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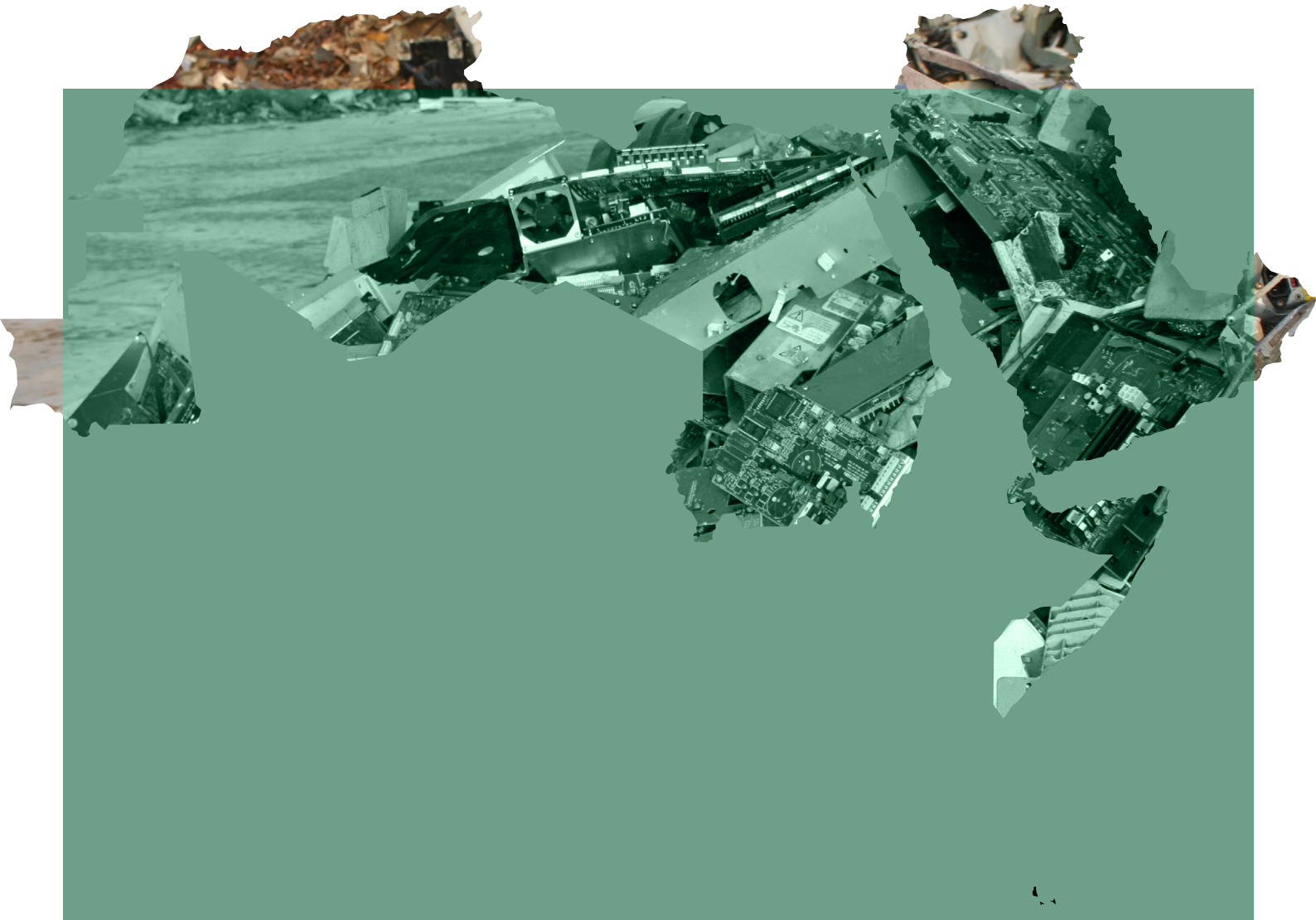
REGIONAL E-WASTE MONITOR

for the Arab States

2021



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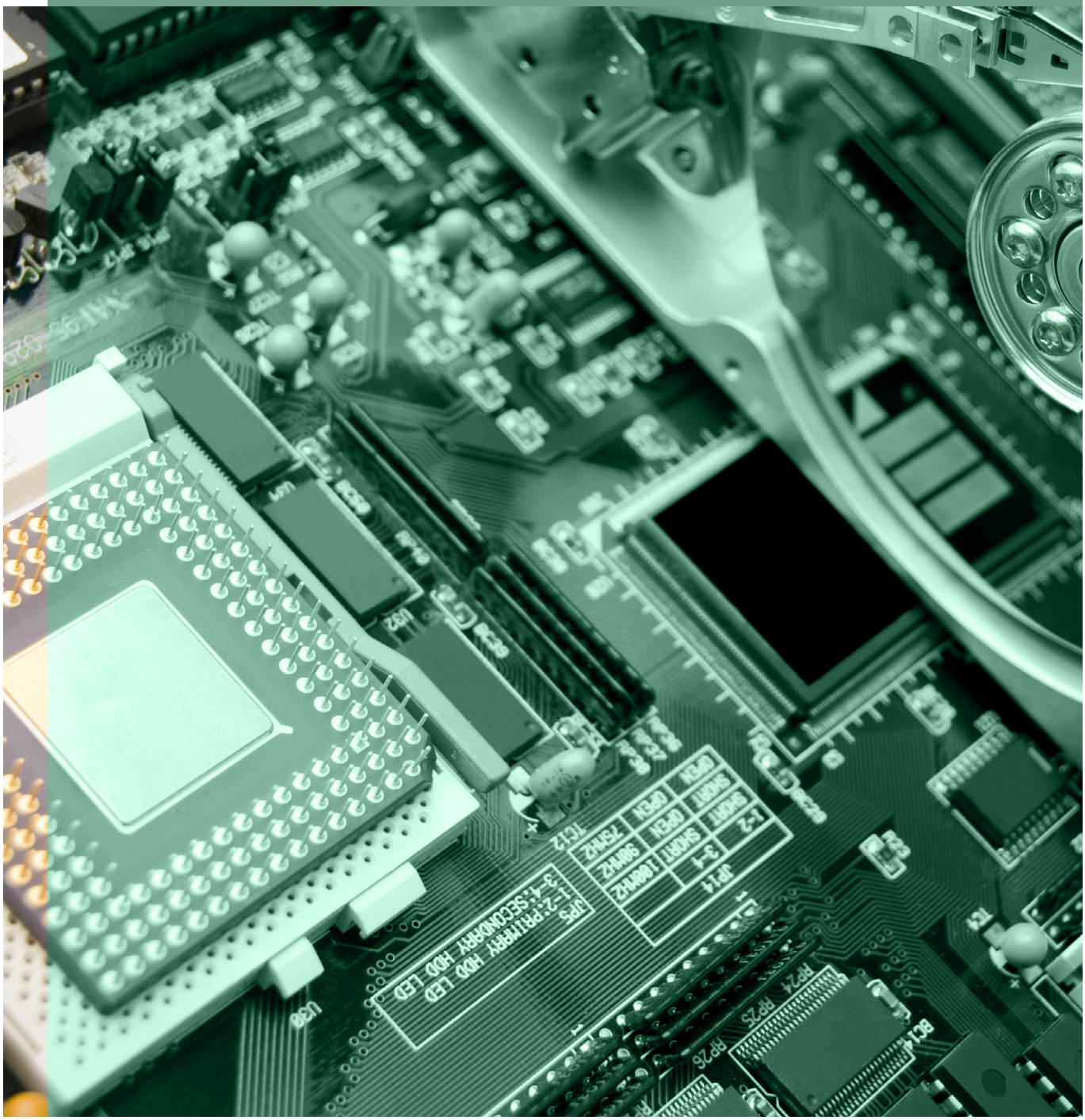
JP1:1-2:PRIMARY HDD LED
3-4:SECONDARY HDD LED
JP14
1-2
3-4
OPEN
SHORT
100MHZ
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EXECUTIVE SUMMARY

E-waste constitutes one of the fastest growing streams of physical waste in the global environment and is a threat to sustainable development. Data on e-waste are required to evaluate developments over time, delineate national and international policies, limit e-waste generation, prevent illegal dumping, promote recycling and create jobs in the recycling sectors. However, few countries collect internationally comparable e-waste statistics, and many countries lack the capacity to collect e-waste data at both regional and national level.

Within the framework of the International Telecommunication Union (ITU) Arab Regional Initiative on environment, climate change and emergency telecommunications and the Global E-waste Statistics Partnership of the United Nations University (UNU), the United Nations Institute for Training and Research (UNITAR) and ITU, the *Regional E-waste Monitor for the Arab States 2021* is the first monitoring effort in the region in relation to e-waste statistics, legislation and e-waste management infrastructure. Its purpose is to enhance the understanding and interpretation of regional e-waste data, with the goal of facilitating environmentally sound management of e-waste.

The key statistical findings for the region are that electrical and electronic equipment (EEE) placed on the market (POM) increased by 30 per cent from 3.2 megatons (Mt), or 8.8 kilograms per inhabitant (kg/inh), in 2010 to 4.1 Mt (or 9.5 kg/inh) in 2019. The Arab States mostly import, rather than manufacture, EEE; the domestic generation of EEE is therefore very limited, and they rely on imports of EEE POM. Over the same period of time, e waste generation in the region increased by 61 per cent from 1.8 Mt (4.9 kg/inh) in 2010 to 2.8 Mt (6.6 kg/inh) in 2019. The largest e-waste generator is Saudi Arabia, with 595 kilotons (kt) (or 13.2 kg/inh) of e-waste, while the lowest is Comoros (0.6 kt, or 0.7 kg/inh), which reflects the vast diversity of the region.

The e-waste generated encompasses a variety of products, with small equipment (category 5 in EU Directive 2012/19/EU, on waste electrical and electronic equipment, also known as the WEEE Directive), temperature exchange equipment (category 1) and large equipment (category 4) comprising the highest share of e-waste generated, for a total of 76 per cent. The annual growth rate is positive for all categories of e-waste, with the exception of screens and monitors (category 2), which shows negative growth rates. Nevertheless, a declining trend has been observed, meaning that the pace of growth has slowed over time for most products.

From the information gathered, the Arab States appear to have collected and managed a total of 2.2 kt (0.01 kg/inh) of e-waste in 2019, which equates to a collection rate of 0.1 per cent, compared to e-waste generated. However, it is worth highlighting that data on e-waste collection and on environmentally sound management (ESM) was available for only four Arab States. E-waste collection for ESM takes place in Jordan, the State of Palestine[1], Qatar and the United Arab Emirates. Jordan has the highest e-waste collection rate of 2.6 per cent (equivalent to 0.1 kg/inh), followed by Qatar (0.5 per cent, or 0.07 kg/inh). Egypt has seven licensed treatment facilities for e-waste, but it was unable to provide official data on the amount of e-waste collected and managed. Some other countries in the region have limited initiatives for e-waste collection that are implemented by various formal and informal actors, but quantitative information was not available owing to lack of organized, separate collection infrastructure for e-waste and/or the absence of official data.

Since 2010, e-waste generation has increased in the Arab States by 61 per cent – to 2.8 Mt in 2019. The collection rate of e-waste is 0.1 per cent in 2019.

[1] See Resolution 99 (Rev. Dubai, 2018) on the status of Palestine in ITU.

No specific e-waste legislation is in place in any State in the region. Of the countries that took part in the broader review (i.e. Algeria, Egypt, Jordan, Lebanon, Oman, Qatar, Saudi Arabia, Sudan and the United Arab Emirates along with the State of Palestine), 10 have well-developed legal and regulatory frameworks in the field of waste management and/or more specifically on hazardous waste, which should also apply to e-waste. In the States that do not have a comprehensive law on general waste (e.g. Mauritania), all e-waste and other hazardous waste is treated alongside municipal waste. The United Arab Emirates is the only country in the region that, as of 2021, applies the principle of extended producer responsibility (EPR) for e-waste and batteries waste, and Jordan and Lebanon are in the process of establishing an EPR system for e-waste. Egypt, Jordan, Lebanon and the United Arab Emirates have adopted legislation or regulations on ESM for waste, but none specifically for e-waste. In most countries, the Ministry of Environment is the custodian government entity for legislating on e-waste. Municipalities and other waste management authorities, as well as private companies and non-governmental organizations (NGOs), collect e-waste for further management, mostly landfilling. Producers and importers play a minimal role in e-waste collection in the region, owing to the overall absence of an EPR system. Informal operators of e-waste also exist in the region and focus on valuable e-waste fractions.

An extended producer responsibility legislation on e-waste has been adopted in one country in the region.

All the Member States of the Arab States region have ratified the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, which sets out formal provisions to govern the transboundary movement of e-waste. Specific national bans on e-waste imports are enforced in some Arab States, including Algeria, Egypt, Kuwait, Lebanon, the State of Palestine, Qatar and the United Arab Emirates. No country in the region has a specific export ban in place, except where the type of e-waste in question is not compliant with the Basel Convention. Kuwait and Qatar, for instance, allow the export of e-waste under

Basel Convention conditions only if there is no plant for recycling or treating waste of that kind within the country.

Only thirteen countries in the region fulfil their formal statistical reporting obligations under the Basel Convention. These statistics therefore do not provide a complete picture of the transboundary movement of e-waste. According to existing reports, between 2016 and 2019, Algeria, Egypt, Qatar and the United Arab Emirates exported 1 645 tons of e-waste for resource recovery and recycling. No e-waste imports have been reported in national reports submitted under the Basel Convention by the Arab States. Low-quality data and a lack of control over the transboundary movement of e-waste in line with the Basel Convention pose a threat to ESM of e-waste and increase the likelihood of illegal movements. Furthermore, imports of used EEE result in more e-waste in recipient countries and place burdens on existing e-waste management. Meanwhile, the functionality of imported used EEE and, where mixed with e-waste, the quantities of imported used EEE remain unknown.

Managing e-waste presents an economic opportunity; in 2019, e-waste generated among Arab States contained an estimated 13 t of gold, 0.47 t of rare earth metals, 1.05 Mt of iron, 96 kt of copper, 167 kt of aluminium, and 0.7 kt of cobalt, representing a total value of USD 3 billion in secondary raw materials. Over 99 per cent of e-waste in the region is not collected or sent to ESM facilities for proper management. Most e-waste is sent to landfill, with the informal sector cherry-picking some valuable components. The hazardous substances in e-waste - comprising, for the region in 2019, at least 4.1 t of mercury, 1.3 t of cadmium, 10.5 kt of lead, 4 kt of brominated flame retardants and 5.6 Mt of greenhouse gas-equivalents from refrigerants — are poorly managed within the region and are most likely to be untreated, which poses various risks to the stability of a healthy environment.

Given the assessment of e-waste management, statistics and legislation and the existing challenges, it is evident that the changes that will need to be applied to improve existing e-waste management systems vary from country to country. Countries in the region will need to: a) introduce and enforce a robust legal and policy framework focused on ESM of e-waste; b) develop basic collection and treatment infrastructure, where absent; and c) monitor and reinforce existing e-waste management systems to make them more efficient and effective. Adequate financing, monitoring and cooperation among all stakeholders are essential to ensure that the implementation of policies on e-waste management is sustained. Five general recommendations, listed below, can be drawn from the analysis presented herein, and an all-encompassing approach, involving all actors and stakeholders in each country or territory, will be needed in order to implement them. A somewhat greater level of transnational cooperation will also be necessary to reduce the burden of large investments and secure the necessary turnaround. The five recommendations are: (i) prevent e-waste generation; (ii) adopt EPR-based legislation and policies; (iii) provide basic collection and treatment facilities; (iv) improve the collection and treatment of e-waste; and (v) raise awareness, pollute less and work safer.

E-waste generated in the Arab States represents a total value of USD 3 billion of secondary raw materials.

ABBREVIATIONS

EEE	Electrical and Electronic Equipment
EEE POM	Electrical and Electronic Equipment Placed On Market
EHS	Environmental Health and Safety
EPR	Extended Producer Responsibility
ESM	Environmentally Sound Management
EU	European Union
E-waste	Electronic Waste, also known as waste electrical and electronic equipment
kg	kilograms
kg/inh	kilograms per inhabitant
ISO	International Standard Organization
IT	Information Technology
ITU	International Telecommunication Union
kt	(metric) kiloton, or 1 million kilograms
LCD	Liquid Crystal Display
LED	Light-Emitting Diode
Mt	(metric) megaton, or 1 billion kilograms
NGO	Non-Governmental Organization
PCB	Polychlorinated Biphenyl
POM	Placed On the Market
PPP	Purchasing Power Parity
SDGs	Sustainable Development Goals
t	(metric) ton, or 1 000 kilograms
TBM	Transboundary Movement
UNITAR	United Nations Institute for Training and Research
UNU-ViE SCYCLE	United Nations University Vice-Rectorate in Europe Sustainable Cycles Programme
UNU-KEY	Product-based classification distinguishing 54 products, used to measure e-waste statistics
USD	United States dollar
WEEE	Waste Electrical and Electronic Equipment

ABBREVIATIONS OF THE ARAB STATES:

ISO Code	Official designation	Short-form designation
DZA	The People's Democratic Republic of Algeria	Algeria
BHR	The Kingdom of Bahrain	Bahrain
COM	The Union of the Comoros	Comoros
DJI	The Republic of Djibouti	Djibouti
EGY	The Arab Republic of Egypt	Egypt
IRQ	The Republic of Iraq	Iraq
JOR	The Hashemite Kingdom of Jordan	Jordan
KWT	The State of Kuwait	Kuwait
LBN	Lebanon	Lebanon
LBY	The State of Libya	Libya
MRT	The Islamic Republic of Mauritania	Mauritania
MAR	The Kingdom of Morocco	Morocco
OMN	The Sultanate of Oman	Oman
PSE	The State of Palestine	The State of Palestine*
QAT	The State of Qatar	Qatar
SAU	The Kingdom of Saudi Arabia	Saudi Arabia
SOM	The Federal Republic of Somalia	Somalia
SDN	The Republic of Sudan	Sudan
SYR	The Syrian Arab Republic	Syria
TUN	Tunisia	Tunisia
ARE	The United Arab Emirates (UAE)	The United Arab Emirates
YEM	The Republic of Yemen	Yemen

*See Resolution 99 (Rev. Dubai, 2018) on the status of Palestine in ITU.

1. INTRODUCTION

A. What is E-waste?

EEE is a term used to describe the wide variety of products that contain circuitry or electrical and electronic components that require a power or battery supply in order to perform their functions. Once EEE is discarded by its owner without the intention of reusing it, it becomes e-waste, which requires separate collection and treatment as it contains scarce, valuable and hazardous materials.

EEE, including ICTs, offer opportunities for development worldwide as they provide access to information for use in science, technology and innovation and foster regional and international cooperation and knowledge sharing that benefits productivity and economic development. EEE includes almost all products available for use in households and businesses, such as laptops, mobile telephones, refrigerators, washing machines, dishwashers and kitchen appliances, as well as toys, servers and musical instruments. Nowadays, even smart clothes and furniture contain electronic components. Over the past couple of decades, the production and use of EEE have increased tremendously, supporting the rapid development of many sectors, including ICT, electric vehicles, clean energy production, medicine and smart cities.

EEE includes a wide range of products with circuitry or electrical components with a power or battery supply. EEE becomes e-waste once it has been discarded by its owner as waste without the intent of reuse.

Once EEE is discarded by its owner without the intention of reusing it, it becomes waste EEE, also referred to as electronic waste or e-waste (Step Initiative 2014). ITU and the legally binding definition of the Basel Convention also defines 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"[(2)]. The way that each type of e-waste has to be collected, treated, disassembled, recycled and disposed of using ESM approaches is affected by the size of the waste and the hazardous components and scarce and valuable materials that it contains.

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

E-waste encompasses a wide variety of discarded products, which fall into six main categories. E-waste may be categorized in different ways, including by product type or size. EU Directive 2012/19/EU, on waste electrical and electronic equipment, (known as the WEEE Directive) and the guidelines on classification, reporting and indicators for e-waste statistics use a treatment-oriented categorization, with six main categories as shown below (Baldé et al. 2015; Forti, Baldé and Kuehr 2018):

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

2. Screens and monitors, comprising liquid crystal displays (LCDs) and light-emitting diodes (LEDs) used in televisions, monitors, laptops and tablets.

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

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

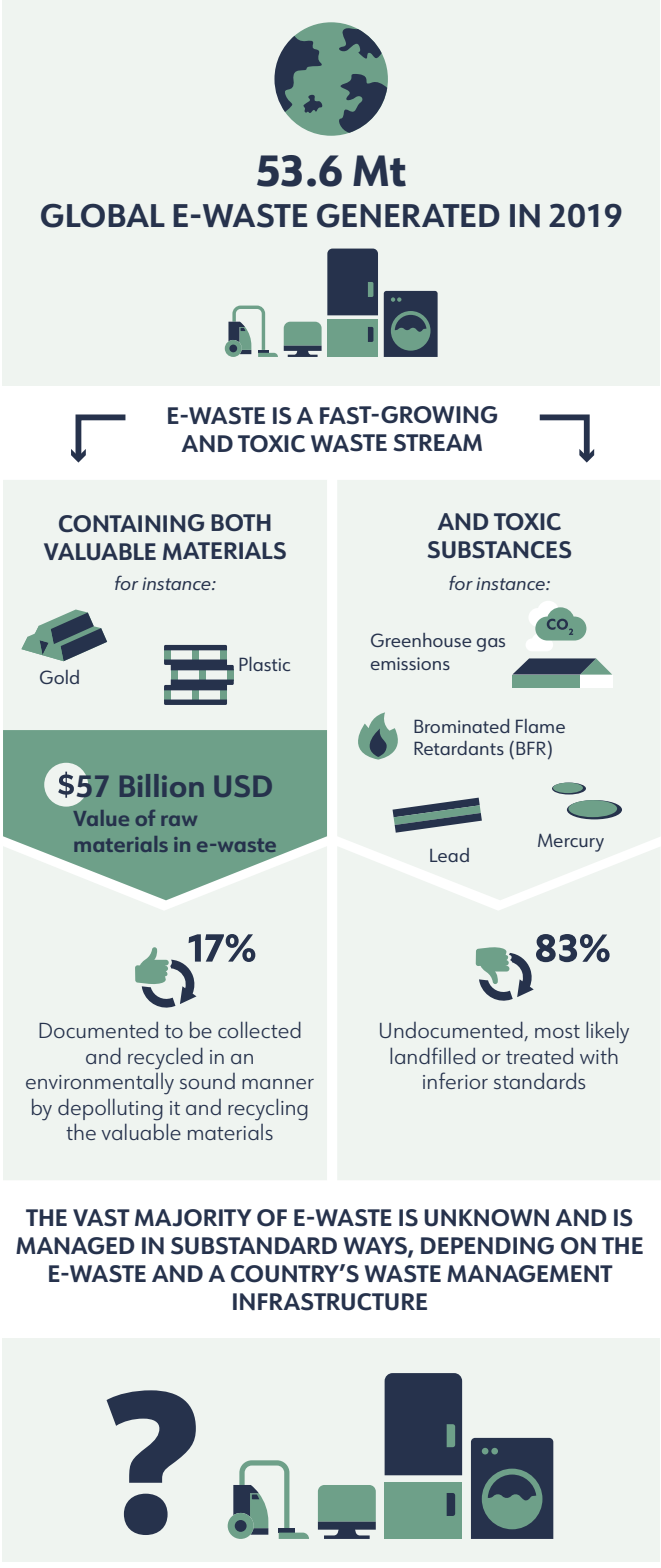
5. Small equipment, comprising microwaves, grills, toasters, personal care products, speakers, cameras, audio sets, headphones, toys, household tools, medical equipment and monitoring systems.

6. Small information technology (IT) and telecommunication equipment, including desktop personal computers, printers, mobile telephones, cordless telephones, keyboards, routers and consoles.

B. E-waste: An International Issue

E-waste constitutes one of the fastest growing streams of solid waste in the global environment. Only about 17 per cent of e-waste was documented as having been collected and recycled in 2019 (Forti et al. 2020). EEE, including equipment used for ICT services, offer opportunities for global development, guaranteeing higher living standards, improve medical treatment, quicker logistics, easier worldwide communication and just-in-time trading, among other things. However, discarded equipment, such as telephones, laptops, sensors, televisions, washing machines, air conditioners, refrigerators, that contain hazardous substances pose considerable risks to human health and the environment, especially when managed inadequately.

The 2020 edition of the Global E-waste Monitor highlighted that a record 53.6 million Mt of e-waste was generated in 2019, an increase of 21 per cent compared with 2014 (Forti et al. 2020). This is linked to the growing number of individuals who are using EEE worldwide, the constant rate of technological development and the phasing out of old technologies, leading to shorter product lifecycles and designs that do not support repair or reuse. The majority of the e-waste not recycled or disposed through an ESM approach is sent to landfill, mixed with other waste streams or incinerated. As a consequence, valuable resources, such as precious metals and rare earth elements, are wasted, and hazardous substances are released into the environment in a way that poses a risk to human health and the environment.



Source: Forti et al. 2020, Global E-waste Monitor 2020

Managing e-waste requires specific legislation and collection infrastructure. In general, e-waste is, unfortunately, poorly regulated and enforced at global level.

As e-waste is a complex and relatively recent waste stream, countries need to introduce specific legislation to enforce ESM treatment and management of e-waste. In 2019, 78 countries (71 per cent of the global population) were covered by legislation, policies or regulation on e-waste, compared with 67 countries (66 per cent of the population) in 2017. Nevertheless, in most cases, policies are neither legally binding nor appropriately supported financially, which has been found to reduce the likelihood of ensuring their implementation and compliance. Furthermore, most legislative instruments concentrate on improving e-waste management, but not reducing the volume of e-waste generated. Most legislation and policies do not fully consider practices such as the repair and reuse of EEE, even though such practices are favourable according to the globally supported waste hierarchy.

