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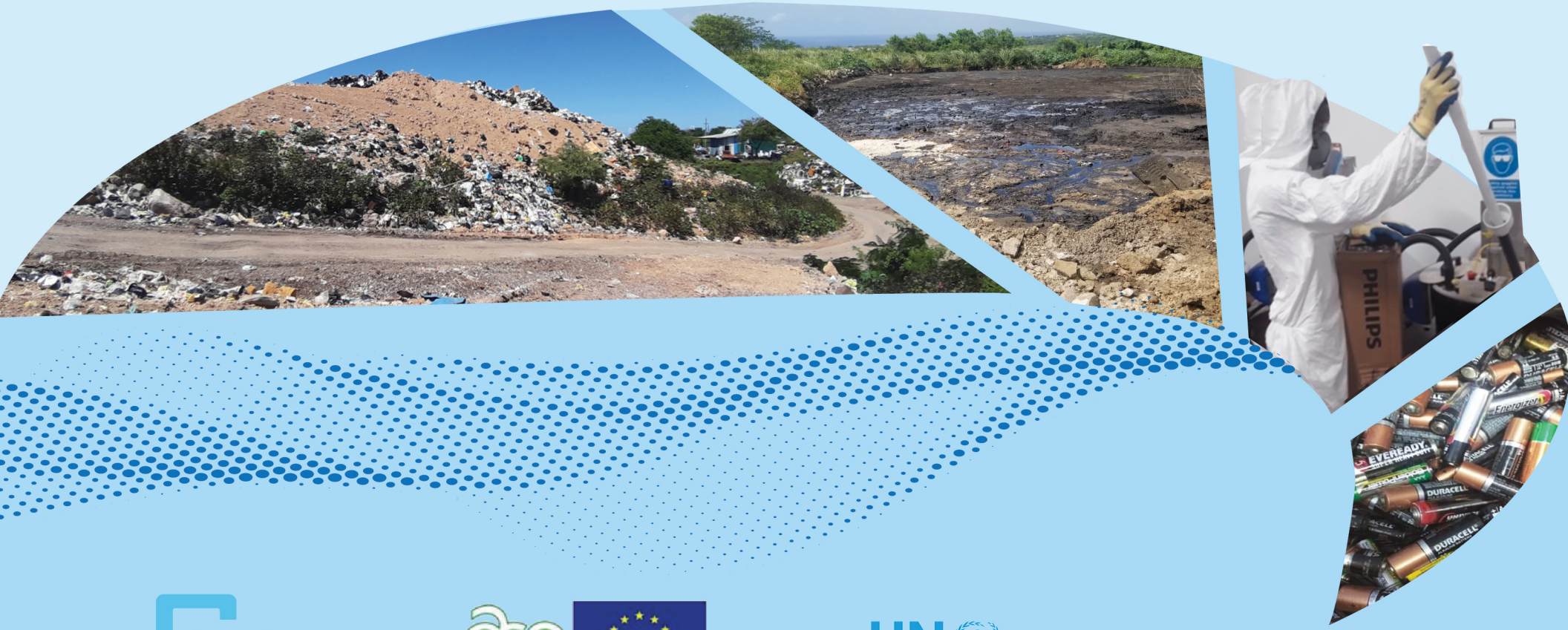
TRAINING MANUAL



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ACP MEAs 3

ENVIRONMENTALLY SOUND MANAGEMENT OF WASTES CONTAINING MERCURY OR MERCURY COMPOUNDS (MERCURY-ADDED PRODUCTS) IN THE CARIBBEAN

TRAINING MANUAL

Environmentally Sound Management of Wastes Containing Mercury or Mercury Compounds (Mercury-Added Products) in the Caribbean

Capacity Building Related to Multilateral Environmental Agreements (MEAs) in African, Caribbean and Pacific (ACP) Countries – The Caribbean Hub

Technical assistance to Parties to implement Articles 3, 4, 10, and 11 of the Minamata Convention on interim storage, disposal of waste in mercury-added products using guidelines from the Minamata Convention ACP MEAs Phase III

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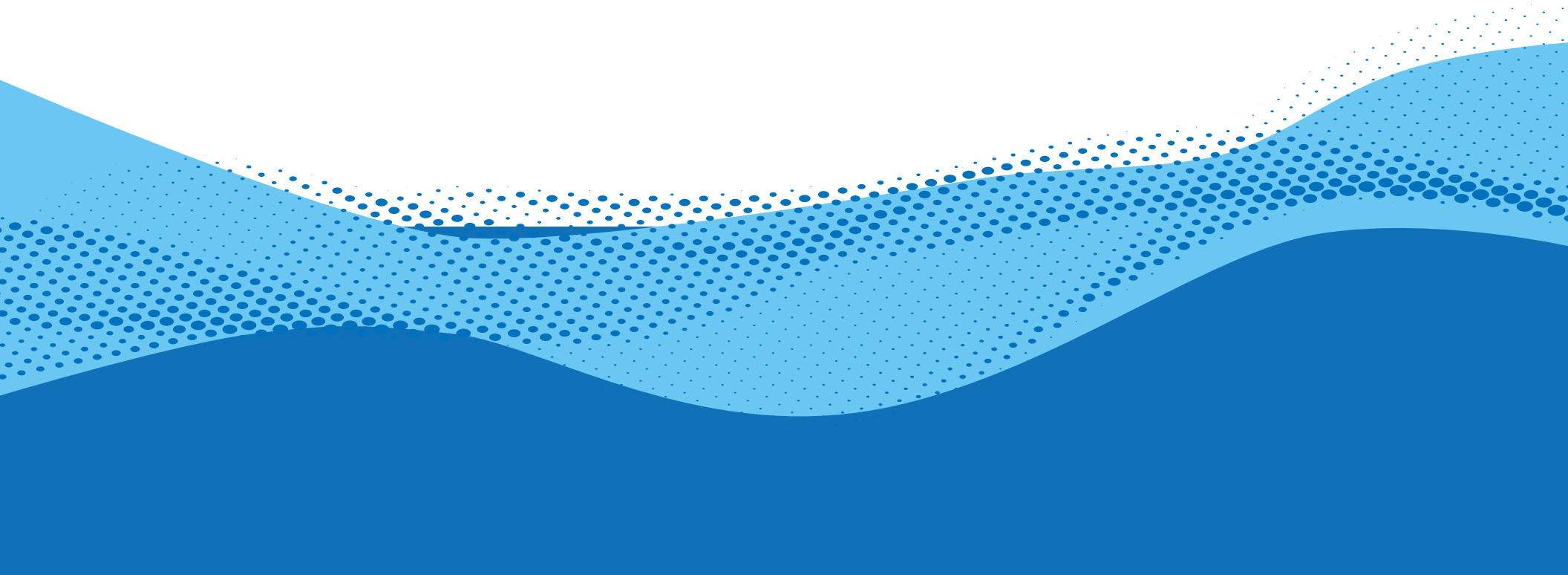

BACKGROUND

Project Title: Technical assistance to Parties to implement Articles 3, 4, 10, and 11 of the Minamata Convention on interim storage, disposal of waste in mercury-added products using guidelines from the Minamata Convention

Coordinating Hub: Caribbean Community (CARICOM) Secretariat

Project Countries: Antigua and Barbuda, The Bahamas, Republic of Cuba, Dominican Republic, Co-operative Republic of Guyana, Jamaica, Saint Kitts and Nevis, Saint Lucia and Republic of Suriname

Consultant: Analissa Rasheed (sub-consultant – BlackForest Solutions)

Aim: National Capacity Building through the development of a training programme to regional/ sub-regional authorities on the environmentally sound management of waste mercury-added products (MAPs).

Scope: Wastes containing mercury or mercury compounds (derived from mercury-added products (MAPs))

This Training Manual on the Environmentally Sound Management (ESM) of wastes containing mercury or mercury compounds complements the Training Programme delivered to regional and sub-regional authorities in August/September 2021.

The modules of the Training Programme are:

- Module 1: Introduction and Strategic Approach to the Management of Waste MAPs
- Module 2: Separation, Collection and Handling
- Module 3: Storage, Packaging and Labelling
- Module 4: Transportation
- Module 5: Environmentally Sound Disposal
- Module 6: Health, Safety and Environment
- Module 7: Applications and Practical Tips

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MODULE 1

Introduction and Strategic Approach to the Management of Waste MAPS

Photo: BCRC-Caribbean

1.1. Mercury - Why is it a concern?

Mercury is a ubiquitous, persistent pollutant of global concern. Although it is naturally released into the environment through geogenic processes (e.g., volcanoes), direct and indirect anthropogenic releases far exceed natural releases. Once in the environment, mercury and its compounds can cycle through air, water, soil and the food chain. It can persist in the environment for a long time and can be transported globally. Despite its known harmful impacts on human and ecosystem health and functioning, mercury continues to be used intentionally in many products and processes (e.g., battery production), and is a by-product of other processes (e.g., burning coal for energy generation).

Exposure and Pathways

Exposure, even to small amounts of mercury, may have toxic effects on the nervous, digestive and immune systems, and on the lungs, kidneys, skin and eyes. Methylmercury is particularly damaging to developing embryos, which are five to ten times more sensitive than adults (USGS 2000).

When a mercury-added product is intact, there are no risks of exposure. When broken, compromised, deposited in landfills – the risk of exposure can arise via mercury vapours (inhalation), dermal contact (elemental mercury), water bodies (surface and ground water as methyl mercury).

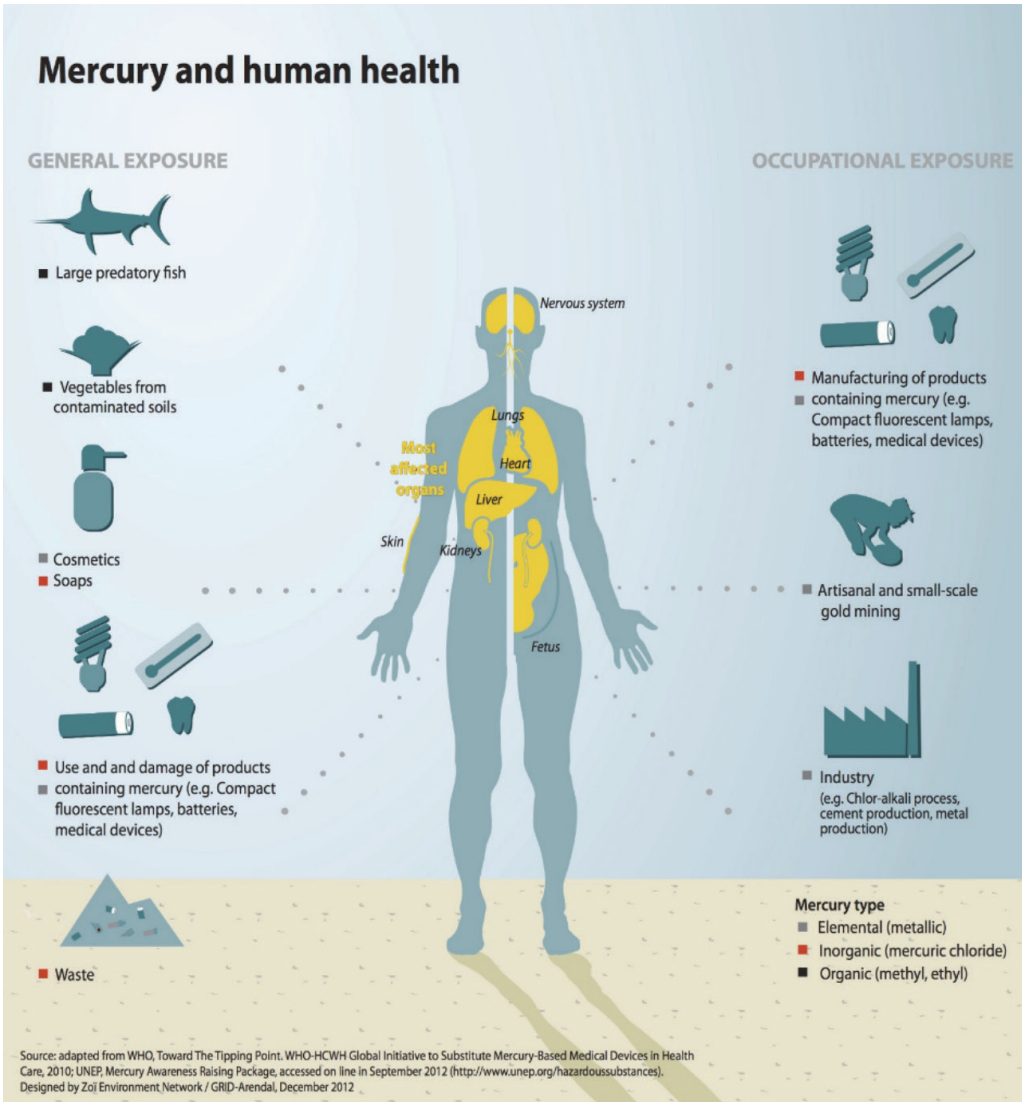

Figure 1-1: Mercury and Human Health (UNEP 2016)

1.2. The Chemicals and Waste Conventions Framework

The Minamata Convention was signed in October 2013 and entered into force on 16th August 2017, and as of 05th October 2021 there are 131 Parties to the Convention. In the Caribbean region, there are nine Parties, all of whom are participants in this project. The Minamata Convention aims to 'protect human health and the environment from anthropogenic emissions and releases of mercury and mercury' (UNEP 2017). There are 35 Articles of the Convention to specifically address the use of mercury by the Parties to systematically control emissions and releases addressing the whole life-cycle from production and use to storage and disposal. Article 11 addresses the issue of mercury wastes, their management in an environmentally sound manner as well as transboundary movement.

A recently conducted Caribbean regional training series on the Minamata Convention can be found here.

The Minamata Convention also produces a new series of digital engagement to provide an opportunity for government officials, scientists, NGOs, and other stakeholders to better understand the Convention's provisions, as well as policy and scientific aspects. The programme can be found at Minamata Online.

At a global level chemicals and waste management is an enabler of many Sustainable Development Goals, primarily Sustainable Development Goals 12: Responsible Consumption and Production and Goal 3: Good Health and Well-Being.

The Basel, Rotterdam and Stockholm Conventions collectively cover a range of objectives and activities related to the chemicals' safety and the environmentally sound management of chemicals and hazardous materials. Given the complementarity of the four Conventions (including the Minamata Convention), it is recommended that countries utilise a synergistic approach to their implementation. Nationally, agencies responsible for implementation of these cluster of Conventions benefit from enhanced cooperation, coordination and knowledge transfer and adopt an integrated management approach.

The Basel Convention aims to protect human health and the environment against adverse effects resulting from the generation, management, transboundary movements and disposal of hazardous and other wastes. The Convention sets provisions for the environmentally sound management of mercury wastes and provides that mercury wastes, when hazardous, are moved transboundary following the Basel Convention prior informed consent procedure.

