

# Reduction of Unintentionally Produced Persistent Organic Pollutants (UPOPs) emissions by improving waste management practices at landfills

## Waste categories and impact potential

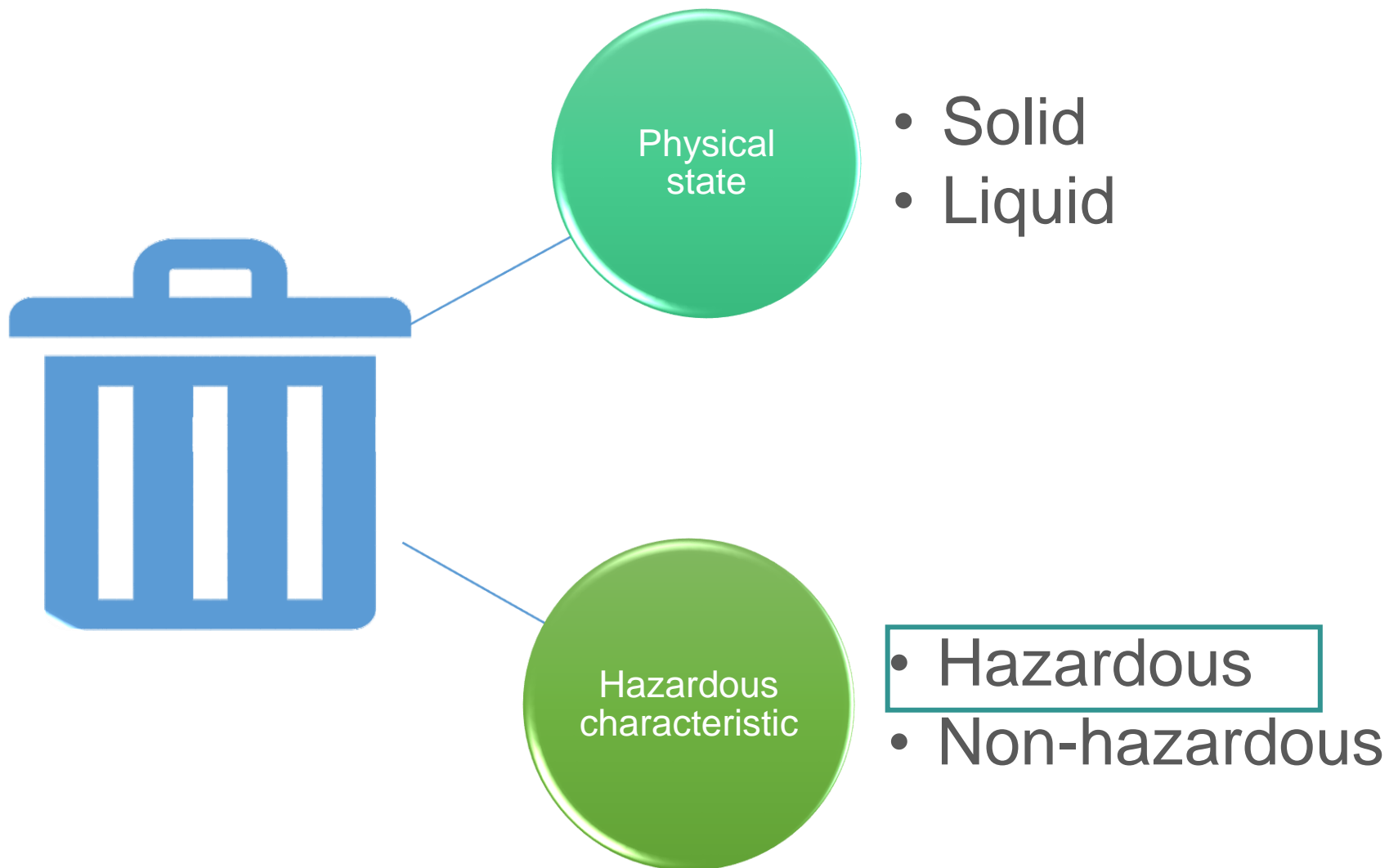
GEF Project ID: 5558 – Component 2 - Development and Implementation of a Sustainable Management Mechanism for POPs in the Caribbean