E-waste management is monitored under Sustainable Development Goal 12 on ensuring sustainable consumption and production patterns.

In 2015, United Nations member States adopted the 2030 Agenda for Sustainable Development. This included the 17 Sustainable Development Goals (SDGs) and 169 targets for ending poverty, protecting the planet and ensuring prosperity for all 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 and to the achievement of the SDGs. E-waste management closely relates 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 material footprints (8.4.1 and 12.2.1) and domestic material consumption (8.4.2 and 12.2.2). Consequently, e-waste remains a global challenge, not only because of its increasing generation worldwide, but also because proper treatment and generation prevention requires the active engagement of a diverse set of actors, sometimes going beyond national borders. The management of e-waste is therefore monitored under SDG 12, in particular indicators 12.5.1 on national recycling rates and 12.4.2 on hazardous waste generation (Forti et al. 2020; UNEP 2021).

ITU's Connect 2030 Agenda[3] includes Target 3.2 on increasing the global e-waste recycling rate to 30 per cent by 2023 and Target 3.3 on raising the number of countries with an e-waste legislation to 50 per cent by 2023.

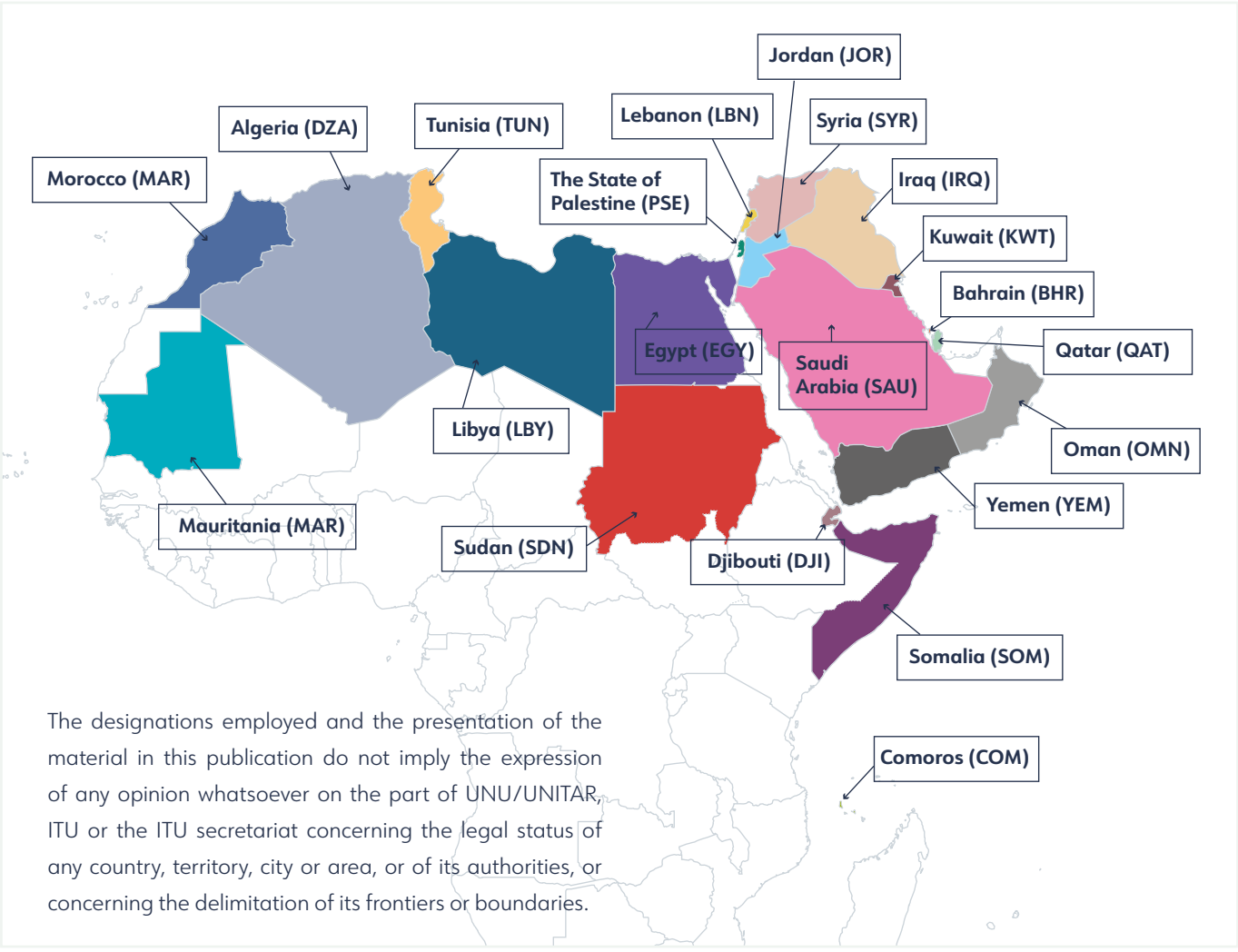
[3] Connect 2030 Agenda: https://www.itu.int/en/mediacentre/backgrounders/Pages/connect-2030-agenda.aspx.

C. Framework condition for the Arab States

This regional e-waste monitor for the Arab States covers 21 countries, plus the State of Palestine[4], which are members of the League of Arab States.

The monitor covers Algeria, Bahrain, Comoros, Djibouti, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, the State of Palestine, Qatar, Saudi Arabia, Somalia, Sudan, the Syrian Arab Republic, Tunisia, the United Arab Emirates and Yemen. The Arab States region stretches from the Atlantic Ocean in the west to the Arabian Sea in the east, and from the Mediterranean Sea in the north to the Indian Ocean in the south-east.

The Arab League, officially the League of Arab States, is a union of Arabic-speaking countries. It was formed in Cairo in 1945 to promote the independence, sovereignty, affairs and interests of its members (Britannica n.d.). The mission of the Arab League is to promote trade and economic growth, as well as sovereignty and political stability, in the region. As of 2021, the Arab League consists of 22 member States, including the State of Palestine, and five observer countries. These are all predominantly Muslim and Arabic-speaking. Through agreements on joint defence, economic cooperation and free trade, among others, the Arab League helps its members to coordinate government and cultural programmes to facilitate cooperation and limit conflict.



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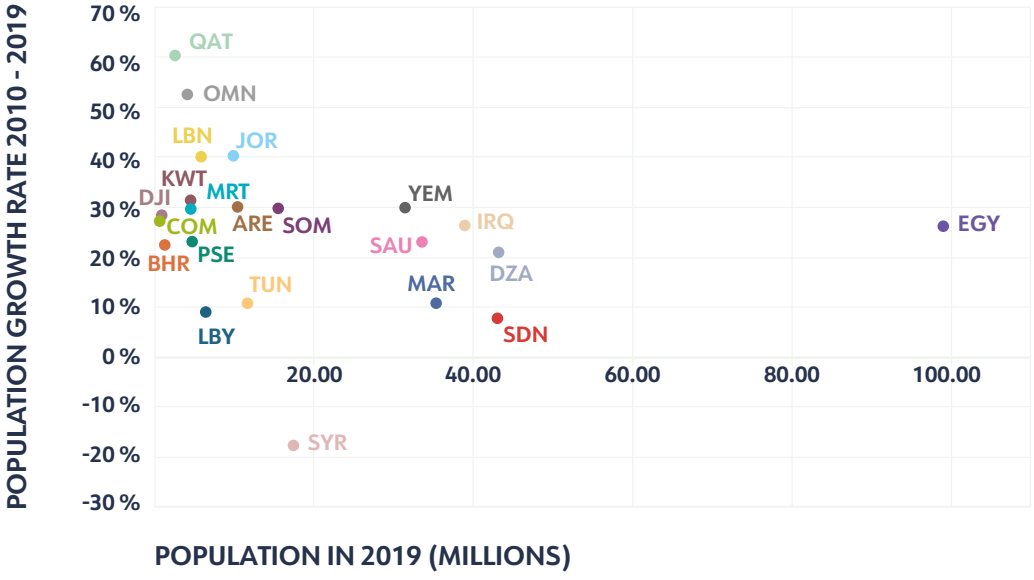
[4] See Resolution 99 (Rev. Dubai, 2018), on the status of Palestine in ITU.

The Arab States region has 429.5 million inhabitants as of 2019, with the most populous being Egypt (99.2 million) and the least populous being Comoros (870 000). The population of the Arab States region grew by 21 per cent between 2010 and 2019.

The Arab States region has 429.5 million inhabitants in 2019.

The Arab States region is located in northern Africa and in Asia, with a total area of 13.1 million km^2 (World Bank 2018). By area, Algeria is the largest Arab State, with a total surface area of 2.4 million km^2. The smallest is Bahrain, which covers just 780 km^2. After Egypt, Algeria is the second most populous country (43.4 million inhabitants), closely followed by Sudan (43.2 million inhabitants). (See Figure 1.) Qatar has the highest growth rate (61 per cent), followed by Oman (52 per cent) and Lebanon and Jordan (both at 40 per cent), while Sudan has the slowest growth (8 per cent). As a result of civil war, however, the population of the Syrian Arab Republic decreased by 18 per cent between 2011 and 2019, as over 5 million individuals sought refuge in other countries (Devadas, Elbadawi and Loayza 2019).

Figure 1. Demographic overview of the Arab States region



The x-axis shows the population in 2019, and y-axis shows the population growth rate between 2010 and 2019.

Inhabitants in the Arab States region have varying levels of access to electricity and the Internet, in addition to disparities in growth rates, poverty levels and gross domestic product (GDP) adjusted for purchasing power parity (PPP)[5], which ranges from USD 1 000 to USD 118 000.

Most of the population of the Arab States region (more than 99.8 per cent) has access to electricity, with the exception of Comoros, Djibouti, Libya, Mauritania, Somalia, Sudan, the Syrian Arab Republic and Yemen (World Bank 2019). (See Figure 2.) Socio-economic development indices for the Arab States also vary widely; GDP adjusted for PPP ranges from USD 1 000 year in Comoros to USD 118 000 per year in Qatar. (See Figure 3.) The region shows an average growth rate of GDP adjusted for PPP of 29 per cent between 2010 and 2019. According to the World Bank, four of the Arab States are considered low income countries (Somalia, Sudan, the Syrian Arab Republic and Yemen), eight are low-middle income countries (Algeria, Comoros, Djibouti, Egypt, Mauritania, Morocco, Tunisia and the State of Palestine), four are upper-middle income countries (Iraq, Jordan, Lebanon[6] and Libya) and six are high-income countries (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates) (World Bank 2021b).

Figure 2. Population with access to electricity in the Arab States region

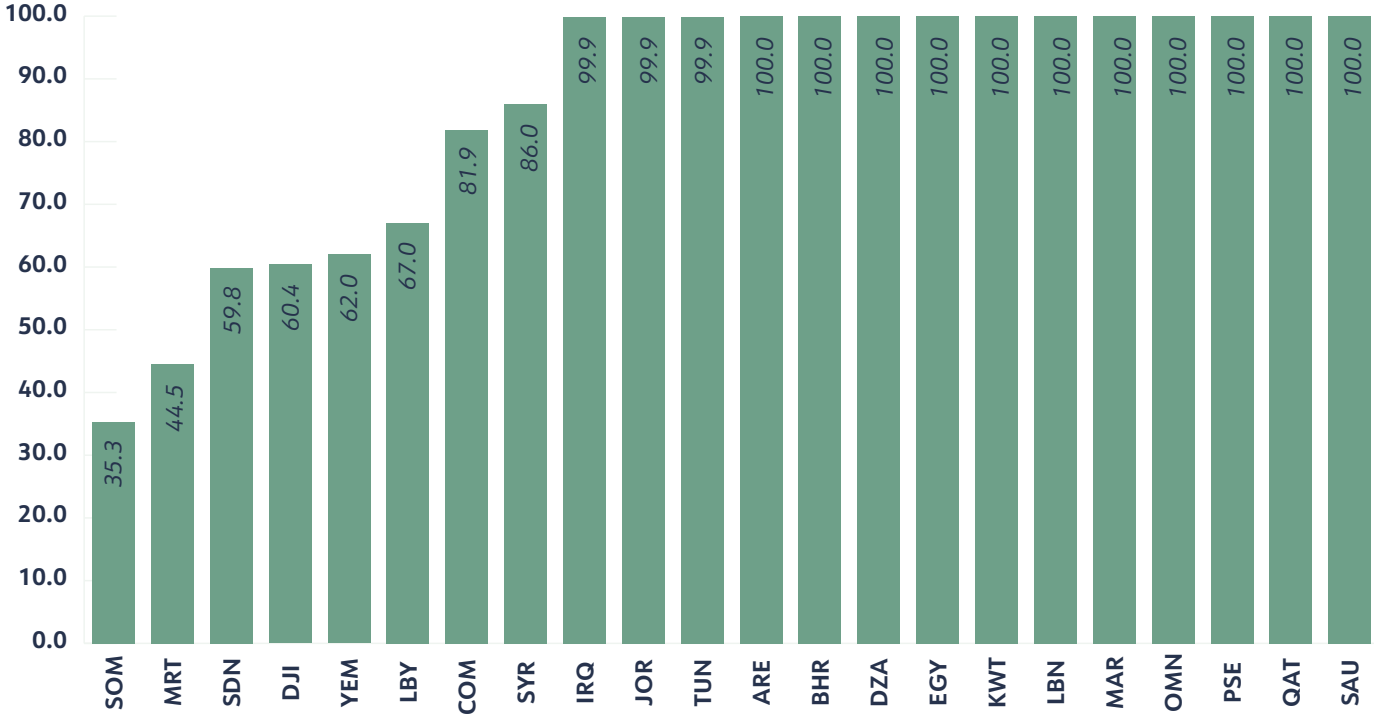


Figure 2 shows the proportion of the population in each State or territory with access to electricity.

[5] PPP is an economic indicator that can be used to compare economic productivity and standards of living between different States, territories and locations. GDP figures can be adjusted to reflect PPP.

[6] Following the financial, social and political crisis which began in 2019, Lebanon is likely to be downgraded to a low-middle income country (World Bank 2021a).

Figure 3. Economic overview of the Arab States region

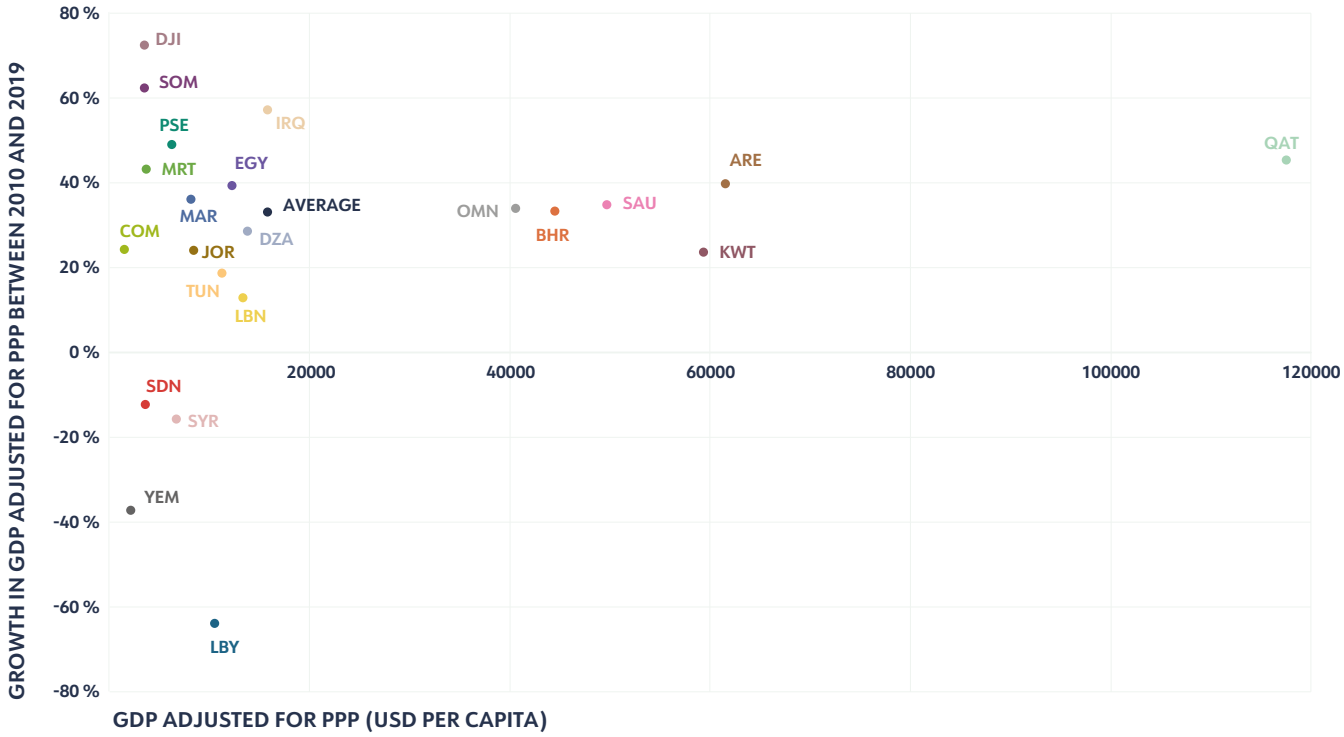


Figure 3 shows GDP per capita adjusted for PPP in United States dollars as of 2019 along the x-axis and the total growth rate of GDP adjusted for PPP between 2010 and 2019 along the y-axis.

D. Background to the report

Within the framework of the ITU Arab Regional Initiative on environment, climate change and emergency telecommunications and the Global E-waste Statistics Partnership, ITU has partnered with UNU-ViE SCYCLE to implement this regional e-waste monitor for the Arab States, with the aim of building regional capacity in collecting e-waste statistics for use by government officials and statisticians and improving e-waste data and statistics in the region.

In particular, this monitor reviews the current situation of e-waste legislation and management in the Arab States, analyses trends in the transboundary movement of e-waste within and into Arab States and provides periodic monitoring on collected e-waste statistics information. It also presents a summary of the e-waste status in the region. This report was prepared in collaboration with governments, national statistical offices, independent experts and recyclers in participating States. It will allow for international comparisons and will facilitate the development of e-waste management systems. It presents an overview of projects and initiatives on e-waste that have taken place in the region in recent years.

Chapters 3 and 4 of this report present a summary of statistics and the transboundary movement of e-waste in participating States. Chapter 5 provides an assessment of e-waste legislation in all participating Arab States. Chapter 6 presents a further assessment of e-waste management on the basis of indicators related to the legislative framework and the infrastructure for 11 States (Algeria, Egypt, Jordan, Lebanon, Mauritania, Oman, Qatar, Saudi Arabia, Sudan, the United Arab Emirates and the State of Palestine). Chapter 7 summarizes the common challenges faced, and Chapter 8 sets out recommendations for e-waste management in the region. The annexes describe the mathematical equations used in the methodology, summarize the data presented in the report and set out the country profiles for Mauritania and Sudan, which, as least developed countries in the region, were selected for in-depth analysis.

2. METHODOLOGY

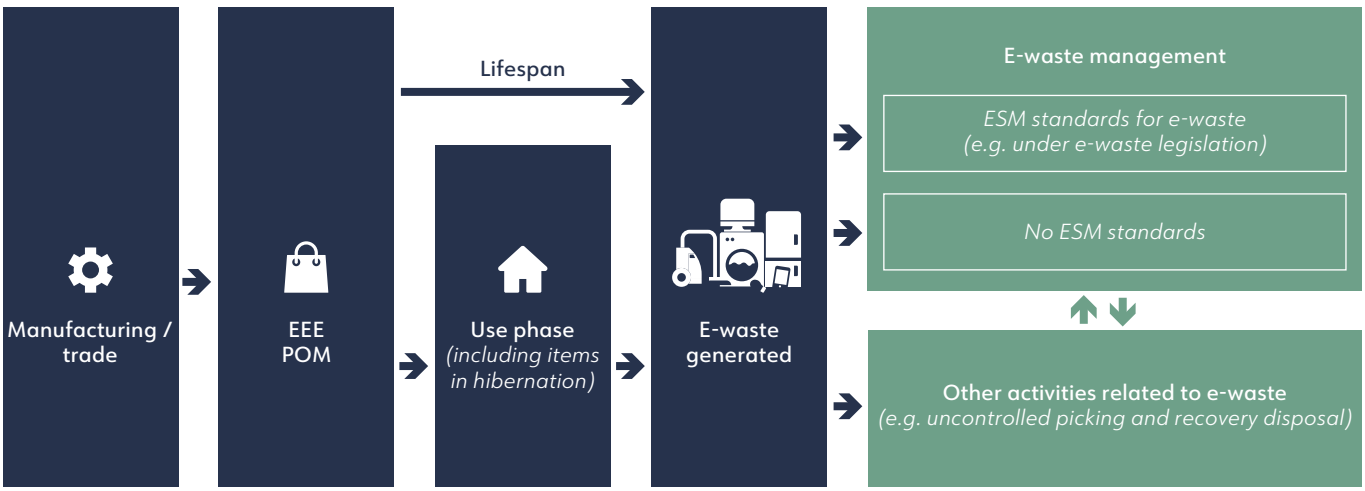
This report compares e-waste statistics, legislation and infrastructure in the Arab States. The statistical methodology follows the principles set out in the internationally harmonized framework, which was developed jointly through the Partnership on Measuring ICT for Development initiative by UNU, ITU, United Nations Environment Programme (UNEP), Eurostat, the Organization for Economic Cooperation and Development and other United Nations agencies. These principles are described in "E-waste Statistics Guidelines on Classification Reporting and Indicators" (Baldé et al. 2015; Forti, Baldé and Kuehr 2018). A novel methodology was developed to assess e-waste legislation and management. The key concepts of the statistical framework and e-waste management assessment are explained in more detail below.

A. E-waste statistics

E-waste statistics follow a mass balance approach to the entire lifecycle of EEE and are calculated using a product-based classification, known as UNU-KEYS.

The measurement framework for e-waste statistics follows a mass balance approach over the entire lifecycle of EEE. This covers the manufacturing phase, placement on the market, the use phase and the generation of e-waste and takes into consideration whether ESM standards are met or whether other activities such as uncontrolled picking and recovery disposal are performed. (See Figure 4.) As a first step, the amount of EEE placed on the market (EEE POM) is calculated. EEE refers to any household or business item with circuitry or electrical components that have a power or battery supply (excluding vehicles) (Step Initiative 2014). EEE POM includes any product supplied to the national market for consumption and use by households, businesses and public authorities. EEE POM has been calculated for 54 products, known as the UNU-KEYS classification. This is a product-based classification in which each UNU-KEY has a homogeneous lifespan, average weight, material composition and hazardousness profile. UNU-KEYS can be linked to the six e-waste categories set out in the WEEE Directive and are used to measure e-waste statistics. (See Annex I.)

Figure 4. Framework for e-waste statistics



E-waste generation is calculated using EEE POM data and lifespans for each UNU-KEY. The amount of e-waste generated is the total mass of EEE that the owner chooses to dispose of without reuse, before any e-waste management activities are conducted.

EEE POM can be calculated though a variety of data sources. The easiest methodology is to use the apparent consumption methodology, according to which EEE POM can be obtained through Equation 1:

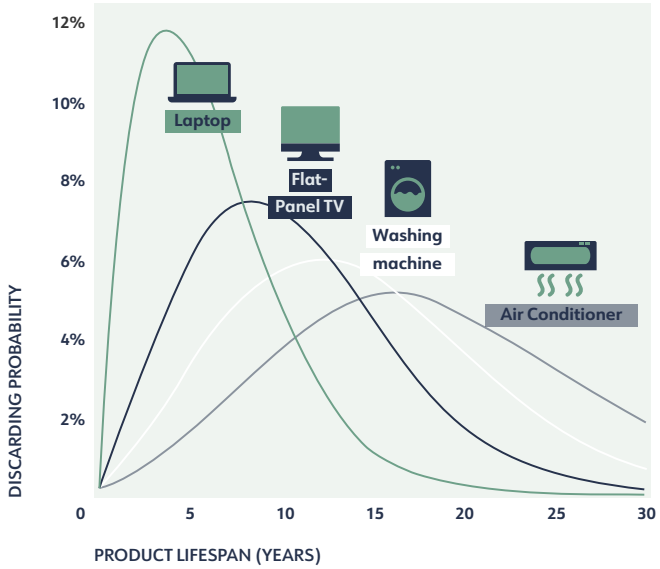
Equation 1:

POM = Import - Export + Domestic Production

EEE POM is calculated for each UNU-KEY, preferably using data from 1980 to the present day. It includes imports of both new and used EEE, in addition to all domestically produced EEE (manufactured new EEE and used EEE for reuse). Since trade statistics and domestic production data are usually expressed in units, a unit-to-weight conversion factor for each UNU-KEY is calculated and applied to obtain the mass of EEE POM.

After a product has been placed on the market, it remains in use, or at the household, business or governmental institute in which it is located, until it is discarded. The lifespan of a product is the period of time between the product being placed on the market and becoming e-waste. This includes the hibernation phase, such as the storing or stock-piling of equipment before placement on the market or the hoarding of equipment before it is actually discarded at end of life, as well as the passing on of equipment from one owner to another (reuse). The lifespan of EEE is expressed as a Weibull function and varies according to the UNU-KEY, with the shape and scale parameters associated to the average lifespan for each individual UNU-KEY. (See Figure 5.)