The Rotterdam Convention seeks to the protection of the environment and human health through the responsible trade and use of hazardous chemicals. The Convention controls the movement of mercury compounds, used as inorganic and organic pesticides, through two key provisions, the prior informed consent procedure and information exchange.

The Stockholm Convention encourages Parties to adopt measures to eliminate or reduce the release of Persistent Organic Pollutants (POPs) into the environment. POPs have been linked to several negative health effects, including cancer, reproductive impairment, immune system changes, and endocrine disruption, in wildlife and human beings. They are characterised by their persistence in the environment and tendency to bioaccumulate. Given their long-range transport, POPs, like mercury, are considered a global pollutant. Though the Convention does not consider mercury wastes, there are provisions for the management of waste articles containing or contaminated with POPs. These articles may contain mercury as a co-pollutant and harmonisation of efforts or approaches can be assessed.

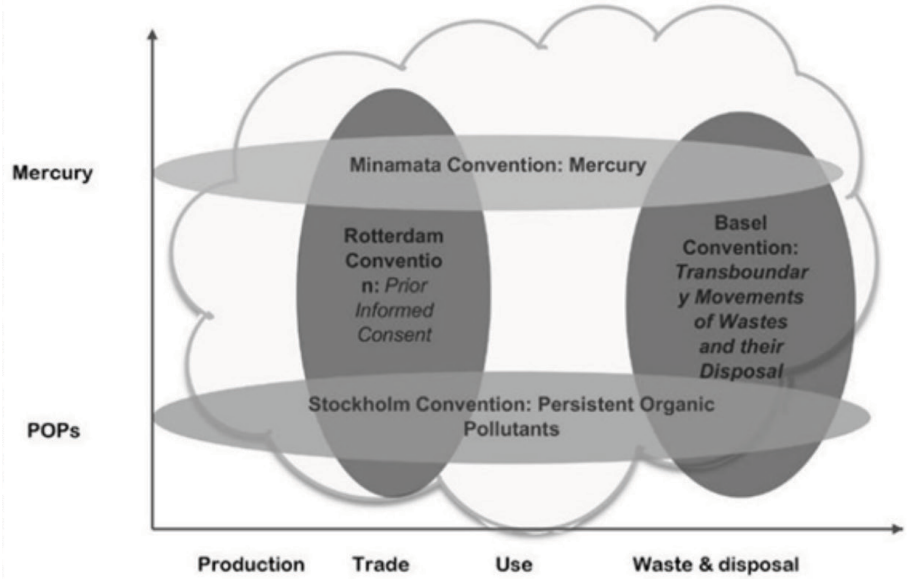

Figure 1-2: Relationship between the Chemicals and Waste Multilateral Environmental Agreements over the Lifecycle (Source: Secretariats of the basel, Rotterdam, Stockholm Copnventions (BRS), and the Minamata Convention on Mercury (MC), 2021)

Regulation on chemicals and waste management also contributes to the broader environmental agenda, namely, conservation and biological diversity, ecosystem services, climate change adaptation and resilience strategies. Two recent reports explore these interlinkages, illustrate the shared pressure points and complexities and demonstrate how to mobilize limited resources towards prioritized solutions.

1.3. Mercury Wastes

There are 3 types of mercury wastes that are disposed of or are intended to be disposed of or are required to be disposed of by the provision of national law or the Minamata Convention. This training manual considers wastes containing of mercury or mercury compounds only, which accounts for the majority of waste mercury-added products. A mercury-added product means a product or product component that contains mercury or a mercury compound that was intentionally added (Article 4 of the Minamata Convention).

Consisting of mercury or mercury compounds	• surplus stock of mercury in certain activities like ablar alkali plants A SCM
Containing of mercury or mercury compounds	• wastes of mercury-added products such as light bulbs, batteries
Contaminated with mercury or mercury compounds	• residues from mining processes, industrial processes, wast management

Waste of mercury-added products release mercury into the environment when they are disposed of into the municipal waste stream. Of greatest concern are mercury vapor releases to the air when products are broken or crushed, while when landfilled organic methylmercury may stay in soils for decades. [https://www.des.nh.gov/sites/g/files/ehbemt341/files/documents/2020-01/ard-28.pdf]

A non-exhaustive list of waste containing mercury and mercury compounds relevant to the Caribbean and their sources are highlighted below. More detailed lists can be found in this technical guide on products with added mercury and risk to the environment and health, on the Mercury in Products – Zero Mercury website and in the EU inventory of existing mercury-added products.

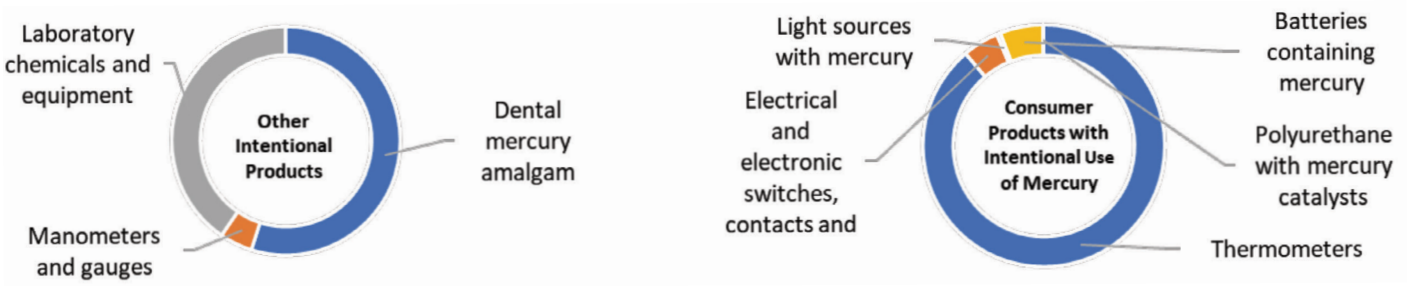

Figure 1-3: Total mercury releases (kg hg/year) to the environment in the region (based on data from 6 Caribbean Minamata initial assessments (MIA)

Inventories are useful to assist with identifying and quantifying the waste mercury and mercury compounds that require storage and thus support the preparation of management plans. As seen above the Minamata Initial Assessments are a good starting point and all Caribbean countries have had prior experience conducting inventories, such as obsolete pesticides and polychlorinated biphenyls. The Toolkit for Identification and Quantification of Mercury Releases (UNEP 2019) and the Methodological guide for the undertaking of national inventories of hazardous wastes under the Basel Convention (UNEP 2015) are two key resources for inventory development.

General practical tips for conducting inventories in the Caribbean are:

- ✓ Utilise questionnaire-based surveys to obtain data from waste generators
- ✓ Conduct research to determine products which may contain mercury – manufacturing date, manufacturer etc.
- ✓ Sampling of wastes containing mercury and mercury compounds to determine mercury content is not recommended because:
    1. a body of information already exists on mercury content in products
    2. opening the product to access the mercury containing component may present a greater health and environmental risk

Products containing mercury	Households	Healthcare facilities	Schools	Laboratories	Industrial facilities	Commercial facilities	Ship dismantling facilities	WEEE recyclers/collectors	ELVs dismantlers	Offices	Collection points	Dental facilities and schools	Crematoria
Batteries	✓	✓			✓	✓					✓		
Non-electronic measuring devices	✓	✓	✓	✓	✓		✓						
Lighting sources	✓	✓			✓	✓			✓		✓		
Electrical & electronic switches, relays	✓				✓			✓	✓	✓			
Dental amalgam												✓	✓
Laboratory and chemicals (scientific equipment)		✓	✓	✓									

Table 1-1: Significant sources of waste mercury-added products (Adapted from UNEP 2021)

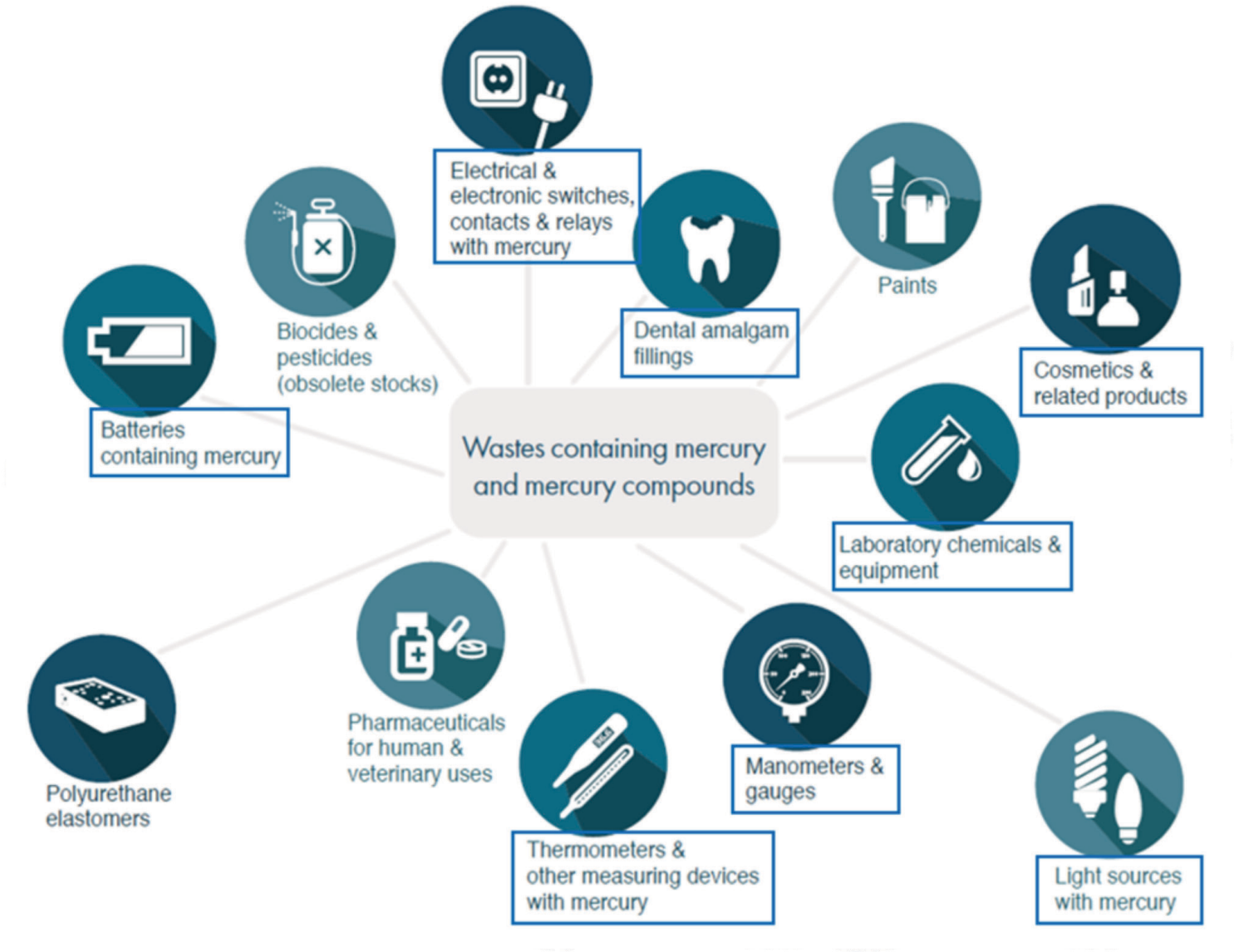

Figure 1-4: Potential Sources of Waste MAPs with those most relevant to the Caribbean marked with a blue box (Adapted from UNEP/ISWA 2015)

1.4. Caribbean Region's Current Capacity to Manage Waste Mercury-Added Products (MAPs)

An assessment of the region's capacity to manage waste MAPs was conducted through a series of online interviews with 12 stakeholders involved in different stages to understand the status of their waste MAPs management and develop a qualitative analysis of their existing capabilities (Rasheed and BlackForest Solutions 2021). The key findings are presented below.

Table 1-2: Stakeholders and the Current Capacity to Manage Waste MAPs (Source: Rasheed and BlackForest Solutions 2021)

	Separation, Collection & Handling	Storage, Packaging and Labelling	Transport	Environmentally Sound Disposal
Large scale generator				
Electric Company	High	High	Not involved in activity	Low
Healthcare facility	Medium	Medium	Not involved in activity	Low
Public Institutions	Low	Low	Not involved in activity	Low
Commercial Sector	Low	Medium	Not involved in activity	Low
Industrial Sector	Low	Medium	Not involved in activity	Low
Small scale generator				
Households	Non-existent capacity	Non-existent capacity	Non-existent capacity	Non-existent capacity
Small Businesses	Non-existent capacity	Non-existent capacity	Non-existent capacity	Non-existent capacity
Solid Waste Management Authority	Not involved in activity	Medium	Not involved in activity	Low
Government Agency	Not involved in activity	Low	Not involved in activity	Low
Hazardous Waste Management Contractor	High	High	High	Medium
E-Waste Recycler	Non-existent capacity	Non-existent capacity	Non-existent capacity	Non-existent capacity
Waste Haulers	Not involved in activity	Not involved in activity	Medium	Not involved in activity
Basel Convention Competent Authority	Not involved in activity	Not involved in activity	Not involved in activity	Low
Minamata Convention Focal Point	Not involved in activity	Not involved in activity	Not involved in activity	Low

	Low		Medium		High
	Non-existent capacity			Not involved in activity	

Common Regional Strengths and Challenges

Strengths:

- All countries have prior experience managing the transboundary movement of hazardous waste but very few have experience specifically with waste MAPs
- Good practices exist at some large-scale generators
- Environmental permitting systems exists in all countries
- Parties to the Basel Convention

Challenges:

- There are no national segregation of waste regulations
- Very few centralised interim storage facilities
- Unfeasibility to install final disposal technologies – prohibitive costs, limited feedstock
- HSE protocols for many generators (notable exception electric companies and waste management contractors) are inadequate
- Waste MAPs management is largely confined to lighting equipment (bulbs and lamps) and lesser extent medical thermometers

1.5. Strategic approach to management of waste MAPs in the Caribbean

Countries should adopt a lifecycle approach to the environmentally sound management of mercury wastes and mercury product discards. Starting out, it is important to conduct an evaluation assessment to determine what categories of MAPs can be most cost effectively managed to collect the most mercury at the least cost.

When this approach is applied to mercury wastes, performance should be assessed during the following stages: production of mercury-added products containing mercury or mercury compounds or of other products using mercury; use of such products; collection and transportation of wastes; and disposal of wastes (UNEP 2021). Actions can include:

- ✓ Reducing the use of mercury-added products through phase-out and transitioning to mercury free alternatives.
- ✓ Banning the import of mercury-added products
- ✓ Setting maximum limits to mercury content in products
- ✓ Strengthening of the regulatory framework across all stages of the lifecycle from import to disposal.

The Minamata Convention requires the phase out of most mercury-added products by 2020. The Zero Mercury Working Group is a key coalition operating under the European Environmental Bureau, who are spearheading activities related to the phase-out of mercury products. They recently commissioned a study on alternatives to mercury-added products in Trinidad and Tobago.

