REGIONAL E-WASTE MONITOR

for the Western Balkans

2023

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The Regional E-waste Monitor for the Western Balkans was implemented through a joint partnership between the International Telecommunication Union (ITU), the United Nations Environment Programme (UNEP), and the Sustainable Cycles (SCYCLE) Programme under United Nations Institute for Training and Research (UNITAR).

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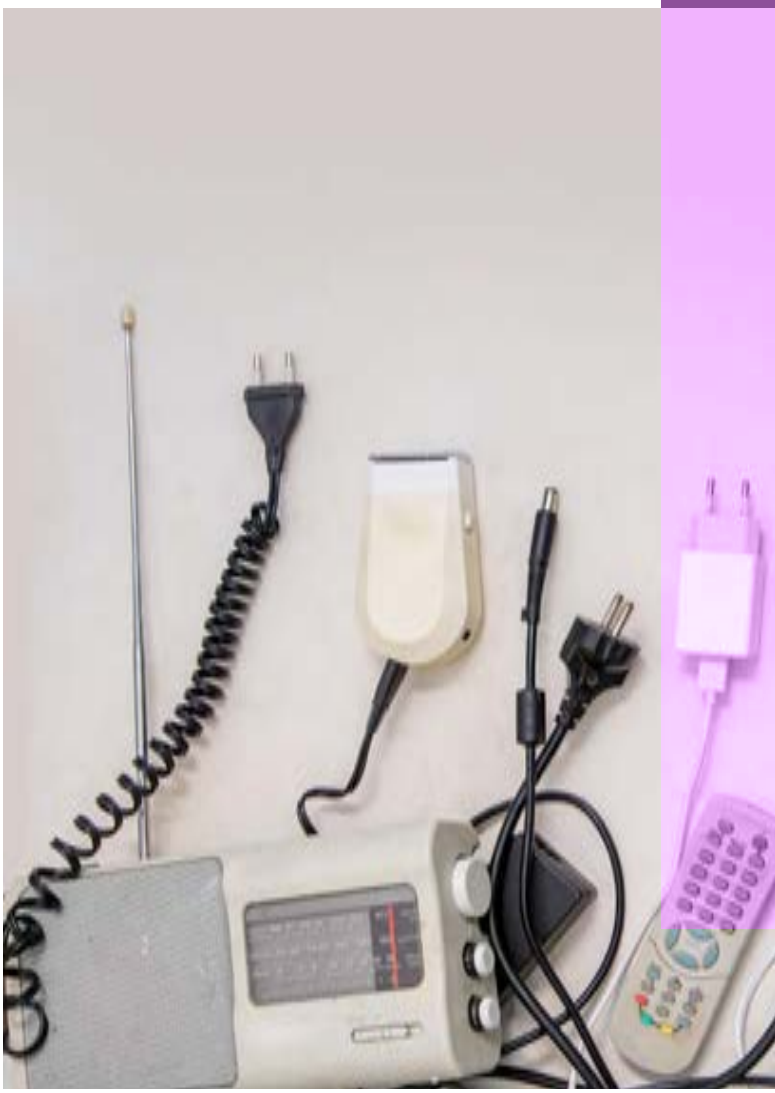
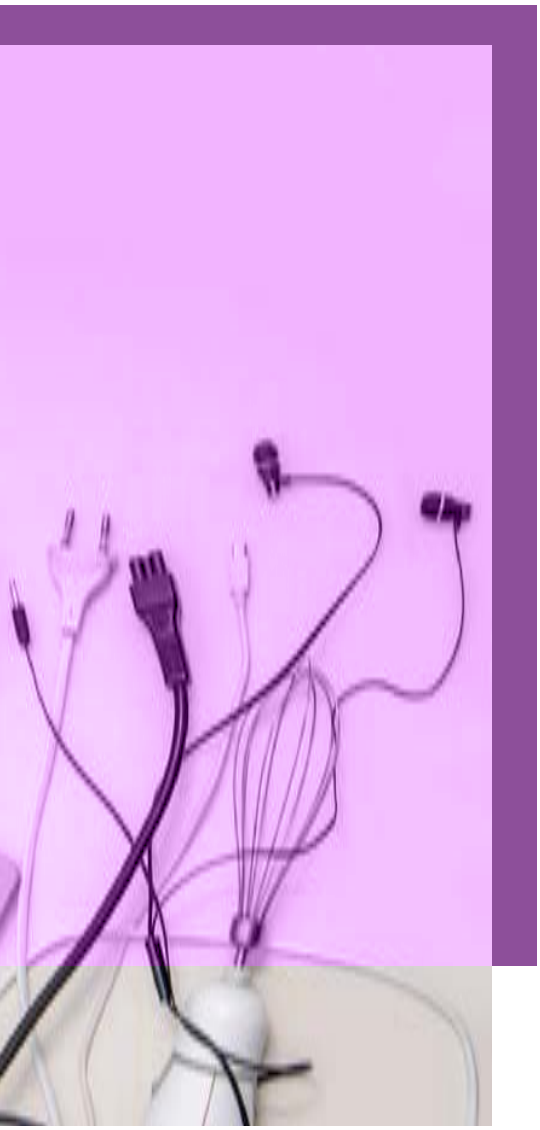
FOREWORD

