# 1. INTRODUCTION

## A. What is E-waste?

**Electrical and Electronic Equipment (EEE) contains all products and parts that run on a power or battery supply. Upon being discarded by its owner, EEE becomes e-waste, which contains both valuable and hazardous materials** [1].

EEE is a term used to define the wide variety of products having circuitry or electrical and electronic components that need a power or battery supply in order to perform their functions. EEE includes almost any such products available in households and businesses – including laptops, mobile phones, fridges, washing machines, dishwashers, cooking and kitchen appliances, many toys, servers, and musical instruments. The use of EEE is increasing rapidly alongside societies' general development and the rapid development of information and communications technology (ICT), and EEE is spreading quickly in emerging sectors such as electric transport, clean energy production, and smart cities, which base their services on EEE and sensors.

***E-waste are discarded products or components that need a power or battery supply in order to perform their functions.***

When an EEE item is discarded, it becomes Waste Electrical and Electronic Equipment (WEEE), also known as electronic waste, or e-waste. According to the StEP (Solving the E-waste Problem) Initiative, e-waste is: 'a term used to cover items of all types of EEE and its parts that have been discarded by the owner as waste without the intention of reuse' [1]. The International Telecommunication Union (ITU) and the legally binding definition of the Basel Convention also define e-waste or WEEE as 'electrical or electronic equipment that is waste, including all components, sub-assemblies, and consumables that are part of the equipment at the time the equipment becomes waste'[4].

Each type of e-waste has a specific size, hazardous components, and valuable materials that affect the way it must be formally collected, treated, recycled, or disposed of in an environmentally sound manner (ESM).



[4] Recommendation ITU-T L.1031/L.1032 and Technical guidelines on transboundary movements of electrical and electronic waste and used electrical and electronic equipment, especially regarding the distinction between waste and non-waste under the Basel Convention (2014).

**E-waste encompasses a wide variety of discarded products and is categorised into six main categories.**

E-waste can be categorised in different ways, including by product type or size. The European Union's WEEE Directive and the 'E-waste Statistics Standards Guidelines' [2] use a treatment-oriented categorisation, with six main categories, as follows:

1. **Temperature exchange equipment**, including fridges, freezers, air conditioners, and heat pumps.

2. **Screens and monitors**, comprising liquid crystal display (LCD) and light-emitting diode (LED) televisions and monitors, laptops, and tablets.

3. **Lamps**, including LED lamps, high-intensity discharge lamps, and compact and straight tube fluorescent lamps.

4. **Large equipment**, including products such as dishwashers, washing machines, ovens and central heating systems, large printing systems, and photovoltaic panels.

5. **Small equipment**, comprising microwaves, grills and toasters, personal care products, speakers, cameras, audio sets and headphones, toys, household tools, and medical and monitoring systems.

6. **Small IT and Telecommunication equipment**, including desktop personal computers, printers, mobile phones, cordless phones, keyboards, routers, and consoles.