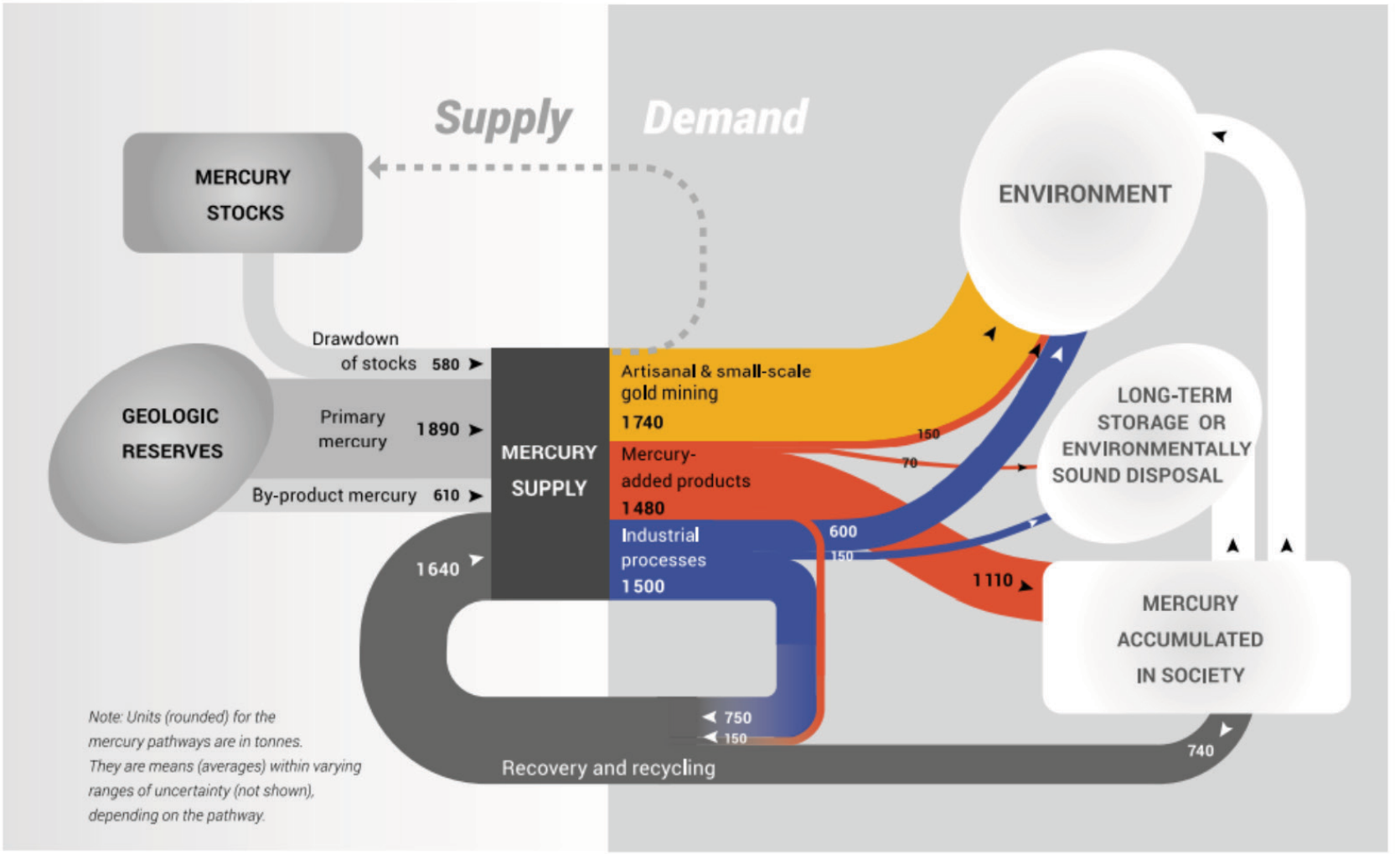

Figure 1-5: Mass balance for mercury products and processes, 2015 (UNEP 2017)

The management of waste MAPs should be considered as another hazardous waste stream and within the wider context of a country's waste management framework. The challenges faced by SIDS are well documented, a sustainable charging system for waste services remains a challenge for many SIDS communities and national level management of hazardous wastes is not a viable option for most SIDS (UNEP 2019). As such, countries should seek to harmonise the ESM of waste MAPs with national waste management policies and strategies and capitalise on synergies among the BRS&M conventions and other multi-lateral environmental agreements to maximise the often-limited country resources (financial, human, infrastructural) and opportunities. Regionally, the UNEP has invested over $65M across 32 chemicals and waste projects in the Latin American and Caribbean, and the region's action plan for cooperation on chemicals and waste management for 2021-2024 recognised the need for continued work on mercury and waste management, specifically management of mercury waste and implement of BAT and BEP to hazardous waste (Intergovernmental Network on Chemicals and Waste for Latin America and the Caribbean, 2020).

Funding Opportunities

- International donor agencies accessed through national focal points – the Global Environment Facility (GEF), Fonds Français pour l'Environnement Mondial (FFEM), GIZ, JICA, EDF, IMO, etc.
- Minamata Convention Specific International Programme
- Regional development banks – CDB and IADB
- GEF STAR national allocations – interlinkages with climate change and biodiversity
- National Waste Management Budgets
- Private initiatives – deposit refund schemes
- Public/Private/NGO partnerships – collection sites for small scale generators

A country does not need to start from scratch or reinvent the wheel to manage their waste MAPs.

Which national documents should a country consider?

- ✓ Status of ratification of the Basel Convention
- ✓ National Plan for the implementation of the Basel Convention and laws to implement the Convention (if the State is a Party to this Convention)
- ✓ National Basel Competent Authority and responsibilities in the Basel PIC procedure (if the States is a Basel Convention Party)
- ✓ Recycling Policy
- ✓ National Hazardous Waste Management Strategy or Guidelines
- ✓ National Implementation Plan for Persistent Organic Pollutants
- ✓ Environmental Permitting Procedures

Regulatory environment

Caribbean countries continue to make progress on the establishment of regulatory frameworks to manage chemicals and waste, however the responsiveness to update/create legislation to deal with current and future situations remains a challenge.

One recommendation is to utilise existing regulations, in this instance, the national environmental permitting regulations, which exists in most Caribbean countries. Under the terms of the permit (or licence), regulators may be able to include conditions related to the safe handling, transport and storage of waste MAPs such as design requirements, waste manifests, storage procedures etc. However, the conditions cannot go beyond the enabling powers of the parent Act and Regulations otherwise the conditions will be ultra vires (beyond the remit of the permitting power).

Key Resources

The United Nations Environment Programme developed a Practical Sourcebook on Mercury Waste Storage and Disposal (UNEP/ISWA 2015), which provides practical options on commercially available storage, treatment, and disposal technologies for mercury waste.

There is also important ongoing work on mercury wastes by the Basel Convention.

UNEP/ISWA 2015

- Practical sourcebook on mercury waste storage and disposal

Practical Sourcebook

Basel Convention Technical Guidelines

- Wastes consisting of elemental mercury and wastes containing or contaminated with mercury

Technical Guidelines | Mercury Wastes

Mercury Waste Management Partnership Area

- Address ESM of mercury wastes through the provision of information on good practices and case studies in both developed and developing countries.

Mercury waste management | Global Mercury Partnership

Why is it necessary to rank the various categories of waste MAPs according to priority for action?

- Caribbean countries have limited resources (financial, human, infrastructure)
- Multiple categories of waste MAPs
- Numerous generators of waste MAPs

Costs and possible impacts are two most important characteristics in considering the right measures to be implemented. Technology application and policy instruments will be more costly than guidelines development and capacity building. However, policy instruments and guideline development will give higher possible impacts. All these categories are important in mercury management however this relationship will give flexibility in planning for mercury-added products management according to the available resources while maximizing possible impacts (Amir Sultan et al. 2017).

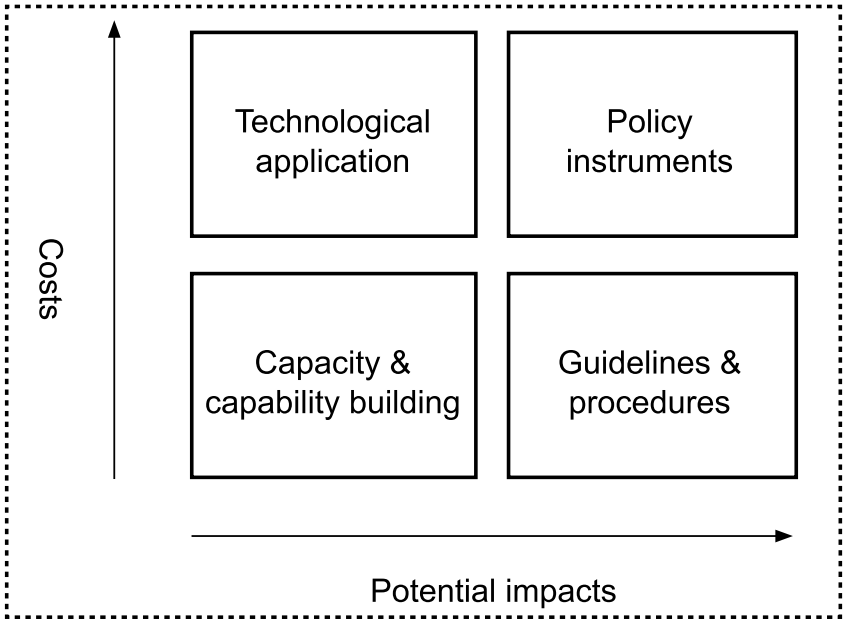

Figure 1-6: Costs and Possible Impacts in Developing Countries (Source: Amir Sultan et al. 2017)

What to consider in a priority for action matrix?

- ✓ Mercury content in the product (see Mercury Inventory Toolkit for mercury content in products)
- ✓ Prevalence of use of the product in your country (see Minamata Initial Assessments for an inventory of products in your country. In some instances where the MIA inventory may not have been to sufficient detail (for e.g. electric switches and relays containing mercury) to identify specific products, generators and patterns of usage more in-depth inventory, using the Mercury Inventory Toolkit is recommended.
- ✓ Existing legislation – working within a regulated and formalised environment leads to more successful outcomes.
- ✓ Systems and facilities already in place or easier to set up – generally, collection of segregated wastes often accounts for the highest costs in the waste management (excluding final disposal if there are no suitable local capabilities), therefore if separation and collection operations already exists, it may be wise to focus on capitalising on these systems first.

- ✓ Multiple categories of waste MAPs are produced by the same generator – a cost effective and efficient opportunity to manage a number of waste MAPs.
- ✓ Ecological and human health risks – consider the categories of waste MAPs which pose the greatest threats to environmental and human health.
- ✓ Accessibility to final disposal solutions – consider costs, ease of transboundary movement, quantities required vs rate of generation.

The priorities determined for each country will be based on the unique characteristics within the country.

Figure 1-7: Inputs into a prioritisation assessment

1.6. Awareness

As part of the development of MIAs in the region, a number of public education and public awareness activities about the Minamata Convention and mercury issues were prepared. The communications strategy package includes an introductory supporting document, animated videos and complementary flyers/promos, infographics/flyers, brochures, technical briefing documents and examples of presentations, videos and information dissemination techniques that can be adapted to suit a country's needs. These are available nationally or through the BCRC-Caribbean website.

Source: BCRC-Caribbean

Awareness about other regional hazardous chemicals and waste initiatives can be found on the Stop the POPs website.

Some key elements to consider when developing a targeted awareness product / campaign are:

- ✓ Who are the target audience(s)?
- ✓ Purpose – capacity building, awareness raising, change in behaviour etc.
- ✓ Products – which product (video, posters, infographics etc) best suits the target audience and the purpose
- ✓ Finances – budget to sustain the campaign and ensure objectives are met
- ✓ Social media platforms – in-house team to manage the content

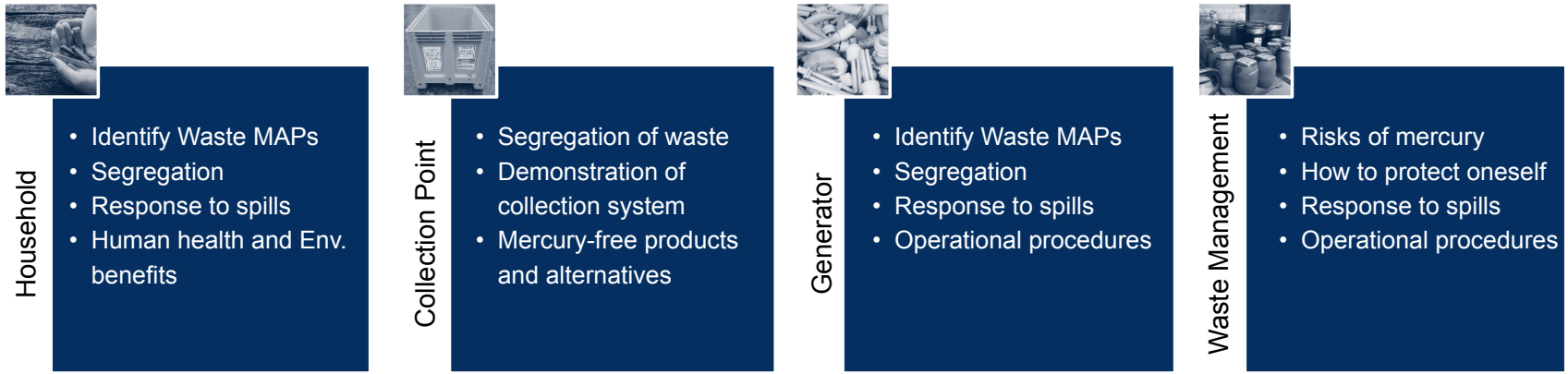

Figure 1-8: Recommended awareness raising topics for various stakeholders to support the management of Waste MAPs

MODULE 2

Separation, Collection and Handling

Photo: BCRC-Caribbean

2.1 Separation and Collection

Waste MAPs must be separated from other wastes. The following measures must also be kept in mind when separating waste MAPs:

- ✓ MAPs should be clearly labelled to ensure their proper separation and consequently their environmentally sound disposal.
- ✓ Waste MAPs should not in any circumstance be disposed of as municipal solid waste or with any other waste stream.
- ✓ Without source separation, waste MAPs pose the risk of releasing mercury and harming human health and the environment.

Figure 2-1: Segregation of Waste MAPs (Source: BFS 2021)

Likewise, waste MAPs must also be collected separately from other wastes and efforts should always be made to prevent breakage.

Since the quantity of waste generated by small-scale generators like households and by large-scale waste generators like companies and hospitals differs, it is recommended that the waste from the two groups of generators can be collected separately. It is suggested that the large scale waste generators be tasked, through regulations, with developing their own strategies and financing for managing mercury waste and priority MAPs. This practice of "polluter pays" is widely accepted around the world for holding larger generators responsible for ESM of their waste.