Figure 5. Examples of EEE product lifespans



The time series of EEE POM and lifespans are then used to calculate the amount of e-waste generated for each UNU-KEY. The mathematical description for calculating the amount of e-waste generated is explained in Annex II. E-waste generated in a country refers to the total weight of all types of EEE (and its parts) that have been discarded by the owner as waste without the intention of re-use, and that had been placed on the market in that country, before any other activity

is carried out, such as collection, preparation for reuse, treatment or recovery, including recycling and export (Seyring et al. 2015).

E-waste generation is the basis for gathering statistics on e-waste flows. An assessment of the amount of e-waste that is treated using ESM approaches is crucial. Other e-waste flows, covering other e-waste management practices, are also considered. To assess e-waste statistics, e-waste imports and exports must also be measured.

In general, waste management involves the collection, transportation, storage and disposal of waste, including aftercare of disposal sites. Waste management can be undertaken by an economic unit within a legal framework, but waste is also handled illegally and by informal economic units (e.g. informal waste picking). In this context, a distinction is made between "waste management" and "other waste related activities" as proposed in the waste statistics framework produced by the Economic Commission for Europe (UNECE 2021). Under that framework, waste management is defined as the set of lawful activities carried out by economic units of the formal sector, both public and private, for the purpose of the collection, transportation and treatment of waste, including final disposal and aftercare of disposal sites. The term "other waste related activities" includes waste dumping, waste picking and disposal and can apply to the informal sector[7].

It is of vital importance that e-waste undergoes depollution, that hazardous fractions are disposed of in an environmentally sound manner and that recyclable components are properly recycled. This is typically, but not exclusively, performed under the requirements of national e-waste legislation. This flow is therefore referred to as "e-waste formally collected" in this report and in the guidelines on classification, reporting and indicators for e-waste statistics. This term implies that the waste is collected under specific legislation on e-waste or an equivalent. In this report, this type of waste is also referred to as "e-waste managed in an environmentally sound manner".

E-waste can also be managed by waste managers involved in various processes such as collection, dismantling and metals recovery which use operations that do not guarantee environmentally sound management. Such operations can cause damage to the environment if hazardous substances in e-waste are not treated. One such example of inferior treatment is when, rather than being separated at source, e-waste is mixed with residual waste and sent to landfill. E-waste may also be mixed and recycled with other waste, such as metal scrap, during which not all recyclable parts are recycled and the hazardous components of e-waste are left untreated. This form of waste management is not accounted for in e-waste flows managed in an environmentally sound manner.

"Other waste-related activities" can refer to the selective dismantling of valuable parts, the recovery of some metals and dumping at uncontrolled landfills. Where handled by informal waste operators, the hazardous components of e-waste are typically left untreated.

The informal sector usually does not comply with minimum safety requirements, environmental standards or depollution techniques. However, the informal sector sometimes hands over intact products of e-waste to the formal sector. For instance, in an EPR-regulated system, those quantities of e-waste should be counted as e-waste collected and recycled in an environmentally sound manner. E-waste can also be disposed of in residual waste or bulk waste, going straight to landfill or waste incineration facilities.

Both used EEE and e-waste are imported and exported, which is referred to as transboundary movement. Both whole products and parts/components can be involved in transboundary movement. It should be determined whether the exported e-waste complies with ESM criteria

[7] The International Labour Organization defines the informal sector as a group of production units comprised of unincorporated enterprises owned by households, including informal own-account enterprises and enterprises of informal employers (typically small and non-registered enterprises). See: ILO (International Labour Organization). 2016. *Minimum wage policy guide.*

in the national legislation and whether it will be managed by e-waste certified recyclers in recipient countries. Depending on the answer, exported e-waste quantities should be included in statistics either on e-waste managed using ESM or on other e-waste management. Imports of e-waste, however, do not need to be added to the national totals of e-waste managed using ESM and should instead be recorded separately. For used EEE, transboundary movement is slightly different; products are not yet considered waste, but data on the movement of used EEE are needed to complete the mass balance calculations for EEE and e-waste. Imported used EEE should be included in the total quantity of EEE POM, and exported used EEE can be defined as a flow to be measured.

International indicators for e-waste, including those under SDG 12, have been defined for EEE POM, e-waste generated, e-waste formally collected and the e-waste collection rate.

To capture the most important dynamics of e-waste, the following indicators are defined in the SDGs and international guidelines:

1. **Indicator 1:** EEE POM.
2. **Indicator 2:** E-waste generated.
3. **Indicator 3:** E-waste managed in an environmentally sound manner (also referred to as "e-waste formally collected" in the guidelines on classification, reporting and indicators for e-waste statistics) and ESM standards for e-waste (e.g. under e-waste legislation)
4. **Indicator 4:** E-waste collection rate (indicator 3 divided by indicator 2) (Forti, Baldé and Kuehr 2018; UNEP 2021; Baldé et al. 2015).

Indicator 1 includes imports of used EEE. Indicator 2 includes exports of e-waste for ESM but excludes imports. Indicators 1 to 3 are measured in kilotons (kt), which is normalized as kilograms per inhabitant (kg/inh) to allow for international comparisons.

The performance of the entire e-waste management system is expressed using the e-waste collection rate, defined as indicator 4, which is measured as a percentage. The collection rate serves as an indication of the progress made by the country or territory towards achieving proper management of the e-waste sector.

The e-waste data are harmonized according to international standards, as per SDG 12 on sustainable consumption and production.

B. E-waste management assessment

National e-waste policy coverage and e-waste infrastructure are assessed by distinguishing between three development stages: A (advanced), B (in transition) and C (basic).
Countries or regions may define their own standards for the environmentally sound management of hazardous waste, according to their national context (UNEP 2021). This gives rise to differences in the interpretation of ESM standards for waste and, consequently, in ESM of e-waste itself. This report therefore provides a novel methodology for further interpretation of the progress made in the development of legislation and management infrastructure for ESM of e-waste, which allows a comparison to be made between countries and regions.

In practice, the implementation of ESM of e-waste requires a comprehensive approach and can be successful only by taking into account many factors, such as socio-economic development, governance structures, geography and trade links and infrastructure, as well as cultural and psychological considerations reflecting consumer behaviours and responses. The description of the stages is shown in Table 1, where A, B, and C can be roughly interpreted as "advanced", "in transition" and "basic" respectively (Honda, Sinha Khetriwal and Kuehr 2016; Huisman et al. 2019a, 2019b and 2019c).

Table 1. Features of the e-waste system matrix at various stages of development

Stage	Legal framework	Infrastructure
A	E-waste legislation, including financing mechanisms, enforcement with efficient controls and monitoring; alternatively, a strong voluntary system with governmental support and collaboration, combined with legally mandated, internationally accepted compulsory nationwide environmental health and safety standards for all facilities.	Widespread network of formal collection channels; e-waste collection is entirely formalized, with only legally authorized e-waste collection taking place, either through legally obligated take-back systems, voluntary initiatives or the transfer of e-waste from the informal sector to a formal collector; depending on the country/territory, there may be high-efficiency and advanced industrial facilities (large and small scale) for recycling and recovery of functions and materials from e-waste, including precious metals and rare earth elements.
B	E-waste-specific draft legislation under discussion or recently enacted; in the early stages of development of an enforcement regime; potentially limited scope of legislation; voluntary environmental health and safety standards with basic minimum thresholds; greater individual awareness about environmental and health risks.	Informal and formal collection channels co-exist; formal collection channels operate within a legal framework, such as a licensing system; informal collectors still exist outside the legal system; voluntary take-back schemes/collection by private sector in operation; semi-mechanized formal small and medium enterprise recycling facilities for e-waste treatment and recycling; dismantling and partial recovery facilities to segregate recyclable fractions; informal sector recyclers that recover copper, gold and other materials using rudimentary methods.
C	No e-waste specific legislation or financing mechanisms; e-waste management depends on ad-hoc local actors; limited or no awareness of environmental health and safety among e-waste processors, and therefore little protection from toxins and hazardous substances released during e-waste treatment and recycling.	Informal collection and/or disposal with municipal waste only; e-waste treatment/recycling on micro and small-scale often run individually by facilities in the informal sector using rudimentary and manual techniques for dismantling, repair, reuse and recycling.

In the indicator framework developed, each available indicator for the legal framework and the collection infrastructure is scored as A, B or C.
The approach taken in this report is to develop a framework of indicators relevant to e-waste legislation and e-waste management. Each indicator must be measurable and meaningful to e-waste management. The indicators chosen represent a pragmatic compromise between the data available and the ideal situation, which sometimes resulted in the use of proxies. Each indicator is scored according to the three stages set out in Table 1. If a score is not known, it is marked as unknown.

Five indicators have been selected to measure the availability and implementation of national and international legislation. (See Table 2.) These cover aspects of national e-waste legislation, such as the treatment and proper management of products, and include whether the legislation defines collection targets and minimum standards for ESM of e-waste. These indicators also take into account obligations under international instruments, such as the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, the Stockholm Convention on Persistent Organic Pollutants and the Minamata Convention on Mercury.

Two indicators are defined to measure the degree of development of collection infrastructure. The first indicator measures whether e-waste collection points are present in all municipalities, are present only in the main cities or are absent. The nature of the collection points varies significantly, as e-waste collection schemes are run variously by, among others, municipal authorities, informal collectors and retailers, depending on the country or territory. In practice, e-waste collection mechanisms refer to the way in which collectors send e-waste for ESM treatment and recycling. Collection points can be organized either by municipal authorities or through producer take-back schemes, including both pick-up and drop-off services. The second indicator on collection infrastructure measures whether e-waste management infrastructure is available in the country or territory.

Table 2. Overview of indicators in the e-waste management system and minimum level required to obtain each stage

	No.	Description of Indicator	Minimum level for stage C	Minimum level for stage B	Minimum level for stage A
Legislation	1.1	**Existence of e-waste specific legislation**	No	In development	Yes: legislation or other measures adopted/ enacted
	1.2	**Enforced products in national e-waste legislation** (mass of all UNU-KEYS as a percentage of all e-waste generated)	At least 0%	At least 20%	At least 75%
	1.3	**National e-waste collection target**	No	Voluntary/in development	Yes
	1.4	**Standards for e-waste management**	No	Voluntary/in development	Yes
	1.5	**Number of multilateral environmental agreements ratified or signed**	1 Ratified or Signed	2 Ratified + 1 Signed	3 Ratified + 1 Signed
Infrastructure	2.1	**E-waste collection points**	No	In the main cities	Yes: in all municipalities
	2.2	**Management facilities for ESM of e-waste**	No	In development	Yes
Performance	3	**E-waste collection rate** (%)			
E-waste quantity	4	**E-waste generated** (in kg/inh and kt)			

E-waste management is assessed by comparing the outcomes of the indicators on legislation and infrastructure with e-waste statistics indicators to determine the overall performance.

In practice, the outcomes of the e-waste management matrix (covering legal development and the development of e-waste management infrastructure), together with the e-waste statistics indicators, can be used to provide an overview of whether a country or territory is developing relevant legislation and building an effective e-waste management infrastructure capable of collecting e-waste, known as the indicator of e-waste generation. The e-waste collection rate refers to the e-waste formally collected for ESM and indicates the effectiveness of such legislation and infrastructure. Together, they can be used to create a dashboard at country level.

C. Data sources

Several data sources have been used and compared to quantify the main statistical indicators and to overcome challenges in data availability and comparability.

Statistical data on EEE POM and e-waste generated were obtained from governments and national statistical offices of the States that took part in the project. Where such data were not available, the datasets provided in the Global E-waste Monitor 2020 were used (Forti et al. 2020). Data on EEE POM and e-waste generated were drawn from national official data for Lebanon and Jordan. For Somalia and the State of Palestine, no data were provided in the Global E-waste Monitor 2020. Data for Somalia and the State of Palestine were estimated using data for other countries in the region in similar economic conditions and adjusting them for PPP. Data on e-waste formally collected have been obtained either from the national official databases and authorities of the States that took part in the study or through direct consultation with private companies active in the field of e-waste collection.

To determine the amount of e-waste imported and exported per country/territory, data have been extracted from the national reports submitted under the Basel Convention for the period 2016-2019. The analysis of whether transboundary movement corresponded to e-waste was performed using a combination of the codes set out in List A (hazardous waste), List B (non-hazardous waste), and the Y-codes of the Basel Convention. (See Annex III.) In addition, all descriptions in the report received were checked to ensure that no declarations had been left out or erroneously included.

Socio-economic conditions were analysed through data on factors such as the population and the GDP adjusted for PPP (obtained from the United Nations Department of Economic and Social Affairs), in addition to the size of the informal sector, the level of access to electricity and the Internet and the proportion of the population below the poverty line (obtained from the SDG Global Database)[8].

Information on the current status of the legislative framework and overall e-waste management in each country or territory was acquired via questionnaires and direct interviews sent to ministries and stakeholders in the e-waste sector.

Data on the status of signatories to the Basel, Stockholm and Rotterdam and Minamata Conventions were obtained from the official UN websites of these conventions.

Where first-hand information could not be retrieved, desk-based literature research was conducted, consisting of reviews of existing papers and national studies in the countries of interest.

[8] SDG Global Database: https://unstats.un.org/sdgs/indicators/database/.

3. OVERVIEW OF E-WASTE STATISTICS FOR THE ARAB STATES

This chapter elaborates on the key e-waste statistical findings made through the above-described approach and methodology for the 21 countries, plus the State of Palestine, that participated in this study.

A. EEE POM and e-waste generated

The quantity of EEE POM in the Arab States region increased from 3.2 Mt (8.8 kg/inh) in 2010 to 4.1 Mt (9.5 kg/inh) in 2019, a rise of 30 per cent. As the region mostly imports, rather than manufactures, EEE, domestic generation of EEE is very limited. E-waste generation in the region increased from 1.8 Mt (4.9 kg/inh) in 2010 to 2.8 Mt (6.6 kg/inh) in 2019, a rise of 61 per cent, equivalent to an average annual increase of roughly 100 kt.

The total amount of EEE POM increased slowly from 3.2 Mt (8.8 kg/inh) in 2010 to 3.4 Mt (8.6 kg/inh) in 2015. After 2015, the amount of EEE POM increased at a faster pace, reaching 4.1 Mt (9.5 kg/inh) in 2019. (See Figure 6.) All data for the 21 countries, plus the State of Palestine, that participated in the study are shown in Annex IV.

Figure 6. EEE POM and e-waste generated in the region, in kilotons, 2010-2019

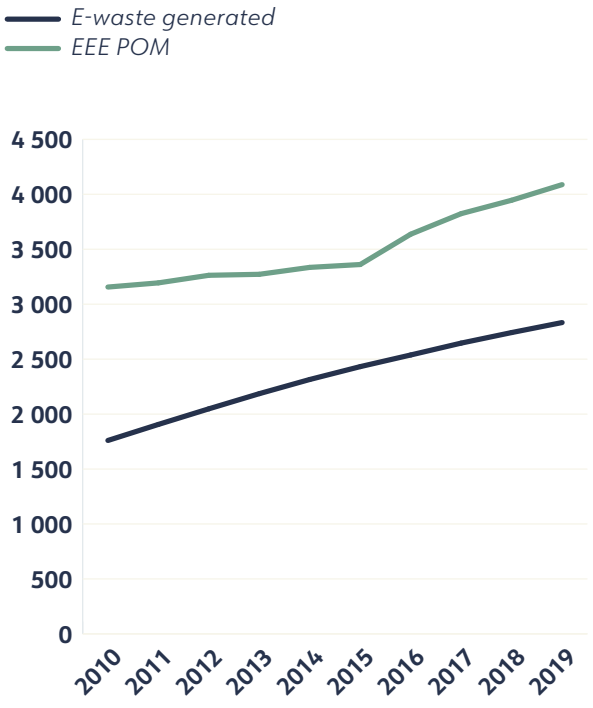
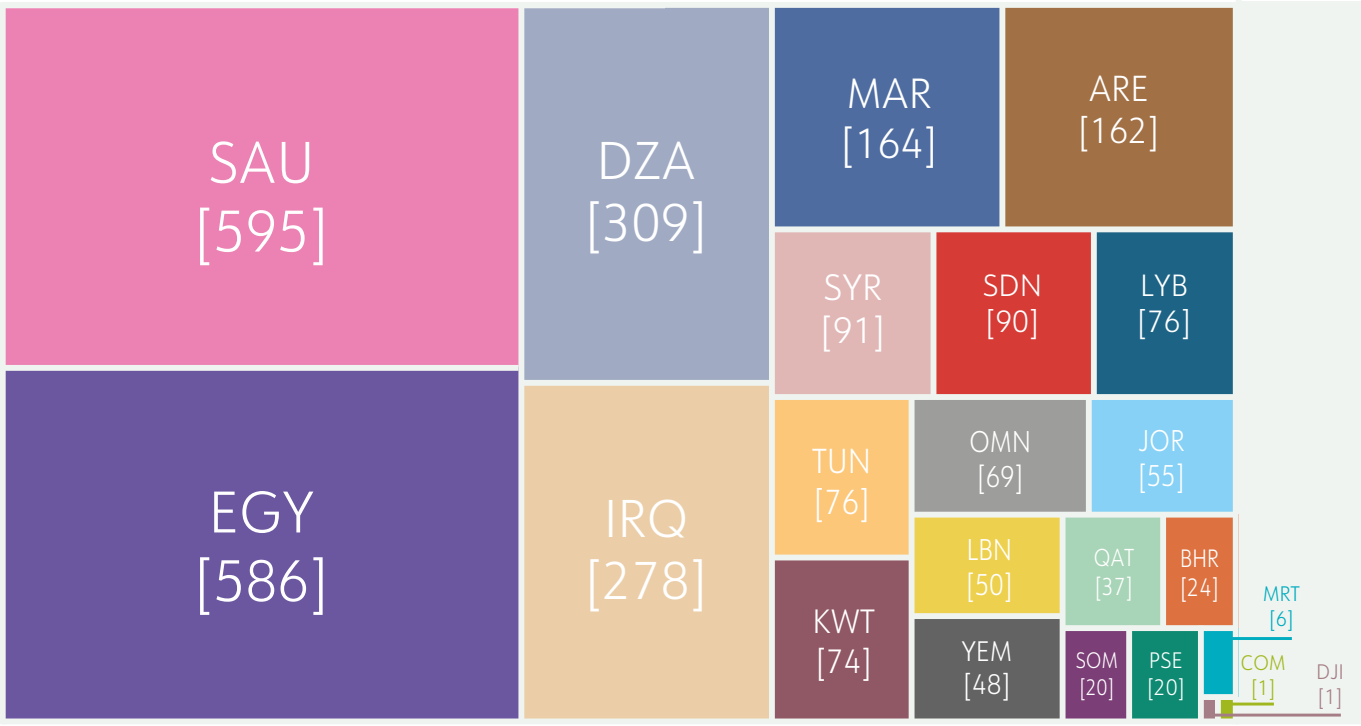


Figure 7. E-waste generated 2019 disaggregated by State/territory, in kilotons, 2019



E-waste generation and EEE POM show a positive correlation with GDP adjusted for PPP. The per inhabitant amount of EEE POM is highest for Qatar (24.9 kg/inh), while the largest e-waste generator is Saudi Arabia (16.3 kg/inh).

The amount of EEE POM in the region varies widely, from 0.8 kg/inh in Comoros to 24.9 kg/inh in Qatar. (See Figure 8.) There is a correlation between the amount of EEE POM and GDP per capita adjusted for PPP, which indicates that the amount of EEE POM increases as GDP adjusted for PPP increases; this correlation appears to be less strong above an adjusted GDP per capita of USD 40 000. Egypt had the greatest level of EEE POM in the region in absolute terms, with 1.1 Mt of EEE POM in 2019, followed by Saudi Arabia (758 kt), Iraq (459 kt) and Algeria (458 kt).

The amount of e-waste generated per inhabitant was highest in Saudi Arabia (16.3 kg/inh) and lowest in Comoros (0.6 kg/inh). (See Figure 9.) Similar to EEE POM, e-waste generated showed a positive correlation with GDP adjusted for PPP, which lessened above an adjusted GDP per capita of USD 40 000. Saudi Arabia is also the largest generator of e-waste in the region in absolute terms, having generated 595 kt of e-waste in 2019, equivalent to 21 per cent of all e-waste generated in the region that year. The second-largest generator of e-waste is Egypt (586 kt; 20.7 per cent), followed by Algeria (309 kt; 10.9 per cent) (see Figure 7).

Figure 8. Amount of EEE POM (in kilograms per inhabitant) compared with GDP adjusted for PPP (in thousands of United States dollars per capita), 2019

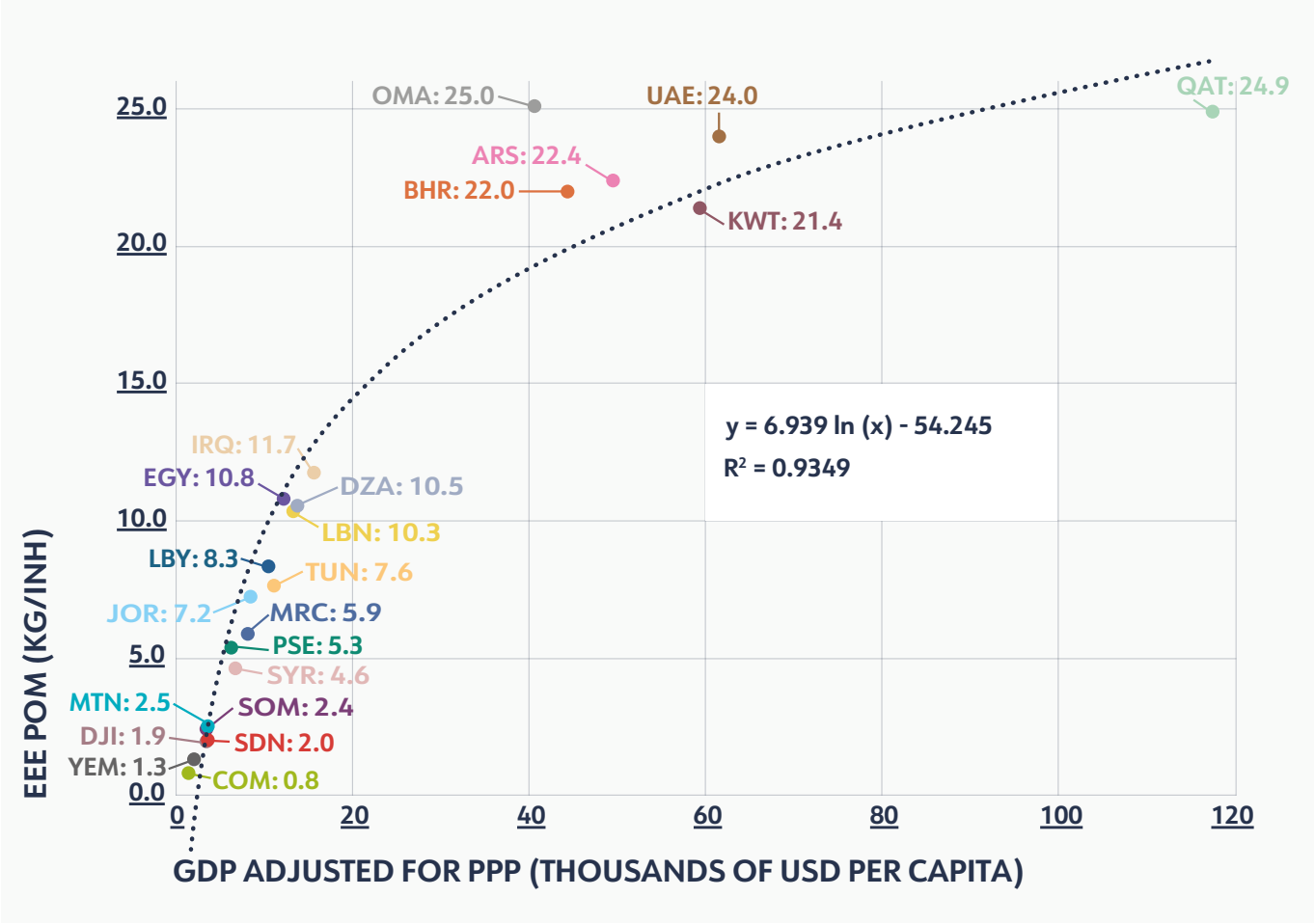
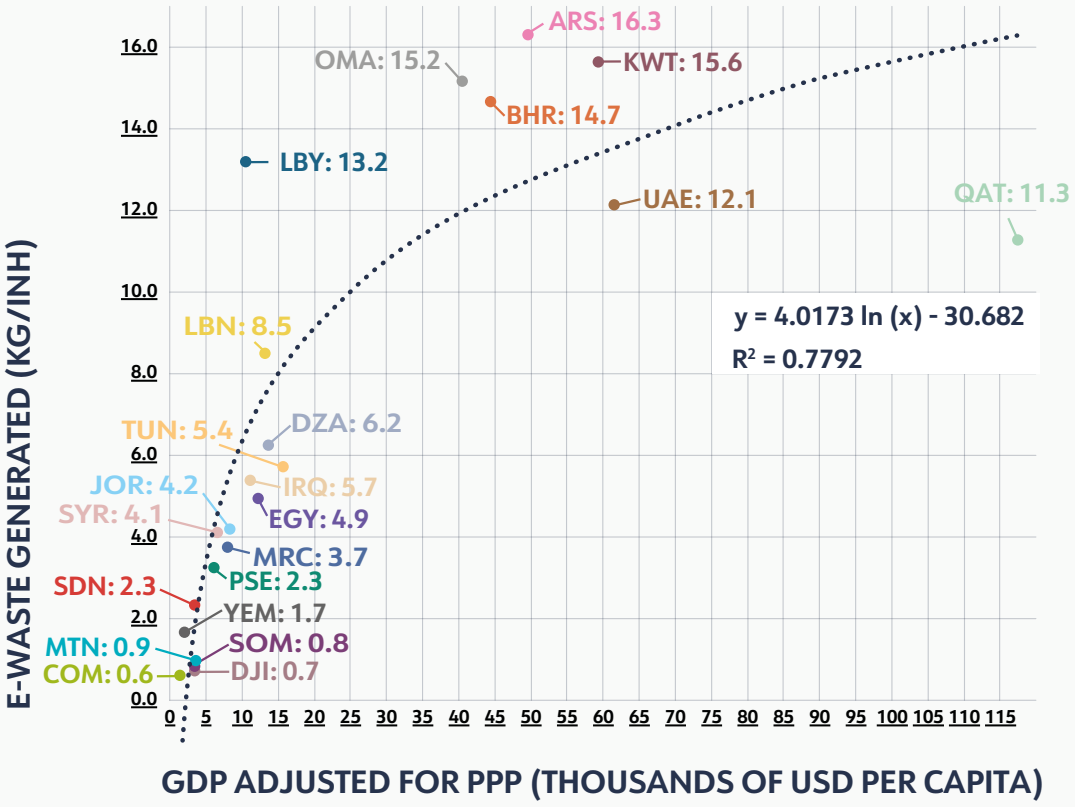


Figure 9. Amount of e-waste generated (in kilograms per inhabitant) compared with GDP adjusted for PPP (in thousands of United States dollars per capita), 2019



B. E-waste categories

Small equipment (category 5 in the WEEE Directive), temperature exchange equipment (category 1) and large equipment (category 4) represent the greatest proportion (by weight) of e-waste generated in the region, at 76 per cent. The annual growth rate is positive for all categories, except for screens and monitors, which shows negative growth rates.

