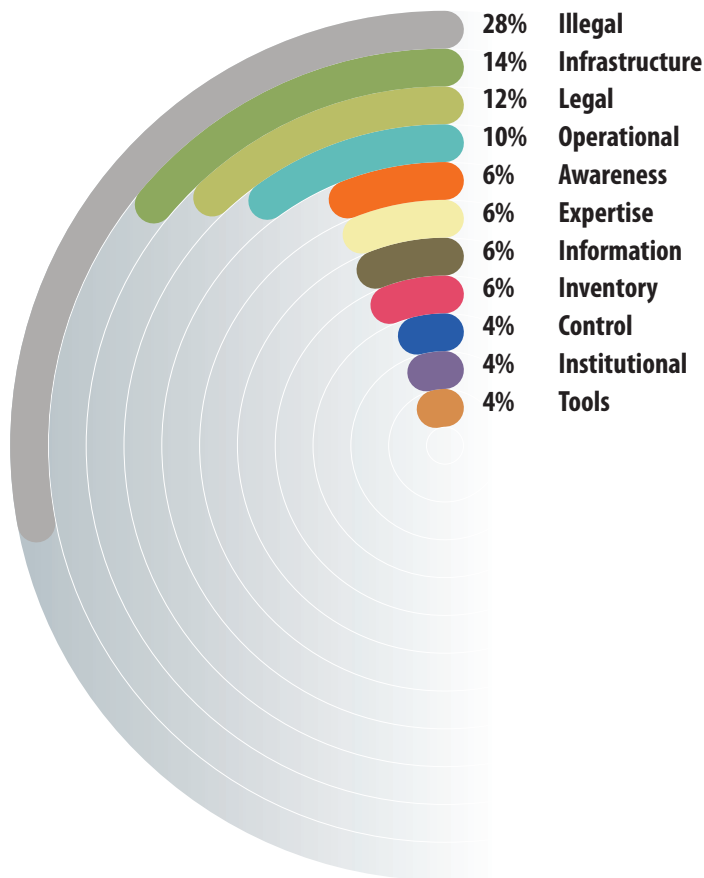
The relevant category was then assigned to each challenging issue, solution needed and area of opportunity for regional cooperation so that further analysis could be performed. The results of analysis are presented in the following sections.

## 5.1 CHALLENGES

Based on the analysis, the control of illegal actions and activities is the most challenging issue (28%) faced by some of the ASEAN member states. The challenges/issues include the illegal import and trade of mercury, illegal operations of ASGM and illegal dumping of mercury waste. These issues were expressed, in particular, by Indonesia, the Philippines and Thailand.

The next major challenging issue faced by the member states are the absence or inadequacy of infrastructure for the ESM of mercury waste, e.g. proper recycling, treatment and disposal facilities. Brunei, Cambodia, Lao PDR and Myanmar confirmed that at the present time there are no proper TSD facilities available in their jurisdictions. Indonesia, Malaysia, Philippines, Thailand and Viet Nam are the member states with treatment and disposal facilities for hazardous waste, but, still need a proper commercial facility for mercury recovery. Therefore, up to the present time, the abovementioned states in most cases export their mercury waste for recycling or disposal under the Basel Convention framework.

Figure 26 summarises in graphics the results of analysis of the challenging issues faced by the ASEAN Member States in the implementation of the ESM of mercury. Categories of the challenging issues are ordered by percentage of statement of issue under the same category.



**Figure 26** The challenging issues faced by the ASEAN member states in the implementation of the ESM of mercury waste

Source: EMB/DENR, Philippines, 2008 data

Brunei Darussalam, Cambodia and Myanmar stated that they still lack of legal basis for the implementation of the ESM of mercury waste in their jurisdictions. Meanwhile, the Philippines stated that its existing regulations need to be amended in order to accommodate some aspect of mercury use in certain sectors, e.g. laboratories and dentistry.

Operational aspect of the ESM of mercury waste management still poses a problem in Myanmar, the Philippines and Thailand. The Philippines faces a low collection of mercury waste from households and lack of standards for contaminated sites management. Meanwhile, Thailand faces the inappropriate segregation and collection system for mercury waste as well mercury waste co-disposal with the common municipal solid waste.