For households and small generators some recommended options for separate collection are:

- ✓ Waste collection stations or drop-off depots: Boxes or containers for waste MAPs should be made available for public use at designated waste collection stations and must be designed to minimize breakage. For example, for compact fluorescent lamps (CFLs), it is important to minimize the "free fall" of lamps by installing soft, cascading flaps. Alternatively, a small open box could ask users to carefully place their spent bulbs inside the box without breaking them. Consumers should be able to use such stations free of charge.

Figure 2-2: Examples of Waste Collection Boxes and Station (Source: WEEE Ireland, EPA USA, Mercury Recycling)

- ✓ Collection by authorized agents. Collection of waste MAPs should be carried out only by authorized agents. To ensure the efficient and safe collection of such wastes, government or other authorities and producers of mercury-added products may need to provide special arrangements, trained personnel, and legal mechanisms such as licensing and ensuring adherence to standards and guidelines.

Figure 2-3: Example of Collection Service Provided by Authorized Agents in the UK (Source: Biffa UK)

✓ Take-back collection programs. Such programs help divert spent or waste products from the waste stream. Take-back programmes are often voluntary initiatives developed by the private sector (e.g., manufacturers and retailers) that offer consumers the opportunity to return used products at their points of purchase or at some other specified facilities. Such programs will additionally benefit if they are incentivised by national policies.

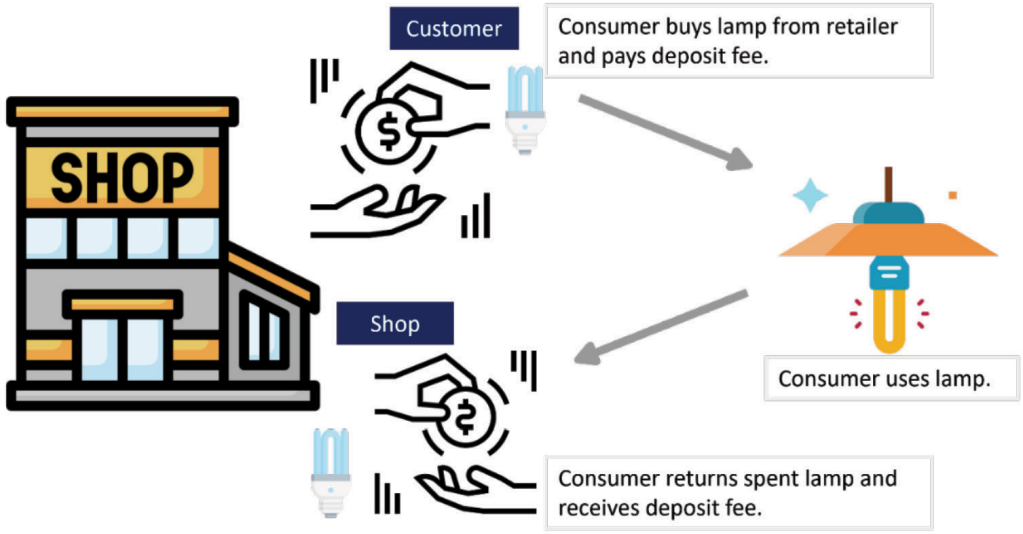

Figure 2-4: Example of a Take-Back Collection Program Source (Source: BFS 2021)

The collection of waste MAPs as well as their subsequent environmentally sound disposal operations requires investment. Manufacturers are bearing some collection costs via their 'extended producer responsibility (EPR)[1] programmes in some countries while governments are bearing the collection costs via national take-back programmes in others. Several times, national take back schemes are also being financed by private actors. Ultimately, how the costs of collection are distributed is a critical decision that national governments, private stakeholders, and waste generators will need to determine.

Extended producer responsibility (EPR) schemes can be effective instruments to encourage the production of mercury-free or low-mercury products and the collection of such products after they have become waste. Other approaches could include paying a rebate for the collection of spent mercury-added products (UNEP 2021). The Basel Convention and OECD both have guidance documents on how to design and implement EPR schemes.

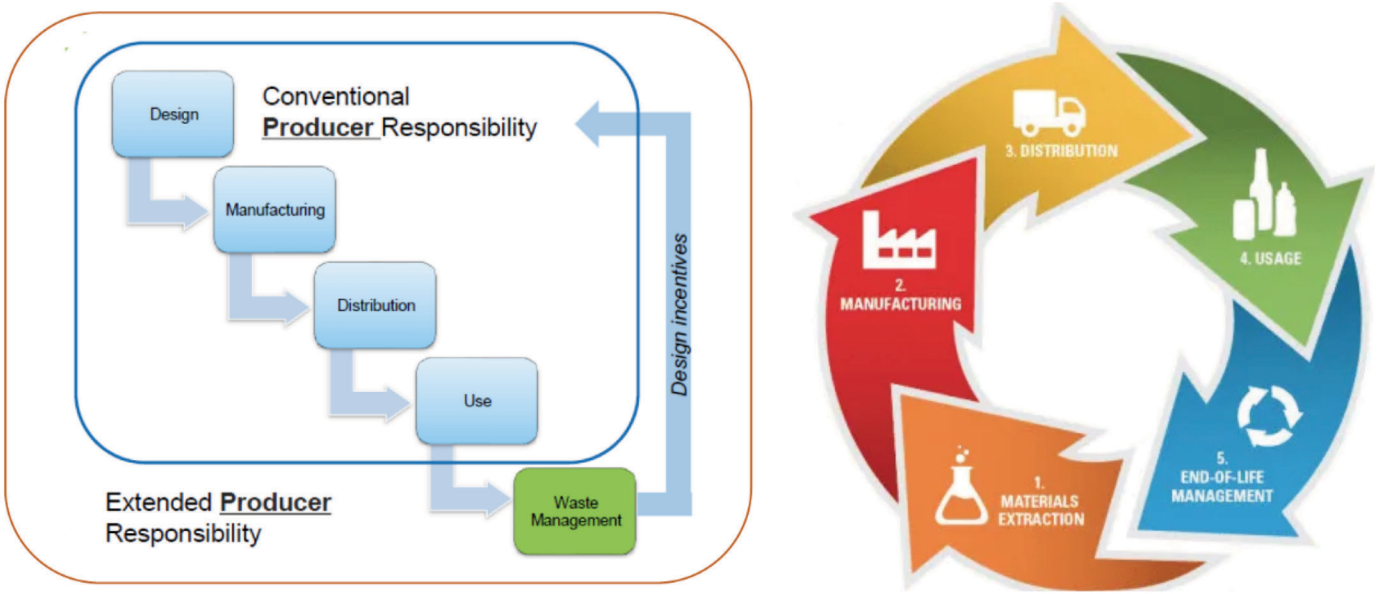

Figure 2-5: Extended Producers Responsibility (Source: Swachhcoin, EcoMENA)

1 Extended Producer Responsibility (EPR) is a policy approach under which producers are given a significant responsibility – financial and/or physical – for the treatment or disposal of post-consumer products. Assigning such responsibility could in principle provide incentives to prevent wastes at the source, promote product design for the environment and support the achievement of public recycling and materials management goals (OECD).

2.2. Handling

Waste MAPs must be handled with care by trained personnel in a way that avoids their breakage and/or spillage into the environment. In general, for waste MAPs, the following measures must be followed:

- ✓ Safely and carefully handle waste MAPs,
- ✓ Prevent breakage or damage to MAPs like fluorescent lamps, thermometers, and electrical and electronic devices,
- ✓ Do not discharge MAPs like paints and pesticides into sinks, toilets, storm sewers, or any rainfall runoff collection system, and
- ✓ Do not mix waste MAPs with other wastes.

While handling waste MAPs, it is also essential that the necessary personal protective equipment be always worn, including, but not limited to:

- ✓ Eye-protection
- ✓ Overalls
- ✓ Respirator Mask
- ✓ Gloves
- ✓ Protective Shoes

Figure 2-6: Minimum PPE Required for Handling Waste MAPs (Source: BFS 2021)

High Hazard PPE

"PERSONAL PROTECTIVE EQUIPMENT (PPE) WORN IN HIGH HAZARD AREAS"

EYE PROTECTION

must always be worn in designated laboratory areas.
Safety glasses that meet ANSI and OSHA specifications are required for work with chemical, biological, radioactive materials and physical hazards

Goggles and Chemical Resistant Face Shield should be used when...
- working with large volumes of corrosive liquids, organic solvents, hazardous chemicals, water or air reactive chemicals ot flammmable compounds
- splash is a hazard
- working with an apparatus with contents under pressure or vacuum
- performing such tasks as sanding or grinding

SHADED GOGGLES/GLASSES

should be worn when...
performing activities that expose eyes to intense UV light or lasers and lenses must be appropriately shaded with optical density based on beam parameters

WELDING HELMET

should be worn with safety glasses
for work with hot materials and open flames such as welding, soldiering and brazing

HALF FACE AIRPURIFYING RESPIRATOR

- must be worn for work with chemical vapors or particulates
- must be properly fit tested every year - facial hair may impede proper seal
- medical evaluation and training is required
- air-purifying respirator with appropriate filter cartridge protects against various particulates, vapors, dust, mists, fumes
- respirators should be worn as a last resort when other engineering controls (fume hood) are not available

CHEMICAL RESISTANT SHOE COVER

For work with large amounts of chemicals or during spill clean-up

FLAME RESISTANT LAB COAT (such as Nomex ® fiber)

should be worn when working...
- with welding equipment
- in environments where quick fires are a threat
- with small quantities of pyrophonic or other highy flammable

RUBBER APRON

should be worn...
- for work with large volumes of corrosive liquids, solvents or flammable compounds
- when working with apparatus under pressure
- when working with water or air reactive chemicals

GLOVES

must be selected specifically for the type of hazard
- to protect hands from chemicals, radiation, biologiucal hazards, abrasions, cutting, heat and cold
- skin contact is a potential source of exposure to toxic materials
- chemical resistant gloves may be made of rubber, neoprene, polyvinyl chloride, nitrile, butyl, etc.
- select glove material based on industry best practice with regards to chemical resistance to subatance(s) being handled
- wear gauntlet length gloves to protect forearms
- go to www.safety.nmsu.edu for guidance on glove selection

What to Do and Not to Do with Gloves
- replace gloves periodically
- contaminated gloves should be rinsed and carefully removed
- do not wear gloves out of lab
- do not use gloves when touching common surfaces such as telephones, computers, door knobs
- do not wear gloves around moving machinery

LONG PANTS

required to cover the legs for work in laboratory
If fire is a threat, fire resistant clothing is required

CLOSED-TOE SHOES

must always be worn
Should have slip resistant soles for work in wet or slippery areas

EMPLOYEES MUST BE TRAINED ON HOW TO SELECT, PROPERLY WEAR, CARE FOR, CLEAN, AND MAINTAIN PPE.
INFORM SUPERVISOR OF NEED TO REPAIR OR REPLACE PPE.
CONTAMINATED PPE MAY BE A HAZARDOUS WASTE, AND SHOULD NEVER BE TAKEN HOME.

NMSU ENVIRONMENTAL HEALTH & SAFETY 646-3327

GO TO NMSU SAFETY WEB AT safety.nmsu.edu

Figure 2-7a:
High Hazard PPE Required for Handling Waste MAPs

Minimum Lab PPE

PERSONAL PROTECTIVE EQUIPMENT (PPE) FOR THE LABORATORY WORKER

EYE PROTECTION

must <u>always</u> be worn in designated laboratory areas.
Safety glasses that meet ANSI Z87.1-1989 standards are required as minimum PPE for work in a laboratory

GLOVES

must be selected specifically for the type of hazard
- to protect hands from chemicals, radiation, biologiucal hazards, abrasions, cutting, heat and cold
- skin contact is a potential source of exposure to toxic materials
- chemical resistant gloves may be made of rubber, neoprene, polyvinyl chloride, nitrile, butyl, etc.
- select glove material based on industry best practice with regards to chemical resistance to subatance(s) being handled
- wear gauntlet length gloves to protect forearms
- go to www.safety.nmsu.edu for guidance on glove selection

INSULATED CRYOGEN

Use to guard against injuries from sparks or scraping against rough surfaces

LEATHER

Use to protect against ultra-cold temperatures when working with liquid nitrogen and other cryogenic hazards

ALUMIZED

Use gloves to insulate hands from intense hear such as molten materials

METAL MESH

Use gloves when using cutting tools or other sharp instruments

<u>What to Do and Not to Do with Gloves</u>
- replace gloves periodically
- contaminated gloves should be rinsed and carefully removed
- do not wear gloves out of lab
- do not use gloves when touching common surfaces such as telephones, computers, door knobs
- do not wear gloves around moving machinery

HAIR CARE

- long hair should be tied back to prevent contamination
- must use hair net to prevent entanglement in rotating equipment

LAB COAT

LAB COAT should be...
- selected to ensure proper fit
- worn buttoned/snapped and sleeves rolled down
- made of a material which is suitable for your work; some synthetic fabrics are extremely vulnerable to partcular chemicals
- fire resistant (synthetic fabrics can burn and melt and must not be worn in areas where open flames or other sources of fire might present the potential of igniting the coat

LAB COAT should be removed when...
- there is reasonable chance that it is contaminated by chemical, radioactive material or biological material

LAB COAT should be worn...
- to prevent splatter and spills from contacting skin and/or contaminating your street clothes
- to prevent non-obvious contamination and impede saturation of regular clothes and skin
- when operations involve harmful liquids or toxic solid materials, even in tiny quantities

Care and Maintenance:
- Protective equipment that has been used in a laboratory and is potentially contaminated with hazardous materials should NOT be taken home
- When lab coats become contaminated with hazardous materials they should be cleaned on site at the university or sent out for cleaning by professionals who have been informed of the potential hazards or disposed of as hazardous waste

LONG PANTS

are required as minimum PPE for work in a laboratory

are required as minimum PPE for work in a laboratory

EMPLOYEES MUST BE TRAINED ON HOW TO SELECT, PROPERLY WEAR, CARE FOR, CLEAN, AND MAINTAIN PPE.
INFORM SUPERVISOR OF NEED TO REPAIR OR REPLACE PPE.
CONTAMINATED PPE MAY BE A HAZARDOUS WASTE, AND SHOULD NEVER BE TAKEN HOME.

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GO TO NMSU SAFETY WEB AT safety.nmsu.edu

Figure 2-7b: Minimum Lab PPE Required for Handling Waste MAPs

MODULE 3

Storage, Packaging and Labelling

3.1. Storage

Waste MAPs can be stored:

1. temporarily at the premises of waste generators pending collection for further operations,
2. temporarily at an interim site pending further recovery or disposal operations, or
3. permanently at a dedicated site as a disposal option – D12 following necessary physico-chemical treatment – D9 (UNEP 2014).

In general, the following measures must be taken for the storage of waste MAPs (UNEP/ISWA 2015)(MC COP 2018)(UNEP 2021):

- ✓ The storage site should be well-chosen, properly planned and strongly built. The specifications for the site are given below.
- ✓ Waste MAPs should be stored separately from all other materials and waste items.
- ✓ A full inventory of waste items at the site must be kept, and regular inspections undertaken.
- ✓ It should be safe and secured from theft, with restricted access only for trained personnel.
- ✓ Emergency plans with fire alarm and suppression systems as well as mercury vapour detection instruments when possible.