When disaggregating the quantities of e-waste generated into the six e-waste categories, the largest category is small equipment (e.g. microwaves) with 34 per cent, followed by large equipment (e.g. washing machines) (21 per cent) and temperature exchange equipment (e.g. refrigerators) (21 per cent) (see Figure 11). Large equipment and temperature exchange equipment are large and bulky appliances which have a relatively high unit weight and long lifespans and are characterized by a possession rate of no more than two appliances per household in low and middle income economies in the region. Small equipment, on the contrary, has a relatively lower unit weight. Small equipment is purchased more frequently and has a shorter lifespan, meaning that it is more often discarded. The smallest category in terms of e-waste generated are lamps (e.g. LED lamps), representing 2 per cent of all e-waste generated by weight; these items are used in every household but have a very small unit weight.

Year-to-year growth rates for all categories of EEE are positive, with the exception of screens and monitors (e.g. LED televisions), the amount of which was placed on the market decreased in mass. This is because, over the past decade, a technological change in computer and television screens has been witnessed, with virtually all cathode ray tube screens having been replaced with flat panel displays. The decrease in the proportion by weight of small IT equipment (e.g. mobile telephones) can be understood to be a result of miniaturization. Although most growth rates are positive, a declining trend has been observed, meaning that the pace of increase is slowing down over time for most products. (See Figure 10.)

Figure 10. Year-to-year growth rates for e-waste generated, 2011-2019

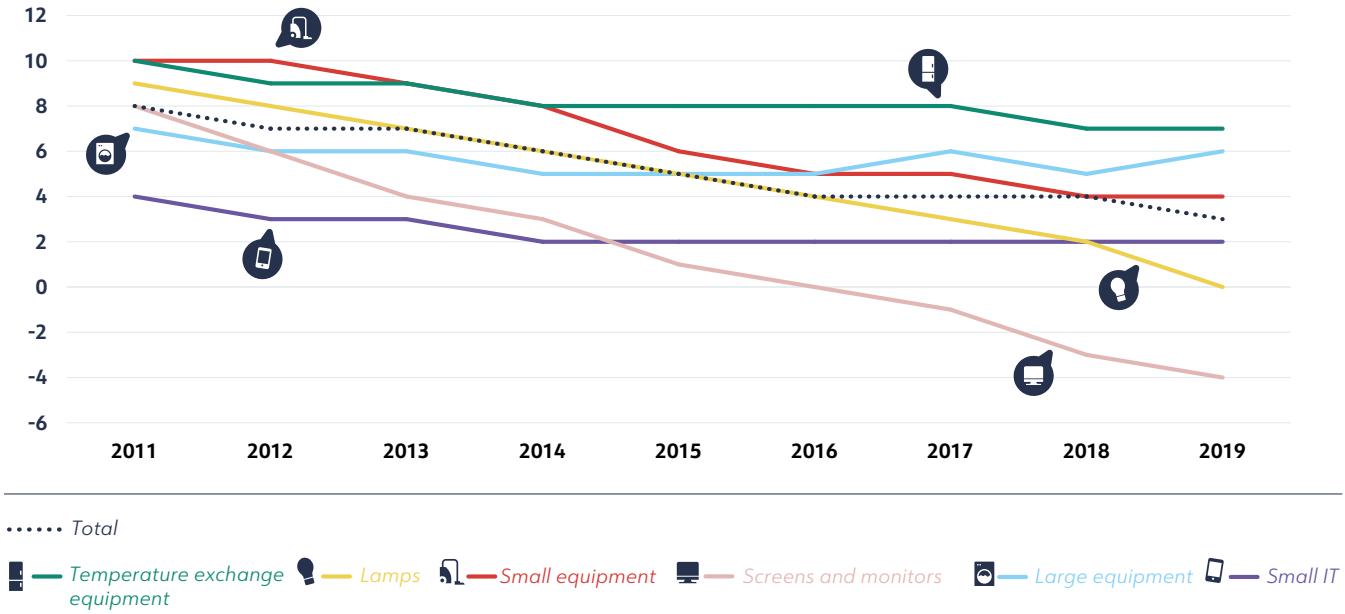
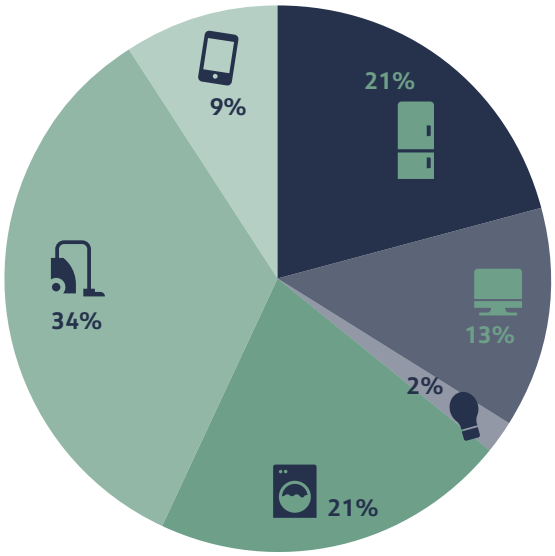


Figure 11. E-waste generated disaggregated by category, 2019



SIX CATEGORIES OF E-WASTE GENERATED IN 2019 (%)

C. Environmentally sound management of e-waste

A total of 2.2 kt (0.01 kg/inh) of e-waste was collected for environmentally sound treatment in 2019 across four Arab States, representing a collection rate of 0.1 per cent of all e-waste generated in the Arab States region. Jordan had the highest e-waste collection rate (2.6 per cent; 0.1 kg/inh), followed by Qatar (0.5 per cent; 0.07 kg/inh). No e-waste collection information was available for 18 of the participating economies owing to a lack of organized, separate collection infrastructure for e-waste and/or an absence of official data.

Data on e-waste collected and ESM were available for only four economies (Jordan, the State of Palestine, Qatar and the United Arab Emirates). The total e-waste collected for ESM in these four economies was 2.2 kt (0.01 kg/inh). (See Figure 12.) They all collect low volumes of e-waste: in 2019, Jordan collected 1.3 kt, the United Arab Emirates 0.7 kt, Qatar 0.2 kt and the State of Palestine 0.08 kt.

With regard to the proportion of e-waste generated in the State or territory that is collected, known as the e-waste collection rate, Jordan achieved the highest rate in the region according to the data received, having collected 2.6 percent of all e-waste for ESM. Jordan also had the highest e-waste collection rate per inhabitant, at 0.1 kg/inh. According to the preliminary results of a survey conducted by the Jordanian Department of Statistics in 2019, 4 per cent of a study sample of e-waste generated by municipalities was delivered to specialist recycling companies. This percentage is lower for the medical sector, where only 1 per cent of the e-waste sampled was sent for recycling. The remaining waste was mostly sent to landfill.

Qatar collected 0.5 per cent of its e-waste, while the State of Palestine and the United Arab Emirates each collected 0.4 per cent. This suggests that, while those economies have the necessary infrastructure, it does not cover the entire population and there is limited access to the e-waste generated.

Other participating countries had very limited e-waste collection in place and could not provide data on e-waste collection owing to the incompatibility of classifications or the absence of official data. There was no statistically relevant correlation observed between GDP adjusted for PPP and e-waste collection in the region. The average amount of e-waste collected per inhabitant in the Arab States region was equivalent to 0.01 kg/inh, giving a collection rate of 0.1 per cent. The Arab States that are not shown in Figures 12 and 13, do not collect data on these areas and likely do not perform e-waste collection for ESM, therefore they are set to 0.

Figure 12. E-waste collected for ESM, in kilograms per inhabitant, 2019

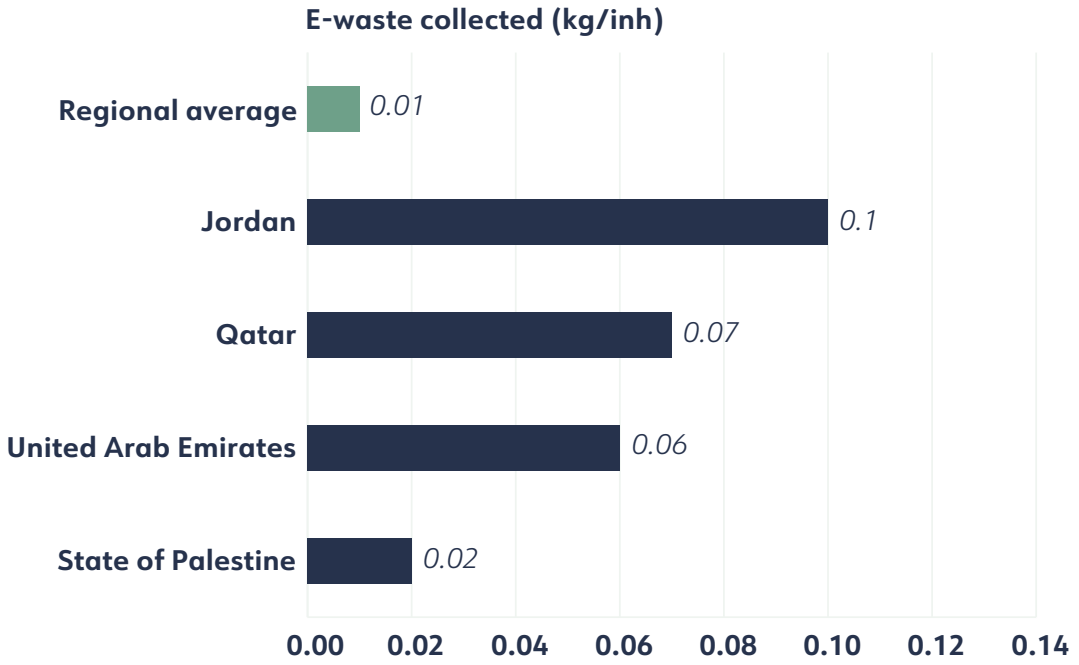
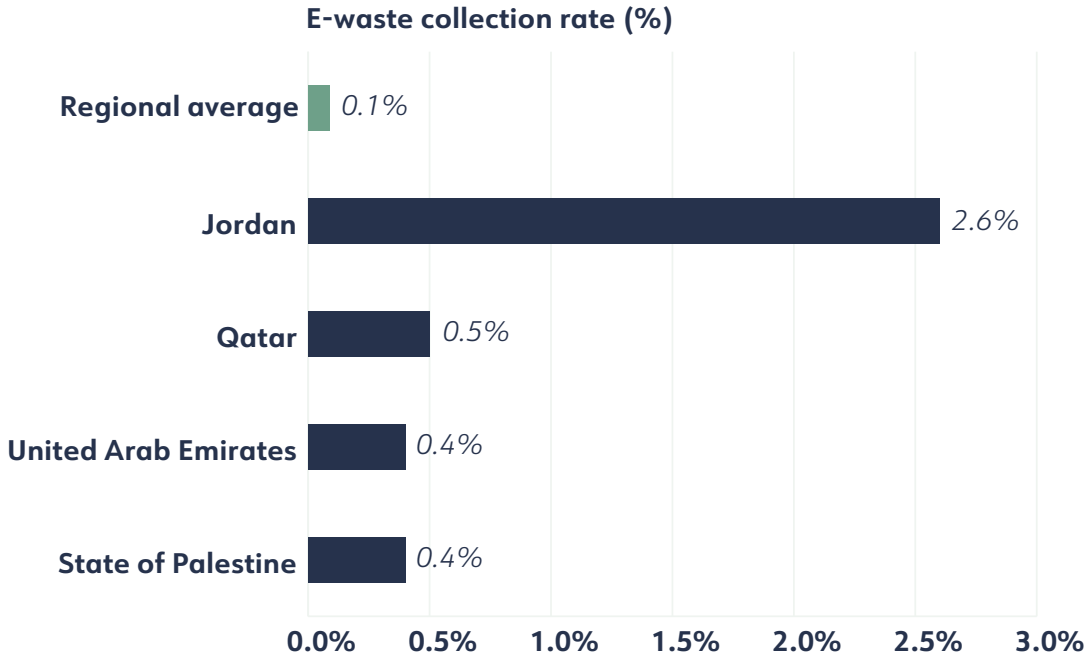


Figure 13. E-waste collection rate, as a percentage, 2019



4. TRANSBOUNDARY MOVEMENT OF E-WASTE

Several regulations at national, regional and international levels have been developed to monitor and control the transboundary movement of e-waste. The Basel Convention is the only global treaty on hazardous waste and other wastes, which encompasses e-waste. It was adopted on 22 March 1989 and entered into force on 5 May 1992. The Parties to the Convention adopted the Nairobi Declaration on the Environmentally Sound Management of Electrical and Electronic Waste in 2006 and the Cartagena Declaration on the Prevention, Minimization and Recovery of Hazardous Wastes and Other Wastes in 2011 in order to promote ESM of hazardous waste, including e-waste.

The Basel Convention defines the "hazardousness" of waste on the basis of the substances present in the waste materials, and it classifies the waste as either hazardous or non-hazardous depending on its chemical properties. The Basel Convention sets out a detailed prior informed consent procedure with strict requirements for the transboundary movement of hazardous wastes. The transboundary movement of hazardous waste and e-waste is subject to that procedure when an importing party and/or an exporting party deems the e-waste concerned to be hazardous, as determined under the provisions of its national law. The following waste subject to transboundary movement are deemed "hazardous wastes" for the purpose of the Basel Convention:

- Wastes that belong to any category contained in Annex I of the Convention, unless they do not possess any of the characteristics contained in Annex III of the Convention.
- Wastes that are not covered under the previous group but are considered to be hazardous waste by the domestic legislation of the party of export, import or transit.

It is important to note that national guidelines concerning the definition of waste may differ, and a material that is regarded as waste in one country may be considered non-waste in another country. In addition to the provisions of the Basel Convention, some parties set national threshold values to distinguish between hazardous and non-hazardous waste, including e-waste.

A. Overview of e-waste import and export legislation and policies

All Arab States are parties to the Basel Convention, which controls the transboundary movement of e-waste, among other kinds of waste.

So far, the regulation of the import and export of e-waste in the Arab States region mostly relies on the provisions of the Basel Convention, to which all Arab States reviewed are signatories[9]. Nonetheless, some Arab States, including Algeria, Egypt, Kuwait, Lebanon, the State of Palestine, Qatar and the United Arab Emirates have also issued national laws on the import and export of hazardous waste, including e-waste. In particular, Egypt has legislation that restricts the import of EEE equipment older than five years from the year of production, with the exception of some EEE in good condition, and completely prohibits the importation of e-waste. In addition, article 46 of Egypt's Telecommunication Regulation Act (No. 10/2003) prohibits the import of used telecommunication equipment for the purpose of trading (GIZ 2014a).

[9] For details on the date of ratification and entry into force for each State or territory, please see: http://www.basel.int/?tabid=4499.

Usually, exportation of e-waste in the Arab States region is conducted according to the rules of the Basel Convention. In Algeria, however, the export and transit of hazardous special waste (including e-waste) are, in all cases, subject to prior authorization by the Minister of the Environment and are permitted only under certain conditions, including:

- compliance with internationally agreed packaging and labelling rules and standards;
- the presentation of a written contract between the exporting economic operator and the processing centre;
- the presentation of an insurance contract with all the necessary financial guarantees;
- the presentation of a movement document signed by the person in charge of the cross-border transport operation;
- the presentation of a signed notification document confirming the prior consent of the competent authority of the importing country.

The import of hazardous special waste (including e-waste) is strictly prohibited in Algeria, in accordance with the provisions of Act No. 01-19 of 12 December 2001, on the management, control and disposal of waste.

Several countries, such as Jordan, Kuwait, Lebanon, Qatar, Saudi Arabia and the United Arab Emirates, prohibit the import of hazardous waste and materials but permit their export under the Basel Convention. More specifically, Jordan and Lebanon allow the export of hazardous wastes (including e-waste) under specific licensing conditions and with the authorization of the supervisory ministry. Kuwait and Qatar allow the export of such wastes under Basel Convention conditions only where no plant for recycling or treating such wastes exists within the exporting country.

B. Overview of e-waste import and export quantities

The findings from the analysis of the transboundary movement of e-waste in the Arab States region are presented in Table 3. The analysis is limited to the official reports submitted under the Basel Convention for the period 2016-2019 and therefore does not provide a comprehensive overview of all the import and export flows of e-waste in the region, especially the highly active informal sector. It must also be stressed that the analysis does not reflect the import and export of equipment declared for reuse, although many studies around the world have shown that a substantial proportion of e-waste is declared for reuse.

Despite being a formal obligation under the Basel Convention, only 13 of the 21 participating States plus the State of Palestine reported statistics on e-waste under the Basel Convention procedures. The picture of transboundary movement of e-waste in the region is therefore incomplete.

Of the 21 participating States plus the State of Palestine, 15 submitted reports under the Basel Convention between 2016 and 2019. Only 13 of the participating States submitted reports in 2018 or 2019. For Morocco and Yemen, the latest report available dates from 2017.

Despite providing annual reports under the Basel Convention, not all participating countries have data on import and export flows of hazardous waste. Statistical data were available for only 13 Arab States for 2018-2019, namely Algeria, Bahrain, Egypt, Jordan, Lebanon, Morocco, Oman, the State of Palestine, Qatar, Saudi Arabia, Tunisia, the United Arab Emirates and Yemen. Iraq and Libya reported very limited statistical data in 2016 and 2018, none of which related to e-waste.

Between 2016 and 2019, Algeria, Egypt, Qatar and the United Arab Emirates exported 1 645 t of e-waste for resource recovery and recycling.

Through the analysis described in the methodology chapter, it has been possible to evaluate the transboundary movement of certain types of e-waste in the region using the official classification system set out in the Basel Convention. The countries that reported transboundary movement of e-waste in the region are Algeria, Egypt, Qatar and the United Arab Emirates. Algeria exported 40 t of waste contaminated with mercury (A1030) to Switzerland in 2017. In 2019, Egypt exported 5 t of "waste electrical and electronic assemblies or scrap containing components such as accumulators and other batteries" (A1180) (further described as "lithium metal batteries in equipment") to Canada for ESM recycling/reclamation of metals and metal compounds (R4 in the official R-codes of the Basel Convention). Between 2016 and 2017, Qatar exported a total of 600 t of e-waste (classified as A1180 and B1110) to Singapore for ESM recycling/reclamation of metals and metal compounds (R4 in the official R-codes of the Basel Convention). In 2018, the United Arab Emirates exported 1 000 t of e-waste (A1180) (further described as "electronic scrap containing precious metals and copper compounds") to the Republic of Korea for ESM recycling/reclamation of metals and metal compounds. In total, between 2016 and 2019, 1 645 t of e-waste were exported abroad from the Arab States region.

A large portion of e-waste generated in Saudi Arabia and Qatar is exported, mainly to China and India. Even though legislation is in place to restrict the movement of hazardous wastes in the region, the near absence of recycling facilities in many countries means that waste must be managed locally within the informal sector or exported. Consequently, many countries in the region (such as Saudi Arabia and Sudan) resort to exporting e-waste for treatment abroad. Additional information provided by the Ministry of Municipality and Environment of Qatar indicates that Qatar exported 45.91 t of e-waste in 2014, 90.4 t in 2015, 248 t in 2017 and 142.9 t in 2019.

None of the Arab States that participated in the study reported cases of e-waste imports under the Basel Convention.

No documented, official imports of e-waste or any other hazardous materials from other countries were reported by any of the participating Arab States. It is worth underlining that reports submitted under the Basel Convention cover regulated and documented transboundary e-waste flows only and do not include flows of illegal e-waste or used EEE.

Table 3. Overview of officially reported transboundary movement of e-waste in the region

State/territory	National report available for 2016-2019	Statistics available	Estimate of e-waste reported under the Basel Convention[10]		Year
			Import (t)	Export (t)	
Algeria	Yes	Yes	-	40	2017
Bahrain	Yes	Yes	-	-	
Comoros	No	No	-	-	
Djibouti	No	No	-	-	
Egypt	Yes	Yes	-	5	2019
Iraq	Yes	No[11]	-	-	
Jordan	Yes	Yes	-	-	
Kuwait	No	No	-	-	
Lebanon	Yes	Yes	-	-	
Libya	Yes	No[12]	-	-	
Mauritania	No	No	-	-	
Morocco	Yes[13]	Yes	-	-	
Oman	Yes	Yes	-	-	
State of Palestine	Yes	Yes	-	-	
Qatar	Yes	Yes	-	600	Total for 2016 and 2017
Saudi Arabia	Yes	Yes	-	-	
Somalia	No	No	-	-	
Sudan	No	No	-	-	
Syrian Arab Republic	No	No	-	-	
Tunisia	Yes	Yes	-	-	
United Arab Emirates	Yes	Yes	-	1 000	2018
Yemen	Yes[14]	Yes	-	-	
Total	15 of 22	13 of 22	0	1 645	

Despite the formal steps taken to ratify the Basel Convention and the national legal frameworks and import bans in place in some countries, the enforcement of these measures continues to pose a significant challenge and reporting remains limited. Consequently, transboundary movement of e-waste in the region is challenging to map and monitor.

[10] These values do not represent the full picture of e-waste imports and exports, but rather only those declared under the Basel Convention. [11] Iraq reported only one record, for 2016. [12] Libya reported only three records, for 2018. [13] The latest available report for Morocco dates from 2017. [14] The latest available report for Yemen dates from 2017.

C. Issues and impact related to the import and export of e-waste

There is poor reporting of transboundary movement of e-waste under the Basel Convention in the region, which poses a threat to ESM of e-waste. Data on the transboundary movement of e-waste is available only for four Arab States (Algeria, Egypt, Qatar and the United Arab Emirates). This shows that, despite the formal steps taken to ratify the Basel Convention by all countries in the region and despite the enactment of national legal frameworks and import bans, the enforcement of these measures continues to pose a significant challenge in all Arab States, and the reporting remains limited. The lack of data on the transboundary movement of e-waste in the region makes the monitoring and mapping of e-waste a huge challenge. There are no official data on e-waste imports and exports for Bahrain, Comoros, Djibouti, Iraq, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, the State of Palestine, Saudi Arabia, Somalia, Sudan, the Syrian Arab Republic, Tunisia or Yemen. The non-reporting of transboundary movement of e-waste under the Basel Convention differs from the findings of this study, especially in the light of interviews with stakeholders. There is evidence that specific fractions of e-waste, such as printed circuit boards, are subject to transboundary movement within the region, but this is not reflected in reporting under the Basel Convention. In the State of Palestine, e-waste is managed primarily by the informal sector, including through illegal burning and disposal in landfills (Thöni and Matar 2019). In the State Palestine, it is estimated that 70-80 per cent of the e-waste managed comes from neighbouring countries. In Lebanon, a certain quantity of e-waste is exported as scrap, mainly by the informal sector, while a small percentage is dismantled by one company and one NGO before being sent abroad to recycling facilities.

The implication of this non-reporting under the Basel Convention is that e-waste can be moved from points where ESM cannot be assured (but is covered by better regulation) to States where value recovery using the best available technology is not guaranteed, thus giving rise to illegal shipments of e-waste within the region and beyond.

Imports of used EEE place burdens on existing e-waste management systems in recipient States, as the used EEE is often mixed with non-functional devices.

Within the region, information on the flows of used EEE imports is scarce. Only Egypt has legislation that specifically restricts the import of EEE equipment older than five years from the year of production, except for some EEE in good condition (GIZ 2014a). The Jordan Standards and Metrology Organization tests and monitors new and used EEE entering the country to ensure that it complies with health and safety standards and falls within the relevant national specifications. The Jordanian Ministry of Industry, Trade and Supply has instructions for importing electronic and electrical devices, provided that the device is no more than three years old.

In general, imports of functioning used EEE do not pose a direct problem, as such EEE will be reused by the local population. However, after some time such items will be discarded; as no fees for collection and recycling usually are paid upon import, this places an additional burden on municipalities and other relevant government agencies, which must deal with the e-waste generated without the resources to do so. The informal sector is subsequently left to handle the collection and treatment of such e-waste. Shipments of used EEE have been shown to contain a mixture of functional devices and e-waste (Odeyingbo, Nnorom and Deubzer 2017). Without EPR, recyclers would require incentives to operate profitably. To achieve this, Saudi Arabia, for example, provides exemption from taxes and incentives for formal recycling facilities.