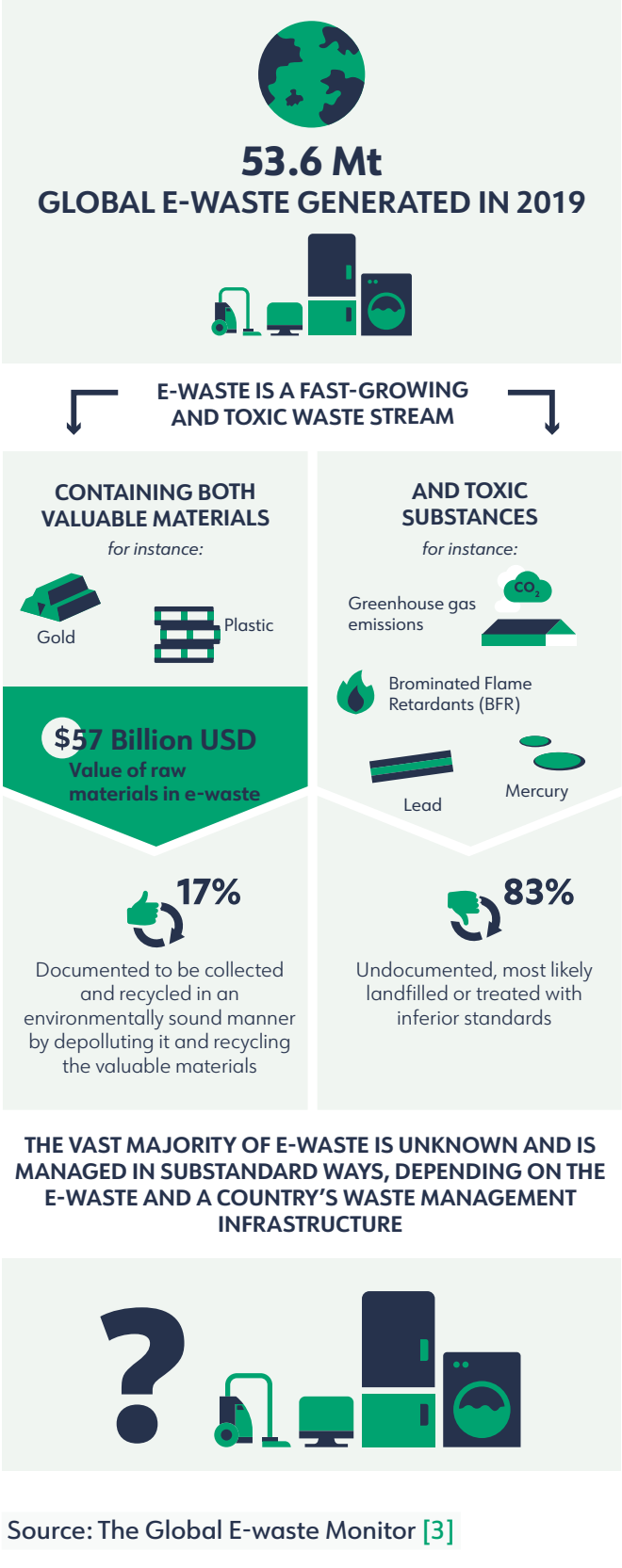
## B. E -waste: An International Issue

**E-waste is one of the fastest-growing waste streams. Globally, only 17 percent is officially collected and recycled, wasting valuable materials and causing damage to the environment** [3].

EEE, including equipment used for information and communication technology services, offers good opportunities for the world's development, guaranteeing higher living standards and satisfying numerous needs. However, discarded equipment – such as phones, laptops, sensors, TVs, washings machines, air conditioners, refrigerators, and many other items that contain harmful substances – poses considerable risks to human health and the environment, especially when managed improperly.

*The Global E-waste Monitor* (2020) highlighted that a record 53.6 million metric tonnes (Mt) of e-waste were generated in 2019 – an increase of 21 percent since 2014 [3]. This increase is linked to the growing number of people using EEE worldwide as well as to a constant technological development and the phasing out of old technologies – i.e. shorter product lifecycle and designs that do not support repair or reuse. Only 17 percent is reportedly formally collected and recycled in an environmentally sound manner. The majority of e-waste that is not recycled or disposed of in an environmentally sound manner usually ends up in landfills, mixed with other waste streams. Consequently, valuable resources, such as precious metals and rare earth elements, are wasted, and hazardous substances are released into the environment in ways that pose risks to human health and the environment.