For temporary storage at the premises of generators or at interim-sites which can also be used as a centralised site to store other types of hazardous waste, the following measures must be taken (UNEP/ISWA 2015)(UNEP 2021)(UNDP 2010):

- ✓ The site should be located within the country, away from residential areas and not in any environmentally sensitive location e.g., earthquake zones, floodplains, wetlands etc.
- ✓ The site should be chosen following public consultations so that the local community informed and can react accordingly in case of an accident or emergency.
- ✓ Its size should depend on the amount of space needed for present and future storage with adequate space for all planned types of waste and for further operations.
- ✓ The floors should be covered with mercury-resistant materials such as epoxy coating to prevent seepage or penetration of mercury from accidents or breakage.
- ✓ It should have a strong ground structure to bear load and hinder natural disasters.
- ✓ It should be constructed with non-combustible and non-porous materials.
- ✓ It should be enclosed, well-protected and well-ventilated with filters and pollution control devices to capture any mercury vapor or dust in case of breakages.
- ✓ It should have impermeable barriers as well as a proper drainage and ventilation system for protecting the ground, water, and air systems nearby.
- ✓ The waste MAPs should only be stored by generators for a limited period of time and should in any case be sent for appropriate recovery or disposal operations as soon as is possible.

Figure 3-1: Temporary storage for mercury lamps at premises of large-scale waste generators (Source: Mercury Recycling Ltd.)

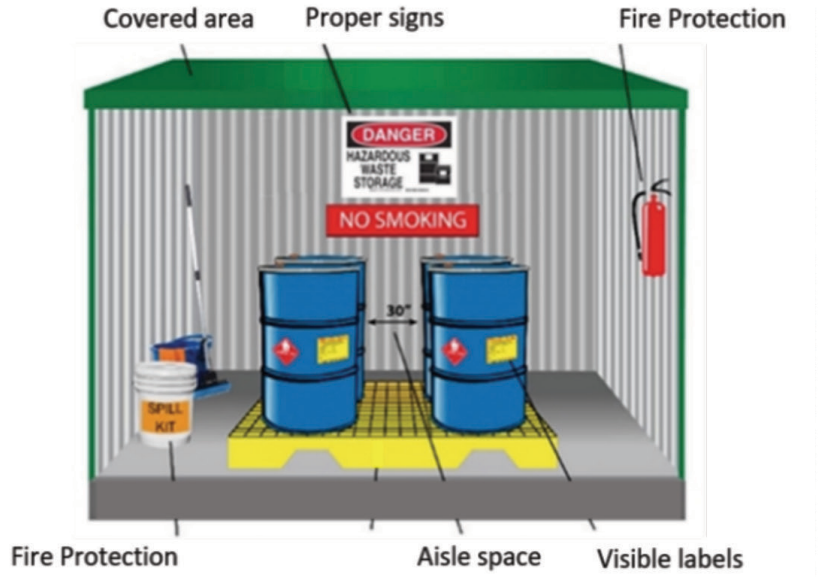

Figure 3-2: Interim Storage Facility for Hazardous Waste, Inside-Out View (Source: Martin County, EPA)

Figure 3-3: Centralised Hazardous Waste Storage Site in Germany (Source: Alba Berlin)

Storage of Mercury-added Products in the San Lazaro Hospital (Philippines)

In response to an administrative order mandating gradual phase-out of mercury in the Philippine health care sector, the San Lazaro Hospital established a mercury management team, among others responsible for the safe storage of spent mercury-added measuring devices and fluorescent lamps. Safety measures were implemented to comply with the Department of Health's 'Guidelines on Interim Storage of Mercury Devices'.[68, 69]

STEP 1

Photo 18:
Placed in the original box and sealed with duct tape

STEP 2

Photo 19:
Wrapped in a labelled plastic bag as primary container

STEP 3

Photo 20:
Placed in a labelled secondary container and sealed with duct tape

STEP 4

Photo 21:
Stored in a dedicated facility in distance of patients' area and offices

Courtesy all pictures: Karen Abejar, Arago

Figure 3-4: A case study on the storage of waste maps in the San Lazaro Hospital in Philippines (Source:UNEP/ISWA 2015)

3.2. Packaging and Labelling

For packaging and labelling waste MAPs prior to collection and transport to a temporary storage facility, it is important to:

- ✓ Use of original product packaging or suitable boxes that can fit the shape of household waste MAPs like mercury lamps, batteries, and thermometers without breaking them.
- ✓ Use of original containers for liquid waste MAPs like pesticides and paints, or other suitable containers with tightly sealed lids to prevent leakage.
- ✓ When original packaging is not available, specially designed containers should be used which are padded, puncture-resistant or air-tight, as required depending on the MAP to prevent its breakage and or spillage.
- ✓ As an additional safety measure, especially for waste MAPs that can break and release mercury in the environment, the (primary) container can further be placed in a secondary container that prevents the release of mercury in case of breakage.
- ✓ The containers should be clearly labelled as containing toxic mercury in all applicable languages and follow local legislations.

For packaging and labelling waste MAPs at interim-storage sites prior to external transportation for environmentally sound disposal:

- ✓ Waste MAPs must be packed in X-type UN approved drums for interim-storage prior to export to other countries for ESD.
- ✓ The UN approved drums in turn must be labelled with (see figure 3-7):
    - o A unique identification number for the drum
    - o UN number for the waste and EWC or other applicable waste codes (see table 3-1)
    - o GHS label or DG class label (see figure 3-5 and figure 3-6)
    - o Quantity and weight of the waste
    - o Place of origin and destination

- ✓ For more guidance on packaging and labelling for international transportation, we recommend consulting applicable international legislations such as the Basel Convention (UNEP 2014), ADR (UN 2014), DGR (IATA 2021) and IMDG (IMO 2021).

In general, the following measures must be taken when packaging and labelling waste MAPs:

- ✓ Only closed containers or UN approved drums should be used with the aim to prevent release of mercury in the environment.
- ✓ Containers should be marked properly and kept away from the public in secure areas.
- ✓ The containers should be marked with the type of waste, the quantities inside the container, the initial date of storage, and other identification markers mentioned above.
- ✓ Since waste MAPs must be exported for environmentally sound disposal operations, and for that they must be packed in UN drums, it could save time and resources if the waste MAPs are packed and transported in UN drums from the beginning.

Figure 3-5: Corrosive, (GHS05), Toxic (GHS06), Health Hazard (GHS08) and Environmental Hazard (GHS09) Pictograms for Labelling Waste MAPs (Source: UN 2011)

Figure 3-6: Dangerous Goods Labels (Source: DGR)

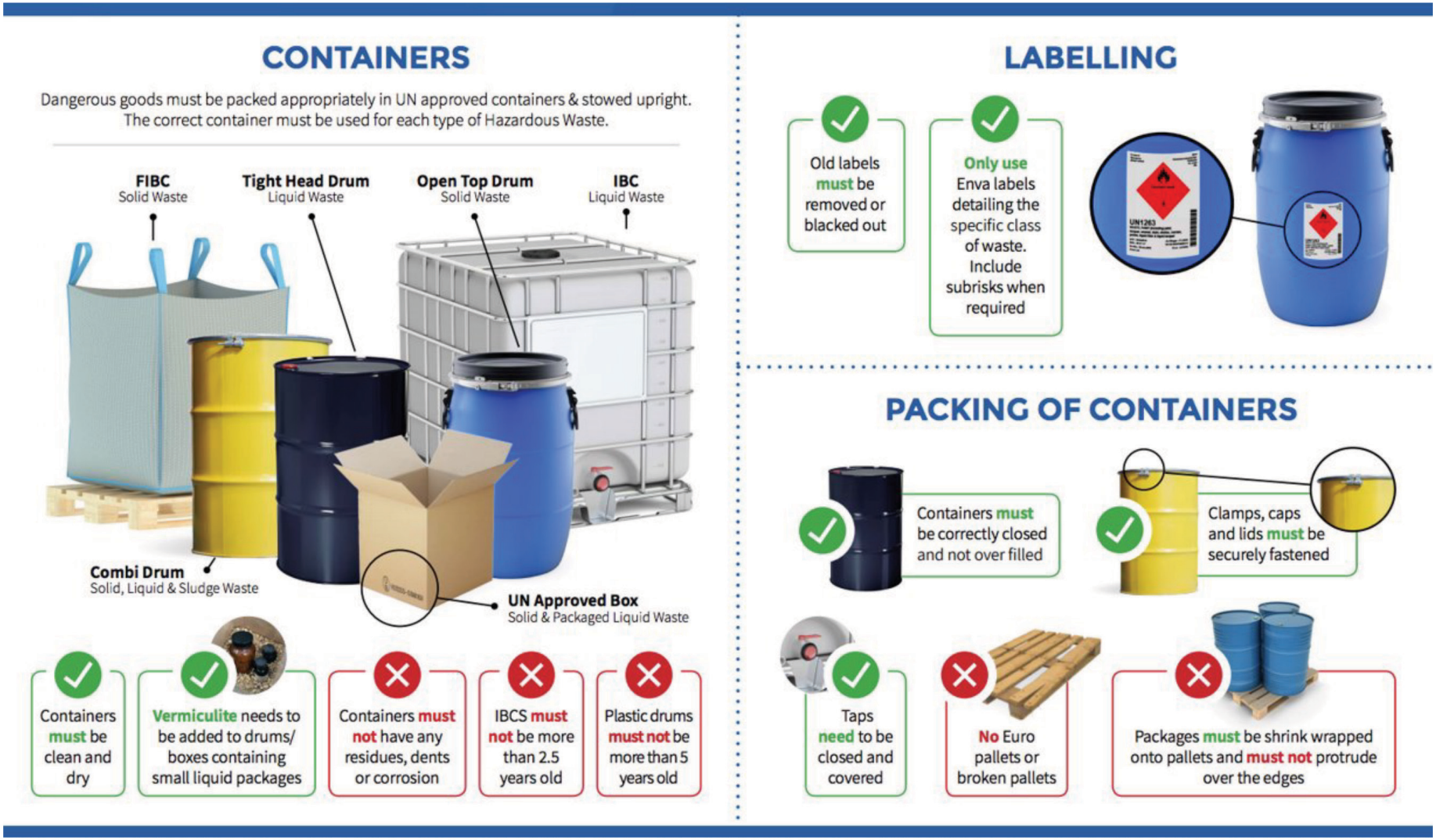

Figure 3-7: Examples of Different Containers and their Packaging and Labelling for Hazardous Waste (Source: ENVA)

UN Code	Description	EWC	Description
3506	mercury contained in manufactured articles (Waste MAPs)	16 01 08	any other components containing mercury
2809	mercury	16 06 03	mercury-containing batteries
3011-3012 & 2777-2778	mercury based pesticides	20 01 21	fluorescent tubes and other mercury-containing waste

Table 3-1: Applicable UN and EU Codes for waste MAPs (Source: BFS 2021)

Figure 3-8: Example of a Waste MAPs being sent in original product packaging to a hazardous waste facility where it is labelled properly and kept for interim storage pending further operations for enviromentally sound disposal (Source: BFS 2021)

MODULE 4 | Transport

4.1. Ground Transport

Waste MAPs generated will need to be transported so they can be disposed of in an environmentally sound manner. Ideally, good practice is to limit the number of times waste, particularly hazardous waste, is moved to minimise potential accidents however, this depends on the waste management system.

Generators and waste hazardous management contractors should be aware of their regulator's requirements. For example, the regulator may allow ground transport of certain quantities or less in the generator's own vehicle; above these quantities would require a licensed transporter and registered vehicle.

On-site movement of waste MAPs at the generator or collection facility in preparation for transport:

- ✓ The specific routes in each facility should be planned to transfer the hazardous waste MAPs to the transport vehicles. Consideration should be given to the time of day, human traffic, hazards along the route, sensitive areas.
- ✓ The waste MAPs should be transported in the appropriate waste containers.
- ✓ All wastes should be appropriately labelled (Section 3.2). Mercury Wastes travelling nationally will need to have a waste label, according to the most common law implementing the GHS, this is an R with the symbol 6 Toxic, as well as the other symbols when they are applicable.

Road transport:

- ✓ The routes to storage facilities and or ports for shipping must be determined before and a job safety risk assessment undertaken. The safest and shortest route should be taken. A contingency plan should plan should be developed and there should be a spill kit, PPE and extra containers for use in case of a spill developed.
- ✓ Licensed vehicles should display appropriate warning signs and placards(depending on the quantities transported and regulator's requirements). Placards are typically larger and more durable versions of the labels placed on the storage container.
- ✓ When required, placards must be placed on each side and on each end of the vehicle.
- ✓ The transporter should inspect all waste containers to ensure they are packed and labelled properly and there are no leaks

Examples of Regulator's requirements

USEPA - Categories of Hazardous Waste Generators

- Very Small Quantity <100 kg/month
- Small Quantity >100 - 1000 kg/month
- Large Quantity >1000 kg/month

UK - Moving dangerous goods

Trinidad and Tobago - Waste Management Rules 2021

- e.g Lamps – 1000 kg/year

- ✓ All waste containers should be firmly secured in the cargo part of the vehicle. The waste should never be transported in the passenger section.
- ✓ Transport vehicles should be kept locked when there is waste in the vehicle expect during inspection, loading and unloading
- ✓ Safety data sheets with emergency procedures should be on the vehicle transporting the waste MAPs

For countries where there are no regulations for the transport of dangerous goods, the UN Recommendations on the Transport of Dangerous Goods – Model Regulations (21st revised eds) can be used as a guide and the regulator can consider incorporating good practice requirements into the environmental permitting system.