The uncertainty over the functionality of all used EEE in a consignment before departure and upon arrival at the destination country opens up opportunities for the illegal transboundary movement of e-waste. A recent study found that consignments of used EEE shipped to a country in West Africa contained about 20 per cent non-functional used EEE (Odeyingbo, Nnorom and Deubzer 2017). In this case, used EEE are interlinked with illegal e-waste imports. Anecdotal evidence from national focal points indicates that also occurs in low and middle income countries; this is yet to be confirmed by academic research, however. To overcome this issue, port customs authorities in Kuwait implement a strict policy wherein used EEE for sale or reuse are considered e-waste and therefore cannot be imported.

5. OVERVIEW OF E-WASTE LEGISLATION AND E-WASTE MANAGEMENT SYSTEMS

This chapter provides an overview of e-waste legislation and international agreements in effect in the participating Arab States. It also focuses on the characteristics of e-waste management in eleven Arab States: Algeria, Egypt, Jordan, Lebanon, Mauritania, Oman, the State of Palestine, Qatar, Saudi Arabia, Sudan and the United Arab Emirates.

A. Status of e-waste legislation

In the Arab States region, there are no specific e-waste laws yet in place. As a consequence, e-waste can only be managed through existing legislation on general waste.

Ten of the 11 States that were part of the broader review (Algeria, Egypt, Jordan, Lebanon, Oman, Qatar, the State of Palestine, Saudi Arabia, Sudan and the United Arab Emirates) have well-developed legal and regulatory frameworks in the field of waste management and/or more specifically on hazardous waste, which should also apply to e-waste. In Algeria, e-waste is classified as special waste or special hazardous waste, pursuant to Act No. 01-19 and its implementing texts, and Executive Decree No. 09-19, on the regulation of special waste collection activity. Qatar has a comprehensive law on the treatment and disposal of hazardous waste, which prohibits the treatment and disposal of hazardous waste in facilities not properly designed to handle hazardous waste (arts. 26 and 29 (vii) of the Executive By-Law of the Environment Protection Act, issued via Decree-Law No. 30 (2002)). Along the same lines, the United Arab Emirates adopted an integrated waste management law in 2018. Lebanon adopted Decree No. 5606/2019, on the determination of the fundamentals of hazardous waste management, which lists e-waste as a type of hazardous waste, in addition to a number of ministerial decisions that regulate the collection, transport and storage of hazardous waste. In the State of Palestine, e-waste is mentioned in the 1999 Environmental Act as a component of hazardous waste, but there is no specific strategy, law or technical specifications on e-waste management (Thöni and Matar 2019). For some other countries, such as Mauritania, provisions on waste and hazardous waste are covered by general environmental law. Information on e-waste legislation in other Arab States in the region could not be assessed during the study period.

In some cases, where there is no comprehensive law on general waste, e-waste and other hazardous waste is treated in the same way as municipal waste.

Countries with well-developed legal and regulatory frameworks for waste or hazardous waste can apply existing legislative provisions – especially those on hazardous waste management – to e-waste, even where such provisions do not mention e-waste. States without a comprehensive law on general waste, such as Mauritania, leave all e-waste and other hazardous waste to be treated alongside municipal waste.

Only the United Arab Emirates has introduced the principle of EPR as of 2021. Jordan and Lebanon are in the process of establishing EPR regulations. No other country or territory in the region has implemented or drafted legislation on an EPR system for e-waste.

The United Arab Emirates is the only country in the region that has addressed the principle of EPR for e-waste and batteries waste, which is set out in Cabinet Decree No. 39 of 2021. In addition, the country is working to issue an integrated waste management strategy that includes EPR as a component. In Jordan, the Ministry of Environment is in the process of establishing an EPR system for e-waste as part of a project supported by international donors[15]. The adoption of EPR for e-waste is also envisioned in Lebanon in its 2019 national strategy for integrated solid waste management. In Algeria, the Ministry of the Environment intends to introduce an EPR system for general waste, including e-waste, during the revision of Act No. 01-19. (See Table 4.)

Several countries have adopted, or are in the process of adopting, ESM standards or policies for waste in general. Jordan has issued a policy on e-waste management specifically, while Bahrain, Sudan and Qatar are in the drafting phase.

Although no country or territory in the region has e-waste-specific legislation, some countries, such as Algeria and Egypt, have detailed national waste management policies that contain provisions on preventing and reducing the production of harmful waste at source and on sorting, collecting, transporting and treating waste via recovery through reuse and recycling using ESM. These countries also have provisions on increasing public enlightenment and awareness of the risks presented by waste and its impact on health and the environment. Egypt actively encourages companies in the waste sector to work towards achieving the family of ISO 14000 standards on environmental management systems and to promote waste recycling in order to preserve natural resources (Info-Prod Research n.d.). The family of ISO 14000 standards was created to help companies reduce industrial waste and environmental damage and to promote environmental management systems within organizations.

An instruction issued by the Jordanian Ministry of the Environment to ensure the sound management of e-waste was approved on 16 February 2021 and entered into force on 17 May 2021. The instruction applies to small and household appliances, IT and telecommunication equipment and consumer equipment, among other thing, which can no longer be disposed of as general waste (Trevor 2021; Compliance and Risks 2021). The Algerian Ministry of the Environment is in the process of finalizing a draft decree to define the modalities for the management of e-waste. In Bahrain and Sudan, a proposal on e-waste management is under development. Similarly, Qatar has drafted legislation on e-waste management, which is currently under review by the Prime Minister's review committee. Qatar is in the process of establishing a team to manage e-waste from a health and safety perspective, comprising representatives from various national agencies, including the Ministry of Commerce and Industry, the General Customs Authority, the Ministry of Public Health, the Ministry of Municipalities and the Environment and the Planning and Statistics Authority.

[15] See: https://procurement-notices.undp.org/view_notice.cfm?notice_id=79825.

Lebanon's proposed national strategy on integrated solid waste management national strategy sets separate collection targets for e-waste: a minimum of 2 kg per capita per year within two years of the introduction of the strategy, and a minimum of 4 kg per capita per year within five years of its introduction. The strategy has been submitted by the Ministry of the Environment to the Council of Ministers and will come into force once adopted.

In Saudi Arabia, a draft regulation on ESM of waste (including e-waste) to promote environmental sustainability and preserve public health and human well-being is under consideration[16]. The draft regulation imposes certain obligations and fees on manufacturers and establishes a national centre for waste management responsible for issuing licences and permits for waste treatments centres (Compliance and Risks 2020). Lastly, the United Arab Emirates enacted a law on integrated waste management in 2018, which applies to e-waste.

The United Arab Emirates has adopted an extended producer responsibility legislation on e-waste since 2021, whereas Jordan and Lebanon are in the drafting phase. Several countries are in the process of adopting environmentally sound management standards for e-waste.

[16] The draft regulation covers waste batteries, hazardous waste, industrial waste (both hazardous and non-hazardous), construction and demolition waste, municipal solid waste, agricultural waste, medical waste, sewage and waste tyres, among other things. Nuclear and radioactive waste are not covered.

Table 4. Presence of e-waste-specific legislation, EPR for e-waste and standards or policies on ESM of e-waste

State/territory	Legislation/regulation specific to e-waste	EPR for e-waste	Standards/policies for ESM of e-waste
Algeria	✗	✗	⚙
Bahrain	✗	✗	⚙
Comoros	✗	✗	✗
Djibouti	✗	✗	✗
Egypt	✗	✗	✗
Iraq	✗	✗	✗
Jordan	✗	⚙	✓
Kuwait	✗	✗	✗
Lebanon	✗	⚙	⚙
Libya	✗	✗	✗
Mauritania	✗	✗	✗
Morocco	✗	✗	✗
Oman	✗	✗	✗
State of Palestine	✗	✗	✗
Qatar	✗	✗	⚙
Saudi Arabia	✗	✗	⚙
Somalia	✗	✗	✗
Sudan	✗	✗	⚙
Syrian Arab Republic	✗	✗	✗
Tunisia	✗	✗	✗
United Arab Emirates	✗	✓	✓
Yemen	✗	✗	✗

⚙ draft stage ✓ present ✗ absent

B. International agreements

There are several international instruments related to e-waste which countries in the region are implementing or have acceded to. These range from multilateral environmental agreements to agreements on restricting the use of hazardous substances in manufacturing or promoting the circular economy. Table 5 provides a summary of all international agreements related to e-waste that have been signed and ratified by the Arab States.

All the Arab States have ratified the Basel Convention and the Stockholm Convention, and almost all (with the exception of Egypt and Comoros) have ratified the Rotterdam Convention. Twelve Arab States have ratified the Minamata Convention.

All Arab States have acceded to two of the three major multilateral environmental agreements relevant to e-waste issues: the Basel Convention and the Stockholm Convention. All 21 Arab States, plus the State of Palestine, are parties to the Basel Convention, and 20 are parties to the Rotterdam Convention. Comoros and Egypt are yet to sign and ratify the Rotterdam Convention.

Algeria, Bahrain, Egypt and Somalia are yet to sign the Minamata Convention. Iraq, Libya, Morocco, Sudan, Tunisia and Yemen have all signed the Minamata Convention but have yet to complete the ratification process. The other 11 countries in the Arab States region (Comoros, Djibouti, Jordan, Kuwait, Lebanon, Mauritania, Oman, Qatar, Saudi Arabia, the Syrian Arab Republic and the United Arab Emirates), plus the State of Palestine, have ratified the Minamata Convention. The Convention entered into force in August 2017 and applies to e-waste issues; in fact, the production, import and export of a list of mercury-containing goods, including EEE (mercury is used in LCD screens, televisions, laptops and fluorescent lights, among other things) are prohibited pursuant to the Convention.

Table 5. Overview of the status of ratification of international agreements

	International Agreements			
	Basel Convention	Rotterdam Convention	Stockholm Convention	Minamata Convention
Algeria	✓	✓	✓	✗
Bahrain	✓	✓	✓	✗
Comoros	✓		✓	✓
Djibouti	✓	✓	✓	✓
Egypt	✓		✓	✗
Iraq	✓	✓	✓	⚙
Jordan	✓	✓	✓	✓
Kuwait	✓	✓	✓	✓
Lebanon	✓	✓	✓	✓
Libya	✓	✓	✓	⚙
Mauritania	✓	✓	✓	✓
Morocco	✓	✓	✓	⚙
Oman	✓	✓	✓	✓
State of Palestine	✓	✓	✓	✓
Qatar	✓	✓	✓	✓
Saudi Arabia	✓	✓	✓	✓
Somalia	✓	✓	✓	✗
Sudan	✓	✓	✓	⚙
Syrian Arab Republic	✓	✓	✓	✓
Tunisia	✓	✓	✓	⚙
United Arab Emirates	✓	✓	✓	✓
Yemen	✓	✓	✓	⚙

✓ Party ⚙ Signatory ✗ not Party; not Signatory

C. Mapping of key stakeholders

In all the Arab States studied, governmental ministries and agencies are in charge of waste management nationally and at municipal and state levels. Their main responsibility is to propose legislations and regulations on waste management and to monitor and enforce their application. Producers, importers, retailers and consumers of EEE constitute major stakeholders, alongside collectors/recyclers and informal operators involved in e-waste. NGOs and other private and civil society organizations are also very active in the waste management sector, especially in building awareness of issues. All these stakeholders are described in more detail below.

Ministries of the environment take the lead on waste legislation. In some Arab States, these ministries, together with other ministries and/or municipal authorities, are responsible for monitoring and enforcing compliance with the laws and regulations in force.

In many Arab States, including Algeria, Egypt, Jordan, Lebanon, Mauritania, Oman, the State of Palestine, Qatar, Saudi Arabia, Sudan and the United Arab Emirates, the regulatory authority responsible for waste management is the national ministry of the environment. These ministries develop and propose elements of national policy and legislation on the environment, including waste management, and ensure their implementation, often in collaboration with other authorities, including the ministries of industry, post, telecommunications and the interior, local governments, municipal authorities, customs authorities and the police. In Lebanon, in addition to the Ministry of the Environment, the Ministry of the Interior and municipal authorities also issue regulations on waste management. In some Arab States, the ministry of the environment and municipal authorities are also responsible for monitoring and enforcing compliance with the laws and regulations in force. They propose, draft and ensure the implementation of environmental policies and regulations related to the prevention and control of pollution and waste management in general. In some States and territories, this responsibility is handled by agencies under the ministry of the environment. For instance, in Egypt, the Waste Management Regulator Agency under the Ministry of the Environment governs the management of solid waste, including collection, transportation, treatment, storage and disposal of solid waste in all governorates and municipalities; meanwhile, the implementation of a collection system is the responsibility of local governments.

Producers and importers play a minimal role in e-waste collection in the region owing to the absence of EPR systems.

Most Arab States depend on imported EEE, both brand new and used, thereby minimizing the direct participation of manufacturers in regional e-waste management owing to the lack of EPR systems in place. However, importers and retailers work voluntarily with their respective associations to contribute towards proper e-waste management and are active in the collection of e-waste in Arab States where take-back systems exist. Owing to the absence of EPR and e-waste management systems across most of the region, however, producers, importers and retailers have no legally assigned roles or responsibilities. Voluntary mechanisms exists, with formal take-back

systems more commonly in operation (e.g. in Qatar). However, in the majority of cases, e-waste ends up in the hands of scrap traders or is sent straight to landfill.

Most e-waste is either handed over to informal e-waste collectors who travel house to house or is collected by general, non-separated municipal waste systems.
Consumers — both large-scale (commercial and public sector) and individuals (households) — are major stakeholders, given that they decide how and when e-waste is generated and discarded. In the absence of formal ESM-based management system, however, consumers must deal with informal operators. There are no schemes to oblige consumers to pay for the collection and treatment of e-waste in the region, especially when purchasing new equipment. Consequently, there is no funding to cover the cost of e-waste collection and recycling services, which discourages formal operators. The prevailing conditions in the region leave consumers with the sole option of using informal collectors or general waste management services that collect e-waste mixed with other types of general waste. This is made easier by the fact that informal operators travel door to door within municipalities to collect e-waste. In some Arab States such as Qatar, consumers can voluntarily deliver e-waste to designated collection points.

Formal environmentally sound e-waste collection exists only in a few Arab States.
Formal collection of e-waste take place in a few Arab States, namely Jordan, Qatar and the United Arab Emirates. In Qatar, for instance, e-waste is collected from residential areas through announced plans organized in coordination with the competent authorities, such as the Ministry of Municipalities and the Environment. E-waste from government offices, industrial and commercial facilities and other sectors is collected through agreements between a licensed private collector and the concerned generator of the e-waste. These agreements are audited and monitored by engineers and inspection teams from the Hazardous Waste Section of the Department of Radiation and Chemical Protection within the Ministry of Municipalities and the Environment. The Qatar Foundation organizes an annual "Qatar Sustainability Week", during which it encourages members of the community to recycle e-waste by depositing it at designated collection points in Education City. During the 2020 event, the Qatar Foundation received more than 4.5 t of e-waste over the course of just seven days (Qatar Living 2020). The e-waste collected during the event is sorted, labelled and packaged at a designated facility (owned by Al Haya Waste Management and Projects Company) and then shipped to recycling facilities in Singapore (Ibrahim 2020).

In the United Arab Emirates, e-waste is collected by municipal authorities and through voluntary disposal at formal collection points (known as United Arab Emirates waste collection centres). In addition, the United Arab Emirates hosts the only e-waste recycling and processing facility in Africa and the Middle East, with a private investment in a state-of-the art plant run by Enviroserve[17]. The facility has the capacity to process 40 kt of e-waste per year across the entire range of e-waste (with the exception of refrigerators). However, owing to a lack of support programmes and the very recent introduction of EPR, a huge portion of e-waste continues to be routed through the informal sector (approximately 20 per cent) or to landfill.

[17] For more information, see: https://enviroserve.org/.

In 2019-2020, the Ministry of the Environment in Jordan started licensing companies for e-waste collection and recycling. Official letters were issued by the Ministry of the Environment in an attempt to control the processing of e-waste, starting from generation and ending with disposal. Seven companies are currently licensed to collect (including from informal collectors) and dismantle e-waste for export in accordance with the Basel Convention rules.

Some recyclers in the region accept e-waste fractions but focus more on other waste streams, while in other States new facilities are under development.

Recyclers that accept e-waste (or fractions of e-waste) are also present in the region (e.g. in Egypt, Lebanon, Oman and Saudi Arabia), but they tend to focus more on a number of other waste streams (e.g. plastic, paper, glass, metal, tyres or oils). For instance, Egypt has seven licensed e-waste recycling companies, but no quantitative information on the amount of e-waste that they collect and manage could be obtained. The e-waste categories most commonly recycled in Egypt are temperature exchange equipment, printed circuit boards and mercury-containing lamps. Lebanon has 33 formal recycling companies for a number of waste streams (e.g. plastics, paper and glass) but none for e-waste, and only a small quantity of this specific waste stream is dismantled, which is performed by one company and one NGO in the country. Some Arab States, such as Algeria and Oman, collect and export e-waste, while also storing some in preparation for the establishment of treatment facilities for ESM of e-waste. In Algeria, collectors approved by the Ministry of the Environment select and collect separately some specific categories of e-waste (e.g. printed circuit boards) to be exported by authorized exporters. In Oman, the Oman Environmental Services Holding Co. (known as Be'ah) is developing a collection scheme and a recycling facility for e-waste. Presently, Be'ah is storing e-waste in a special storage facility, but no formal e-waste recycling currently takes place. Evergreen Gulf Recycling Hub is constructing a major e-scrap facility (which is approximately 85 per cent complete) in Dhofar Governorate, Oman. The facility will have an annual processing capacity of about 10 000 t and will allow the country to adopt a processing and recovery approach for e-waste management, rather than sending e-waste to landfill or exporting waste abroad.

Informal operators lead the way in e-waste management in the region.

The e-waste management system in the Arab States region is mainly dominated by the informal sector, in both high and low income countries. The absence of e-waste-specific legislation, EPR and formal recycling facilities in most countries in the region are the main drivers of informal activity. However,

in some Arab States that have a formal sector (e.g. Jordan, Qatar and the United Arab Emirates), the formal sector coexists with the informal sector.

For instance, the Jordanian Ministry of the Environment is working to ensure that all informal e-waste collectors and operators obtain licences, in accordance with the law. In this regard, an initiative for e-waste collection and recycling proposed by Enviroserve-Jordan is awaiting approval by the Jordanian authorities.

The absence of assigned responsibilities encourages the informal sector to handle the collection of e-waste for the purpose of recovering materials (e.g. copper, aluminium and lead). Hazardous fractions are either dumped, resulting in environmental pollution and human exposure to toxins, or disposed of with municipal waste (Arab News 2012). The recovered valuables are exported or sold to operators of crude recycling.

The main actors in the region are informal scrap dealers and waste pickers that collect both ferrous and non-ferrous waste and mainly operate door to door.

The existing infrastructure in the region is grossly insufficient for ESM of the huge quantities of e-waste generated. This consequently facilitates the transboundary movement of certain fractions of e-waste both within the region and to established recyclers outside the region. In some cases, consumers voluntarily dispose of e-waste at informal collection points.

In 2019, in a preliminary baseline assessment of e-waste (not yet published at the time of writing), the United Nations Industrial Development Organization, in coordination with the Lebanese Ministry of Industry, conducted a survey of 619 households in the Beirut and Mount Lebanon regions of Lebanon and 31 businesses and institutions across the country. The survey showed that an estimated 15 per cent of e-waste in households and 12 per cent in institutions and businesses was disposed of alongside regular waste. The remainder of the e-waste was discarded in various ways; most was given to scrap dealers, the majority of whom operated informally (22 per cent among households, 33 per cent among institutions and businesses). Only 5 per cent of e-waste in households and 19 per cent in institutions and businesses was sent to specialized e-waste processors.

The Palestinian Central Bureau of Statistics estimates that almost the entire volume of e-waste in the State of Palestine is managed by the informal sector (using a door-to-door approach), with approximately 200 informal workshops and facilities present in the territory. Between 70 and 80 per cent of treated e-waste in the State of Palestine comes from illegal and unregistered movements and is then recycled, illegally burnt or disposed of in landfills in the State of Palestine, with the active participation of workers under the age of 18 (Thöni and Matar 2019). In 2020, the European-Palestinian Centre for Electronic Waste Recycling was established with funding from the European Union. The Naqaa Association for Recycling Electronic Waste – a cooperative association of 17 licensed owners of informal e-waste recycling establishments – was also set up to manage the Centre. In addition, three factories are in the process of being licensed to recycle e-waste.

The existing infrastructure is insufficient to deal with the quantities of e-waste generated in the region. However, in some States new facilities are under development and there are initiatives supporting waste management.

In a 2014 assessment conducted in Sudan, it was found that e-waste scrap was commonly broken apart to recover copper, aluminium, lead and other metals; this has become increasingly common in the last decade, especially among young people. This practice has harmful consequences for both workers and the environment. Copper wire coated in polyvinyl chloride (PVC) was also commonly burned by children, in particular homeless children, at dumping sites to extract brass and other elements, which were then sold to garbage sellers (Bannaga Consult 2014).

Repair and refurbishment of end-of-life EEE for export is also common in the region.

In the region, the refurbishment of disposed EEE at end of life is handled by the informal sector. In the wealthier Arab States, especially in western Asia, large numbers of migrant workers reuse or repair donated used EEE from wealthy households for later export (Forti et al. 2020). In Qatar, a local licensed private company is involved in collecting and exporting e-waste generated in the country. The company collects computers, monitors, copiers, fax machines, printers, televisions and other EEE once they become obsolete. After testing, 8 to 12 per cent of used EEE collected in Qatar is deemed suitable for refurbishment. This used EEE is offered for free to labourers, who refurbished the EEE and subsequently return it to use. Any non-refurbished equipment is exported to recycling facilities abroad after inspection and approval by the Department of Radiation and Chemical Protection of the Ministry of Municipalities and the Environment. The provisions of the Basel Convention are followed in the shipping of e-waste. In 2018, the Qatari Ministry of Transport and Communications launched the Green Computer Club initiative in association with the Ministry of Education and Higher Education and

the Ministry of Municipalities and the Environment. The initiative enables employers to provide free ICT tools and Internet access to migrant workers in their accommodation with the aim of integrating them into the digital community (The Peninsula 2018). Green Computer Club, which are based out of secondary schools, refurbish and upgrade used computers (donated by ministries and organizations) using licences donated by Microsoft. The computers are installed at ICT facilities in accommodation units for migrant workers countywide. Unlimited Internet connectivity is provided by Vodafone. In addition to educational and environmental benefits, this initiative increases students' awareness of social responsibility and e-waste management, recycling and green technology (Qatar, Ministry of Transport 2018). The initiative, which targets the 1.5 million migrant workers in Qatar, is designed with the aim of building a knowledge-based economy (Qatar, Ministry of Transport n.d.). The initiative aims to establish 1 500 ICT facilities across Qatar by the end of 2018 and to refurbish 15 000 computers by the end of 2019 (Better Connections n.d.). E-waste produced in the refurbishment process is managed by Alhya Enviro.

Initiatives run by NGOs and donor agencies support waste management in the region.

In some countries in the Arab States region (e.g. Lebanon and Sudan), plus the State of Palestine, NGOs, cooperatives and the private sector are actively involved in waste management.

For instance, in Lebanon, a partnership between NGOs and the Lebanese IT Syndicate (which represents the Lebanese IT community) is under development with the aim of improving the management of e-waste from small IT and communication equipment.

6. ASSESSMENT OF E-WASTE LEGISLATION AND MANAGEMENT

The absence of e-waste legislation, combined with lack of collection and treatment infrastructure, hinders the collection of e-waste in the Arab States.

This chapter assesses e-waste legislation and management in Algeria, Egypt, Jordan, Lebanon, Mauritania, Oman, the State of Palestine, Qatar, Saudi Arabia, Sudan and the United Arab Emirates in order to provide an overview for the region. The outcomes are summarized in Table 6, which presents a dashboard of indicators for legislation, infrastructure, collection rates and quantities of e-waste generation. The scores for each individual State and territory can be found in Annex IV.

As can be seen in Table 6, while the Arab States generate less e-waste per inhabitant than the European Union, they also have a less developed framework for e-waste legislation and e-waste management infrastructure. The lack of legislation and infrastructure explains why the Arab States have a collection rate below 1 per cent and why most e-waste is unmanaged. In contrast, in the European Union, where e-waste management legislation and infrastructure are advanced, the e-waste collection rate is 50 per cent.

Jordan has the highest reported collection rate, at 2.6 per cent, and achieved a score of advanced or in transition for three of the five indicators for legislation. The degree to which the legal framework and e-waste collection is enforced in Jordan can therefore be said to be stronger than the average in the region.

The United Arab Emirates reported a collection rate of 0.06 kg/inh, or 0.4 per cent of all e-waste. Nonetheless, it has the most developed e-waste collection infrastructure in the region, with good coverage of e-waste collection points and e-waste treatment capacity. Further work is needed to enforce e-waste law in the country, in particular the recent introduction of EPR. The full list of products to be covered by EPR is still under definition, however.

All other States in the region have limited e-waste legislation and management infrastructure, resulting in e-waste collection rates below 1 per cent. Egypt has a relatively advanced management infrastructure compared with many other countries in the region, but no quantitative data could be obtained on performance, and the Egyptian legislature has yet to develop a legislative framework for e-waste. Oman, Qatar and Saudi Arabia are on, or nearly on, par with the EU average in terms of e-waste generation. Algeria is in the process of developing a legislative framework for e-waste management standards, but it does not have a treatment infrastructure at the moment, and collection points are available only in main cities. Mauritania, Sudan and the State of Palestine have no e-waste legislation or infrastructure; however, they generate very little e-waste (less than 4 kg/inh).