The relentless advancement of technological innovation, coupled with shorter product lifespans, and the increased accessibility of electronic devices, has fueled a surge in the generation of e-waste across the globe, and the Western Balkans are no exception. The Western Balkan nations of Albania, Bosnia and Herzegovina, Montenegro, North Macedonia, and Serbia stand at the forefront of a shared challenge – the escalating issue of electronic waste, or e-waste. This report, *The Regional E-waste Monitor for the Western Balkans*, examines the contemporary landscape of e-waste in the region. In addition to the statistics, it offers an insightful exploration into the complex interplay of factors driving this surge and provides practical recommendations for sustainable solutions.



At the heart of the e-waste challenge lies the dual nature of electronic devices – they are tools of innovation and convenience, yet their improper disposal poses significant risks to the environment and human health. Conversely, responsible e-waste management practices, such as recycling and proper disposal, can recover rare materials, reducing the burden on our finite resources. Measuring e-waste volumes is an important step towards addressing this e-waste challenge. Data helps to evaluate developments over time, and set and assess targets and policies. Better e-waste data helps minimize its generation, prevent illegal dumping, promote recycling, and create jobs in the reuse, refurbishment and recycling sectors.

The statistics presented in the report underscore a compelling narrative: the uptake in the use of Electrical and Electronic Equipment (EEE) over the past decade has significantly increased the volume placed on the market and the subsequent increase in e-waste generation. Large equipment (washing machines, copying equipment, etc.) and small equipment (fans, vacuum cleaners, etc.) emerge as major contributors, shaping the e-waste landscape in these nations.



As the report delves into the specifics of e-waste categories, it also offers a broader perspective on the challenges and opportunities that come with managing this growing waste stream. E-waste is not merely a numerical concern; it represents a complex interplay of environmental, economic, and societal factors. The report encourages readers to consider the broader implications of this issue, recognizing the need for a holistic approach that transcends statistics.

This report joins other global, national, and regional monitors that aim to collect data and analyze the e-waste landscape around the world. *The Regional E-waste Monitor for the Western Balkans* is a result of a collaboration between the International Telecommunication Union (ITU), the United Nations Environment Programme (UNEP), and the United Nations Institute for Training and Research (UNITAR). It finds that the challenges presented by e-waste are not insurmountable; they are opportunities for positive change. A call to action resonates throughout the document, urging stakeholders, policymakers, and the public to collectively address the e-waste challenge. It envisions a future where technology coexists harmoniously with responsible waste management practices, ensuring a sustainable and vibrant future for the Western Balkans.