# Understanding waste categories and their impact potential

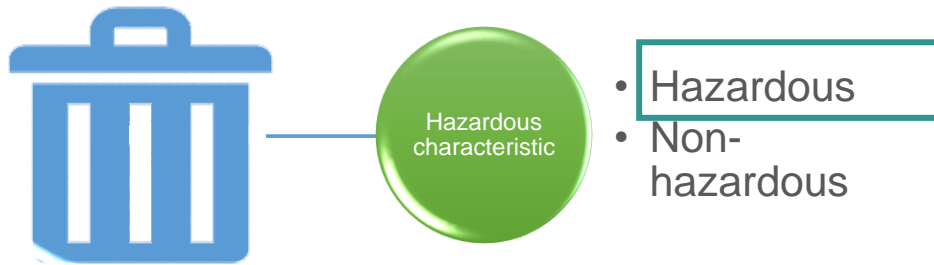
# Classification of waste by source and characteristics

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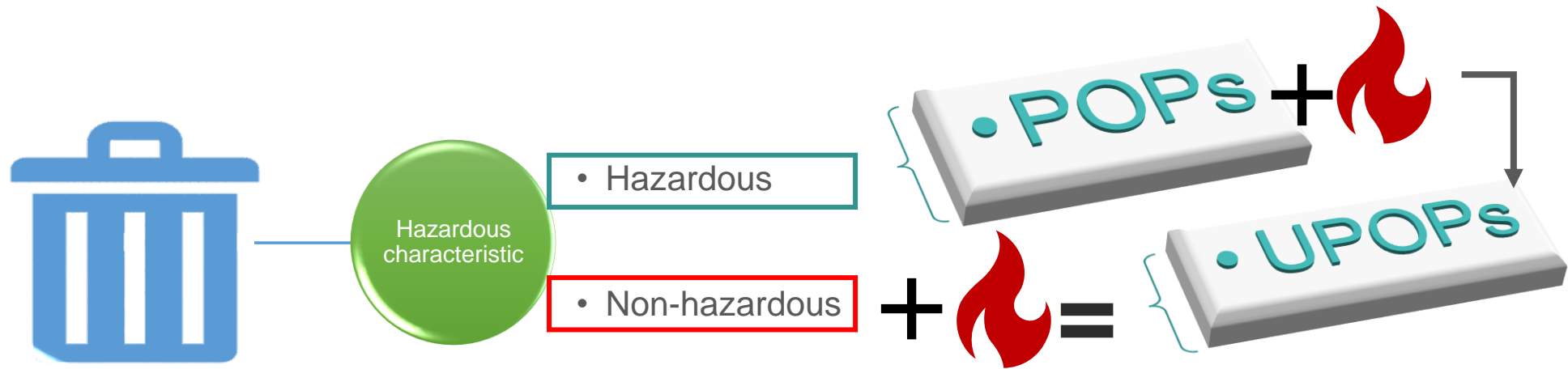


- Waste is deemed hazardous based on their chemical and physical properties and/or their effect on human and environmental health

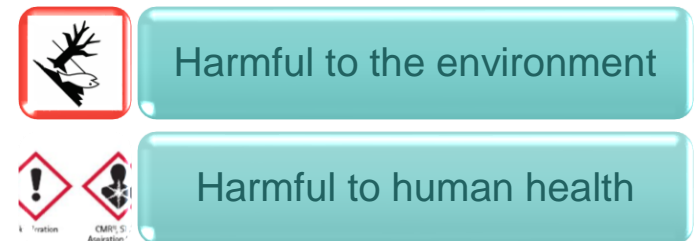


# Classification of waste by source and characteristics

## Classification by characteristics



- Hazardous waste may readily contain Persistent Organic Pollutants (POPs).
- Both hazardous and non-hazardous waste may generate Unintentional POPs (UPOPs) in case of fire.
- POPs and UPOPs pose significant threats to human and environmental health



# Waste streams – description 1/3

## Classification by source

Municipal solid waste/ household waste

- Combination of several waste types generated in households
- Includes kitchen scraps, packaging, paper, plastics, furniture, light bulbs, WEEE, batteries, etc.