**Table 31** Compiled inputs from the member states on the challenges, needs and opportunities in the implementation of the ESM of mercury waste, tagged with the appropriate categories as specified in Table 28

Member State	Challenge	Challenge Category	Need	Need Category	Opportunity	Opportunity Category
Brunei Darussalam	Lack of technical expertise	Expertise	Training	Education	Training on ESM of HWM & mercury waste	Education
Brunei Darussalam	Unavailability of treatment, recovery or disposal facilities of mercury waste	Infrastructure	Develop a good TSD facility	Infrastructure	International cooperation in infrastructure development	Infrastructure
Brunei Darussalam	Lack of inventory	Inventory	Conduct inventory	Inventory	Training on inventory	Education
Brunei Darussalam	Lack of laws or regulations specifically for mercury waste management	Legal	Improve legal & regulatory instruments	Legal	Training and information exchange	Education
Brunei Darussalam	Lack of guidelines for mercury waste management	Tool	Dissemination and training on TG for ESM of Mercury	Education	Training and information exchange	Education
Cambodia	Limited public awareness	Awareness	Public awareness raising	Education	Training and information exchange	Education
Cambodia	No monitoring system in place	Control	Developing monitoring system	Control	Training and information exchange	Education
Cambodia	Limited skilled officials dealing with Hg issues	Expertise	Developing capacity of relevant agencies' officials	Education	Training and information exchange	Education
Cambodia	Difficulty in identifying mercury waste, even for the government officers	Expertise	Training in mercury waste identification	Education	Training and information exchange	Education
Cambodia	Lack of data and information on Hg issues	Information	Establishing data and information management mechanism	Information	Training and information exchange	Information
Cambodia	Limited institutional capacity	Institutional	Enhance institutional capacity	Institutional	Training and information exchange	Education
Cambodia	No specific law or regulation	Legal	Developing a specific law or regulation	Legal	Training and information exchange	Education
Indonesia	Illegal import of mercury keeps occurring and difficult to control due to the limited capacity of authorities	Illegal	Limit the port of entry for mercury importation	Control	Cooperation in law enforcement	Control

Member State	Challenge	Challenge Category	Need	Need Category	Opportunity	Opportunity Category
Indonesia	Illegal import of mercury keeps occurring and difficult to control due to the limited capacity of authorities	Illegal	Control the mercury distribution and cut the line to illegal miners	Control	Cooperation in law enforcement	Control
Indonesia	Illegal trade and processing of mercury keep increasing, in particular, due to the increasing number of ASGM activities/sites	Illegal	Law enforcement related to the mercury trade and use needs to be promoted and maintained	Control	Cooperation in law enforcement	Control
Indonesia	Illegal import of mercury keeps occurring and difficult to control due to the limited capacity of authorities	Illegal	Law enforcement on all sectors	Control	Training and information exchange	Education
Indonesia	Increasing (number of) illegal small-scale mining activities	Illegal	Law enforcement on all sectors, in particular the illegal mining activities	Control	Training and information exchange	Education
Indonesia	Increasing (number of) illegal small-scale mining activities	Illegal	Create other source of income for illegal miners	Economy	Develop economic cooperation	Economy
Indonesia	Illegal trade and processing of mercury keep increasing, in particular, due to the increasing number of ASGM activities/sites	Illegal	Promoting public awareness of the adverse impacts of mercury and its management	Education	Multi-stakeholders cooperation in public awareness raising	Education
Indonesia	Increasing (number of) illegal small-scale mining activities	Illegal	Introduce the use of mercury control apparatus	Education	Technology training, demonstration and information exchange	Education
Indonesia	Increasing (number of) illegal small-scale mining activities	Illegal	Information and technology for solving the mercury contamination in soil/land, water, as well as prevention of mercury pollution, etc.	Information	Training and information exchange	Information
Indonesia	Illegal trade and processing of mercury keep increasing, in particular, due to the increasing number of ASGM activities/sites	Illegal	Institutional capacity strengthening through improvement of commitment and coordination among stakeholders in the reduction and elimination of mercury use (phase-out)	Institutional	Regional cooperation in promoting and acceleration of the Minamata Convention ratification process and maintaining regional communication on the ESM of mercury and mercury waste in each country of ASEAN	Information