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EXECUTIVE SUMMARY

E-waste (also known as Waste Electrical and Electronic Equipment) is on the rise in the Western Balkan countries of Albania, Bosnia and Herzegovina, Montenegro, North Macedonia, and Serbia, just as it is across the rest of the globe. Technological innovations, brief product lifespans, and an increased purchasing-power due to a growing middle class are among the key drivers for the increase of WEEE. This *Regional E-waste Monitor for the Western Balkans* provides actual facts and, as well, describes and analyses statistics, the key-stakeholders, current policies and legislation, technological practices, and societal interdependencies; it also provides recommendations on how to better cope with the e-waste issue. These facts, analyses, and recommendations are vital in order to avoid wasting valuable resources, keep the environment and workers from harm, generate income, and secure future production chains for products – which, combined, will thereby help to improve our lives.

The amount of Electrical and Electronic Equipment (EEE) Placed on Market (POM) in the Western Balkans region increased from 0.16 Mt (9 kg/inhabitant) in 2010 to 0.21 Mt (13 kg/inhabitant) in 2021. Likewise, the regional e-waste generated nearly doubled from 0.09 Mt (5.3 kg/inhabitant) in 2010 to 0.15 Mt (9.0 kg/inhabitant) in 2021.

Large Equipment (Category IVa[1]) and Small Equipment (Category V) are the largest categories of both EEE POM and e-waste generated, at 65% (Category IVa 40%, Category V 25%) and 59% (Category IVa 29%, Category V 30%), respectively. The e-waste generation growth rates in all countries of the region are generally positive, with the exception of Lamps, Small IT, and Screens and Monitors.

[1] According to the EU WEEE Directive and the *'E-waste Statistics Standards Guidelines'*, EEE is classified into six main treatment-oriented categories: Temperature Exchange Equipment (Category I), Screens and Monitors (Category II), Lamps (Category III), Large Equipment incl. PV panels (Categories IVa and IVb), Small Equipment (Category V) and Small IT (Category VI).

The Western Balkan countries collected and managed 38.4 kt (2.4 kg/inhabitant) of e-waste in an environmentally sound manner in 2021, which yields a total collection rate of 27%. Environmentally sound e-waste management may be defined as taking all possible steps to ensure that end-of-life products and waste are managed in a manner that will protect human health and the environment, and it involves the separate collection, dismantling, and pollution of hazardous substances and recycling of valuable materials, while other waste-related activities include waste dumping, waste-picking, disposal, etc. and may include the informal sector[2,3]. All Western Balkan countries have specific legislation on this currently in force, supporting the environmentally sound management of e-waste. In practice, the environmental sound management of e-waste in the Western Balkans occurs mainly in Serbia, North Macedonia, and Bosnia and Herzegovina.

In considering material design, EEE is a complex product that includes precious metals (e.g. silver and gold), critical raw materials (e.g., aluminum, cobalt, and palladium), strategic raw materials (e.g. nickel and copper), and common metals such as iron. As these materials are still valuable after separation and recycling, they can reenter the market and partially cover the supply demand of the current economy. It is estimated that in 2021, the Western Balkans could recover 4.2 kt of secondary raw materials – equivalent to $34 million USD – embedded in e-waste through formal collection and recycling. In 2021, the environmentally sound collection of e-waste in the Western Balkans also avoided 76.4 kt of CO_2-equivalent emissions through the recycling of secondary raw materials, in contrast with primary raw material extraction.

All five Western Balkan countries analysed have specific e-waste legislation in place and legislated Extended Producer Responsibility (EPR) on e-waste – where producers, manufacturers, and importers are held financially and physically responsible for the handling and disposal of post-consumer e-waste – but only two countries, North Macedonia and Bosnia and Herzegovina, have functioning EPR schemes, while Albania, Montenegro, and Serbia are working toward full EPR implementation. And though all five Western Balkan countries also set certain management standards prescribed in the relevant e-waste laws, information is not available on the actual implementation and monitoring or on whether or not they are at all enforced. All countries have ratified the relevant multilateral environmental agreements: the Basel, Rotterdam, and Stockholm Conventions. But the Minamata Convention on Mercury is yet to be signed by Bosnia and Herzegovina and ratified by Serbia. Nonetheless, the countries' national reporting on transboundary movement of e-waste under the Basel Convention is still limited. Most countries of the region have also implemented specific e-waste import bans, while e-waste exports and transits are allowed. But the importing and exporting of Used EEE (UEEE) is not legislated, and the flows of UEEE are not restricted. UEEE is travelling through the Western Balkans region, and the limit in proper reporting does not allow for distinguishing between new EEE and UEEE or for ensuring that UEEE is not already e-waste. However, all five countries signed the regional agreement 'Sofia Declaration on the Green Agenda', which, if properly utilised, could further facilitate environmentally sound management of e-waste (ref. section II. Circular economy and III. Depollution).