Industrial, commercial and institutional waste

- From the tourism industry, retail sector (markets, supermarkets, stalls) schools, offices, government institutions.
- Includes packaging, office supplies, food waste, garden waste, bulky waste, WEEE, paints..

Construction and demolition waste

- From construction companies, building owners, including after hurricane clean-up
- Includes mixed debris, lumber, concrete including reinforcement bars, packaging, HDPE and PVC pipes, PVC window frames

Parks and gardens (green) waste

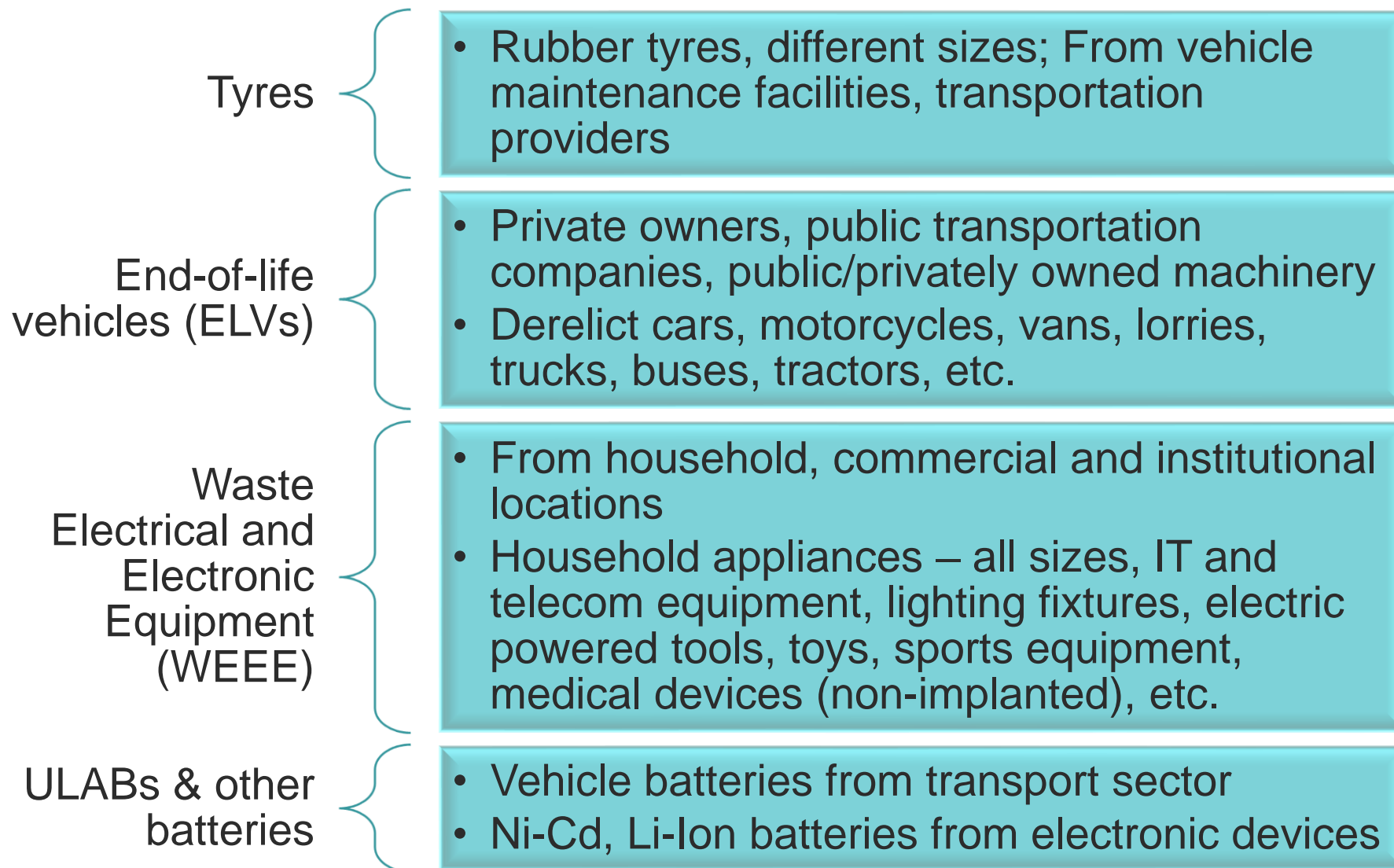
- From private gardens, parks, road verge maintenance, Beautification projects works
- Includes organic plant and bush cuttings