Table 6. Dashboard of e-waste management system and performance[18]

Region/State/ territory	Legislation (5 indicators)	Infrastructure (2 indicators)	Collection Rate	E-waste Generated
EU-27	●●●●●	●●	●●●●●	●●●●●●●●●
Arab region	●◕○○○	◕○	○	●●●◐
Saudi Arabia	●◕○○○	●○	○	●●●●●●●●◑
Oman	●○○○○	◕○	○	●●●●●●●●
United Arab Emirates	●●○○○	●●	○	●●●●●●●◐
Qatar	●◕○○○	●○	○	●●●●●●◑
Lebanon	●◕◕◕○	◕○	○	●●●●
Algeria	◕○○○○	◕○	○	●●●◐
Egypt	○○○○○	●◕	○	●●●
Jordan	●●◕○○	◕○	◐	●●◑
State of Palestine	●○○○○	◕○	○	●●
Sudan	●◕○○○	◕○	○	●
Mauritania	●○○○○	○○	○	◑

For Legislation and Infrastructure: ● indicates advanced , ◕ transitional, ○ basic, and ○ unknown.
For Collection Rate: ● indicates 10%, ◐ 7.5%, ◐ 5%, ◐ 2.5%, ○ less than 1%.
For E-waste Generated: ● indicates 2 kg/inh, ◐ 1.5 kg/inh, ◐ 1 kg/inh, ◐ 0.5 kg/inh.

Notes:
> EU-27 = the 27 member States of the European Union.
> All data are for the year 2019, with the exception of Jordan and EU-27, for which the data are for the year 2018.

[18] Countries in the Arab States region have been ordered on the basis of the number of indicators for which a score was obtained. The ranking does not represent judgment of the overall performance of the country or territory.

7. COMMON ISSUES AND CHALLENGES

Most e-waste generated in the region (99 per cent) is not collected and managed using facilities that guarantee ESM. Rather most e-waste is sent to landfill or is collected by the informal sector, which strips the waste of valuable components, leaving the plastics and hazardous fractions to be dumped. Jordan collects and recycles most e-waste (2.6 per cent) in the region.
Although the 21 countries in the region, plus the State of Palestine, have very diverse profiles and economic and societal features, some common issues and challenges have been identified. From the information collected, as a whole the region collects and treats only about 0.1 per cent (2.2 kt; 0.01 kg/inh) of e-waste generated in the region at ESM facilities. Consequently, most e-waste generated in the region (more than 99 percent) is not collected and is not sent to facilities that guarantee ESM. The main factor contributing to this poor performance is the low rate of e-waste collection. The near absence of infrastructure for formal collection and recycling in most Arab States, paired with a lack of awareness among the general population of the dangers of using inappropriate approaches to manage e-waste, are also key factors. Separate collection of e-waste and the use of designated collection centres is almost non-existent in the region. The absence of specific e-waste legislation and the weak enforcement of existing legislation and regulations on hazardous waste mean that e-waste is generally disposed of with general waste before any take-back processes for ESM can be initiated. To date, mandatory disposal of e-waste with licensed collectors and processors is completely absent. The situation is further complicated by the fact that in some Arab States, significant amounts of e-waste are collected by the informal sector, which is a consequence of the absence of any formal recycling scheme. The informal sector is driven by the existence of large amounts of e-waste and by the margins that can be made by harvesting valuables, such as gold or palladium, from e-waste, even without proper recycling systems in place. This sector therefore primarily focuses on dismantling e-waste and retrieving the most valuable and attractive components, mostly for export; the remaining components are disposed of in municipal landfills.

SIX DRIVING REASONS HAVE BEEN IDENTIFIED AS TO WHY E-WASTE COLLECTION RATES IN THE REGION REMAIN LOW:

Driver 1: Increasing volumes of e-waste

In the Arab States region, e-waste generation grew by 61 per cent between 2010 and 2019, a faster growth rate than that seen at global level.
In general, there is an increase in the amount of e-waste generated in the region owing to increased demand for EEE. E-waste generation in the region increased from 1.8 Mt (4.9 kg/inh) in 2010 to 2.8 kt (6.6 kg/inh) in 2019, representing a growth rate of 61 per cent. The growth rate of e-waste generation in the Arab States region is higher than that in both the Commonwealth and Independent States region (50 per cent) and the Latin America region (56 per cent) (Baldé et al. 2021; Wagner et al. 2021). At global level, the growth rate is 52 per cent. The e-waste collection rate in the region was 0.1 per cent in 2019. The quantity of e-waste generated is expected to grow further over the coming decades as the region develops and the middle class population grows. If collection rates do not substantially improve, the absolute quantity

of unmanaged e-waste will also further increase, with detrimental consequences for human health and the environment.

Driver 2: Absence of e-waste-specific legislation

Specific legislation on e-waste collection and ESM is lacking in the region.

Very few States in the region have the prerequisite framework for ESM of e-waste. Most e-waste is managed within general hazardous waste management regimes, as none of the Arab States have specific legislation on e-waste, EPR and/or environmental health and safety standards, with the exception of the United Arab Emirates, which introduced EPR legislation in 2021. Many Arab States do not, therefore, have sufficient e-waste collection points or processing facilities, which makes it impossible to collect all e-waste for ESM.

If there are no appropriate legal instruments in place, or if they are not properly enforced, then e-waste collection will be limited. While e-waste-specific regulations are lacking in all Arab States, regulatory texts that define the procedures for the management of special waste, including electronic waste, allow for monitoring and control in some States. Although some Arab States are currently drafting such legislation, EPR systems are, so far, absent in all the States in the region, with the exception of the United Arab Emirates. The lack of political will to enforce existing regulations on hazardous waste management also contributes to the persistence of e-waste in the region.

Driver 3: Limitations of management infrastructure

E-waste-specific collection centres and treatment facilities are insufficient in many Arab States.

Most Arab States lack organized e-waste collection and treatment facilities. For the few States with an existing formal collection system, the inadequacy of e-waste-specific collection bins and collection points remains a challenge. Often, e-waste collection centres are located only in the main cities. The near absence of formal treatment facilities in the region, either specifically for e-waste or that accept some e-waste fractions, could be linked to a lack of awareness among companies and investors or the perception that they cannot compete with the informal sector, which is always cheaper. Other possible explanations relate to the high energy costs of treating e-waste and the complexity of the e-waste stream, which comprises various types of materials (including complex plastics). With the absence of formal collection and treatment systems, there is no incentive for e-waste to be collected and treated.

The shortages in basic e-waste management infrastructures makes it easier for the informal sector to thrive, as it is more efficient at providing door-to-door collection of e-waste, which is typically the approach preferred by consumers as it is more convenient and presents no cost – in fact, financial reward can be obtained from collectors for certain categories of e-waste. As a result, more e-waste is routed towards the informal sector. Formal e-waste management in the region is therefore undermined primarily owing to the lack of public awareness regarding the hazards of improperly managing e-waste. Presently, no official system of e-waste collection and treatment exist in the region, with the exception of the United Arab Emirates, which has sufficient collection points and a formal recycling facility.

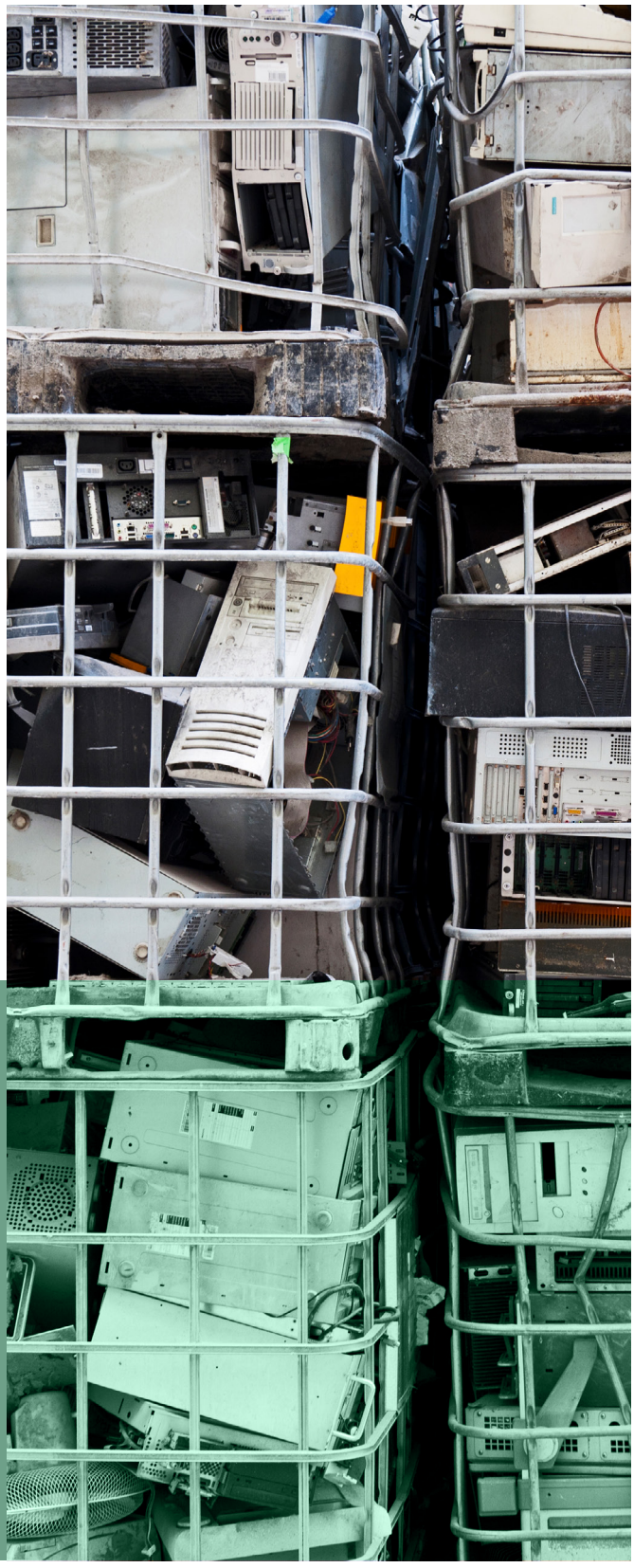
ESM treatment and recycling infrastructure at national level is not sufficient to manage the level of e-waste generated in the region. Only a small fraction of collected e-waste is treated domestically, and some is exported for recycling.

Most States in the region do not have e-waste depollution facilities or recycling infrastructure. Existing companies are involved only in the preliminary processing of e-waste and are often restricted to dismantling and selling the more commercially attractive fractions. Only a few operators in the region registered as "e-waste recycling" companies perform deep treatment, in which not only the precious metals, but also all the other useful fractions, such as bulk metals, are extracted. In general, e-waste is mostly handled by the informal sector or treated alongside other categories of waste. In addition, many Arab States lack separation mechanisms and recycling infrastructure. The challenge is multipronged in most States where the e-waste management sector lacks human experience, skills and training, as well as the necessary infrastructure and financial resources. The prevalence of the informal sector and the lack of regulations in the region mean that e-waste is often diverted to informal trade and landfill. By making use of the e-waste processing capacity developed in the United Arab Emirates and by supporting the full establishment of other e-waste recycling and processing companies in the region, the proportion of e-waste collected for ESM could be increased.

Driver 4: Competition between formal and informal sectors for valuable components of e-waste

The informal sector collects more e-waste and focuses more on valuable components, while the hazardous fractions and less valuable components are often sent to landfill.

Within the Arab States region, informal treatment or landfilling of e-waste is a common practice, despite being illegal in some of States. Informal recycling thrives as it is associated with lower operating costs than official waste processors. Formal operators are known to be at a disadvantage compared with the informal sector, owing to the significant cost of investment required to set up



recycling infrastructure and the bureaucracy involved in licensing and in meeting regulatory requirements. In addition, there are no legal or regulatory frameworks to stimulate the development and enhancement of formal operators in many States in the region. Consequently, the informal sector appears to thrive, receiving more materials than formal recyclers.

Driver 5: Legal and illegal import and export issues

Informal operators drive flows of e-waste across borders owing to an absence of legislation and to lax enforcement of generic hazardous waste legislation.

The absence of the prerequisite frameworks for ESM of e-waste (including e-waste specific legislation and EPR, environmental health and safety standards, collection mechanisms and recycling infrastructure) in the region and the lax enforcement of existing legislation on waste management are driving flows of e-waste within and beyond the region. In some countries, most e-waste is exported, leading to the loss of its potential value. There are reported cases of illegal transboundary movement of cathode ray tube screens and other e-waste fractions within the region. These activities are a consequence of the insufficient enforcement of existing legislation restricting the illegal transboundary movement of e-waste.

Driver 6: Compilation of e-waste statistics is a recent development in many countries

The compilation of e-waste statistics is still developing in many Arab States. Relatively few States in the region have reliable data on EEE POM, e-waste generated and e-waste formally collected and treated.

Data compilation on e-waste is still developing in many Arab States and remains non-existent in others. While some countries have been successful in compiling core e-waste data, such as quantities of EEE POM, e-waste generated and formal collection of e-waste, others continue to move at a slower pace. One of the main

challenges faced in this study was the significant gap between e-waste generation and e-waste collection. Statistics on other flows, on e-waste entering landfills, on the activities of the informal sector, on mixing of e-waste with other recyclable waste (such as metal scrap), on e-waste export and imports and on the likely fate and destination of informally collected e-waste are not well quantified. For instance, the e-waste sector in the region is not yet regulated and controlled, and the governments do not have yet a comprehensive national inventories of e-waste generated and collected and of management routes. In most of the region, e-waste continues to be disposed of alongside municipal solid waste or managed informally. Some initiatives on ESM of e-waste have been launched in several countries (e.g. Egypt, Jordan, Lebanon, Qatar and the United Arab Emirates), but ESM of e-waste remains unorganized and unregulated. In many countries, e-waste generated is not reported to the local authorities.

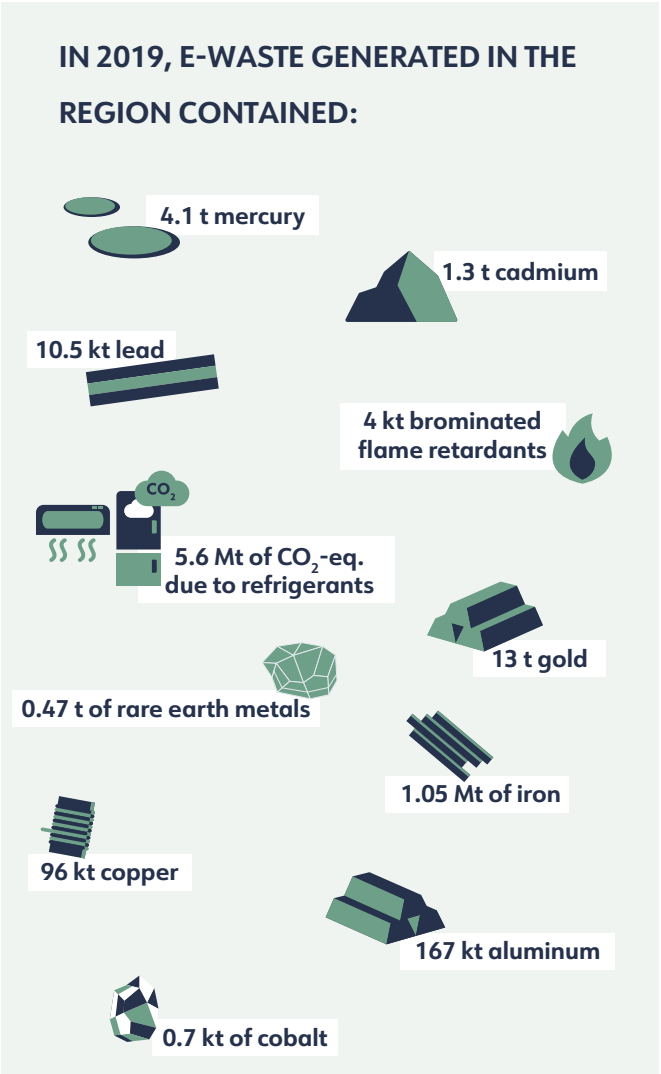
The lack of reliable e-waste data in the region makes it hard to design fact-based interventions to improve the collection of e-waste or to perform a realistic assessment of the environmental impact of the sector and of the losses of secondary resources through non-adoption of ESM.

For most countries, the official e-waste statistics do not represent the entire picture, which represents a missed opportunity to understand the true situation of the sector and the whereabouts of the majority of e-waste. It also makes it difficult to understand the markets, financial incentives and behaviours of consumers and e-waste managers. This lack of information limits the ability to design fact-based interventions to increase e-waste collection and recycling and to return more secondary raw materials back into the economy, thereby reducing the associated environmental impact. Reliable statistics on the amount of e-waste generated are required to enable investors, recyclers and companies to plan how to enhance the concept of recycling.

THE IMPACT ON THE ENVIRONMENT, OCCUPATIONAL HEALTH AND RESOURCE MANAGEMENT IS DISCUSSED BELOW.

Impact 1: On the environment and on resources management

The majority of e-waste is sent to landfills or collected by the informal sector, causing damage to the environment as hazardous substances are released during inappropriate recycling practices. Waste recycling performed by the informal sector could allow hazardous fractions to re-enter production.



As a result of the lapses observed in the region, some e-waste fractions sent to landfill and/or managed through other non-formal routes could cause immediate and long-term harm to the population and the environment. The non-formal recycling of e-waste performed before waste reaches landfills or at the landfill sites themselves could allow hazardous waste fractions to re-enter recycling loops, instead of being disposed of in an environmentally sound manner.

E-waste contains hazardous substances such as cadmium, lead, mercury and brominated flame retardants, which can leak into the environment. Refrigerants in temperature exchange equipment can also be emitted directly into the environment, thereby contributing to the emissions of greenhouse gases.

E-waste generated in the region contains USD 3 billion of valuable materials. Unmanaged e-waste represents a loss of potential resources.

E-waste also contains valuable materials, such as platinum metal group metals, rare earth metals and other base metals. If sent to landfill, these materials cannot be recycled and used as a secondary resource. When monetized using the prices from refined metals, the e-waste generated in 2019 had a value of USD 3 billion.

Impact 2: On occupational and community health

Activities conducted by informal operators have a negative impact on the health of workers in the sector and on the community.

The informal collection and treatment of e-waste is widespread in the region, and the material demands of this sector drive the illegal transboundary movement of e-waste. Material recovery from e-waste and the extraction of valuable fractions, including through the labour-intensive manual dismantling of e-waste using simple tools, are common in many countries. The workers involved in these highly polluting operations are usually from the poorest and most vulnerable population groups (e.g. women and children) and rarely use personal protective equipment (WHO 2021). Usually, the easily accessible components are isolated and then sorted and sold to merchants or recyclers. The remaining, less valuable components are transported to domestic waste landfills. In many countries in the region, informal dismantling and material recovery of e-waste is performed without the necessary health and safety and environmental supervision.

In the region, there is generally little public awareness of the hazardous nature of e-waste and the threats to human health and the environment posed by crude waste management techniques. Some dangerous processes used to handle e-waste by informal processors include open burning, direct melting of plastics, toner extraction and burial or dumping of less valuable fractions, especially those that contain hazardous components such as lead, polychlorinated biphenyls and chlorofluorocarbons, which can directly affect the soil and contaminate water sources. These activities represent a direct threat to the health of workers, nearby communities and the environment.

8. RECOMMENDATIONS

E-waste management in the Arab States region faces a myriad of challenges, prompted by a complete absence of e-waste-specific policies and legislation, which are key to the development of a proper system and an appropriate response. Consequently, the region is almost completely lacking any form of EPR to ensure adequate take-back and funding of collection and recycling of e-waste as necessary to guarantee environmental and human safety and ESM of e-waste. Many countries in the region have generic legislation on hazardous waste, which can be applied to e-waste.

As the needs of the region vary according to the economic and societal status of each country or territory and the associated challenges, the following recommendations apply to all countries to varying degrees and at different levels of prioritization. They must be combined with the introduction of a clear and robust legal framework for e-waste and relevant national policies. It is also recommended that each stakeholder group (namely governments, producers, retailers, recyclers and informal sector) should be allocated a specific role in developing an efficient system that facilitates the state-of-the-art collection and recycling of substantially more e-waste on the basis of the principal of environmentally sound management.

The general recommendations can be grouped into five main areas:

1. **Prevent e-waste generation**
2. **Adopt EPR-based legislation and policies**
3. **Provide basic collection and treatment facilities**
4. **Improve the collection and treatment of e-waste**
5. **Raise awareness, pollute less and work safer**

1. Prevent e-waste generation

The "waste hierarchy", wherein prevention is given primacy over other treatment options, is well known. For example, EU Directive 2008/98/EC, on waste, (known as the Waste Framework Directive) clearly states that "waste prevention should be the first priority of waste management". Such policies should be pursued with a view to breaking the link between economic growth and the environmental impacts associated with the generation of waste. Most industrial groups and public policies focus primarily on recycling and safe disposal of e-waste, rather than on reuse of EEE (McCann and Wittmann 2015). Prevention and reuse are at the top of the waste hierarchy, however, as they are seen as environmentally preferable to recycling, thanks to energy savings in

the production phase and a reduction in raw material usage, except where inefficient products remain in service.

Across the world, the same principal applies: "the best e-waste is the one that does not exist" (McCann and Wittmann 2015). Greater attempts must therefore be made to minimize e-waste generation. The decreasing longevity seen in EEE products is driven by production and consumption patterns, however, as consumers are fascinated by the trendiness of EEE, low prices for new technology and the new models and innovations that are frequently launched on the market (McCann and Wittmann 2015). While understandable, these trends are fuelling the ever-growing e-waste mountain. Greater attempts need to be made in the Arab States region to make consumers aware of the implications of EEE production, usage and final disposal with a view to driving behavioural change, where reuse and refurbishment are favoured over recycling, where repair services become an important indicator in procurement and purchasing decisions and where, instead of purchasing a product, consumers increasingly purchase only the service that the product provides. In such cases, ownership rests with the producer and service provider, which have an interest in easy collection and maximum reuse of materials and components, while also supporting technological innovation. Reusing a product and extending its lifetime is the most effective and environmentally sound option.

Adopt EPR-based legislation and policies

Clear legislative instruments and resulting policies are required to drive ESM of e-waste in the region.

Within the Arab States region, there are different degrees of introduction, coverage and implementation of legislative and regulatory frameworks on general waste. Some legislation specifically mentions e-waste, while other legislation lists only hazardous solid waste for special attention; e-waste usually falls under hazardous solid waste, as it can contain elements of concern, such as lead, cadmium, mercury and brominated flame-retardants. A well-defined legislative framework is required in all Arab States, in addition to regulatory EHS guidelines. This will enable the relevant authorities to distinguish between new EEE, used EEE and e-waste for ESM. To achieve this, it is imperative that countries in the region introduce legislative instruments that are clear and tailor-made for the national context, taking into account societal factors, among others. Specific legislation pursuant to which consumers must hand over e-waste to licensed collectors and collectors must, in turn, send the collected e-waste to licensed processors is required in order to redirect e-waste from dumpsites and the informal sector and guarantee ESM. In some countries, the government should accelerate the use of licensed operators and new entrants to initiate formal collection and treatment. The legal framework should make provisions for mandatory data reporting and storage using statistical coding harmonized with the international trade codes, which facilitate the assessment of system performance and comparison both nationally and internationally.

Legislated funding (through EPR) is required to finance e-waste management in the region.
For effective e-waste management, a financial system on the basis of EPR needs to be legally defined, which should apply to all e-waste categories and should assign specific responsibilities to stakeholders. Governments in the region should introduce EPR to finance ESM of e-waste with the effective participation of all stakeholders. The absence of legislated funding to finance e-waste management systems in the region has an impact on both the environment and public health (with the attendant loss of some recoverable resources).

The EPR system is based on the "polluter pays" principle, in which the consumer pays for end-of-life management of the products, such as by applying advanced recycling or disposal fees to purchases, which has been shown to provide an effective solution for e-waste management. This approach has been adopted in many countries, especially within the European Union, to finance e-waste management systems. In EPR, producers (or their representatives, namely importers) have a legal obligation to take back products at end of life to ensure their proper disposal to a degree that is often equal to the proportion of products that they put on the market. The absence of EPR in the Arab States region discourages formal financial flows to fund ESM of e-waste, thereby encouraging the selection of only valuable materials by the informal sector, while hazardous fractions are abandoned. This is a major hindrance to the establishment of formal e-waste recycling systems in the region.

The absence of EPR in almost all the countries in the region denies existing recyclers the finances to collect more e-waste, pay for depollution and improve recycling.

A harmonized legal framework that allows trade in e-waste would facilitate the transboundary movement of e-waste to existing recyclers.
Some Arab States have made greater progress than others in areas such as policy, infrastructure provision and monitoring. These States now need to make further progress towards developing e-waste specific legislation based on EPR and with better reporting based on the UNU-KEYS. States at the other extreme should start by enforcing existing regulations on hazardous waste management. No country or territory in the region has defined directives, collection and treatment targets or EPR with a clear division of roles and responsibilities among stakeholders. Since many countries in the region lack ESM treatment facilities, a harmonized regional agreement that allows trade in e-waste would facilitate the transboundary movement of e-waste to the few existing recycling facilities.

Arab States should learn from good practices within and outside the region in order to leverage existing experience.
Improving the e-waste management system in the region requires countries to learn from others of a similar economic status both within and outside the region and to leverage those experiences in introducing legislative frameworks. There are also benefits to gain from learning from countries with advanced e-waste management systems, such as those in the European Union, with a view

to avoiding past mistakes and building substantially on existing experiences; efforts should be made not to copy such models directly, however, as each State or territory will require a tailor-made e-waste management system. This approach will not only save time and financial resources but will also eliminate potential pitfalls.