Since 2010, e-waste generation has increased in the Western Balkan countries by 67 percent – to 0.15 Mt in 2021, while the average e-waste collection rate in the region is at 27 percent.

[2] UNECE. (2021) Task Force on Waste Statistics – Conference of European Statisticians. UNECE, Geneva, 2021 under approval (United Nations Economic Commission for Europe, UNECE). [3] ILO definition of informal sector: 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 (2017) section 4.5 on informal economy workers.

As in most countries globally, the Western Balkans' Ministries of Environment are the lead governmental authorities for e-waste policies, while various agencies and municipalities handle collection of fees and monitoring and enforcement. In countries with EPR schemes in place, producers, importers, and retailers are responsible for the collection and treatment of e-waste through the established Producer Responsibility Organisations (PRO), alongside the private recycling companies. But consumers also play an important role either as individual persons or institutions or companies: while generating e-waste, they decide to store, repair, or discard the products. All five countries host both small and medium-sized recyclers. But these recyclers do not have adequate supply of material input to operate optimally, which forces them to deal with informal operators, who are especially strong in e-waste collection in the region. Seeing the threats of e-waste, but also the opportunities proper e-waste treatment can provide, Non-Governmental Organisations, PROs, donor agencies, and other public institutions are involved in public awareness-raising, educational activities, and e-waste collection programmes in the entire region.

Overall, the Western Balkan countries face major challenges with an incomplete implementation of EPR schemes and a poor e-waste management system for monitoring and enforcement. The lack of reliable data is also a constraint since reliable data is vital for assessing the current status, monitoring progress, and deciding on appropriate policies and countermeasures on the policy side, as well as for infrastructure development, awareness-raising, etc. There is shortage of e-waste collection and treatment infrastructure in Albania and Montenegro, and in these countries, separate collection of e-waste is hardly implemented. In countries where an e-waste management infrastructure exists, such as Bosnia and Herzegovina, North Macedonia, and Serbia, the collected e-waste is usually pre-processed and then exported. Though there are many local companies licensed for e-waste collection and processing in the region, not all of them are operational. The shortage of collection also poses a risk for the formal recyclers, which depend too much on a dominant informal sector that impacts the economics of the treatment industry. There are also reasonable concerns that some informal operators could be engaging in some manual pre-processing of specific valuable parts without taking the necessary environmental health and safety measures. This presents many environmental problems and poses a risk to the health of operators, their family members, and their neighbourhoods.

Six general recommendations can be drawn from the analysis presented herein, and an all-encompassing approach, involving all actors and stakeholders in each country, will be needed in order to implement them. A somewhat strengthened transnational cooperation is necessary to reduce the burden of large investments and secure the necessary turn-around. The six recommendations are: (i) Prevent More, (ii) Be More Aware, (iii) Collect More, (iv) Treat better, Work safely, Pollute Less, (v) Pay Adequately, and (vi) Train More.

The recycling infrastructure of the region faces shortage of material supply to work optimally due to the limitation of the formal collection network.