Recyclable packaging

- Mainly from commercial premises (markets, supermarkets, hotels and resorts, restaurants, bars
- Includes: PET and HDPE bottles, aluminium and steel cans, glass bottles and sometimes other polymers and cardboard.

# Waste streams – description 2/3

## Classification by source



# Waste streams – description 3/3

## Classification by source

Agricultural  
Pesticide  
Residues and  
Used Containers

- Farmers and importers/distributors of agricultural pesticides
- Insecticides, herbicides, rodenticides, bactericides, fungicides, larvicides and contaminated containers

Laboratory  
Chemicals  
(hazardous)

- From education institutions and testing laboratories
- Waste organic solvents (also chlorinated), waste inorganic solutions containing heavy metals, mixed expired chemicals

Oils and  
petroleum  
contaminated  
waste

- From the transport sector (maintenance garages), power plant, oil importers/distributors
- Include used motor oil, heavy fuel oil sludge, oil filters, oily rags, contaminated absorbents, etc.

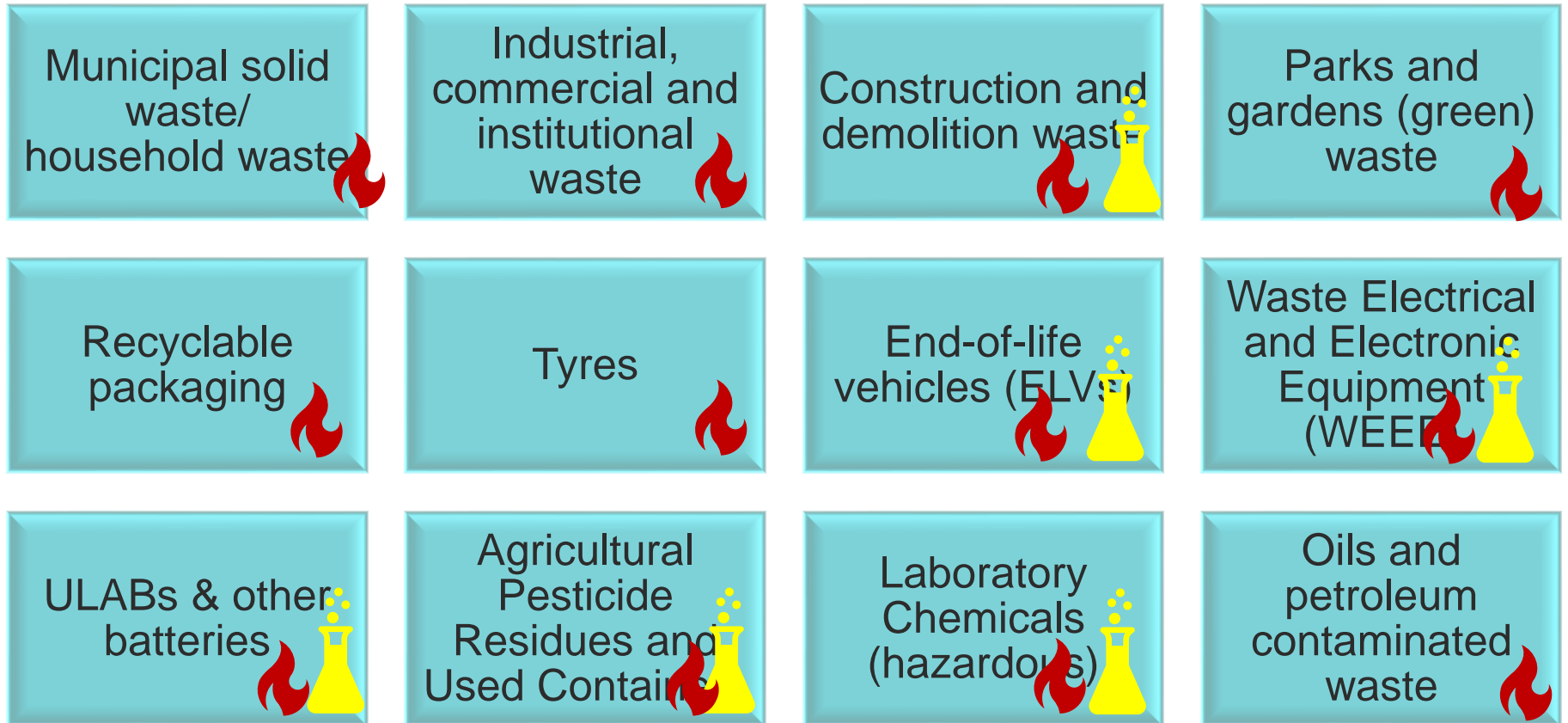
Medical waste

- From hospitals and clinics, pharmacies, medical schools, dental facilities, vet clinics and schools, autopsy centers, nursing homes for the elderly, households
- Medical devices, medical textiles, expired pharmaceuticals, infectious waste, sharps, etc.



# Classification of waste by source and characteristics

## Classification by source



May contain POPs

Medical waste  



May generate UPOPs  
in case of fire

Understanding  
waste categories  
and their impact  
potential

# Impact potential of waste streams on environment and human health

## Hazardous, POPs containing and uPOPs producing potential

- 2012 – Battery recycling (1<sup>st</sup>), lead smelting (2<sup>nd</sup>) and **dumpsites**(5<sup>th</sup>) among the top toxic pollution sources worldwide. In 2016 the situation is ~ unchanged (Pure Earth, formerly Blacksmith Institute and the Green Cross)
- Lead and chromium are found in almost a third of the identified dumpsites: ~ 370,000 to 1.2 million Disability-Adjusted-Life-Years = number of years lost due to ill-health, disability or early death