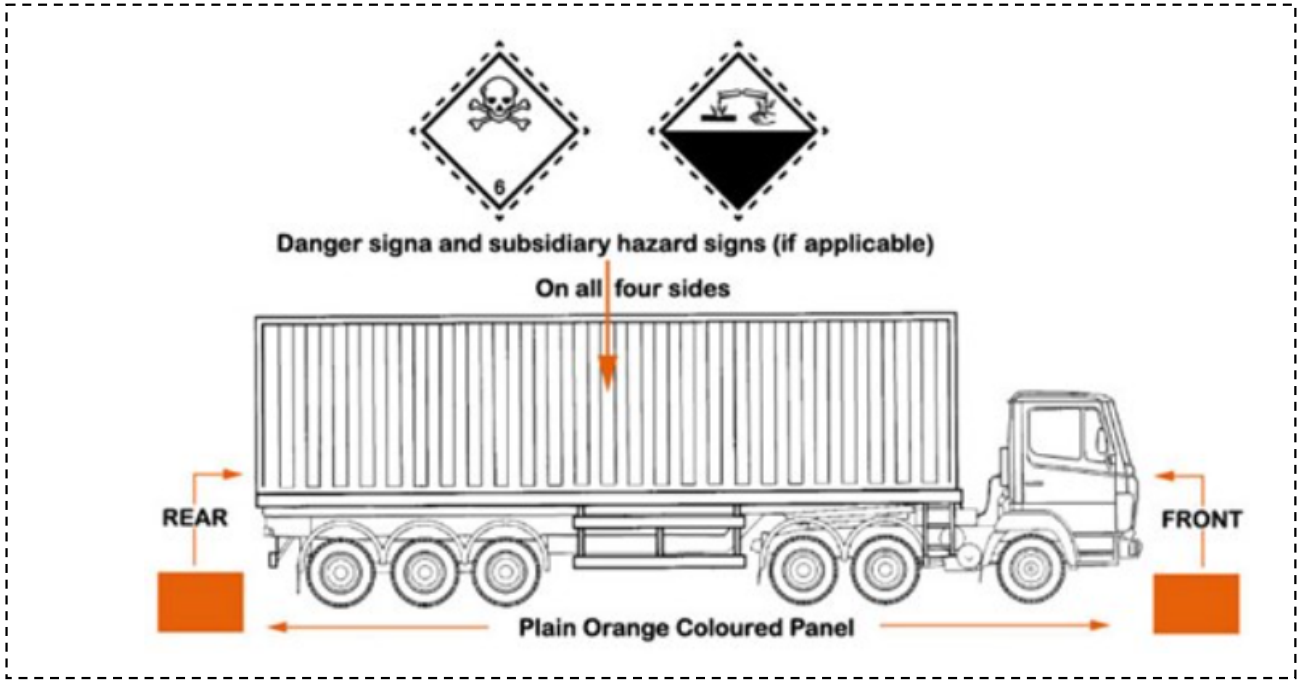

Figure 4-1: Transport of waste mercury from Guatemala (Source: BFS 2021)

4.2. Transboundary Movement

For the parties to the Minamata and Basel Conventions, transboundary movement of mercury wastes defined under the Minamata Convention is allowed only for the purpose of environmentally sound disposal in conformity with Article 11 of the Minamata Convention (mercury wastes are disposed of in an environmentally sound manner and only recovered, recycled, reclaimed, or directly re-used for a use allowed under the Convention) and with the Basel Convention. For parties to the Minamata Convention but not to the Basel Convention, they should follow relevant international rules, standards, and guidelines when they plan to transport mercury wastes defined under the Minamata Convention across international boundaries. An Article 11 Agreement should be in place between the Basel non-party and a Basel Party concerned by the transboundary movement.

Under the Basel Convention responsible the generator or the exporter must receive a prior informed consent in a notification document from the Basel competent authorities of all the States concerned with the transboundary movement. A contract for the environmentally sound disposal of the mercury waste subject to the transboundary movement should exist between the generator or the exporter and a disposal facility in the importing country, before shipping the waste to proper recovery or disposal options into another State.

Under the Basel Convention, a Transboundary Movement means any movement of hazardous wastes or other wastes:

- from an area under the national jurisdiction of one State
- to or through an area under the national jurisdiction of another State, or to or through an area not under the national jurisdiction of any State,

provided at least two States are involved in the movement
This leaflet presents an overview of the Basel Convention control system for the TBM of hazardous wastes and other wastes.

Work on electronic approaches to the notification and movement documents is ongoing. This should improve the efficiency of the process.

The Export and Import Control Tool can in identifying whether the Basel Convention applies and what legal requirements should be borne in mind before initiating a transboundary movement.

Further information on the Prior Informed Consent procedures and TBM can be sought from your country's Basel Convention Competent Authority

Documentation to support the Basel Convention's Prior Informed Consent procedure include:

- ✓ Legally, enforceable, written and signed contracted between the exporter and disposer
- ✓ Insurances to cover all potential liabilities including accidents
- ✓ Notification document
- ✓ Movement document
- ✓ Disposal certificate

Some key considerations for an exporter of waste containing mercury or mercury compounds:

- ✓ The shipment must be certified as properly packed and labelled in accordance with relevant international standards.
- ✓ The shipment should mark the containers with appropriate signs, including the specified label, the proper shipping name, and the UN number and include an emergency response telephone number.
- ✓ Upon arrival, the transport vehicle should be visually inspected for any obvious leaks, spills, breakages or other releases and all suspected mercury sources should be documented and reported to management.
- ✓ The shipment is accepted as compliant or rejected as non-compliant based on the inspection, and a written report including all the relevant information should be kept by the facility.
- ✓ The shipment should travel with safety data sheets and other relevant information in compliance with international standards and, if applicable, the Basel Convention.

Figure 4-2: Application of ADR placarding when transporting dangerous goods in freight containers (Source: Transport's Friends)

4.3. Waste Manifests

A waste manifest or consignment note should accompany the movement of waste MAPs domestically. For TBM, the notification form and a movement document should always accompany the shipment.

Ideally, the need for and the requirements of a waste manifest should be part of a country's waste and or hazardous waste regulations. However, in the absence of these regulations, there are best practices and guidelines can be prepared and their adoption promoted through stakeholder engagement and awareness raising.

Waste manifests should be used for:

- Collections from generators by waste haulers
- Movement between premises of the same generator/business
- Movement from temporary and centralised interim storage facilities

At a minimum the waste manifest should contain the following information:

- Contact information for generators, facilities, waste haulers (essentially anyone involved in the movement of the waste)
- A unique identifier
- Description of the waste – quantities, concentrations, physical form, hazard code, container types, numbers and sizes, UN identification number
- Vehicle and carrier details
- Signature and date for each responsible person

Additionally, the following must be kept in mind:

- Copies of the waste manifest should be kept by the generator, transporter, receiver/storage facility and if applicable, the regulatory authority.
- Each copy should contain the signature of the responsible persons handling the wastes.
- Entities should keep waste manifests for at least 3 years.

MODULE 5

Environmentally Sound Disposal

As per the Technical Guidelines (UNEP 2021), only the following recovery and disposal operations, as provided for in Annex IV, parts A and B, of the Basel Convention (2014), should be permitted for the purpose of environmentally sound disposal of mercury wastes.

Code	Recovery Operations	Code	Disposal Operations
R4	Recycling/reclamation of metals and metal compounds	D5	Specially engineered landfill
R5	Recycling/reclamation of other inorganic materials	D9	Physico-chemical treatment
R8	Recovery of components from catalysts	D12	Permanent storage
R12	Exchange of wastes for submission to operations R4, R5, R8 or R13	D13	Pre-processing prior to submission to D5, D9, D12, D14 or D15
R13	Accumulation of material intended for operations R4, R5, R8 or R12	D14	Repackaging prior to submission to D5, D9, D12, D13 or D15
		D15	Storage pending any of the operations D5, D9, D12, D13 or D14

Table 5-1: Recovery and Disposal Operations for Mercury Waste (Source: UNEP/ISWA 2015)

5.1. Recovery of Waste MAPs

Recovery operations lead to resource recovery, recycling, reclamation, direct re-use, or alternative uses. Mercury recovery from solid waste generally comprises of 3 stages (UNEP 2021) (UNEP/ISWA 2015):

1. Pre-Treatment

Pre-treatment serves to increase the efficiency of subsequent steps by removing materials other than those containing mercury. It is only necessary for some mercury wastes, particularly waste MAPs, which are crushed or disassembled to facilitate the separation of mercury from other components. Examples for pre-treatment include mechanical crushing of fluorescent lamps (see figure 5-2), removal of impurities from batteries, or dismantling of electric switches.

2. Thermal-Treatment

The mercury is separated by heating it above its vaporization temperature. Due to its low boiling point (ca. 356.73°C), most of the mercury in the waste enters the off gas/stream and is separated from other components (e.g. zinc). Flue gas treatment devices can effectively capture

mercury and mercury compounds generated during thermal treatment. Several thermal treatment processes and technologies are available, such as rotary kilns, multiple hearth furnaces, or indirect heated vacuum dryers. Thermal treatment is used for many types of mercury wastes, e.g., to recycle button-cell batteries, reactivate spent carbon, or decontaminate sludge and soil.

3. Purification or Refinement

After having entered the exhaust gas system, mercury vapour emitted during waste treatment is washed out via indirect cooled condensers and condensed in the cooling area. The mercury remains in a liquid slurry. It is then purified by several steps of successive distillation to render it re-usable as a commodity or eligible for disposal.

The following figure provides an overview of the processes of mercury recovery from solid waste.

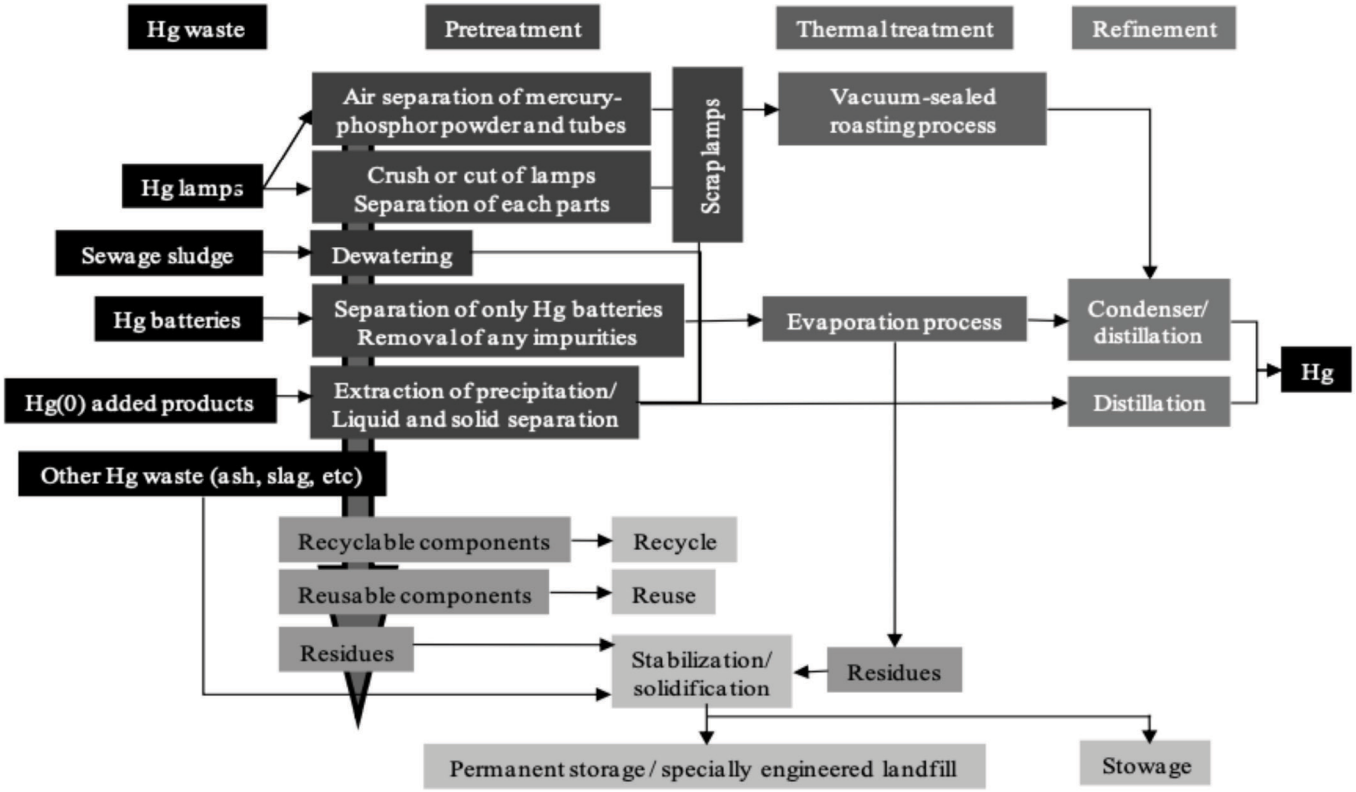

Figure 5-1: Process Flow for Recovery of Mercury from Wastes (Source: UNEP 2021)

Environmentally sound recovery of mercury and treatment of mercury waste includes the following steps:

- ✓ To the extent feasible, establish a mass balance, i.e., monitor the amount of mercury entering on one end and captured on the other and, if possible, investigate where mercury is lost during the process.
- ✓ Treatment steps during which mercury may be emitted should take place in a closed system under negative pressure to prevent vapour emissions to the atmosphere.
- ✓ Mercury in the exhaust air is captured (for example by indirect condensation combined with sulphur impregnated activated carbon filters).
- ✓ Mercury in the wastewater is isolated using various physico-chemical treatment steps (for example precipitation, ion exchange).
- ✓ Mercury emissions and releases are continuously monitored.

It is important to note that it is often not possible to extract all mercury contained in the waste. Moreover, a small, but significant proportion will be 'lost' during treatment processes. Some mercury will vaporize during pre-treatment, remain in the fly/bottom ash during thermal treatment. Mercury residuals from processing of wastes either undergo further treatment or are disposed in specially engineered landfills or permanently stored.

For waste MAPs thus pre-treatment is especially important since it serves to increase the efficiency of subsequent steps by removing materials other than those containing mercury. However, extra care should be taken as recovery of mercury from waste MAPs have an added risk of releasing mercury into the environment when broken or damaged.

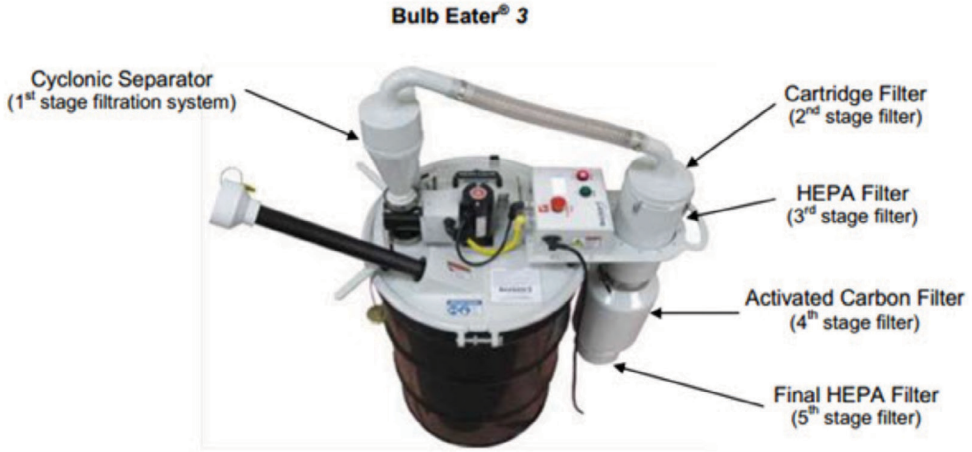

Figure 5-2: Bulb-Eater Device Which is Used for Mechanical Crushing of Mercury Containing Bulbs (Source: Terra Cycle)

5.2. Disposal of Waste MAPs

Disposal operations are those operations which do not lead to the further possibility of resource recovery, recycling, reclamation direct re-use or alternative uses.