**Managing e-waste requires specific legislation and collection infrastructure and generally is poorly regulated and enforced globally.**




Source: The Global E-waste Monitor [3]

As a complex and relatively recent waste stream, countries need to introduce specific legislation to enforce sound environmental treatment and management of e-waste. In 2019, 78 countries (comprising 71 percent of the global population) were covered by a legislation, policy, or regulation on e-waste, which is a significant development from the 67 countries (66 percent of the population) identified in 2017. Nevertheless, in most cases, policies are neither legally binding nor appropriately supported financially, which has been found to be less compelling for ensuring their implementation and compliance. Also, most legislative instruments concentrate on improving e-waste management, but neither the reduction of the volumes of e-waste generated nor management practices, such as repair and reuse of EEE, have yet been properly examined.

**E-waste management is monitored in the United Nations' Sustainable Development Goals under SDG 12 on Sustainable Consumption and Production.**

In 2015, the United Nations Member States adopted the 2030 Agenda for Sustainable Development. This agenda included the 17 Sustainable Development Goals (SDGs) and 169 targets for ending poverty, protecting the planet, and ensuring prosperity for all people over a 15-year span. Increasing e-waste generation and adopting improper and unsafe treatment and disposal approaches pose significant challenges to human health and the environment, as well as to the achievement of the SDGs. E-waste management is closely related to many SDGs, such as SDG 8 on decent work and economic growth, SDG 3 on good health and well-being, SDG 6 on clean water and sanitation, and SDG 14 on life below water. Considering the high raw material demand for EEE production, e-waste also relates to the SDG indicators on the material footprint (SDGs 8.4.1 and 12.1.1) and the SDGs on the domestic material consumption (SDGs 8.4.2 and 12.2.2). Consequently, e-waste remains a global challenge because of its increasing generation worldwide and because the proper treatment and prevention of its overall generation requires active engagement of a diverse set of actors, sometimes going beyond national borders. As such, the management of e-waste is monitored in SDG 12 on responsible consumption and production, under indicator 12.5.1 (national recycling rate) and indicator 12.4.2 on hazardous waste generation, which has a specifically defined sub-indicator [3], [4][5].


ITU's Connect 2030 Agenda set targets of increasing the global e-waste recycling rate to 30 percent (Target 3.2) and raising the number of countries with e-waste legislation to 50 percent by 2023 (Target 3.3)[5] .



[5] ITU's Connect 2030 Agenda (PP-18 Resolution 200, Rev. Dubai, 2018) https://www.itu.int/en/mediacentre/backgrounders/Pages/connect-2030-agenda.aspx.

## C. POP Management: An International Issue

Persistent Organic Pollutants (POPs) are organic compounds that are resistant to environmental degradation through chemical, biological, and photolytic processes [5]. They are primarily products and by-products resulting from industrial processes, chemical manufacturing, and the wastes resulting from such processes and manufacturing. POPs are intentionally produced (e.g. pesticides) or unintentionally released from incomplete combustion or reaction processes.

POPs pose a particular hazard, due to four of their characteristics: (1) they are toxic, (2) they are persistent, resisting normal processes that break down contaminants, (3) they accumulate in the body fat of people, marine mammals, and other animals and are passed from mother to foetus, and (4) they can travel great distances on wind and water currents. Most POPs generated in one country easily cross national boundaries, affecting people and wildlife far from where they are used and released, including those where POPs have never been used – thus presenting a transboundary problem. Today, POPs are found almost everywhere: in our food, soil, air, and water. Wildlife and humans around the world carry amounts or traces of POPs in their bodies at or near levels that can cause injury. Specific effects of POPs can include cancer, allergies and hypersensitivity, damage to the central and peripheral nervous systems, reproductive disorders, and disruption of the immune system. Some POPs are also considered to be endocrine disrupters, which can damage the reproductive and immune systems of exposed individuals as well as their offspring by altering the hormonal system; they can also have developmental and carcinogenic effects[6]. Though POPs have been in use for decades, the world has only recently learned of their deadly qualities. Armed with knowledge regarding the dangers of POPs, many countries have since begun limiting or banning their production, use, and release.