Member State	Challenge	Challenge Category	Need	Need Category	Opportunity	Opportunity Category
Indonesia	An on-line hazardous waste management reporting system has been developed recently. It seems that a number of barriers are encountered, e.g. low level of awareness of the system among the hazardous waste generators/users, limited capability in hazardous waste identification among the generators, internet connection problems in many parts of Indonesia, etc.). Therefore, the current results are not yet reliable for use.	Information	A nation-wide training programme for hazardous waste generators/users is needed to be developed and implemented effectively and efficiently.	Education	Regional cooperation in the development and use of database on hazardous waste (including mercury waste) management is needed among the ASEAN member states.	Information
Indonesia	The costs of management of the unintentionally-generated mercury waste (e.g., from oil & gas mining) are high due to the unavailability of treatment facility	Infrastructure	A proper facility for mercury waste treatment is needed locally.	Infrastructure	Regional cooperation in infrastructure development	Infrastructure
Indonesia	Currently, there is no technology for mercury recovery at commercial scale in Indonesia.	Infrastructure	Develop mercury recovery facility	Infrastructure	Investment opportunity for foreign companies possessing the appropriate technology for mercury waste at commercial scale.	Infrastructure
Indonesia	Indonesia has to deal with significant quantities of contaminated sites and the resulting hazardous waste while lacking the capacity of licensed operators of hazardous waste management.	Infrastructure	Develop mercury recovery facility	Infrastructure	Regional cooperation in infrastructure development	Infrastructure
Indonesia	There is no data of the unintentionally-generated mercury waste available	Inventory	A national inventory of the unintentionally-generated mercury waste is needed to be conducted periodically	Inventory	Training and information exchange	Education

Member State	Challenge	Challenge Category	Need	Need Category	Opportunity	Opportunity Category
Myanmar	Environmental awareness	Information	To conduct and knowledge, rising to support, Environmental Education	Education	Ministries, NGO, INGO, CSO and other stakeholders	Education
Myanmar	The regional and International cooperation	Institutional	To promote international cooperation	Education	Enter to the Basel Conservation, Stockholm Convention and effort to enter the Minamata Convention	Education
Myanmar	Specific Law, Rule	Legal	To formulate law & regulations	Legal	Experts and Finances	Education
Myanmar	Sectoral laws and policies concerning with hazardous waste management	Legal	To formulate sectoral regulations	Legal	Finances and actually aim to target	Education
Myanmar	Hazardous waste management as a priority area in environmental concerns	Operation	To implement	Operation	Inventory to choose the area, finance, monitoring and good party	Education
Myanmar	Hazardous waste management guidelines and priorities	Tool	To formulate law & regulations	Legal	Finances and cooperation with other sectors	Education
Philippines	Low awareness of local government units on the hazards of mercury-containing wastes	Awareness	Include in the LGU's solid waste management plan provisions for collection and storage of household hazardous waste in their Material Recovery Facilities (MRFs)	Education	Increased IEC on the health and environmental hazards of mercury	Education
Philippines	Mercury monitoring in the environment	Control	Increase capacity to monitor mercury in products, land, air, and water	Education	Capacity-building on mercury monitoring	Education
Philippines	ASGM - Monitoring of illegal trade of mercury	Illegal	Develop an effective control system	Control	Training in effective control system and enforcement	Education
Philippines	ASGM - Mindset of mining communities that they would rather die from mercury poisoning than go hungry	Illegal	Improve economy	Economy	Economic cooperation	Economy
Philippines	ASGM: Easy access to mercury in commercial markets	Illegal	Develop alternatives for cheap yet high-yield non-mercury technologies	Education	Capacity-building in mercury-free technologies for gold mining.	Education

Member State	Challenge	Challenge Category	Need	Need Category	Opportunity	Opportunity Category
Philippines	Contaminated Sites	Infrastructure	Include remediation standards for mercury in the current draft guidelines on contaminated sites	Infrastructure	Pilot/demonstrate remediation technologies.	Education
Philippines	Limited TSD facilities for phased-out medical devices such as thermometer and sphygmomanometers	Infrastructure	Develop mercury recovery facility	Infrastructure	Regional cooperation in infrastructure development	Infrastructure
Philippines	Mercury-added products not covered by the existing CCO for Mercury and Mercury Compounds: Dental amalgam - Training on its use is required by the school curriculum; venturimeters - Used in chemistry and engineering schools for laboratory experiments	Legal	Amend existing regulations	Legal	Training and information exchange	Education
Philippines	Contaminated Sites	Operation	Include remediation standards for mercury in the current draft guidelines on contaminated sites	Legal	Capacity-building on standard formulation remediation technologies.	Education
Philippines	Low collection of mercury-containing wastes from households	Operation	Develop mechanism and provide incentives to increase collection from households	Operation	Information exchange	Information
Thailand	Illegal dumping of mercury waste	Illegal	Develop or improve control system	Control	Enforcement training	Education
Thailand	Poor facilities, no proper disposal	Infrastructure	Develop proper TSD facility	Infrastructure	International cooperation in infrastructure development	Infrastructure
Thailand	Mercury waste co-disposed of with MSW	Operation	Improve landfill acceptance control	Control	Technology and operation control training	Education
Thailand	No appropriate segregation & collection system	Operation	Improve operational aspect of collection	Education	Training on ESM of HWM & mercury waste	Education
Viet Nam	Lack of Awareness on Hg waste management	Awareness	Raise public awareness	Education	Training and information exchange	Information
Viet Nam		Expertise	Build capacity to store, dispose of Hg and environmental rehabilitation	Education	Training and information exchange	Education