3. Provide basic collection and treatment facilities

Supporting existing recyclers with incentives (e.g. tax exemptions) will encourage formal recycling.

Some countries in the region may start by formalizing the informal sector, rather than banning informal operations outright. When combined with the introduction of mandatory returns through designated channels and the regulation of other illegal activities (e.g. mixing e-waste with other waste streams, manual dismantling, burning and acid leaching of precious metals) used in informal operations, this will ensure that e-waste is directed towards formal recycling. Until EPR systems are operating effectively, incentives (e.g. the tax exemptions used in Saudi Arabia or the monetary incentives for destocking special and hazardous waste used in Algeria) can be used to encourage the development of formal recycling. To prevent the continuation of illegal collection and treatment of e-waste, it is necessary to introduce effective monitoring of the entire value chain to discourage informal recycling and enforce punitive measures for violating legislation and EHS requirements for e-waste processing. Changing the present e-waste scenario in the region will require an adequate number of collection points to be provided (including by increasing their territorial density), which must be made easily accessible and more visible. Security at collection points must also be improved to prevent diversion.

To ensure ESM of e-waste in the region, regulatory procedures for trading in and the transboundary transportation of e-waste to existing recycling facilities within the region are required.

In addition to setting up new recycling facilities in the region, it is also important to develop regional legal and regulatory procedures and technical guidelines for the transboundary transportation of e-waste and the resultant residual fractions for ESM. This will discourage smuggling, informal operations and the resultant environmental pollution while ensuring a ready supply of materials to processing facilities. The region needs to formalize e-waste trading businesses, while addressing the economics behind criminal behaviour by increasing the costs of illegal activities and introducing punitive measures for non-compliance.

4. Improve the collection and treatment of e-waste

The waste hierarchy - which places priority on activities that prevent waste generation, while encouraging reuse, recycling and, of course, appropriate treatment of residual fractions - should be the basis of policy formulation in the region.

Each country and territory in the region should select a definite combination from the already existing policy instruments within and outside the region, taking into account the prevailing national expertise and resources. These policy instruments should adopt the waste hierarchy, which places high priority on activities that prevent waste generation, while encouraging reuse, recycling and, of course, incineration and disposal of residual fractions.

Data collection and system monitoring (of quantities and flows of e-waste) are essential to track developments and identify leaks and possible policy modifications.

Reliable e-waste statistics are necessary for formulating policies that address e-waste challenges in the region. They are also required by investors interested in setting up recycling facilities and measuring progress in the sector, including:

- conducting an evaluation of developments over time;
- setting and assessing targets;
- identifying policy best practices and necessary reforms.

Such information is essential for initiating policies to minimize e-waste generation, prevent illegal dumping and emissions, promote recycling and create jobs in the reuse, refurbishment and recycling sectors. The achievement of sustainability and a circular economy in this sector hinges on reliable data collection and storage. Reliable data are essential to identifying leaks in the value chain and preventing illegal activities, such as the transboundary movement of e-waste into the informal sector. Adequate collection points/bins and recycling facilities are required for ESM of e-waste; these can be more efficiently implemented where sound e-waste data are available. E-waste data should cover annual statistics on EEE POM, e-waste generation, collection, transboundary movement and treatment, with all stakeholders reporting based on the UNU-KEYS categorization system. Reliable data are required for setting and reviewing collection and recycling targets, developing policies and allocating adequate finances. Reliable data on the performance of the sector are essential for evaluating efforts to attain the SDGs and their 169 targets, which are measured by indicators and official statistics.

Some economies which receive transboundary movements of e-waste in the region (such as the State of Palestine) should develop an action plan to implement a roadmap for electronic waste management while combating illegal imports and the improper management of e-waste (e.g. open burning).

Incentives can be used to facilitate good practices among operators.
Given the absence of the basics components required to facilitate ESM of e-waste (e.g. e-waste legislation and functioning formal sector), the region should start by incentivising good practices as outlined in this report. Over time, if non-compliant practices persist, punitive measures could be introduced through a framework that sets out provisions to increase the costs of illegal operations. Through the relevant government agencies, countries should create national strategies and action plans for e-waste management that focus on creating guidelines for e-waste collection and treatment and that set ambitious yet achievable collection and treatment targets.

5. Raise awareness, pollute less and work safer

Awareness raising among end users and informal operators on the potential hazards of adopting bad practices in the disposal of e-waste is essential.
Governments and NGOs should initiate programmes to bridge the information gap among consumers and informal operators, many of whom may not be aware of the hazards of the improper disposal of e-waste or the existing policy and legal framework. This approach will reduce the prevalence of bad practices in the disposal of e-waste.

Consumer awareness is crucial for influencing attitudes towards disposal. This may be implemented in various ways depending on national capacity and public habits, such as through educational programmes at school, consumer campaigns on social media, informational brochures and announcements or programming through television, cinemas, radios and newspapers. These approaches should be combined with initiatives such as door-to-door collections, placement of collection containers and green procurement by municipal authorities and governments. The potential of children as ambassadors for change should also be seriously considered.

Educational and re-training programmes should be initiated for informal operators, especially on the illegality of activities such as informal e-waste processing and waste trafficking, with emphasis on the resulting environmental damage and on alternative approaches.

E-waste management standards should be introduced and enforced in all countries in the region.
Currently, only one country surveyed has adopted specific e-waste management standards, while such standards are in the process of development in other two countries. EHS standards, in line with regional and international best practices, should be introduced by law in each country and territory in the region. The International Labour Organization, the World Health Organization and ITU, among others, have developed such standards[19]. Such standards should specify methodology for the organization of collection, transportation, processing, depollution/decontamination, treatment and disposal of residual fractions.

[17] See: https://www.ilo.org/sector/activities/sectoral-meetings/WCMS_673662/lang--en/index.htm, https://www.who.int/teams/environment-climate-change-and-health/settings-populations/children/e-waste, https://www.itu.int/en/ITU-T/about/groups/Pages/sg05.aspx and http://www.basel.int/Implementation/Publications/TechnicalGuidelines/tabid/2362/Default.aspx.

ANNEXES

Annex I. E-waste categories

Table 7. UNU-KEYS categorization

UNU-KEY	Full name	Category number in WEEE Directive
0001	Central Heating (household-installed)	4
0002	Photovoltaic Panels	4
0101	Professional Heating & Ventilation (excl. cooling equipment)	4
0102	Dishwashers	4
0103	Kitchen (e.g. large furnaces, ovens, cooking equipment)	4
0104	Washing Machines (incl. combined dryers)	4
0105	Dryers (wash dryers, centrifuges)	4
0106	Household Heating & Ventilation (e.g. hoods, ventilators, space heaters)	4
0108	Fridges (incl. combi-fridges)	1
0109	Freezers	1
0111	Air Conditioners (household-installed and portable)	1
0112	Other Cooling (e.g. dehumidifiers, heat pump dryers)	1
0113	Professional Cooling (e.g. large air conditioners, cooling displays)	1
0114	Microwaves (incl. combined, excl. grills)	5
0201	Other Small Household (e.g. small ventilators, irons, clocks, adapters)	5
0202	Food (e.g. toaster, grills, food processing, frying pans)	5
0203	Hot Water (e.g. coffee, tea, water cookers)	5
0204	Vacuum Cleaners (excl. professional)	5
0205	Personal Care (e.g. tooth brushes, hair dryers, razors)	5
0301	Small IT (e.g. routers, mice, keyboards, external drives & accessories)	6
0302	Desktop personal computers (excl. monitors, accessories)	6
0303	Laptops (incl. tablets)	2
0304	Printers (e.g. scanners, multi-functionals, faxes)	6
0305	Telecom (e.g. [cordless] phones, answering machines)	6
0306	Mobile Phones (incl. smartphones, pagers)	6
0307	Professional IT (e.g. servers, routers, data storage, copiers)	4
0308	Cathode Ray Tube Monitors	II

UNU-KEY	Full Name	Category number in WEEE Directive
0309	Flat Display Panel Monitors (LCD, LED)	2
0401	Small Consumer Electronics (e.g. headphones, remote controls)	5
0402	Portable Audio & Video (e.g. MP3, e-readers, car navigation)	5
0403	Music Instruments, Radio, Hi-Fi (incl. audio sets)	5
0404	Video (e.g. video recorders, DVD, Blu-ray, set-top boxes)	5
0405	Speakers	5
0406	Cameras (e.g. camcorders, photo, and digital still cameras)	5
0407	Cathode Ray Tube TVs	2
0408	Flat Display Panel TVs (LCD, LED, Plasma)	2
0501	Lamps (e.g. pocket, Christmas, excl. LED and incandescent)	5
0502	Compact Fluorescent Lamps (incl. retrofit and non-retrofit)	3
0503	Straight Tube Fluorescent Lamps	3
0504	Special Lamps (e.g. professional mercury, high & low pressure sodium)	3
0505	LED Lamps (incl. retrofit LED lamps and household LED luminaires)	3
0506	Household Luminaires (incl. household incandescent fittings)	5
0507	Professional Luminaires (offices, public space, industry)	5
0601	Household Tools (e.g. drills, saws, high-pressure cleaners, lawnmowers)	5
0602	Professional Tools (e.g. for welding, soldering, milling)	4
0701	Toys (e.g. car racing sets, electric trains, music toys, biking computers)	5
0702	Game Consoles	4
0703	Leisure (e.g. large exercise, sports equipment)	4
0801	Household Medical (e.g. thermometers, blood pressure meters)	5
0802	Professional Medical (e.g. hospital, dentist, diagnostics)	4
0901	Household Monitoring & Control (alarm, heat, smoke, excl. screens)	5
0902	Professional Monitoring & Control (e.g. laboratory, control panels and invertors)	4
1001	Non-Cooled Dispensers (e.g. for vending, hot drinks, tickets, money)	4
1002	Cooled Dispensers (e.g. for vending, cold drinks)	1

Table 8. Categories of EEE covered by the WEEE Directive

Category number	Description
1	Temperature exchange equipment
2	Screens, monitors and equipment containing screens having a surface greater than 100 cm^2
3	Lamps
4	Large equipment
5	Small equipment
6	Small IT and telecommunication equipment

Annex II. Mathematical equations

The mathematical description of e-waste generated is a function of the lifespan of EEE and the amount of EEE POM in the previous years. In particular:

- *E-waste generated (n)* is the quantity of e-waste generated in evolution year *n*.
- *POM (t)* is the product sales (POM) in any historical year *(t)* before year *n*.
- t_0 is the initial year that a product was sold.
- $L^{(p)}$ *(t, n)* is the discard-based, lifetime profile for the batch of products sold in historical year *t*.

$$E\ waste\ generated\ (n) = \sum_{t=t_0}^{n} POM\ (t) * L^{(p)}\ (t,n)$$

The lifespan $L^{(p)}$ *(t, n)* is the lifespan profile of an EEE product sold in year *t*, which reflects its probable obsolescence rate in evaluation year *n*. The discard-based lifespan profile for a product can be modelled using several probability functions. The Weibull distribution function is considered the most suitable for describing discard behaviour for EEE and has been applied in the European Union and in scientific literature.

Owing to social and technical developments, a product's lifespan can be time-dependent. For instance, the cathode ray tube monitor rapidly became outdated as a result of technological developments in flat-screen monitors. In such cases, lifespan distributions should ideally be modelled for each historical sales year. The Weibull function is defined by a time-varying shape parameter $\alpha\ (t)$ and a scale parameter $\beta\ (t)$, as described in the equation below:

$$L^{(p)}\ (t, n) = \frac{\alpha\ (t)}{\beta\ (t)^{\alpha(t)}}\ (n - t)^{\alpha(t) - 1} e^{-[\,(n-t)\,/\,\beta(t)\,]^{\alpha\ (t)}}$$

For other, more stable products, time-independent lifespans are sufficient to describe actual behaviour. In such cases, the variations in the shape and scale parameter over time are minor and, as such, can be disregarded. The distribution of product lifespans in such cases can thus be simplified as follows:

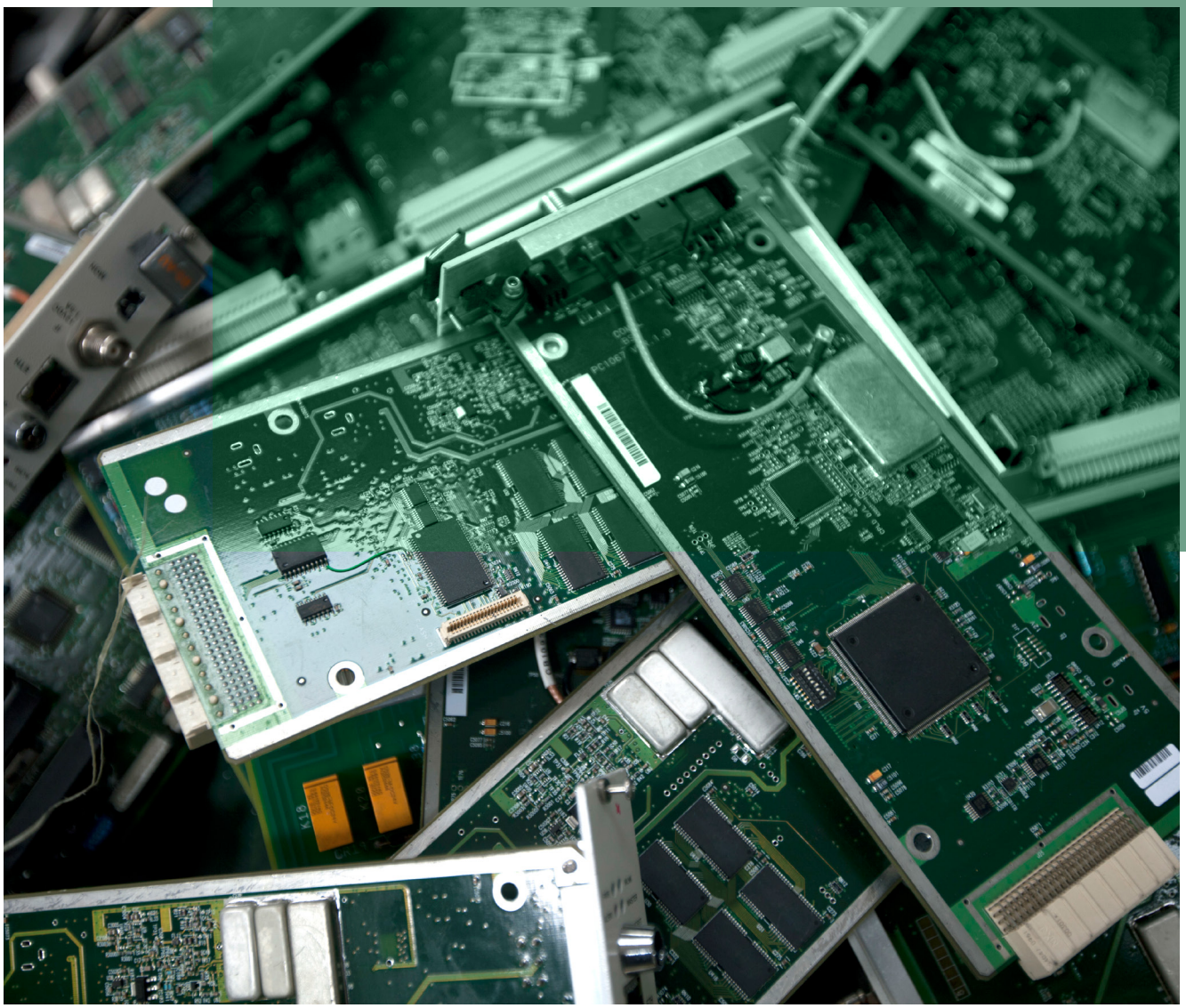
$$L^{(p)}\ (t, n) = \frac{\alpha}{\beta^{\alpha}}\ (n - t)^{\alpha - 1} e^{-[\,(n-t)\,/\,\beta\,]^{\alpha}}$$

Annex III. List of waste and substances relevant to e-waste covered by the Basel Convention

A/B code	Description	Type of e-waste or component	Y code
A1180	Waste electrical and electronic assemblies or scrap containing components such as accumulators and other batteries included on list A, mercury-switches, glass from cathode-ray tubes and other activated glass and PCB-capacitors, or contaminated with Annex I constituents (e.g. cadmium, mercury, lead, PCB) to an extent that they possess any of the characteristics contained in Annex III (note the related entry on list B B1110).	Any e-waste.	All.
B1110	Electrical and electronic assemblies: • Electronic assemblies consisting only of metals or alloys. • Waste electrical and electronic assemblies or scrap (including printed circuit boards) not containing components such as accumulators and other batteries included on list A, mercury-switches, glass from cathode-ray tubes and other activated glass and PCB-capacitors, or not contaminated with Annex I constituents (e.g. cadmium, mercury, lead, PCB) or from which these have been removed, to an extent that they do not possess any of the characteristics contained in Annex III (note the related entry on list A A1180). • Electrical and electronic assemblies (including printed circuit boards, electronic components and wires) destined for direct reuse, and not for recycling or final disposal.	Any e-waste.	All.
B4030	Used single-use cameras, with batteries not included on list A.	UNU-KEY 0406.	All.

A/B code	Description	Type of e-waste or component	Y code
A1170	Unsorted waste batteries excluding mixtures of only list B batteries. Waste batteries not specified on list B containing Annex I constituents to an extent to render them hazardous.	Most likely batteries from e-waste.	All.
B1090	Waste batteries conforming to a specification, excluding those made with lead, cadmium or mercury.	Most likely batteries from e-waste.	All.
A1010	Metal wastes and waste consisting of alloys of any of the following: antimony - arsenic - beryllium - cadmium - lead - mercury - selenium - tellurium - thallium.	Mercury in switches, contacts and thermometers.	Y31 (lead; lead compounds). Y29 (mercury; mercury compounds).
A1020	Waste having as constituents or contaminants, excluding metal waste in massive form, any of the following: - Antimony; antimony compounds - Beryllium; beryllium compounds - Cadmium; cadmium compounds - Lead; lead compounds - Selenium; selenium compounds - Tellurium; tellurium compounds.	Could also be PCB (next to A1180) or antimony as flame retardants; lead compounds.	Y25 (selenium; selenium compounds), Y27 (antimony; antimony compounds), Y31 (lead; lead compounds).
A1030	Waste having as constituents or contaminants any of the following, - Arsenic; arsenic compounds - Mercury; mercury compounds. - Thallium; thallium compounds.	Mercury and arsenic found in fluorescent and backlight lamps; mercury-added waste.	Y29 (mercury; mercury compounds).
A1190	Waste metal cables or insulated with plastics containing or contaminated with coal tar, PCB, lead, cadmium, other organohalogen compounds or other Annex I constituents to an extent that they exhibit Annex III characteristics.	Waste metal cables or cables insulated with plastics	All.
A2010	Glass waste from cathode ray tubes and other activated glass.	Cathode ray tube screens.	Y31 (lead; lead compounds).

A/B code	Description	Type of e-waste or component	Y code
A3180	Wastes, substances and articles containing, consisting of or contaminated with PCB, polychlorinated terphenyl, polychlorinated naphthalene or polybrominated biphenyl, or any other polybrominated analogues of these compounds, at a concentration level of 50 mg/kg or more.	Could include brominated flame retardants (in plastics) and persistent organic pollutants in fractions of e-waste.	Y10 (waste substances containing or contaminated with PCBs and/or polychlorinated terphenyl and/or polybrominated biphenyls) Y27 (antimony; antimony compounds).



Annex IV. E-waste statistics and management assessment scores for each State and territory

State/ territory	Legislation					Infrastructure	
	1.1 Existence of e-waste-specific legislation/ EPR	1.2 Enforced products in national e-waste legislation (% of mass of e-waste generated)	1.3 E-waste collection target	1.4 Minimum standards of e-waste management	1.5 Number of multilateral environmental agreements ratified or signed	2.1 E-waste collection points	2.2 Treatment facilities for ESM of e-waste
Algeria	no	0%	no	in development	3 ratified	in main cities only	no
Egypt	no	0%	no	no	2 ratified	in main cities only	yes
Jordan	in development	0%	no	yes	4 ratified	in main cities only	no
Lebanon	in development	0%	in process	in development	4 ratified	in main cities only	no
Mauritania	no	0%	no	no	4 ratified	no	no
Oman	no	0%	no	no	4 ratified	unknown	in process
Qatar	no	0%	no	in development	4 ratified	in all municipalities	no
Saudi Arabia	no	0%	no	in development	4 ratified	in all municipalities	unknown
Sudan	no	0%	no	in development	3 ratified, 1 signed	in main cities only	no
State of Palestine	no	0%	no	no	4 ratified	unknown	in process
United Arab Emirates	yes	under definition	no	yes	4 ratified	in all municipalities	yes

State/territory	Year	EEE POM		E-waste generated		E-waste collected		Collection rate
		kg/inh	t	kg/inh	t	kg/inh	t	%
Algeria	2019	10.5	457 801	7.1	308 622			
Bahrain	2019	22.0	33 176	15.9	24 048			
Comoros	2019	0.8	684	0.7	641			
Djibouti	2019	1.9	2 082	1.0	1 119			
Egypt	2019	10.8	1 068 855	5.9	585 767			
Iraq	2019	11.7	459 306	7.1	278 330			
Jordan	2018	7.6	75 412	5.3	52 693	0.1	1 295	2.4
Kuwait	2019	21.4	100 378	15.8	74 414			
Lebanon	2019	10.3	62 727	8.2	49 811			
Libya	2019	8.3	54 706	11.5	75 892			
Morocco	2019	5.9	208 552	4.6	164 484			
Mauritania	2019	2.5	11 758	1.4	6 377			
Oman	2019	25.0	110 061	15.8	69 247			
Qatar	2019	24.9	68 469	13.6	37 406	0.07	185	0.5
Saudi Arabia	2019	22.4	758 168	17.6	594 916			
Somalia	2019	2.4	37 259	1.3	20 207			
State of Palestine	2019	5.3	26 566	4.0	20 021	0.02	75	0.4
Sudan	2019	2.0	85 397	2.1	90 065			
Syria	2019	4.6	80 793	5.2	91 052			
Tunisia	2019	7.6	89 755	6.4	75 747			
United Arab Emirates	2019	24.0	257 855	15.0	161 727	0.1	645	0.4
Yemen	2019	1.3	40 792	1.5	47 967			
Average		9.53		6.59		0.01		0.1
Total			**4 090 552**		**2 830 554**		**2 200**	

Annex V. Country profile of Mauritania

Country:

Mauritania

4 674 000 inhabitants
1.03 million km²
Borders: Western Sahara, Atlantic Ocean, Senegal, Mali and Algeria

GDP per capita PPP: $3 669 USD
Average size of households: 6.1 members (2017)

National legislation on e-waste:

Extended producer responsibility:	✖
National e-waste standards:	✖
E-waste collection target:	✖
Product coverage in UNU-KEYs:	0 of 54
Product coverage (% weight) of total and per category:	0% of e-waste generated

0% 0% 0% 0% 0% 0%

International Conventions:

	Signature	Ratification/Accession	Entry into force
Basel Convention	-	16 August 1996	14 November 1996
Rotterdam Convention	1 September 1999	22 July 2005	20 October 2005
Stockholm Convention	8 August 2001	22 July 2005	20 October 2005
Minamata Convention	11 October 2013	18 August 2015	-

EEE POM (2019):	E-waste generated (2019):	E-waste managed environmentally soundly (2019):
11.8 kt. 2.5 kg/inh.	6.4 kt. 1.4 kg/inh.	0.4 kt. 0 kg/inh.

(Source: UNU / UNITAR)

Formal/environmentally sound e-waste management system in place:

✖

National legal framework

Mauritania has no legislation on e-waste or on waste in general. Waste is mentioned in Ordinance No. 84-208 of 20 September 1984, on the Hygiene Code, and in Law No. 2000-045 of 20 September 1984, on the Environmental Code[20].

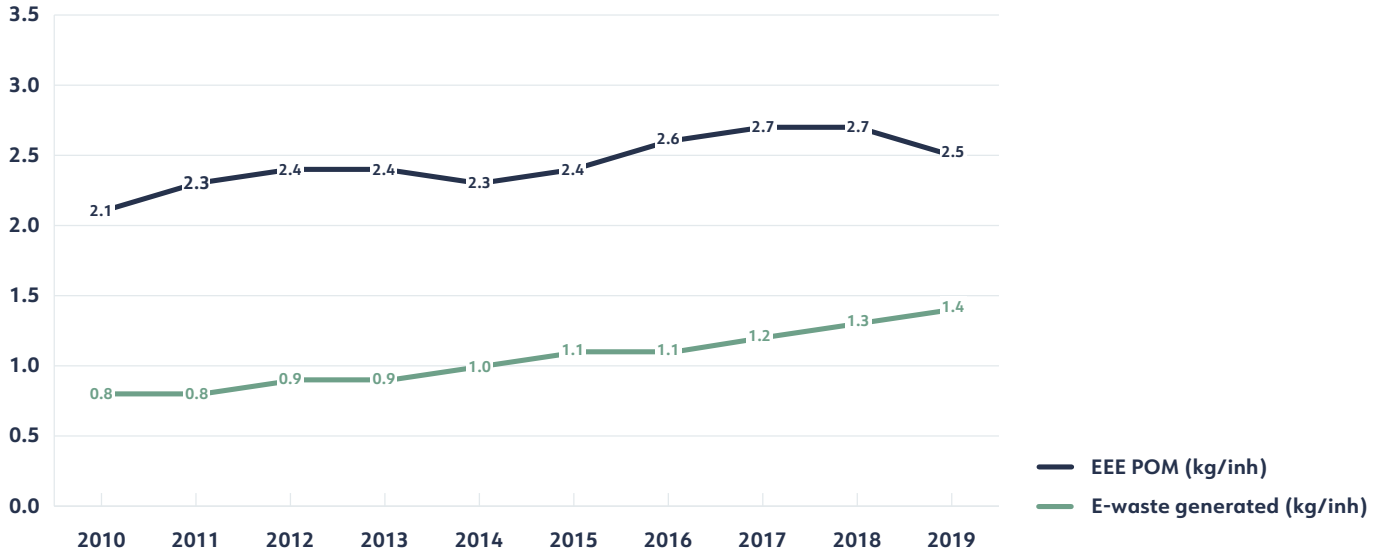
Mauritania has neither infrastructure nor legislation for e-waste, which is treated as general waste. However, the authorities of the country have recently begun to develop a strategy on e-waste.