ABBREVIATIONS

CRT	Cathode Ray Tube
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, synonym of Waste Electrical and Electronic Equipment (WEEE)
GEF	Global Environment Facility
HS Code	Harmonised System Codes
Inh	Inhabitant
IT	Information Technology
ITU	International Telecommunication Union
kt	(Metric) Kiloton, or 1,000,000 kg
MEA	Multilateral Environmental Agreement
NGO	Non-Governmental Organisation
PCB	Printed Circuit Board
POM	Placed On Market
PPP	Purchasing Power Parity
PRO	Producer Responsibility Organisation
PV panel	Photovoltaic panel
REM	Regional E-waste Monitor
SCYCLE	Sustainable Cycles Programme
SDG	Sustainable Development Goal
t	(Metric) Ton, or 1,000 kg
TBM	Transboundary Movement
UEEE	Used Electrical and Electronic Equipment
UN Comtrade	United Nations Commodity Trade Statistics Database
UNECE	United Nations Economic Commission for Europe
UNDESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
UNITAR	United Nations Institute for Training and Research
UNU	United Nations University
UNU-KEY	Product-based classification distinguishing 54 products, used to measure e-waste statistics
WEEE	Waste Electrical and Electronic Equipment

	OFFICIAL COUNTRY NAME	NAME USED IN THE REPORT
ALB	Republic of Albania	Albania
BiH	Bosnia and Herzegovina	Bosnia and Herzegovina
MKD	Republic of North Macedonia	North Macedonia
MNE	People's Republic of Montenegro	Montenegro
SRB	Republic of Serbia	Serbia

1. INTRODUCTION

A. What is E-waste?

Electrical and Electronic Equipment (EEE) contains all products and parts that run on a power or battery supply. Upon being discarded by its owner, EEE becomes Waste Electrical and Electronic Equipment (WEEE) or electronic waste (e-waste) for short, which currently constitutes the fastest growing waste stream globally.

Electrical and Electronic Equipment (EEE) includes a wide range of products, including nearly all household or business items (excluding vehicles) with circuitry or electrical components that have a power or battery supply for performing their functions [1]. EEE is increasingly used in everyday living activities at home, work, transport, school, health, recreation, etc. Typical examples include refrigerators, washing machines, lamps, dishwashers, laptops, servers, electric transport, mobile phones, dialysis machines, imaging equipment, and musical instruments. The use of EEE is growing rapidly alongside the overall development of societies, and demand is increasing as new features are introduced, especially in Small IT and telecommunication devices (such as mobile phones and tablets).

Electrical and Electronic Equipment (EEE) includes a wide range of products with circuitry or electrical components that have a power or battery supply for performing their functions.

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

According to the EU WEEE Directive[4] and the 'E-waste Statistics Standards Guidelines' [2], EEE is classified into six main treatment-oriented categories:

1. Temperature Exchange Equipment

2. Screens and Monitors

3. Lamps

4. Large Equipment (incl. PV panels)

5. Small Equipment

6. Small IT and Telecommunication Equipment

The six categories can be further detailed using the product-oriented UNU-KEYs classification, which divides EEE into 54 different product-centric categories. The UNU-KEYs focus on similarities in function, comparable material composition, average weight, and similar end-of-life attributes. The full list of the UNU-KEYs and six e-waste categories can be viewed in Annex A.

Once the EEE is discarded, it becomes Waste Electrical and Electronic Equipment (WEEE), also referred to as electronic waste (e-waste). E-waste refers to all electrical and electronic equipment (EEE) and its parts that have been discarded by its owner as waste without the intent of reuse [1].

[4] eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:02012L0019-20180704 (Annex II).

B. E-waste: An Issue of Concern in the Western Balkan Region

Managing the increasing quantities of e-waste generated annually has become a global challenge, due to the waste's material composition and the inadequacies of collection and treatment infrastructure.

Economic development and rapid change in technology render EEE obsolete, making e-waste the fastest growing waste stream globally. The rising quantities of e-waste pose a threat to the environment, while simultaneously providing business opportunities for extracting and recycling the raw materials embedded in the e-waste stream. Each type of e-waste has a specific size, hazardous components and valuable materials that affect the way it must be collected, treated, recycled, or disposed of in an environmentally sound manner (ESM). Unfortunately, the vast majority of EEE is mismanaged and creates considerable material losses of valuable commodities such as steel, aluminum, copper, and rare earth metals, leading to a greater pressure to extract new raw materials and causing indirect environmental impacts as a result. The adoption of inappropriate management options may cause potential exposure to a complex mixture of chemicals, some of which release toxicity and have environmental properties that have not yet been thoroughly investigated, especially to workers from exposure to hazardous processes and chemicals from improper use, toxic fumes, and other harmful substances. Existing evidence indicates that chronic exposure to such practices might disproportionately impact women and children by affecting neonatal development and impacting hormonal levels and immune function[5]. As a complex and relatively recent waste stream, countries need to introduce specific legislation to enforce ESM for e-waste. Though more countries have introduced specific policies and legislative/regulatory frameworks, implementation and enforcement are sometimes inadequate. As well, most developed countries focus on improving e-waste management systems, but not on the reduction of the volumes of e-waste generated in the first place.