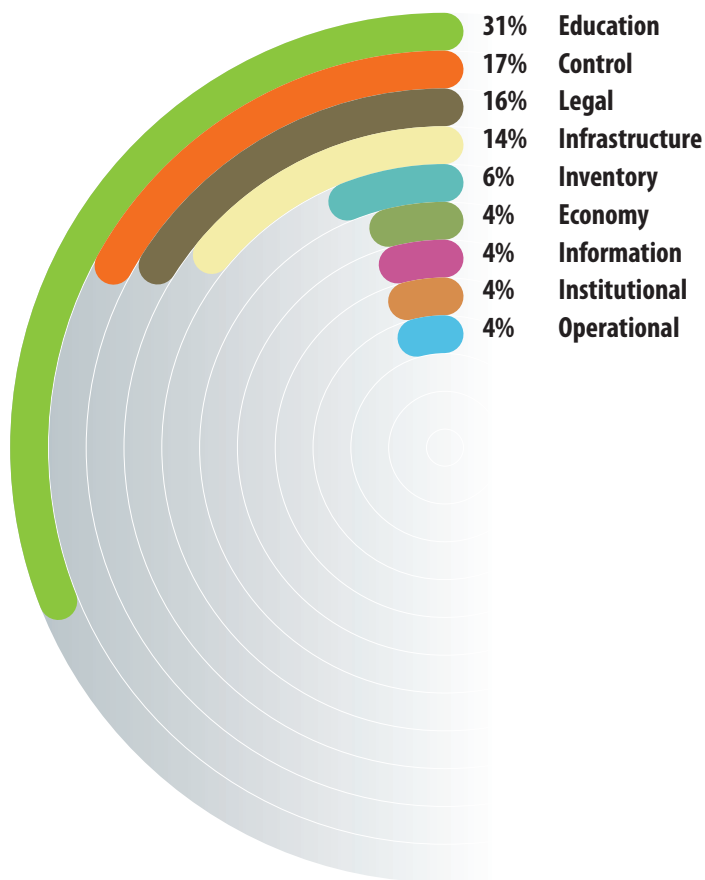
Member State	Challenge	Challenge Category	Need	Need Category	Opportunity	Opportunity Category
Viet Nam	No comprehensive national Hg waste inventory	Inventory		Inventory	Training on inventory	Education
Viet Nam		Legal	Develop legal system on Hg	Legal	Training and information exchange	Education
Viet Nam	No regulations that specify rules, responsibilities and guidance of Hg waste from different sources	Legal	Develop National Action Plan and Implementation Plan on Hg, including Sectoral Action Plan on Elimination and Reduction of Hg	Legal	Training and information exchange	Education

The next challenging issues expressed by the member states are low public awareness in mercury-containing products, their hazards, proper uses and management of waste; lack of expertise among government officers and hazardous waste management facility operators in identifying mercury waste and the ESM of mercury waste in practice; no inventory and monitoring systems set up; scarcity of information and data on mercury; and lack of institutional capacity in the implementation of the ESM of mercury waste.

## 5.2 NEEDS FOR SOLUTIONS

As reflected by the graphic in Figure 27, the major area of solutions needed in the implementation of mercury waste in the ASEAN region is education, followed by proper control or law enforcement measures, legal framework development or improvement, development and or improvement of infrastructure for mercury recycling, recovery, treatment, storage and disposal. The next are sound inventory system establishment, economic development to eliminate poverty, which has led to illegal ASGM activities. Establishment or improvement of reliable information centres or information networks as well as institutional capacity development or strengthening are the next areas of solutions needed for the implementation of the ESM of mercury waste. Furthermore, improvement in the operational aspect of the ESM of mercury management in the region is also still needed.