The effort by many countries of limiting or banning POP production and use culminated in the Stockholm Convention on Persistent Organic Pollutants. More than 180 countries are signatories to the Convention and have agreed to eliminate or reduce the release of POPs into the environment[7]. The Stockholm Convention is an international treaty for protecting human health and the environment from POPs. The Convention was adopted in 2001 and entered into force in 2004, initially covering 12 chemicals [5]. The 12 POPs include eight pesticides (aldrin, chlordane, DDT, dieldrin, endrin, heptachlor, mirex, and toxaphene), two types of industrial chemicals (polychlorinated biphenyls or PCBs and hexachlorobenzene), and two chemical families of unintended by-products of the manufacture, use, and/or combustion of chlorine and chlorine-containing materials (dioxins and furans). Currently, 16 additional POPs have been added by 181 Parties (as of 2017) to the Stockholm Convention [6].

The Basel, Rotterdam, and Stockholm Conventions (which entered into force in May 1992, February 2004, and May 2004, respectively) focus on protecting human health and the environment from hazardous chemicals and waste, including POPs. Specifically, the Stockholm Convention commits all Parties to eliminate or restrict the production, trade, use, and waste of specific POPs. The Stockholm Convention on Persistent Organic Pollutants aims to phase out and eliminate the production and use of these chemicals, as well as new ones that could be added over time.

All 13 countries included in this Regional E-waste Monitor have completed ratification, acceptance, approval, or accession to the convention. The National Implementation Plan requires each Party to develop a policy framework for effective management of POPs [7].



[6] http://www.pops.int/TheConvention/ThePOPs/tabid/673/Default.aspx.
[7] https://www.thegef.org/topics/persistent-organic-pollutants.

E-waste may contain POPs such as PCBs, polybrominated diphenyl ethers (PBDEs), and other halogenated flame retardants. Brominated flame retardants (BFRs), like all flame retardants (FRs), act to decrease the risk of fire by increasing the fire resistance of the materials to which they are applied (e.g. e-waste plastics). Approximately 25% of e-waste (by weight) consists of plastics in the form of various polymers (mainly acrylonitrile butadiene styrene [ABS], polypropylene [PP], and polystyrene) [21]. However, such plastics contain a wide range of additives, such as flame retardants, fillers, pigments, and stabilisers, which collectively impact the recycling of e-waste plastics. Restricted BFRs (e.g. Octa-BDE and Deca-BDE) represent only a small and rapidly declining fraction of all BFRs found in e-waste plastic streams, reflecting the restrictions on use of these substances that have now been in place for more than a decade (2003 for Octa-BDE, 2008 for Deca-BDE). One of the challenges encountered by e-waste plastic recyclers is the presence in their input of legacy additives – substances added into EEE plastics in the past but whose use has been discontinued (voluntarily or by law), due to concerns regarding human and environmental health. Such additives include low molecular weight phthalates (such as DEHP, BBP, DBP, and DIBP, used as plasticisers), heavy metals (such as lead and cadmium compounds, used as stabilisers), and some brominated flame retardants (BFRs, such as octaBDE and decaBDE, used in external housings, and HBCD, used in foams). Plastics containing BFRs have to be removed during the treatment process of e-waste so that they do not end up in recyclables [21].

However, due to their potential to form POPs (e.g. polybrominated dioxins and furans, PBDD/F) during processing, the use of certain BFRs (POPs-BFRs) is being restricted.

These 28 compounds, or group of compounds, are listed as POPs under the Stockholm Convention, either in Annex A (Elimination), Annex B (Restriction), or Annex C (Unintentional production). Annex A includes 5 BFR compounds, referred to as POP-BFRs:

- Hexabromobiphenyl (hexaBB), listed in 2009.
- Commercial pentabromodiphenyl ether (c-pentaBDE, consisting mainly of tetraBDE and pentaBDE), listed in 2009.
- Commercial octabromodiphenyl ether (c-octaBDE, consisting mainly of hexaBDE and heptaBDE), listed in 2009.
- Hexabromocyclododecane (HBCD), listed in 2013
- Commercial decabromodiphenyl ether (c-decaBDE consisting mainly of decaBDE), listed in 2017.