As mentioned in the previous section, waste MAPs must undergo adequate pre-treatment to first recover mercury from the product before they can be disposed of in any operation mentioned in Table 5-1. This is done because waste MAPs can otherwise break and release mercury in the environment, and hence the mercury must be removed from them.

Mercury recovered from waste MAPs can then be chemically stabilized and or physically solidified using commercially available technologies in processes that are referred to as stabilisation or solidification, which comes under D9 – physico chemical treatment as a disposal option for mercury wastes. Two of the most used Stabilization/Solidification (S/S) approaches are described below.

1. Sulphur Stabilization of Mercury

Sulphur and elemental mercury (recovered from waste MAPs like thermometers through pre-treatment) are mixed under heat in a vacuum mixer, thus reacting to form mercury sulphide. Reported characteristics of the final product:

- Product is a powder with no detectable releases of mercury vapour.
- Complies with applicable leaching standard.
- Weight increases by approximately 16%, volume approximately 6-fold.

2. Sulphur Polymer Stabilization of Mercury and Mercury Containing Wastes

Mercury is stabilized with sulphur as mercury sulphide and then incorporated and microencapsulated (solidification) in a polymeric sulphur matrix. Characteristics of the final products:

- High compressive strength; very low porosity.
- Difficult to reverse the process.
- Final product after treatment of metallic mercury contains about 70% of mercury by weight.
- Monolithic and crushed samples comply with applicable EU leaching acceptance criteria for inert solid waste.

The objective in both processes is to immobilize the mercury in a solid and low permeable matrix so that the waste complies with the acceptance criteria for disposal in specially engineered landfills or permanent storage in underground facilities. While these processes also involve recovery of mercury, the final operation for the mercury being treated here is disposal, under D9.

However, please note that it is NOT recommended to dispose waste MAPs directly in specially engineered landfills or permanent storage since they pose a risk of breakage (UNEP 2021) (UNEP/ISWA 2015).

Alternatively, it is also possible to remove mercury completely by thermal desorption (Econ Industries 2015). Thermal desorption is a process that uses either indirect or direct heat exchange to heat primarily organic contaminants to a high enough temperature to volatilize and separate them from a contaminated solid matrix and then either collect or destroy them. Thermal desorption using indirect heat exchange is a recommended option for waste MAPs like batteries.

Several thermal treatment technologies have been used in the past however two methods have proven to be suitable while remaining economically viable on an industrial scale:

1. Rotary kilns

Here, input wastes, such as mercury containing batteries are transported by a scraper chain directly into the feeding screw of the rotary kiln. The wastes are continuously treated at temperatures up to 800 degrees Celsius. As a result, mercury is transformed into a gas phase and can be removed as exhaust vapor from the rotary kiln. The treatment is carried out at under pressure to prevent dust emissions. The exhaust air is transported by a cyclone, which separates dust particles, into the post-combustion chamber. After combustion, the remaining exhaust gas reaches the three-stage treatment, in which the exhaust gas is cooled down to achieve a condensation of mercury and water, passed through an electro filter to achieve the deposition of aerosols and then fed to an active carbon filter system for final cleaning (Remondis 2020).

Figure 5-3: Rotary Kiln at the Remondis QR Site in Dorsten (Source: Remondis 2020)

2. Vacuum thermal processing

Vacuum thermal processing enables the treatment of thermometers, batteries, especially button cells, dental amalgam, electrical switches and rectifiers, fluorescent powder, exhaust tubes, crushed glass, soil, sludge, mining residues and catalyst materials, among others. The vacuum thermal process generally includes the following stages:

i. Heating the input waste in a special kiln or in a charging operation at temperatures of between 340°C and 650°C and pressures of a few millibars so that the mercury contained in the waste evaporates;
ii. Applying thermal post-treatment to mercury-containing vapour at temperatures ranging from 800°C to 1000°C, where, for example, organic components can be destroyed;
iii. Collecting and cooling of mercury-containing vapour; and
iv. Using distillation to generate pure liquid mercury.

The residue that remains at the end of the vacuum thermal processing is essentially mercury-free and is recycled or otherwise disposed of depending on its composition (GMR Leipzig n.d.).

Figure 5-4: Mercury Recovery from Industrial Waste by Vacuum Thermal Processing (Source: Econ Industries)

MODULE 6

Occupational Health and Safety

6.1. Workers involved in waste MAPs management

Exposure to mercury through the handling of waste mercury-added products poses a major health concern to worker directly involved in the management of waste MAPs particularly in relation to the operation of drum top crushers (bulb eaters).

An organisation should conduct an exposure assessment to determine the potential exposure pathways, likelihood and extent of impact. The questions an exposure assessment seeks to answer are:

- Who or what is exposed?
- Does the exposure occur through inhalation, drinking water, dermal contact or another route?
- How much exposure occurs?
- How often and for long does exposure occur

Based on the exposure assessment, a regular training programme for employees in effective ESM and health and safety measures should be instituted. These can include:

1. Proper PPE. See Section 2 (Handling) for more details on the appropriate PPE
2. Preventative measures such as proper handling, labelling, storage
3. Spill kits
4. First-aid medical supplies and wash area located near (NOT IN) sites where the wastes are handled/stored
5. Periodic monitoring of ambient air quality – portable samplers, colorimetric badges
6. Monitoring of individual workers – baseline established prior to potential exposure and annual monitoring samples – urine or blood.
7. Fortifying a person's response to exposure by regular intake of selenium

Operations in the Caribbean which can have a high direct exposure to workers:

- Stabilisation or solidification of wastes containing mercury or mercury compounds
- Waste collectors, truck drivers and workers at transfer stations
- Waste workers on the working face of the landfill

Mandatory Contents for a Mercury Spill Kit

- Instructions,
- PPE (rubber or nitrile gloves, safety goggles, respiratory protection, protective clothing, disposable shoe covers
- Containers – air tight, sealable bags, plastic containers, steel jars
- Items for removing mercury – flashlight, plastic cards, small plastic scoop, tweezers, eye droppers, duct tape, vapour suppression agents (sulphur powder, absorbent pads, brush, zinc or copper flakes
- Materials for decontamination – vinegar, hydrogen peroxide, cotton swabs for when using sulphur powder, decontaminant solution, pieces of soap and paper towels
- Labelling – mercury waste labels, caution tape

- Informal sector scavenging on landfills
- Crushing of CFLs
- Dental offices
- Temporary (and informal) storage sites

Air Quality Monitoring

Air sampling at workplaces where mercury wastes are handled monitors the exposure of workers to mercury vapour. An air quality monitoring plan at various locations within a workplace really depends on number of locations, length of sample lines and sampling rates required.

Ambient air permissible limits:
- 1 µg/m3 for inorganic mercury vapour (WHO, 2006; WHO Regional Office for Europe, 2000)

Ceiling limit:
- 0.1 mg/m3 (8-hr [TWA]) – OSHA, US

Background monitoring: Useful to determine mercury in the ambient air in the work environment and for emergency response to mercury spills and verification of spill clean-up. There are numerous portable mercury analysers on the market. The estimated cost ranges from US$10,000-15,000

Personal exposure assessment: badges, such as a colorimetric badge, is a useful input into a comprehensive exposure assessment for operations. The estimated cost for pack of 10: US$200

Figure 6-1: (From left) AirMet, Jerome 405, Lumex portable mercury analysers, CBISS colormetric badge

Medical Monitoring

The amount of mercury in a person's body can be estimated by measuring mercury in urine or blood.

Blood Analysis: provides information about exposures to both methylmercury and inorganic mercury within the past month or two. It is suitable for evaluating single high exposure (test to be conducted immediately after event). The estimated cost for a test is US$50.

Urinalysis: provides information about exposure to inorganic and elemental mercury (and not methylmercury). It is suitable to measure long term exposures. It is a relatively easy and non-invasive sample to collect. The estimated cost for an analysis is US$120.

Pre-employment physical examinations should be carried out to establish a baseline for determining an individual's background mercury level and to ensure that an employee has normal body chemistry for mercury removal. Medical monitoring should be undertaken regularly (every 1-3 years depending on the extent of exposure). Employers should consider alternative jobs for workers who become pregnant and are breastfeeding.

6.2. Public Health and Safety

Public health and safety are a key concern, particularly in areas where waste MAPs are likely to be aggregated and stored, such as collection points, dismantling sites for such products as WEEE or ELVs and temporary and consolidated interim storage facilities. Examples in the Caribbean where the public can become exposed to unhealthy concentrations:

- Through unauthorized or unrestricted access to facilities involved in mercury wastes management
- Unsecured public collection sites
- In their homes
- Along poorly planned on-site transport routes

Mercury levels in the nearby communities should be monitored. Testing of human hair is a good indicator of the mercury pollution levels in these communities. The International Pollutants Elimination Network has led the global studies on mercury monitoring in humans, particularly women of childbearing age. Some Caribbean countries have previously participated in these studies. Mercury concentrations above 1.0 ppm in hair (USEPA's reference dose) have been related to neurological impairments and other adverse effects.

In the Caribbean, the Biodiversity Research Institute has conducted numerous studies on mercury levels in humans and biota. In 2021 a 3-year project led by Antigua and Barbuda and BRI to develop a Caribbean Region Mercury Monitoring Network commenced.

6.3. Environmental Monitoring

An ecological risk assessment on potential impacts from sites used to manage waste MAPs should be conducted. This includes monitoring abiotic media such as soil, sediment, water and air for mercury levels.

Recommended sites for regular environmental monitoring (primarily drinking water and air exposure pathways) are:

- ✓ Sites that are involved in the storage and pre-treatment of waste MAPs
- ✓ Disposal sites (landfills)

Mercury analysis is typically performed in a dedicated laboratory. A databank of existing laboratories with capacity to perform mercury analyses is maintained by UNEP Chemicals to support the effectiveness evaluation of the Stockholm Convention (e.g., Global POPs Monitoring Plan), other MEA needs, and to serve as a reference for UNEP's projects. For screening purposes, test kits are available and can be used in the field. Laboratory test method selected can influence the reliability of the environmental monitoring data therefore well-established sampling procedures should be selected: International Organization for Standardization, the European Committee for Standardization, the United States Environmental Protection Agency, the Global Environment Monitoring System and the American Society for Testing and Materials.

MODULE 7

Applications and Practical Tips

Photo: Separate2Create Trinidad and Tobago

In this section, application of different stages of waste MAP management are provided for:

1. mercury lamps
2. thermometers
3. dental amalgam
4. electric switches containing mercury in automobiles
5. batteries containing mercury

These are the outputs from Group Activity sessions at the Training Programme workshops where the aim was to begin the conversation on possible frameworks/strategies for the ESM of various waste MAPs categories in the Caribbean. The sessions allowed the participants to apply the tools learnt and presented in the preceding sections to the Caribbean context. It is hoped the information can be used as starting points for the development of national strategies and proposals to apply for funding.

Practical tips for cleaning up of small-scale spills from easily broken mercury lamps and thermometers are also included.

Figure 7-1: A Broken Mercury-Containing CFL Lamp (Source: LightBulbs.com) And Thermometer (Source: Shutterstock)

7.1. Applications

Mercury Lamps

Strategic Planning

- Main Generators: Households, offices, distributors, importers, producers
- Estimation of generated quantities: Inventory through consultations.
- Stakeholders involved: Hazardous waste management companies, Ministry of Environment, Customs Department, Producers or distributors.
- Existing initiatives: Barbados – discount to leave CFLs and purchase LED lighting. Company crushes the CFLs.
- Institutions coordinating implementation: Minamata Convention National Focal Point (lead), Ministry responsible for the Environment and Waste Management, Financial partners (private sector), generators.
- Strategic Partnerships: generators (EPR scheme), waste handlers (capacity building), communities (collection)
- Financing: public/private partnerships, support from NGOs, grant funding.

Separation, Collection & Handling

- Mass collection points for households and small businesses; large scale generators – collection by authorised agents. Guidelines and SOPs to drive the initiative, in the absence of legislation
- Collection schemes: campaigns for household waste, EPR schemes with collection at supermarkets or popular shops, energy unit to collect CFLs from households, streetlamps and government agencies.
- Handling - It is crucial that workers and contractors receive regular training in handling hazardous Waste.

Storage, Packaging and Labelling

- Small scale generators – temporary storage onsite (if possible) and collection points for households
- Large scale generators – temporary storage onsite and depending on the volumes a centralised storage site whereby multiple companies can share (pay a fee) to use the storage facility
- The inventory data can be used to determine the capacity required for storage.
- Environmental considerations – area where no natural disasters are expected, EIA required, away from identified fault lines
- Technical considerations – planning of the space based on the expected materials to be received per period, easily accessible for transportation, routine inspections, enough land space, land use zoned for industrial activities, proper fencing and signage
- Social considerations – away from residential areas, emergency response plan required
- For temporary storage, the spent mercury containing lamps are stored on-site in the original product boxes, a long box that fits the shape of the lamp or in UN-approved drums (for exporting). Crushed lamps should be stored as mercury-containing waste

- Type of packaging – X type UN drums, HDPE or metallic
- Labelling – UN Code (3506), Weight, Pictograms (corrosive, toxic, health hazard, environmental), ID number.

Transport

- Inland transportation: vehicle appropriate for hazardous waste collection.
- Transportation requirements: correct PPE, regular training, route should be identified, collection time should be fixed and reliable, have an emergency plan (spill kit), vehicle should be kept locked, back up containers.
- Regulatory environment: rely on international or national regulations, USEPA regulations.

Environmental Sound Disposal

- If regular export will take place (e.g., every year) and to generate savings, it is advised that the spent lamps are compacted in a lamp crusher paying close attention to limiting worker exposure as significant quantities of mercury are released when the drum is emptied. Given the likelihood of exposure, it is recommended that these unit be operated outside. The filters and the crushed glass (possibility of contamination) must be exported for final disposal. Prior to final disposal, the mercury containing lamps must be distilled and undergo physico-chemical treatment through stabilization.

Health, Safety and Environment

- Health and safety measures in place where waste is being processed in interim storage or shipping. Regular training for workers.
- Checklist printed in office
- Safety kit near-by and PPE (proper gloves, masks and boots)
- 1-3 individuals tested (blood or urine) every year

Further resources

- HANDLING AND DISPOSAL OF FLUORESCENT LAMPS (almr.org)
- Collection of mercury lamps from households - Japan

Thermometers

Strategic Planning

- Sources: Hospitals, medical facilities, clinics, households, laboratories
- Stakeholders: Manufacturers, Medical Authorities, Solid waste management/Govt Authorities, Households
- Finance: private sector funding, government subsidies

Separation, Collection & Handling

- Community collection points for households, Collection bins separate in hospitals
- Take back to pharmacies

- Authorized collectors who go around collecting thermometers
- Collection stations/centre for waste MAPs, or even for other Hazardous Wastes
- PPE required: Masks, gloves, overalls etc.
- Special care must be taken while handling Thermometers, to ensure that they do not break. Thermometers are fragile and extra caution needs to be taken place throughout all stages to ensure that they do not break.