National e-waste statistics

E-waste statistics are not available for Mauritania. The main statistical indicators were therefore estimated using UNU/UNITAR internal data and the United Nations Commodity Trade Statistics Database (UN Comtrade).

The amount of EEE POM in Mauritania has increased consistently, from 2.1 kg/inh (6.8 kt) in 2010 to 2.5 kg/inh (11.8 kt) in 2019, with the exception of the period 2013-2014, when the amount of EEE POM decreased slightly from 2.4 kg/inh to 2.3 kg/inh. (See Figure 14). The data for 2019 show that Mauritania stands considerably below the average for the Arab States region with regard to the amount of EEE POM per inhabitant (2.5 kg/inh, compared with 9.5 kg/inh).

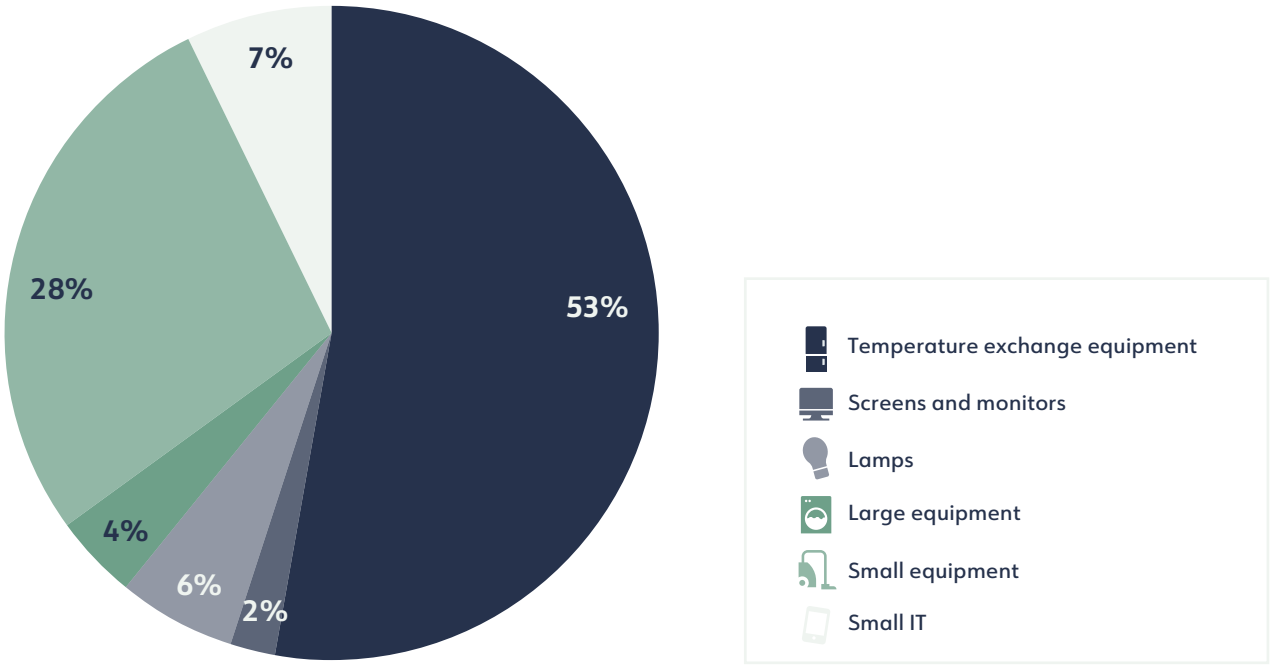
Figure 14. Quantity of EEE POM and e-waste generated in Mauritania, 2010-2019



[20] http://www.droit-afrique.com/upload/doc/mauritanie/Mauritanie-Code-2000-environnement.pdf.

Of the total amount EEE POM in Mauritania for 2019, the largest proportion was temperature exchange equipment (category 1), equivalent to 53 per cent of the total or 1.4 kg/inh. Conversely, the lowest proportion was screens and monitors (category 2), representing 2 per cent of all EEE POM or 0.1 kg/inh. (See Figure 15.)

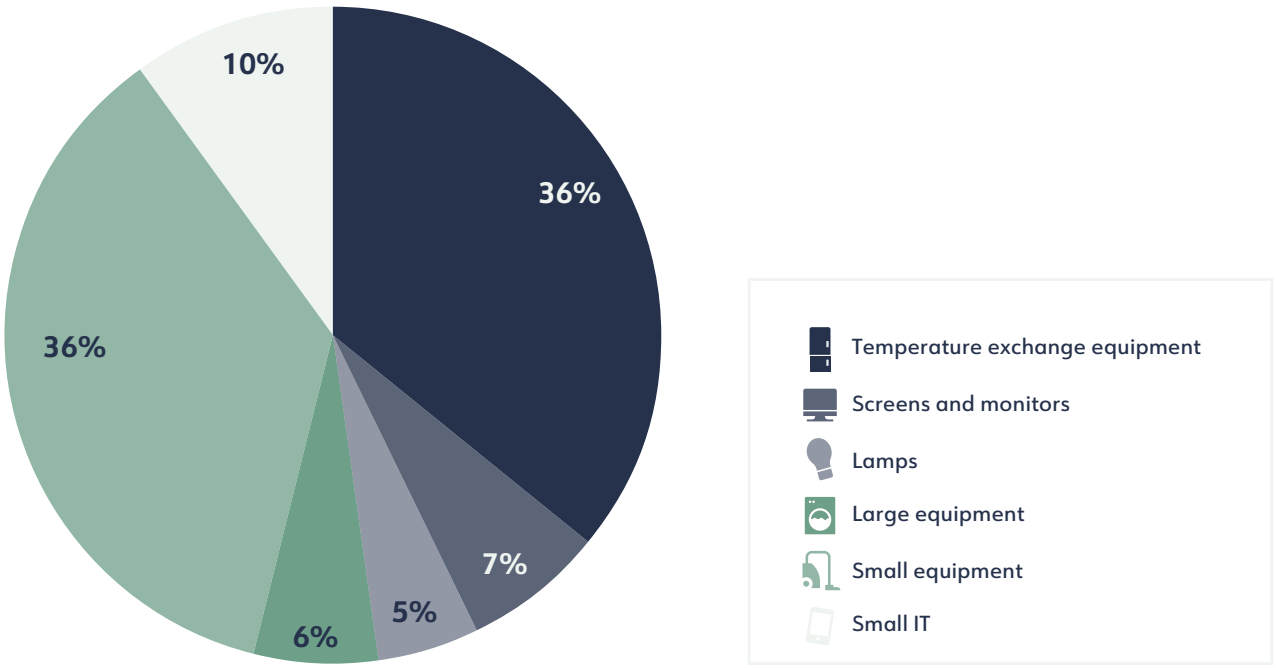
Figure 15. Breakdown of EEE POM by category, Mauritania, 2019



The amount of e-waste generated in Mauritania almost doubled from 0.8 kg/inh (2.4 kt) in 2010 to 1.4 kg/inh (6.4 kt) in 2019. As with EEE POM, the amount of e-waste generated in Mauritania is below the regional average (1.4 kg/inh, compared with 6.6 kg/inh).

Temperature exchange equipment (category 1) and small equipment (category 5) represented the highest proportion of e-waste generated in Mauritania in 2019, at 0.5 kg/inh (36 per cent) for each category. Lamps (category 3) represented the smallest proportion, at 0.07 kg/inh (5 per cent). (See Figure 16.)

Figure 16. Breakdown of e-waste generated by category, Mauritania, 2019



Information on the collection and recycling of e-waste in accordance with ESM principles in Mauritania could not be retrieved so far. As the e-waste management system and legislative framework remain in the initial development stage, it is realistic to assume that the current amount of e-waste collected for ESM is close to zero.

E-waste management system

Waste management in Mauritania is a municipal responsibility, under the authority of the Ministry of Interior. However, the municipal authorities do not yet have the technical, human or financial capacities required to play their role as contractors and deal with the challenges faced (GIZ 2014b).

The Ministry of the Environment and Sustainable Development was established in 2007. Decree No. 190-2008 establishes the responsibilities of the Ministry and the administrative organization of the Department[21]. Within the Ministry, the Department of Pollution and Environmental Emergencies is responsible for promoting and supporting local policies on waste management in partnership with local authorities and for controlling operations related to waste treatment, including recycling, recovery, incineration and disposal (art. 26).

Waste management in the capital city of Nouakchott is performed through private international operator Pizzorno, which is bound by contract to the Agency for Urban Development regarding the collection of household waste and its disposal in a landfill site located 25 km from the city. In addition to this formal collection, a network of small operators has developed in various parts of the city, who offer door-to-door collection in carts drawn by mules (GIZ 2014b).

In other cities, solid waste collection services are managed directly by the municipal authorities or delegated to small private operators (GIZ 2014b).

Operating informally, adults and children recover and sell the collected materials to specialized recyclers. Informal but larger private actors recover certain products (by purchasing, and sometimes stealing, plastics, scrap metal, aluminium, etc.) in Nouakchott and the secondary cities for sale to companies, including those based in India and China (GIZ 2014b).

According to the information collected from the country, there is no formal or informal sector for the management of e-waste specifically.

Import and export

According to article 67 of the Environmental Code of Mauritania, "all waste from abroad is presumed to be dangerous within the meaning of this law." Article 68 prohibits "all acts relating to the import, purchase, sale, transit, transport, deposit and storage of toxic or radioactive industrial waste from abroad" throughout the territory of Mauritania.

Unfortunately, it was not possible to retrieve official data on e-waste imports and exports in Mauritania.

National projects and initiatives on e-waste

The city of Nouakchott has a strategy for solid waste management (GIZ 2014b). The telecommunication regulatory and the Ministry of the Environment have begun to develop a strategy on e-waste. No further information on the strategy was available as of December 2020.

[21] See: http://anac.mr/ANAC/JOf/2008/1179%20fr%20sc.pdf.

Annex VI. Country profile of Sudan

Country:

Sudan

43 222 000 inhabitants
1.886 million km²
Borders: Egypt, Eritrea, Ethiopia, the Central African Republic, Chad, Libya, South Sudan and the Red Sea

GDP per capita adjusted for PPP: $3 571 USD
Average size of households: 5.6 members (2017)

National legislation on e-waste:

Extended producer responsibility:	✖
National e-waste standards:	✖
E-waste collection target:	✖
Product coverage in UNU-KEYs:	0 of 54
Product coverage (% weight) of total and per category:	0% of e-waste generated

0% 0% 0% 0% 0% 0%

International Conventions:

	Signature	Ratification/Accession	Entry into force
Basel Convention	-	9 January 2006	09 April 2006
Rotterdam Convention	-	17 February 2005	18 May 2005
Stockholm Convention	23 May 2001	29 August 2006	27 November 2006
Minamata Convention	24 September 2014	-	-

EEE POM (2019):	E-waste generated (2019):	E-waste managed environmentally soundly (2019):
85.4 kt. 2.0 kg/inh.	90.0 kt. 2.1 kg/inh.	0 kt. 0 kg/inh.

(Source: UNU / UNITAR)

Formal/environmentally sound e-waste management system in place:

✖

National legal framework

In Sudan, the Higher Council for the Environment and Natural Resources is responsible for the establishment of hazardous waste laws (in coordination with the relevant authorities, such as the Higher Council for the Environment and Urban and Rural Promotion) and for the enforcement and monitoring of waste-related regulations.

Sudan does not have dedicated legislation or policies on e-waste. However, e-waste is covered under general waste legislation, including:

- Environmental Protection Act (2001).
- Environmental Protection and Promotion Act (2008).
- Hazardous Waste Regulations (2011).
- General Telecommunication Regulations (2012).
- Telecommunication and Postal Regulation Act (2018).
- Regulatory guidelines issued by the Telecommunication and Postal Regulatory Authority in 2016 (amended in 2020).

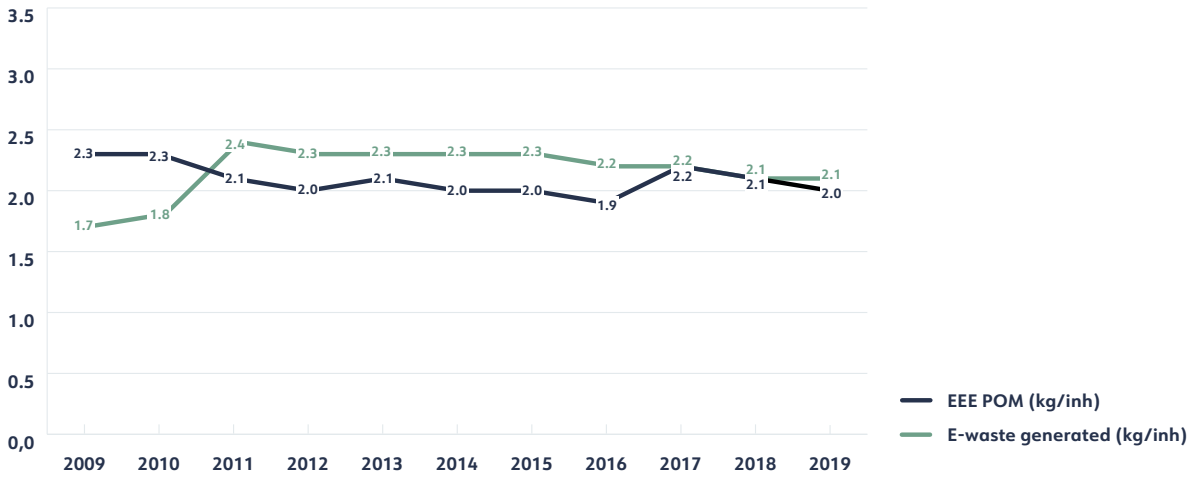
A proposal on e-waste management is under development; it was expected to be incorporated into the national legislative framework in 2020, but, as of August 2021, it remains pending.

National statistics

Sudan does not compile e-waste statistics. UNU/UNITAR internal data were used to quantify the main e-waste statistical indicators for the country.

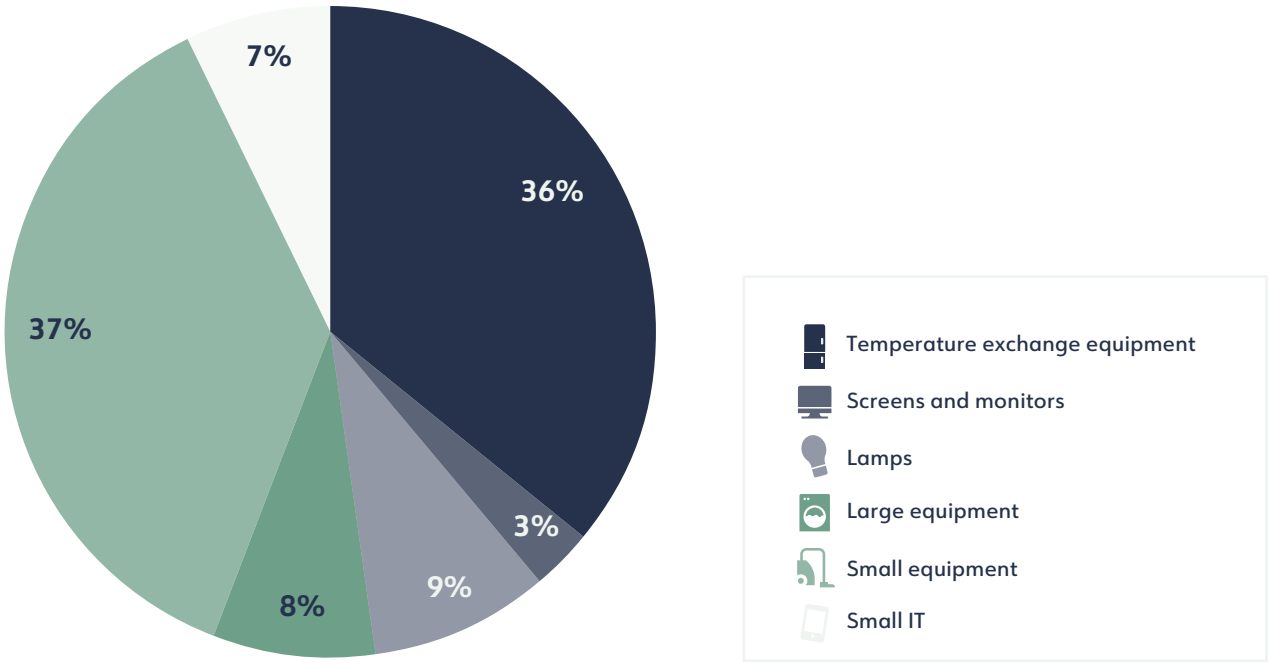
The total amount of EEE POM in Sudan has remained relatively stable over the years, decreasing only slightly from 2.3 kg/inh (91.4 kt) in 2010 to 2.0 kg/inh (85.4 kt) in 2019, which was driven primarily by the decrease in the amount of screens and monitors placed on the market (-64 per cent), in addition to temperature exchange equipment (-23 per cent) and large equipment (-17 per cent). (See Figure 17.) Sudan has always stood substantially below the average of level of EEE POM for the Arab States region (equivalent to 9.5 kg/inh in 2019).

Figure 17. Quantity of EEE POM and e-waste generated in Sudan, 2010-2019



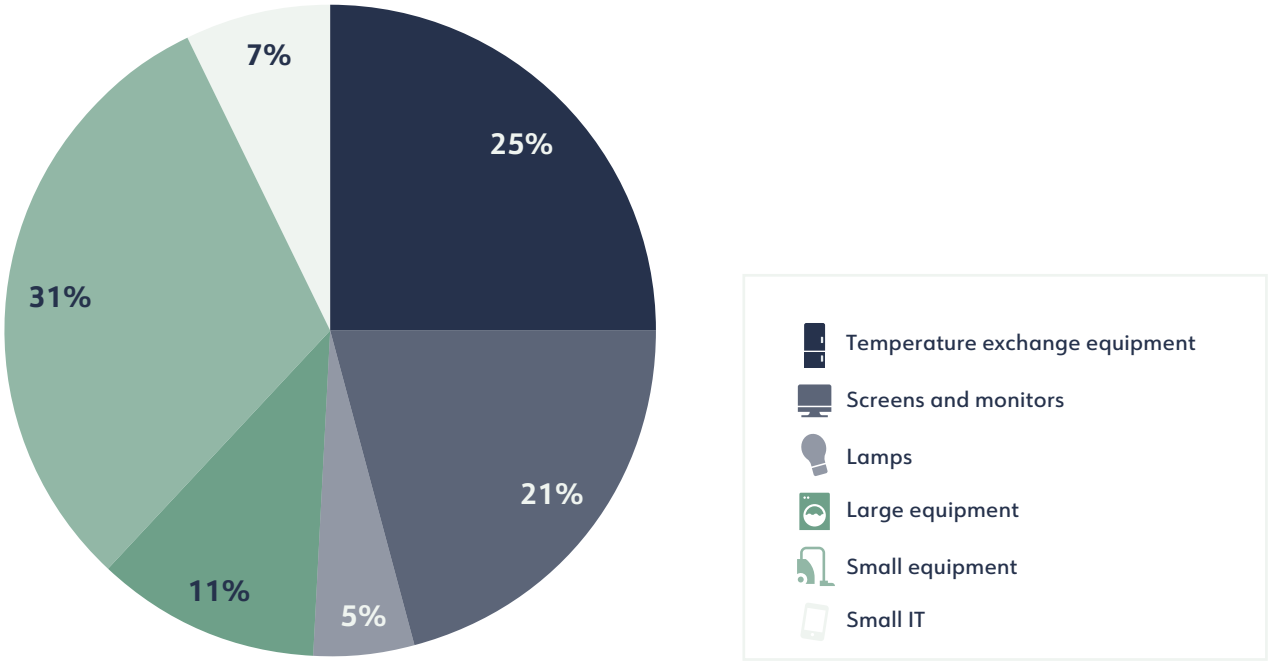
The highest proportion of EEE POM in Sudan in 2019 was represented by small equipment (category 5), with 0.74 kg/inh (37 per cent), and temperature exchange equipment (category 1), with 0.71 kg/inh (36 per cent). Conversely, screens and monitors (category 2) represented the lowest proportion, as 0.1 kg/inh (3 per cent). (See Figure 18.)

Figure 18. Breakdown of EEE POM by category, Sudan, 2019



As with EEE POM, the amount of e-waste generated in Sudan varies insignificantly from one year to the next, demonstrating only a slight decrease from 2.4 kg/inh (77 kt) in 2011 to 2.1 kg/inh (90 kt) in 2019, following an initial increase of 0.6 kg/inh between 2010 and 2011. The amount of e-waste generated per inhabitant in Sudan is approximately three times lower than the regional average (equivalent to 6.6 kg/inh in 2019). (See Figure 19.)

Figure 19. Breakdown of e-waste generated by category, Sudan, 2019



In 2019, most e-waste in Sudan was small equipment (category 5) (0.7 kg/inh; 31 per cent), temperature exchange equipment (category 1) (0.5 kg/inh; 25 per cent) and screens and monitors (category 2) (0.4 kg/inh; 21 per cent). Lamps (category 3) represented the smallest category, at 0.1 kg/inh (5 per cent).

Sudan did not provide information on the documented quantity of e-waste that is collected and recycled in line with ESM principles in the country.

E-waste management system

Sudan has a formal e-waste management system, which falls under the responsibility of the Higher Council for the Environment and Natural Resources, municipal authorities and distributors and retailers. There are collection points and maintenance centres, which are managed by the private sector, but no recycling facilities. The collection points are used to collect, sort and export e-waste. Consequently, there is no capacity to recycle e-waste in the country.

Sudan has a small formal e-waste management infrastructure, with collection points and maintenance centers, but no recycling capacity.

E-waste is also managed by the informal sector, including minor informal activities to recover copper, aluminium and lead. No partnerships between the formal and informal sectors have been established.

To improve e-waste management, regulatory guidelines for the management of e-waste from telecommunication equipment were issued in 2016, pursuant to which this category of e-waste is exported to recycling entities in line with the Basel Convention. In 2018, a committee on the ideal management of e-waste from telecommunication equipment was also set up, comprising representatives from telecommunication operators, telecommunication equipment suppliers and government agencies. In addition, a memorandum of understanding for the management of e-waste from communication equipment was signed between the Telecommunication and Postal Regulatory Authority and the Higher Council for the Environment and Natural Resources.

Upstream, the Telecommunication and Postal Regulatory Authority is in charge of issuing accreditations in line with international standards for equipment, devices and systems and for approving type clearance mechanisms (internationally accredited certificates from recommended laboratories). The authority also conducts technical conformity inspections of communications equipment. Within this framework, some operators have been banned for indiscriminately selling e-waste from telecommunication equipment.

Import and export of e-waste

In 2006, Sudan ratified the Basel Convention. The Higher Council for the Environment and Natural Resources is the focal point for approving the necessary documents for the transboundary transport of hazardous waste.

The 2011 Hazardous Waste Regulations provide for the application of export bans on hazardous waste (including e-waste), but they do not contain any provisions on the import of such waste, which would help reduce the amount of e-waste entering the country.

E-waste management in Sudan is based on the export of e-waste to foreign recycling plants, in accordance with the Basel Convention. The Higher Council for the Environment and Natural Resources is responsible for issuing licences for the export of waste on suitable terms and for ensuring that waste is not destroyed or disposed of in any unsound or unforeseen manner. The Telecommunication and Postal Regulatory Authority and the Sudanese Customs Authority are responsible for approving the issuance of licences to exporting companies.

While Sudan had no law banning the import of hazardous waste (including e-waste), telecommunication licence holders are not allowed to import used equipment or recycled devices. Compliance with this interdiction is monitored by the Telecommunication and Postal Regulatory Authority.

To date, no official data on e-waste imports and exports are available for Sudan.

National project and initiatives on e-waste

As of early 2020, there were no ongoing e-waste projects in Sudan, owing resource limitations. Nonetheless, the Higher Council for the Environment and Natural Resources is coordinating with other parties, such as the Telecommunication and Postal Regulatory Authority and the Central Bureau of Statistics, to conduct a national survey of households in Sudan to collect data on e-waste and other hazardous waste.

In 2014, the Sudanese Council for Environmental Affairs and Bannaga Consult conducted a baseline environmental assessment of e-waste in the state of Khartoum as part of a pilot project (Bannaga Consult 2014). The report highlighted that, in Sudan, e-waste is treated as mixed residual waste, which is collected by trucks and brought to intermediary stations where it is compressed and then sent to dumping sites. It has also been observed that extraction processes are predominantly carried out by scrap sellers, who are mainly interested in fraction such as copper, plastics and iron.

There is currently a low awareness of the dangers of e-waste among the population and workers in the formal and informal sectors. The Telecommunication and Post Regulatory Authority has therefore developed a protocol to raise community awareness of environmentally friendly ICT, establish national policies and principles on green ICT, reducing the adverse environmental impact resulting from the expanded use of ICTs, protecting humans and the environment from the risks of e-waste and improper recycling and support the use of ICT systems as an aid to reduce emissions from other sectors.

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