- Dumpsites are a more serious health risk than malaria for at least the 1.6 billion people of India, Indonesia and Philippines
- ~ 1/5 of the global cancer incidence is associated with environmental exposures. Number is disproportionately higher in developing countries.

**No data readily available on the impacts of waste management in the Caribbean region.**

# Wastes received and potential impacts

Landfills receive household waste, medical waste, used oil, contaminated pesticides containers, obsolete chemicals, among others.

Burning of solid waste (especially certain plastics) =>  
smoke and contaminants in air:  
Fine irritating particles, carbon monoxide, dioxins & other



## uPOPs from Emissions of disposal site

- Dioxins and furans (PCDDs and PCDFs) - persistent non-biodegradable organic compounds produced through uncontrolled burning of waste.
- Produced unintentionally - trigger biological response in humans that results in neurological, immunologic and reproductive problems.
- These have been also considered responsible for respiratory disorders and elevated cancer risks.

# Hydrogen Sulphide

- A colourless, flammable gas with a characteristic odour of rotten eggs.
- Produced in dumpsites when sulphate- bearing materials (such as gypsum and plasterboard) with high concentrations, are mixed with biodegradable waste.
- At low concentrations,  $H_2S$  may result in irritation to the mucous membranes of the eye and respiratory tract.
- Exposure to high concentrations results in depression of the central nervous system, loss of consciousness

# Heavy metals and hazardous organic compounds in leachate, air and soil close to disposal site

- Heavy metals can be found in leachate, air and soil produced either from plastic burning or smelting of scrap metals and WEEE (lead, mercury, cadmium and arsenic mainly)
- Cause neurological impairments, anaemia, kidney failure, immunosuppression, gastrointestinal and respiratory irritation, abnormalities of skeletal system, inflammation of liver, cancer of liver
- Volatile organic compounds are also present. Inhaling certain VOCs can lead to eye, nose, and throat irritation, headache, loss of coordination, nausea, and damage to liver, kidney, and central nervous system.