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***1) They are toxic.***
***2) They are persistent, resisting normal processes that break down contaminants.***
***3) They accumulate in the body fat of people, marine mammals, and other animals and are passed from mother to foetus.***
***4) They can travel great distances on wind and water currents.***

## D. Framework Condition for the LATAM Countries

**This report covers 13 Latin American (LATAM) countries located in Central and South America.**

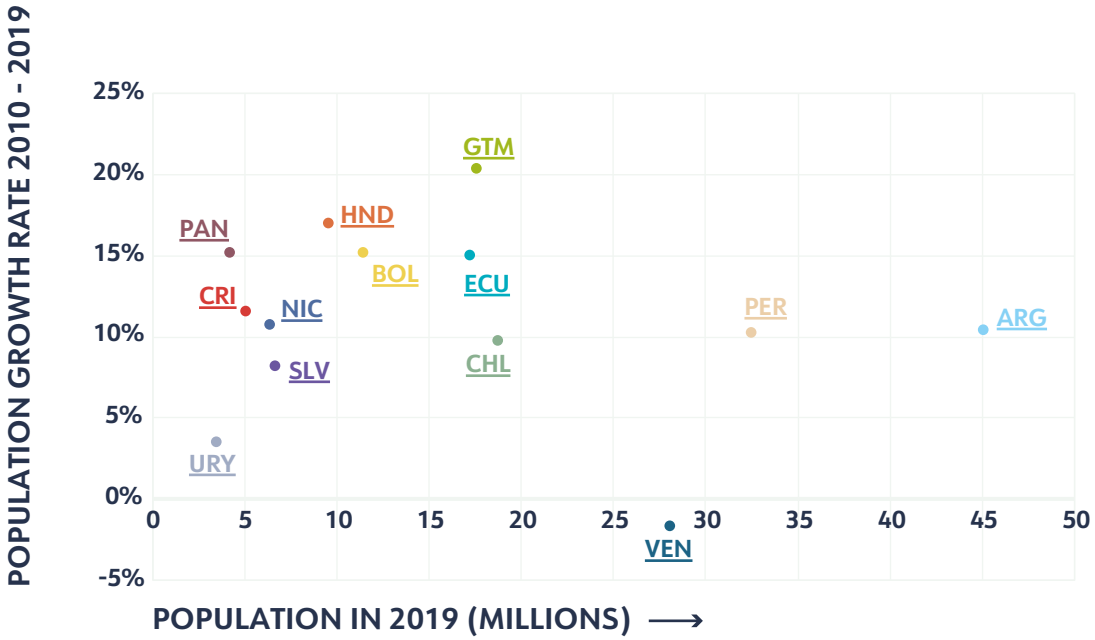
The countries in the scope of the Regional E-waste Monitor for Latin- America are: Argentina (ARG) Bolivia (Plurinational State of, BOL), Chile (CHL), Costa Rica (CRI), Ecuador (ECU), Guatemala (GTM), Honduras (HND), Nicaragua (NIC), Panama (PAN), Peru (PER), El Salvador (SLV), Uruguay (UGY), and Venezuela (Bolivarian Republic of, VEN).