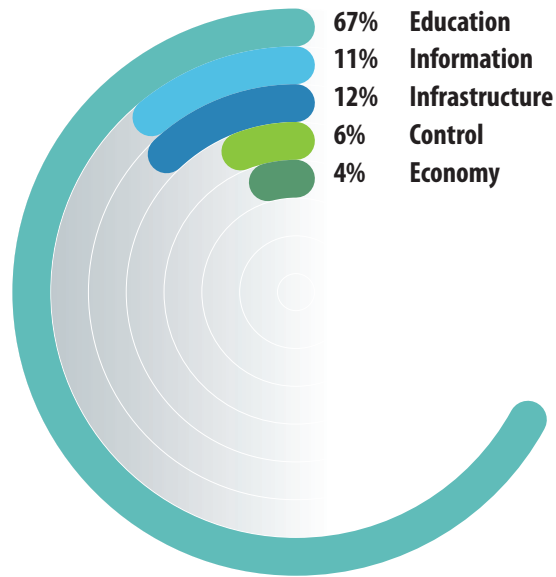
**Figure 27** The categories of the needed solutions for the implementation of the ESM of mercury waste in ASEAN

## 5.3 OPPORTUNITIES FOR REGIONAL COOPERATION

The most probable opportunities for developing regional cooperation in the ESM of mercury waste in the ASEAN region is in the education area. The regional cooperation in the education area may be developed in the forms of training, coaching, experts exchange, research support, technology demonstration, etc.

The next probable areas are the establishment or improvement of regional information networks and regional cooperation in the provision of adequate infrastructure for the ESM of mercury waste.

As shown in Figure 28, regional cooperation may be developed or improved in the areas of control or enforcement and economic development to deal with the illegal transboundary movement and trade of mercury and poverty as one of the underlying factors of the illegal mercury trade and ASGM activities.



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**Figure 28 Opportunities for Regional Cooperation in the ESM of Mercury Waste in ASEAN**

# 6

## CONCLUSIONS AND RECOMMENDATIONS

### 6.1 CONCLUSIONS

#### 6.1.1 RESULTS OF THE STUDY

##### Hazardous Waste Management System

Based on the criteria for Hazardous Waste Management System elements set out under this study, there are considerable variations among the member states. Indonesia, Malaysia, the Philippines, Singapore, Thailand and Viet Nam already have all basic elements of hazardous waste management systems. Brunei Darussalam, Cambodia, Lao PDR and Myanmar still need to further develop some elements of their hazardous waste management systems, in particular the infrastructure and other resources as well as proper hazardous waste operations scheme and control system.

### Regulatory framework

The regulatory framework in most member states has already addressed the basic provisions for the ESM of mercury waste as part of the general hazardous waste. Brunei, Lao PDR and Myanmar may still need to address the authorisation and inspection of mercury disposal facilities in their regulatory framework. The majority of the member states have also required or promoted mercury use reduction, but, only three member states have set out a target date for phase-out of mercury use in certain products.

Most member states, except Cambodia and Lao PDR, have established a classification system for hazardous waste, including mercury, by either adopting the Basel Convention's classification system or establishing their own national system. Indonesia and Malaysia have also developed the regulatory requirements for Mercury-contaminated sites management. The rest may still need to address it in their regulatory framework, as appropriate.

### Institutional Framework

All member states have already established their institutional framework for the implementation of the mercury/hazardous waste management. However, there are plenty of opportunities for them to further develop and or strengthen their institutional capacity to implement the ESM of mercury and mercury waste management more effectively.

### Infrastructure for Mercury/Hazardous Waste Management

Indonesia, Malaysia, the Philippines, Singapore, Thailand and Viet Nam already have the basic infrastructure for Mercury/Hazardous Waste Management in place. Myanmar has just started developing a hazardous waste disposal facility since 2015. However, none of them have a proper commercial facility for mercury recovery. The rest of the member states still need to develop the basic infrastructure for the ESM of hazardous waste including mercury waste.

### Mercury/Hazardous Waste Management Operations

Indonesia, Malaysia, the Philippines, Singapore, Thailand and Viet Nam have also established proper HWM operation schemes. However, some of them still need enforcement as improper operations still occur, e.g. in Indonesia, Thailand and Viet Nam. The rest of the member states still need to establish proper HWM operations to support their HWM systems effectively.

### HWM Practices in selected activities

Due to the nature of the majority of their operations, illegal ASGM operators have not implemented any ESM of mercury waste and they are still the largest contributor to the mercury emissions and releases in the region. Nevertheless, both Indonesia and the Philippines have considered the formalisation of ASGM operations and started with public awareness programme. In addition, a project in the Philippines has introduced mercury-free gold extraction process to the ASGM societies.

Mercury cells technology has been phased-out in all member states, which have chlor-alkali industry. All member states, except Indonesia and Thailand, have no mercury-containing lamps industry. However, due to decreasing demands for fluorescent lamps, they may not continue producing the fluorescent lamps.