# Priority substances in leachate associated with health risks

- Aniline
- Arsenic
- Pentachlorophenol
- Naphthalene
- Polycyclic aromatic hydrocarbons
- Toluene



## Is leachate generation a problem?

- Leachate in well run sanitary landfills - discharged following treatment in an on-site process, and/or at an off-site sewage works.
- Use of landfill liners - very effective in containing leachate and only a tiny amount of leachate might be released via the landfill lining system to land or groundwater
- Continuous monitoring procedures - identify leakages
- Leachate releases from modern landfills to surface or groundwater are unlikely to pose a significant risk of adverse effects on health.

(Source: EA (environment Agency), updating the landfill leachate Pollution Inventory Tool. - Technical report , 2003 U.K)

# Identifying sources of POPs and UPOPs emissions and Hazardous Waste

- WEEE contains several persistent, bio accumulative and toxic substances such as lead, nickel, chromium, mercury and persistent organic pollutants.
- The open burning of plastic coatings from electric cable and wiring from WEEE releases PCDD/ PCDF, PAHs, Hydrogen chloride, heavy metals, CO, Sulphur dioxide, ash, etc.
- These contaminants usually find their way into the air, water and soil.

# Some environmental contaminants and their typical concentrations in WEEE

Contaminant	Relationship with WEEE	Typical WEEE concentration (mg/kg)
Polybrominated diphenyl ethers (PBDEs) polybrominated biphenyls (PBBs) tetrabromobisphenol-A (TBBPA)	Flame retardants	
Polychlorinated biphenyls (PCB)	Condensers, transformers	14
Polychlorinated dibenzo-p-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs)	Product of low-temperature combustion of PVCs and other plastics	
Antimony (Sb)	Flame retardants, plastics (Ernst et al., (2003))	1700
Cadmium (Cd)	batteries, tonners, plastics	180
Chromium (Cr)	data tapes and floppy disks	9900
Nickel (Ni)	batteries	10,300
Mercury (Hg)	Fluorescent lamps, batteries, switches	0.68
Lead (Pb)	Solder (Kang and Schoenung, (2005))	2900

(adapted from Brett H. Robinson, e-waste: An assessment of global production and environmental impacts, Science of the Total Environment 408 (2009) 183–191)

# Lead Acid Batteries- Chemical composition

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<u>Component</u>	<u>wt %</u>
<b>Lead (alloy) components (grid, poles, etc.)</b>	25-30
<b>Electrode paste (fine particles of lead oxide and lead sulphate)</b>	35-45
<b>Sulphuric acid (10-20%)</b>	10-15
<b>Polypropylene</b>	5-8
<b>Other plastics (PVC, PE, etc.)</b>	4-7
<b>Ebonite</b>	1-3
<b>Other Materials (glass etc.)</b>	<0.5

## Used Oil

Contain heavy metals such as antimony, chromium , nickel, cadmium, and copper. The presence of copper and chromium are known to catalyse PCDD/PCDF formation.