[5] https://wedocs.unep.org/bitstream/handle/20.500.11822/41533/womem_waste.pdf?sequence=3&isAllowed=y

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

The United Nations' 'Global indicator framework for the Sustainable Development Goals (SDGs) and targets of the 2030 Agenda for Sustainable Development' has targets for ESM of e-waste as well as targets on the well-being of operators in the sector. SDG 12 (Sustainable consumption and production) has indicators for improving national recycling rates (SDG 12.5.1), reducing hazardous waste generation (SDG 12.4.2) and the ESM of chemicals and all waste, and substantially reducing waste generation through prevention, reduction, recycling, and reuse (SDG 12.5) to reduce pollution and minimise their adverse impacts on human health and the environment (SDG 12.4).

C. Socio-economic Framework Conditions in the Western Balkans

The five countries covered in this report seek to join the EU and have signed the Sofia Declaration on the Green Agenda Declaration, which acknowledges the European Green Deal.

This Regional E-waste Monitor (REM) of the Western Balkans covers the following countries: Albania (ALB), Bosnia and Herzegovina (BiH)[6], Montenegro (MNE), North Macedonia (MKD), and Serbia (SRB). In recent years, these countries have stepped up efforts to reduce dependence on landfilling and modernise waste management infrastructures and have introduced or strengthened EPR (e.g. for e-waste, batteries, or packaging) and aligned their legal framework with that of the EU. Nearly all of the countries established ambitious waste collection and recycling targets modelled on those in the EU, which they all aspire to join. In practice, however, waste collection and recycling rates remain relatively low in comparison to most European countries[7].

[6] Bosnia and Herzegovina (BiH) is composed of three territorial units – two of which are entities (Federation of BiH, FBiH and Republika Srpska, RS), while the third unit is Brčko District. [7] https://www.intellinews.com/bnegreen-cleaning-up-the-western-balkans-waste-problem-253776/

During the Western Balkans Sofia Summit, held on 10 November 2020, the countries endorsed the Declaration on the Green Agenda that aligns with the EU Green Deal. The Sofia Declaration acknowledges the European Green Deal as the European Union's new growth strategy toward a modern, climate-neutral, resource-efficient, and competitive economy. The Sofia Declaration supports and accelerates changes and processes in the region with the overarching goal of addressing climate change[8]. It also intends to develop circular economy strategies, looking at the entire lifecycle of products, waste prevention, modern waste management and recycling, reuse, repair, and re-manufacturing. In the Green Agenda, the Western Balkan countries agreed to make further progress in construction and maintenance of waste management infrastructure as well as implementing consumer-targeted initiatives to raise citizens' awareness on waste, separate collection, and sustainable consumption[9].

The entire region has about 16 million inhabitants, with Serbia being the most populous country (at 6.9 million inhabitants), while Montenegro is the smallest (at 0.63 million inhabitants).

The region has a population of 15.97 million inhabitants (inh) (2021) with a population decline of -2%. Serbia is the most populous country with a population of 6.9 million inhabitants, followed by Bosnia and Herzegovina (3.5 million), Albania (2.86 million), North Macedonia (2.08 million)[10] , and Montenegro (0.63 million) as of 2021 (see Figure 1).