Waste mercury-containing lamps from households and institutional buildings are generally managed the same way as ordinary municipal solid waste in most member states jurisdictions. In some member states, e.g. Indonesia, waste MCL recycler accepts the waste MCLs from industrial customers, but not from the households. However, some member states, e.g. Malaysia, the Philippines, Thailand have established collection centres for voluntary recycling programme.

#### Inventories of Mercury and Mercury Waste

Less than half of the ASEAN member states have conducted national inventory of mercury using the UNEP Toolkit, namely Cambodia, the Philippines and Thailand. Myanmar has been conducting a sectoral inventory of mercury since 2015 and has targeted to finish in 2017. The rest of the ASEAN member states may still need to conduct a national inventory, as necessary.

Based on the received responses to the questionnaire, two member states - Indonesia and the Philippines - have developed national inventory of mercury waste. Malaysia might have its own national inventory of hazardous waste including the mercury waste. The Philippines have a consistent waste stream code use and assignment to all hazardous waste management actors so that it is easy to track and isolate data on a certain waste stream from its generation, transportation, treatment, disposal and export as well as in permit specifications. The rest of the ASEAN member states may still need to develop their national inventories of mercury waste.

#### Challenges, Needs and Opportunities

Illegal import and trade of mercury as well as illegal ASGM are the most significant challenges in the region, in particular in Indonesia and the Philippines. The latter is due to their wide geographic distribution and very significant mercury quantities involved. Similar problems also occur in Cambodia, Myanmar and Thailand at a lower degree.

Most of the basic challenging issues may be solved with appropriate educational programmes, effective control system and law enforcement, and legal & regulatory framework improvement. In addition, provision of a proper infrastructure for mercury waste management, development of national inventories of mercury waste, institutional capacity strengthening and reliable information centres are still needed in the region.

There are a number of opportunities for developing or improving regional cooperation, mostly in the area of education/training. The next opportunities are in the area of information network, infrastructure and control and law enforcement network.

## 6.1.2 DATA GAPS

The study has revealed that there are a number of information and data gaps. The major information and data gaps are in the areas of the actual mercury supplies, mercury distribution (material flow), mercury waste generation, mercury waste management practices, and mercury waste export.

## 6.2 RECOMMENDATIONS

Based on analysis of the current state of the mercury/hazardous waste management systems of the ASEAN member states and the challenges, needs and opportunities, some actions and activities may be taken at the national level and some others may be taken at the regional level.

### 6.2.1 ACTIONS AND ACTIVITIES AT THE NATIONAL LEVEL

#### Inventories of mercury waste

Inventory is a crucial initial step in the ESM of mercury waste. The results of inventory provide insight on the mercury waste and the risks it poses to the human health and the environment. They also serve as a scientific reference for formulating or reviewing the current policies, legislations and regulations pertaining to the ESM of mercury waste and environmental protection. Therefore, despite not being perceived as the prime solution to the current challenging issue, it is highly recommended for the ASEAN member states which haven't conducted national inventory of mercury waste to do so. The national inventory may be developed in phases, starting with a preliminary inventory. It is also recommended to update the inventory regularly.

#### Education - Public Awareness Raising

The illegal import/trade of mercury and ASGM issue, some operational problems related to the general public, improper use and disposal of mercury-added products and many more issues may partially be resulted from low public awareness. Therefore, it is recommended that the member states develop and/or improve their public awareness raising programmes as part of educational measures in an effective manner. In addition to the conventional methods, the currently popular social media may also be used to disseminate important information on mercury and its compounds, mercury-added products, mercury hazards and impacts on human health and the environment, proper storage, use and disposal, etc. In the populated areas where internet or even electricity is not available or the literacy of the people is still relatively low, more appropriate methods that are more effective should be used. However, the public awareness raising programme should also be coupled with the provision of waste mercury-added products collection facilities with temporary storage even if a recycling facility is not yet available.

#### Education – Expertise/Professional Development

In order to improve the knowledge, skill and expertise of the personnel of the agencies/institutions involved in mercury and mercury waste management, member states are recommended to develop or improve the existing expertise/professional development programme for their personnel as appropriate. The expertise or skills important for development, should be relevant to the roles, responsibilities and tasks of each group of personnel. Some areas of expertise or skills to be developed or improved may include the identification of mercury waste, hazards communication, proper handling of mercury-containing materials, monitoring and control, effective inspection and safety aspect of inspection, etc. The existing reference such as the Basel Technical Guidelines for the ESM of Mercury Waste as well as the UNEP's Practical Sourcebook on Mercury Waste Storage and Disposal may be used for training.