Pollutant type	Examples	Origin
Polynuclear aromatic hydrocarbons		Petroleum - Base Lubricant
Mononuclear aromatic hydrocarbons	Alkyl benzene	Petroleum - Base Lubricant
Dinuclear aromatic hydrocarbons	Naphthalene	Petroleum - Base Lubricant
Chlorinated Hydrocarbons	Trichlorethane	Use of contaminated oil
Metals	Barium Aluminium Zinc Chromium Copper	In additives In Engines

# Oil & Fuel Storage Facilities

The most common hazardous wastes at Oil & Fuel Storage facilities are:

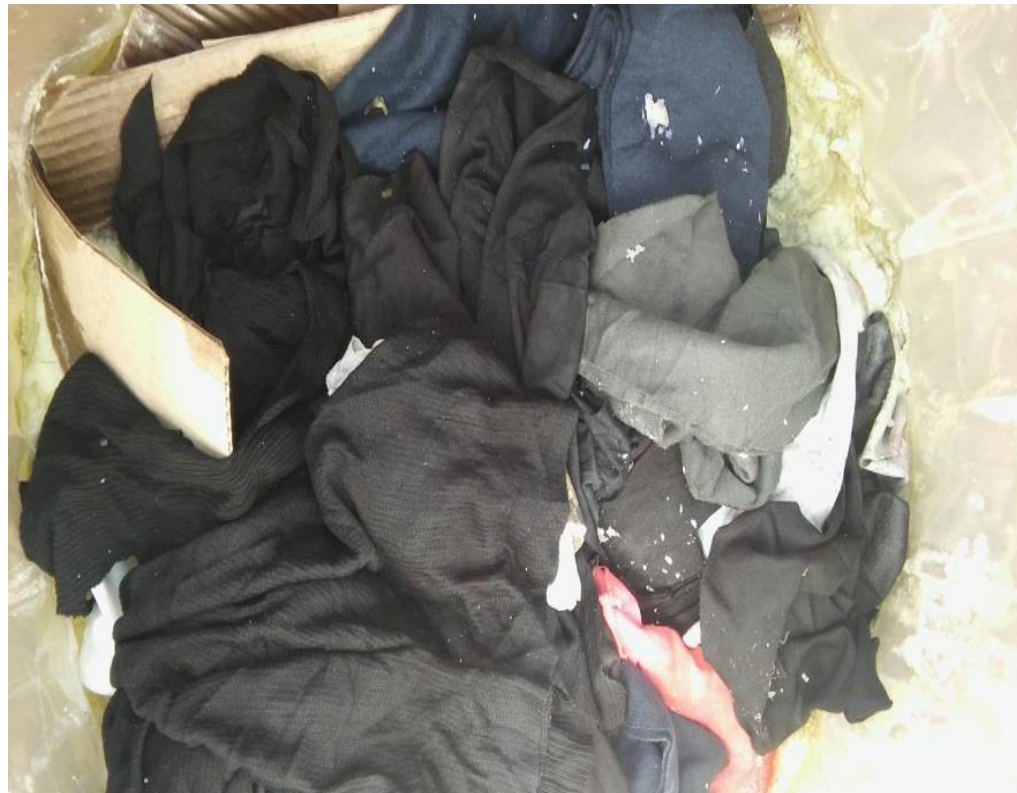
- Contaminated absorbent materials
- Sludges from tank cleaning
- Empty contaminated packaging
- Oily waters
- Laboratory Chemicals
- Sludges from ducts cleaning
- Additives etc.



RWA, 2019

# Rags / Absorbent Materials/Used PPE

Workshops, Metal Industries, Oil Storage Facilities,  
Laboratories



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# Laboratories

The most common hazardous wastes in Chemical Laboratories:

- Expired Chemicals
- Aqueous Solutions from Analyses
- Contaminated PPE
- Absorbent Materials / Filters