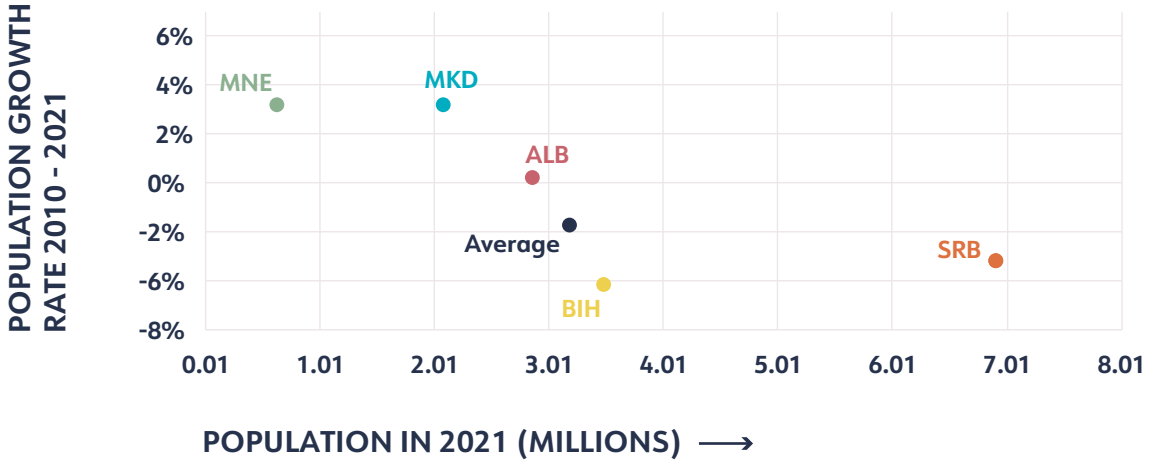
The Western Balkan region has 16 million inhabitants as of 2021, with an overall declining population.

[8] https://www.rcc.int/docs/546/sofia-declaration-on-the-green-agenda-for-the-western-balkans-rn [9] https://www.rcc.int/download/docs/Leaders%20Declaration%20on%20the%20Green%20Agenda%20for%20the%20WB.pdf/196c92cf0534f629d43c460079809b20.pdf [10] According to the State Statistical Office of North Macedonia, the information on population differs slightly from the World Prospect Population of the United Nations Department of Economic and Social Affairs, and it was equivalent to 1.8 million (1,829,954) in 2021.

North Macedonia and Montenegro have a population growth rate of 1%, while the other countries have registered declining demographics over the past decade.

The population of the region is on the decline with an average rate of -4% between 2020 and 2021. North Macedonia and Montenegro register a population growth rate of 1%, but the other countries have declining populations, with Bosnia and Herzegovina having the highest declining population rate of -6%, then Serbia (-5%) and Albania (-2%) (Figure 1). Population decline in the region is attributed to an aging population, sinking birth rate, and emigration[11]. The region has seen rampant migration over the decades due to factors that include the breakup of Yugoslavia and the civil wars and economic hardships that followed[12]. Due to the region's complicated history, citizens of a country can get passports from neighboring 'mother countries' to travel abroad. This is more likely when the 'mother country' belongs to the EU, since EU citizenship includes the right to work anywhere in the Union. For example, many Croatian passport holders working abroad are probably from Bosnia and Herzegovina, thus making it hard to determine the exact country of origin of a migrant from that claimed for economic and migration reasons[13].

Figure 1. Demographic overview of the region per country. The 2021 population is shown on the x-axis, and the population growth rate from 2010 to 2021 is shown on the y-axis