### Legal and regulatory framework

Some member states, either based on analysis or their statement on the challenges they face, may need to review their legal and regulatory framework in order to identify any deficiency in addressing the specific aspects of mercury and mercury management in their jurisdictions, e.g. mercury trade, households mercury waste disposal, and mercury-contaminated sites management. Definition of roles, authorities and responsibilities of the national agencies/institutions may also be reviewed and re-established in a law or regulation, as appropriate. The review may be best carried out after, and by incorporating the results of, a national inventory in order to ensure that well-informed decision-making can be taken to improve the legal and regulatory framework. In developing or improving the regulatory framework, the member states may take into account the Basel Technical Guidelines for the ESM of Mercury Waste as well as the UNEP's Practical Sourcebook on Mercury Waste Storage and Disposal.

### Control, Law Enforcement

Upon establishment of the necessary legislation and regulation, an effective monitoring and control or law enforcement system is needed, among others, to eliminate or reduce the illegal import/trade of mercury, improper disposal of mercury-containing materials and mercury waste and various operational aspect of mercury waste management as concerned by some member states.

### Infrastructure for Mercury/Hazardous Waste Management

The unavailability or inadequacy of sound infrastructure for mercury/hazardous waste management in some member states will not ensure the effective implementation of the ESM of mercury and other hazardous waste. A national inventory may help member states identify the priority waste streams to start with the development of proper facilities for hazardous waste management. It is recommended that the member states with limited human and financial resources engage in public-private partnerships in the development of the needed infrastructure. The interested private sector/investor usually will start with a feasibility study.

### Information network

Along with the education programme, an information network needs to be established or further developed. The main information centre may be hosted by the government and the other information centres may join and be coordinated in a network.

### Institutional capacity building or strengthening

Member states may need to review their institutional capacity in undertaking their responsibility in the management of mercury and mercury waste, e.g. in the area of monitoring, control of mercury-added products trade, control of ports and border to prevent illegal import of mercury, control of ASGM growth, effective inspections, etc.

## 6.2.2 ACTIONS AND ACTIVITIES AT THE REGIONAL LEVEL

### Capacity building programmes.

Based on analysis, the biggest opportunity for regional cooperation is in the area of education, e.g. training in expertise/professional development and institutional capacity strengthening. Member states may take benefit from the existence of regional organisations in the ASEAN region such as the Basel Convention Regional Centre for South-East Asia, UNEP Regional Office for Asia-Pacific, the Regional Resource Centre for Asia-Pacific of the Asian Institute of Technology and the Secretariat of ASEAN. The

abovementioned regional organisations are also recommended to harmonise their specific roles in the region, maintain a good cooperation and improve coordination in conducting regional activities in the area of hazardous chemicals and waste management. They may cooperate and coordinate in the development of educational/training programmes in various areas, e.g. environmental policy development, environmental diplomacy, the ESM of mercury and the general hazardous waste management, public awareness raising programme development, national inventory development, mercury-free technology and mercury management technology application, monitoring system development, law enforcement, detection of environmental crime, etc.

Coordinated inventories of mercury and mercury waste.

The majority of the member states have not developed a national inventory of mercury waste. It is recommended that national inventory be included as a regional project. The regionally coordinated national inventories of mercury and mercury waste may also serve as hands-on training for the national experts. The advantages of the regionally coordinated national inventories are, among others, standardised methods, quality assurance & quality control and comparable results, effective use of resources, better opportunity for cooperation and knowledge and experience sharing among the participating member states, better chance for the aggregation of national data to develop the regional situation map, and efficiency. Under that regional activity, there will be a better opportunity to develop a chart of compatibility between the Basel Convention hazardous waste classification and the national classification as well as the Harmonised System Codes.

Regional information centres/networks.

All regional organisations may specialise in certain information themes, but, they may also develop regional information network, interlinked with one another. Member states may take benefit from the regional information network and, in return, provide regular update of their national information to keep the information and database in the regional information network updated. The regional information network may also serve as one of the probable medias for maintaining good cooperation among the member states. All member states and regional organisations in the ASEAN region may wish to review and configure the regional information network as appropriate.

Regional cooperation in monitoring, control and law enforcement.

Due to the issue of transboundary movement of mercury and other hazardous materials, it is logical that all member states develop and maintain a regional cooperation in monitoring, control and law enforcement. Cooperation in this area is not a new thing in the region since a global customs initiative, named "Operation Demeter", coordinated by the Secretariat of the World Customs Organisation (WCO), demonstrated a success in seizing an illegal transboundary movement of hazardous waste from Europe to countries in the Asia-Pacific and African regions (photo in figure 29). It is highly recommended that all member states maintain and promote a regional cooperation in this area. A regular, e.g. annual, regional meeting at which all member state experts share new information, results of research, monitoring and control technology, law enforcement cases, etc. may serve as a form of regular regional communication maintenance.