**The 13 countries have 206.1 million inhabitants (inh), collectively, the most populous country being Argentina (45.1 million inh) and the least populous being Uruguay (3.5 million inh). The average population growth of the 13 countries from 2010 to 2019 was 10 percent.**

***The LATAM countries have 206.1 million inhabitants (2019).***

In terms of demographics, the 13 countries have, collectively, 206.1 million inh (2019). As of 2019, the most populous country is Argentina with 45.1 million inh, followed by Peru (32.5 million inh) and Venezuela (Bolivarian Republic of) (28.1 million inh) (Figure 1). The population growth rate for the 13 countries between 2010 and 2019 averaged 10 percent. Between 2010 and 2019, Guatemala's population growth rate was 20 percent, followed by Honduras (17 percent), then Bolivia (Plurinational State of), Panama, and Ecuador (15 percent each), while Uruguay had the smallest growth (4 percent). All countries' populations grew, except for Venezuela's (Bolivarian Republic of); the Venezuelan population decreased, as more than 5 million people emigrated due to economic and political crises domestically, with about 80 percent of them residing in other Latin American countries[8].

Figure 1. Demographic overview of the region [8]



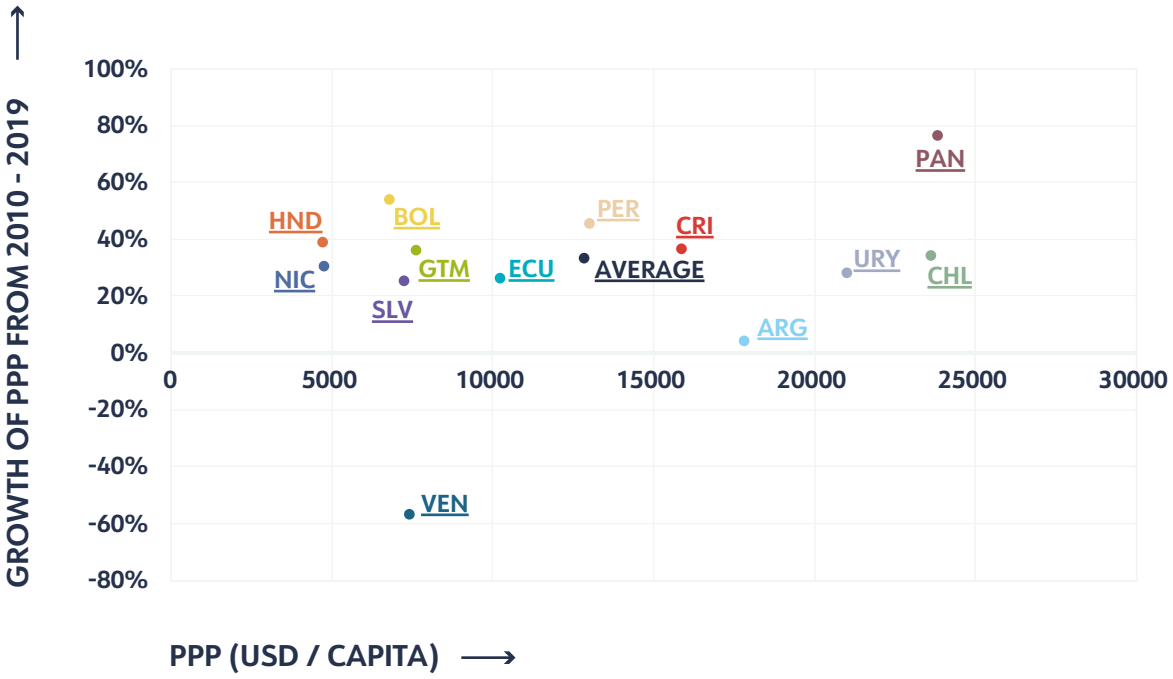



[8] https://www.worldbank.org/en/programs/world-bank-support-to-the-venezuelan-migration#:~:text=World%20Bank%20Support%20to%20Venezuelan,host%20countries%20to%20integrate%20migrants.