Storage, Packaging and Labelling

- Thermometers must always be stored safely and securely, should not be exposed to extreme temperatures, humidity, or sunlight, must be stored at a room temperature of 20-26 degrees.
- Should be stored preferably in the original product packaging, and when that is not available, they must be stored in suitable sealed air-tight containers with padding to prevent breakage.
- Containers with thermometers must be marked as such, with a 'Hazardous Mercury Waste' label.
- For export purposes, it should also include the relevant pictograms for waste MAPs, the weight of the container, the UN number and place of origin and destination.
- Not feasible to store near a landfill.
- Example of St Kitts and Nevis – Interim Storage at Environmental Health Department
- New interim storage facility in Antigua and Barbuda
- Jamaica has an interim storage facility, however more safeguards are required
- JPS Jamaica has a bulb eater for onsite facility, useful for others

Transport

- Transportation in public roads should be pre planned, approved and authorized
- Jamaica receives escorted transportation when needed, requested between a particular timeframe.
- In Trinidad, regulations, permits required, is an extensive process and understanding of the risk associated because of the transportation of toxic material

Environmentally Sound Disposal

- For thermometers, recovery of mercury is done through thermal treatment in a box kiln through distillation.
- Once the mercury is recovered, it undergoes physico-chemical treatment so that the waste complies with the acceptance criteria for disposal in specially engineered landfills or permanent storage in underground facilities.

Health, Safety and Environment

- Saint Lucia – ensure you have measures in place while waste is being processed in interim storage or shipping
- Checklist printed up in office
- Safety kit nearby and PPE available

- 1-3 individuals tested (blood or urine) every year
- Trinidad & Tobago – PPE is extremely important (proper gloves, masks and boots) to avoid reaching to requiring blood or urine tests)

Further Resources

- Mercury Thermometers | US EPA
- Water Sanitation and Health (who.int) - WHO WASH Health care waste modules

Dental Amalgam

Strategic Planning

- Generators – Amalgam waste - dentists offices, dental hospitals and schools, dental technicians. Unused/obsolete amalgam - distributors (obsolete or unused). Funeral homes.
- The MIAs provide a useful foundation to determine quantities generated, however in some countries the inventory exercise needs to be expanded. Expected – very small quantities generated
- Key stakeholders – generators, national dental associations, community groups (esp. rural areas), customs brokers
- Funding – national budgets. Funds should be directed to awareness programmes and not purchase of equipment
- No direct existing initiatives. In the public sector, can include as part of the overall medical waste management programme (with dental amalgam waste clearly treated as hazardous waste and not medical waste). Include the need for proper management and alternatives in the dental school's curriculum.

Separation, Collection & Handling

- Amalgam Separators to collect dental amalgam wastes at the dentists.
- Challenge: how to encourage uptake. Legislation is recommended but the timeframe and challenges may make this an unrealistic solution.
- Financial incentives (tax breaks/credits) for 1-2 years. Reduce the quantities of waste produced – insurers can refuse to cover dental amalgams; increase the duties on the import of dental amalgams.
- Third party (licenced waste contractor) with responsibility for collection and handling.

Storage, Packaging and Labelling

- Temporary storage at the generator. Collection container stored in a sealed and labelled bucket.
- Interim storage facilities – public health care centres (reliable?), 3rd party licenced contractor sites are likely to have proper procedures and protocols in place.
- Due to small quantities generated – possibility for regional or sub-regional collaboration on interim storage facilities
- Labelling – follow guidelines

Transport

- Type of road transport will be determined by quantities generated. Likely to be small quantities therefore private vehicles and vans can likely be involved – however ensuring compliance becomes a big challenge. National legislation needs to be consulted.
- Another option is for a third-party licenced contractor to be responsible for collection from the generators site to the interim storage site – accepts the risk.
- Funding for transportation (and even storage) can be covered through a fee administered by the Medical Board upon obtaining and renewing dental licences to operate.
- Appropriate insurance for vehicles transporting the waste is critical.

Environmentally Sound Disposal

- No pre-treatment locally. Collect and ship abroad.
- Accumulate various categories of waste MAPs to generate higher volumes at a faster rate to facilitate financially feasible export

Health, Safety and Environment

- Workers – regular urinalysis. Includes dentists, dental technicians, janitorial staff, third party operators – both director and auxiliary employees
- Third party contractor site – storage of collected containers – regular environmental monitoring (drinking water and ambient air quality)

Further Resources

- Circabc (europa.eu)
- Mercury in Dental Amalgam | US EPA
- Amalgam Separators and Waste Best Management (ada.org)
- Webinar | Eliminating Dental amalgam use in the EU - The way forward - YouTube

Mercury containing switches in automobiles

Strategic Planning

- Primarily found in US made vehicles manufactured pre-2003. Of the vehicles on the road, as many as up to 30% can be pre-2003 vehicles of which <10% are US made.
- Sources: End of Life Vehicle facilities, Scrapyard dealers, Repair shops, Ministry responsible for Transport, waste brokers.
- Inventory resource: vehicle import data from Customs, NIPs
- Challenge – no deregistration of vehicles at their end of life
- Integration with existing depollution programmes, if present.
- Government funding for disposal due to the small quantities. Suitable for a proposal to a donor agency

Separation, Collection & Handling

- Dismantlers remove the switch(es) and place the mercury pellets or assemblies in the provided storage bucket.
- Ideally removal of the switches should be part of a wider depollution programme.
- Raising awareness should be the first stage.
    1. Targetted campaign for dismantlers
    2. Public campaign to encourage citizens to act responsibly
    3. Ministry of Transport website
- Collection by authorized and trained dismantlers only.
- Workers at the ELVs facilities, scrap yards or repair shops can be trained on dismantling procedures.
- Do not require specialized hazardous waste contractor. Training programme on proper health and safety protocols also required.

Storage, Packaging and Labelling

- Temporary storage at the dismantlers sites. Consolidated storage at a government facility. The regulator can ensure the integrity of the storage sites through the environmental permitting/registration procedure.
- Storage time at temporary storage sites – 1 year after which has to be stored at the consolidated storage site.
- Plastic lined plastic buckets with lid.
- Labelling - Basel Convention – A1180, EWC – 16 01 08, UN Code - 3506

Transport

- Small quantities – can be transported in dismantlers or relevant Ministry vehicle. Buckets secured in the trunk of the vehicles.
- Transboundary movement in accordance with the Basel Convention PIC

Environmental Sound Disposal

- No pre-treatment locally. Collect and ship abroad

Health, Safety and Environment

- Environmental and biomonitoring around the sites such as dismantling facilities are recommended.
- Challenge – no licensing of these facilities so unable to include monitoring in permits.

Further Resources

- ELVS Mercury Switch Program | US Ecology
- Managing Mercury Switches Found in Vehicles Fact Sheet | Department of Toxic Substances Control (ca.gov)

Batteries containing mercury

Strategic Planning

- Implementation and coordination: Ministry of Health and Environment, Ministry of Commerce, Solid Waste Management Department
- Public Awareness - Social Media, Government information service, Radio / TV, Meetings, Posters / Leaflets at storage site, Billboards,
- Relevant Stakeholders: Importers, Distributors, Electronic Repair Shops, E-waste Recyclers, Users (households, industries, small, medium-large companies)
- Inventories: Enquire from Customs Department/Trade Ministry import volumes of direct imports and Electronics with such batteries, undertake a rapid assessment via the administration of a questionnaire, verify if mercury batteries are still being imported or used (due to the content of toxic mercury and environmental concerns about its disposal, the sale of mercury batteries is now banned in many countries)
- Funding: Partnership with all stakeholders (Public Private Partnerships), Include Polluter Pays Principle in national regulations, GEF

Separation, Collection & Handling

- 2 separate containers (basic cardboard containers): 1 labelled mercury containing batteries and 1 general batteries
- Third-party partnership for the collection: Responsible for monitoring waste bins, once bins are filled, call for collection
- Additional training of existing workers who are already collection special waste
- Code of practice for the whole value chain of the mercury battery – guidelines and standard operating procedures
- Exporter should be responsible for the storage, monitored by the government

Storage, Packaging and Labelling

- Collection and storage of bins:
  - National Solid Waste Management Authorities - responsible for storing the collected batteries
  - National Storage for chemical waste with different ministries or establishing a partnership with private company with storage place
- At interim storage facilities, consolidate storage should be in sealed drums (to prevent spillage)
- Conduct ESIA prior to construction

Transport

- Certified waste haulers

Environmentally Sound Disposal

- No pre-treatment locally. Collect and ship abroad
- Regional approach to reach min volume to export (20 tons) - previous experience with other types of hazardous wastes (PCBs and obsolete pesticides).

Health, Safety and Environment

- Medical Assessment of workers prior to operations
- Ambient air quality monitoring at storage sites

Further Resources

- NEWMOA Fact sheet on mercury batteries

7.2. Practical Tips for Small Scale Clean Up

Mercury Lamps

Fluorescent bulbs contain a small amount of elemental mercury, typically between 2 and 5 milligrams in common four-foot tubes and about the same for most compact fluorescent lamp (CFL) bulbs. When broken, mercury vapours may be released into the air. The mercury released from broken bulb is mostly in vapor form. If properly cleaned up, broken bulbs or CFLs do not pose a serious health risk. Though the amount of mercury released from a broken tube or CFL is small, proper disposal of the broken bulb and minimization of personal exposure are necessary. Ideally, breakage should be handled by trained professionals, but in their absence the following guidelines must be followed (USEPA, n.d.).

Before cleaning up a broken mercury lamp:

- ✓ Have people and pets leave the room.
- ✓ Air out the room for 5-10 minutes by opening a window
- ✓ Shut off the central forced air heating/air-conditioning system if you have one.
- ✓ Collect materials needed to clean up broken bulb:
    - o stiff paper or cardboard,
    - o sticky tape,
    - o damp paper towels or disposable wet wipes (for hard surfaces), and
    - o a glass jar with a metal lid or a sealable plastic bag.

Cleaning-up a broken lamp:

- ✓ DO NOT VACUUM. Vacuuming could spread mercury-containing powder or vapor.
- ✓ Be thorough in collecting broken glass and visible powder. Scoop up glass fragments and powder using stiff paper or cardboard.
- ✓ Use sticky tape, such as duct tape, to pick up any remaining small glass fragments and powder. Place the used tape in the glass jar or plastic bag.
- ✓ Place clean-up materials in a sealable container.

After cleaning-up a broken mercury lamp:

- ✓ Promptly place all bulb debris and clean-up materials, outdoors in a trash container or protected area until materials can be disposed of. Avoid leaving anything indoors.
- ✓ Make sure to dispose the remnants of the bulbs (broken or unbroken) separately.
- ✓ If practical, continue to air out the room where the bulb was broken and leave the heating/air conditioning system shut off for several hours.

Thermometer (and other non-electronic measuring devices)

A broken mercury-containing thermometer can be toxic if the vapours are inhaled. The risk of poisoning from touching or swallowing mercury from a broken thermometer is low if appropriate clean-up measures are taken. Ideally, breakage should be handled by trained professionals, but in their absence the following guidelines must be followed (USEPA, n.d.).

Preparing for cleaning-up a broken thermometer:

- ✓ Have everyone else leave the area; don't let anyone walk through the mercury on their way out. Make sure all pets are removed from the area. Open all windows and doors to the outside; shut all doors to other parts of the house.
- ✓ DO NOT allow children to help you clean up the spill.
- ✓ Mercury can be cleaned up easily from the following surfaces: wood, linoleum, tile and any similarly smooth surfaces.
- ✓ If a spill occurs on carpet, curtains, upholstery or other absorbent surfaces, these contaminated items should be thrown away in accordance with the disposal means outlined below. Only cut and remove the affected portion of the contaminated carpet for disposal.

Cleaning-up a broken thermometer:

- ✓ If there are any broken pieces of glass or sharp objects, pick them up with care. Place all broken objects on a paper towel. Fold the paper towel and place in a zip locking bag. Secure the bag and label it as directed by your local health or fire department.
- ✓ Locate visible mercury beads. Use a squeegee or cardboard to gather mercury beads into small mercury balls. Use slow sweeping motions to keep mercury from becoming uncontrollable. Take a flashlight, hold it at a low angle close to the floor in a darkened room and look for additional glistening beads of mercury that may be sticking to the surface or in small, cracked areas of the surface. Note: Mercury can move surprising distances on hard-flat surfaces, so be sure to inspect the entire room, including any cracks in the floor, when searching.
- ✓ Use the eyedropper to collect or draw up the mercury beads. Slowly and carefully squeeze mercury onto a damp paper towel. Alternatively, use two pieces of cardboard paper to roll the mercury beads onto the paper towel or into the bag. Place the paper towel in a zip locking bag and secure. Make sure to label the bag as directed by your local health or fire department.

- ✓ After you remove larger beads, put shaving cream on top of small paint brush and gently “dot” the affected area to pick up smaller hard-to-see beads. Alternatively, use sticky tape, such as duct tape, to pick up any remaining small glass fragments (Peel the tape very slowly from the floor to keep the mercury beads stuck to the tape.) Place the paint brush or duct tape in a zip locking bag and secure. Make sure to label the bag as directed by your local health or fire department.
- ✓ Place all materials used with the cleanup, including gloves, in a trash bag. Place all mercury beads and objects into the trash bag. Place the trash bag outside in a secured area and label it as directed by your local health or fire department.
- ✓ Contact your local health department, municipal waste authority, or your local fire department to find out how to conduct proper disposal in accordance with local laws.

8 List of Acronyms and Abbreviations

ASGM	Artisanal and Small-Scale Gold Mining
BAT	Best Available Technique
BCRC-Caribbean	Basel Convention Regional Centre for Training and Technology Transfer for the Caribbean
BEP	Best Environmental Practice
BFS	BlackForest Solutions GmbH
BRS&M	Basel, Rotterdam, Stockholm and Minamata Conventions
CARICOM	Caribbean Community
CDB	Caribbean Development Bank
CFL	Compact Fluorescent Lamp
EDF	European Development Fund
ELV	End of Life Vehicle
EPR	Extended Producer Responsibility
ESM	Environmentally Sound Management
ESD	Environmentally Sound Disposal
EU	European Union
EWC	European Waste Code
GEF	Global Environment Facility
GHS	Global Harmonised System
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
HSE	Health, Safety, Environment

IADB	Inter-American Development Bank
JICA	Japan International Cooperation Agency
LCD	Liquid Crystal Displays
MAPs	Mercury-Added Products
MEAs	Multi-lateral Environmental Agreements
MIA	Minamata Initial Assessment
NGO	Non-Governmental Organisation
NIP	National Implementation Plan for Persistent Organic Pollutants
PCB	Polychlorinated biphenyl
PIC	Prior Informed Consent
POP	Persistent Organic Pollutant
PPE	Personal Protective Equipment
SDG	Sustainable Development Goals
SIDS	Small Island Developing States
TBM	Transboundary Movement
UN	United Nations
UNEP	United Nations Environment Programme
WEEE	Waste Electrical and Electronic Equipment
WHO	World Health Organisation

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