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**Figure 29 International meeting on “Operation Demeter” at the Secretariat of the WCO, Brussels, Belgium, 2009**

Source: D. Wardhana H.S., 2009

#### Feasibility study on regional mercury recovery centre

The absence of, and the need for, a proper recycling and recovery facility for mercury in the member states’ jurisdictions may not be fulfilled by developing one in each member state’s jurisdiction. It is known that developing such a facility requires high capital and operational investment. Therefore, developing a regional facility for mercury recovery may be a more feasible option. A member state may host the facility to serve the region. However, the option is subject to the TBM requirements. There are also a number of issues to be taken into consideration. Hence, a feasibility study on the development of a regional facility for mercury recovery needs to be performed first.

## 6.3 THE NEED AND RECOMMENDATIONS FOR DEVELOPING A REGIONAL STRATEGY ON THE ESM OF MERCURY WASTE

Based on analysis of the challenges and needs of the responding ASEAN member states, there are a number of common problems identified, among others:

- › the growth and uncontrolled ASGM activities in several member states;
- › illegal import of mercury is still difficult to deal with;
- › no proper inventories of mercury and mercury waste conducted in the majority of member states;
- › limited public awareness on the hazard and risk of mercury poisoning;
- › insufficient policies and regulatory framework to cover the mercury management;
- › limited capacity of the institutions responsible for certain aspects of mercury and mercury waste management, including mercury releases monitoring and mercury-contaminated sites management;
- › limited expertise, even among the public service personnel, in mercury waste identification and management;
- › inadequate infrastructure or appropriate technology for mercury and mercury waste management at the commercial scale.

Since the common problems faced by some member states are basic issues and may be interrelated, it is logical that the ASEAN develop a regional strategy for the ESM of mercury waste. The regional strategy is expected to direct and help the region to further strengthen its communication and cooperation in dealing with mercury and other hazardous waste issues.

In developing a regional strategy for the ESM of mercury waste, some factors need to be taken into consideration such as listed hereunder.

- › Goals, objectives and the time span of the strategy
- › Member states profiling, characterisation
- › Identification of key stakeholders
- › Identification of relevant regional organisations
- › Identification of the readily available resources in the region
- › Deeper and focused regional study on mercury waste management in ASEAN based on baseline information (this scoping study), with more detailed scope
- › Strength, weakness, opportunities and threats (SWOT) analysis may also be performed
- › Priority setting
- › Regional communication forum on mercury in-line with the AWGCWM
- › Regional inventories and database of mercury and mercury waste

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# APPENDIX

## HWM SYSTEM ELEMENTS & PARAMETERS

### REGULATORY FRAMEWORK

#### **Main Elements/Provisions**

- › There is regulatory distinction of mercury as commodity and as waste
- › Specific law and or regulation(s) is (are) established for hazardous waste management
- › Mercury waste is covered under the main law or regulation for hazardous waste management
- › Mercury waste is also specifically regulated
- › Mercury waste is legally defined
- › Threshold limit set for mercury waste
- › Generators are required to be registered
- › Disposal facilities for mercury waste are subject to authorisation
- › Disposal facilities are subject to inspection
- › Transboundary movement requirements are set-out for mercury waste export

#### **Mercury Elimination**

- › Reduction of mercury use is legally required
- › Phase-out of mercury mining/production is already set
- › Phase-out of mercury use in certain activities/products is already set

#### **Regulatory Classification of Mercury Waste**

- › Y29 Mercury, mercury compounds
- › A1010 Metal wastes and waste consisting of alloys of, a.o. mercury
- › A1030 Wastes having as constituents or contaminants of, a.o. mercury; mercury compounds
- › A1180 Mercury in waste electrical and electronic assemblies or scrap; mercury switches

#### **Mercury-Contaminated Sites Management Aspect**

- › Legally required
- › Criteria for remediation or clean-up accomplishment (e.g. maximum level of mercury in the contaminated media)

**Institutional Framework**

- > Involved national institutions
- > Lead role
- > Support roles

**General Operations, Procedures/Processes**

- > Waste generation through recovery, disposal and export

**HWM Facilities, Commercial Services**

- > Transportation
- > Recovery
- > Treatment
- > Storage
- > Disposal





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