**The difference in economic power per inhabitant is large across the countries studied, but nearly the entire population has access to electricity and internet. Between 1-4 percent of the populations of Venezuela (Bolivarian Republic of), Costa Rica, Ecuador, Nicaragua, El Salvador, Panama, and Peru are below the poverty line ($1.90 a day), while 9 percent of Guatemala and 16 percent of Honduras live below the poverty line.**

In terms of socioeconomic development, the countries have a very wide range of product purchasing power parity (PPP)[9], ranging from $5,000 USD/year in Honduras and Nicaragua to $24,000 USD/year in Panama and Chile (Figure 2). All countries except Venezuela (Bolivarian Republic of) show a growth of PPP. According to the World Bank classification, three countries are high-income countries (Chile, Panama, Uruguay)[10], six are upper middle-income countries (Argentina, Costa Rica, Ecuador, Guatemala, Peru, and Venezuela - Bolivarian Republic of), and four are lower middle-income countries (Bolivia - Plurinational State of, El Salvador, Honduras, and Nicaragua). As for poverty, available data for 2014 shows that only seven of the countries (Venezuela - Bolivarian Republic of, Costa Rica, Ecuador, Nicaragua, El Salvador, Panama, and Peru) have between 1 and 4 percent of the population living below poverty line ($1.90 a day), while 9 percent of Guatemala and 16 percent of Honduras live below the poverty line. In 2017, not all of the population in some countries studied have access to electricity. For example, in Costa Rica, 99 percent of the population have access to electricity; in Bolivia (Plurinational State of), 96.3 percent[11]; Guatemala, 93 percent; Honduras, 87 percent; Peru, 84 percent; and Nicaragua, 68 percent. By contrast, 100 percent of the population in Argentina, Chile, Ecuador, El Salvador, Panama, Uruguay, and Venezuela (Bolivarian Republic of) have access to electricity (not shown).

Figure 2. Economic overview of the region showing the purchasing power parity in USD/capita in 2019 (x-axis), the total PPP growth rate from 2010 to 2019 (y-axis, bottom), and the share of the population with access to electricity (top) [8]






[9] The purchasing power parity (PPP) is an economic indicator that allows for comparing economic productivity and standards of living between different countries and locations. PPP can be used to adjust the gross domestic product (GDP). [10] High income | Data (worldbank.org). [11] Access to electricity (% of population) - Latin America & Caribbean | Data (worldbank.org).

## E. Background to the Report

Though some assessments, projects, and initiatives on e-waste have been undertaken in recent years, a comprehensive overview and analysis of the e-waste and POPs contained in the e-waste plastic situation in the Latin-American region is still lacking. This report strives to fill the gap by presenting the past and current e-waste situation and POPs contained in e-waste plastics managed in the 13 countries under the scope of the PREAL project. This LATAM Regional E-waste Monitor presents an overview of the regional e-waste status and has been prepared through a collaboration with governments, national statistical offices, and countries' independent experts. This overview allows for international comparisons and contributes to the development of more effective e-waste as well as appropriate POP management systems in the region.

Within the regional effort toward strengthening the National Initiatives and Enhancement of Regional Cooperation for the ESM of POPs in Waste Electronic or Electrical Equipment (E-waste) in Latin-American countries, the United Nations Industrial Development Organization (UNIDO) partnered with the United Nations University (UNU), Vice-Rectorate in Europe (ViE), and Sustainable Cycles (SCYCLE) Programme (UNU-ViE SCYCLE) to implement the *Regional E-waste Monitor for Latin America: Results for the 13 countries participating in project UNIDO-GEF 5554* (known primarily as the PREAL project), which is focused on building regional capacity on e-waste statistics for government officials and statisticians and improving e-waste data and statistics in the region. Within the LATAM Regional E-waste Monitor, special focus will be given to plastics, especially those containing POPs, to provide data and information required for establishing 'custom-made' e-waste management systems.

Specifically, this study reviews the current situation of e-waste and POP legislation and management in the 13 countries analysed in this report. It also analyses the trend in transboundary movement (TBM) of e-waste within and out of these countries and provides a periodic monitoring on formally collected e-waste and POP statistics information for these materials and understudies efforts at ESM of these materials.