## Medical wastes

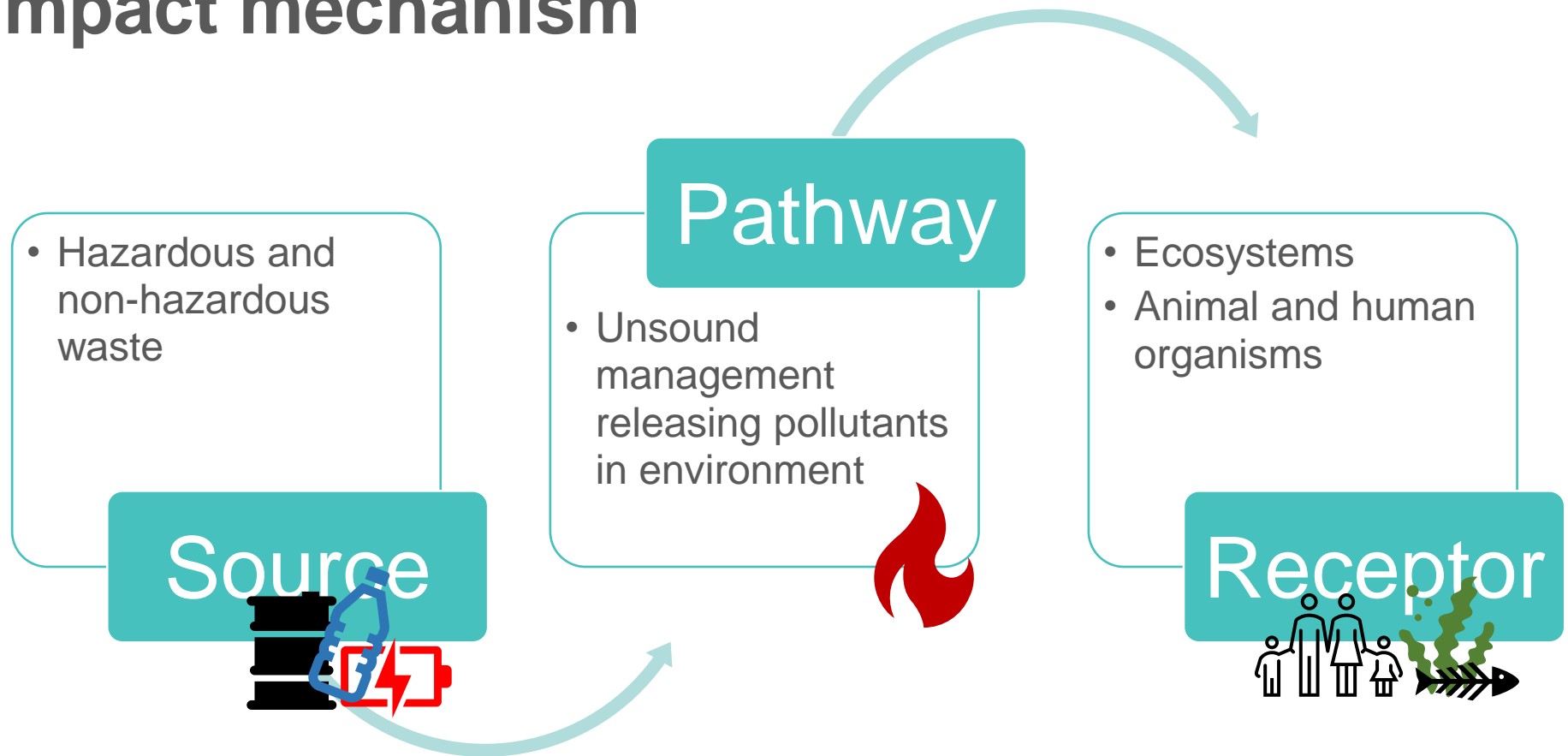
- Hazardous due to: physical, chemical, radiological and/or microbiological risks.
- May cause intoxication (acute/chronic exposure) and injuries (cuts and/or punctures, burns)
- Many of the chemicals and pharmaceuticals used in health-care establishments are hazardous (e.g. toxic, genotoxic, corrosive, flammable, reactive, explosive, shock-sensitive).
- These substances are commonly present in small quantities in medical waste; larger quantities may be found when unwanted or outdated chemicals and pharmaceuticals are disposed of.
- Medical textiles can contain flame retardants or other constituents which release UPOPs when burnt

# Soil contamination from tyre fire



RWA, 2019

# Impact mechanism



- POPs and UPOPs can be prevented from reaching ecosystems and living organisms either through preventing their occurrence or eliminating the pathways through which they reach receptors.
- Sound waste management practices are needed to eliminate this pathway, through waste prevention, source segregation and sound treatment and disposal.