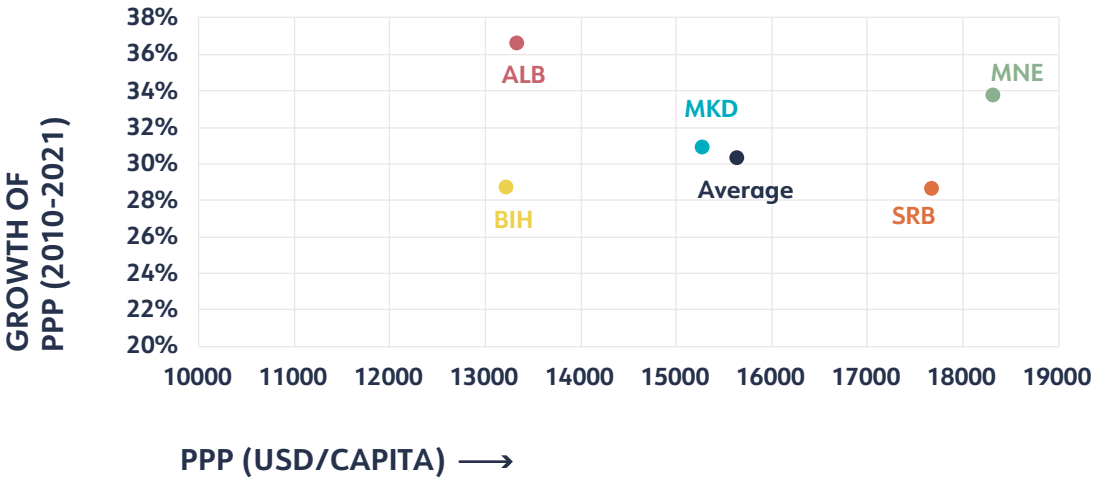
[11] The long decline: mass migration batters Balkans – EURACTIV.com.
[12] Demographic crisis in the Balkans (euobserver.com).
[13] The Balkans are getting short of people | The Economist.

Though there is not much difference in purchasing power per inhabitant in the region, with nearly the entire population having access to electricity and internet, with access being between 72% and 81%; about 3% of the population is below the poverty line in three countries.

The region has socioeconomic development in line with the product purchasing power parity (PPP)[14], varying from $13,000 USD/year in Albania and Bosnia and Herzegovina to $15,000 USD/year in North Macedonia and then to $18,000 USD/year in Montenegro and Serbia (Figure 2). The entire region shows a growth of PPP, ranging from 29% to 37% (Figure 2). According to the World Bank classification, all five countries are upper-middle income countries[15]. Three of the five countries' populations live below the poverty line, according to available SDGs data for 2018: North Macedonia at 3.4%, Montenegro at 2.8%, and Serbia at 2.9%. All countries attained 100% population access to electricity in 2020, while for the same year, access to the internet hovered between 72% and 81% (Albania at 72%, Bosnia and Herzegovina at 73%, Montenegro and Serbia at 78%, and North Macedonia at 81%).

The countries in the Western Balkan region have an average PPP of $15,600 USD in 2021.

Figure 2. Economic overview of the region. On the x-axis, PPP in 2021; on the y-axis, the PPP growth rate from 2010 to 2021



[14] The purchasing power parity (PPP) is an economic indicator that allows for comparing economic productivity and standards of living between different countries and locations. It can be used to adjust the gross domestic product (GDP).
[15] New World Bank country classifications by income level: 2022-2023.

2. METHODOLOGY

Though some assessments, projects, and initiatives on e-waste have been undertaken in recent years, a comprehensive overview and analysis of the e-waste situation in the Western Balkans region is still lacking.

This study reviews the current e-waste legislation and management in the five countries in the Western Balkan region. Also presented in this report is the trend in transboundary movement (TBM) of e-waste within and out of these countries, as well as a periodic monitoring of collected e-waste statistics. Data presented in this report has been prepared through a collaboration with the countries' governments and national statistical offices and with independent experts of the countries. It is expected that the results of this study will benefit policy makers as well as private sector stakeholders and investors that may be interested in e-waste collection and recycling. This will facilitate the further development of e-waste ESM systems in the region. The approach adopted will allow for international comparisons, since it is similar to that used in previous REMs projects conducted.

The statistical methodology used in this report follows the same principles as the internationally harmonised framework, which has been developed by the Partnership for Measuring ICT for Development as a joint effort by the United Nations University (UNU)/United Nations Institute for Training and Research (UNITAR), International Telecommunication Union (ITU), United Nations Environment Programme (UNEP), the Statistical Office of the European Union (Eurostat), and other United Nations (UN) agencies that have been described in 'E-waste Statistics Guidelines on Classification Reporting and Indicators' [2][3]. For the assessment of e-waste legislation and management, a novel methodology has been developed. The key concepts of the methodology are explained in more detail below.

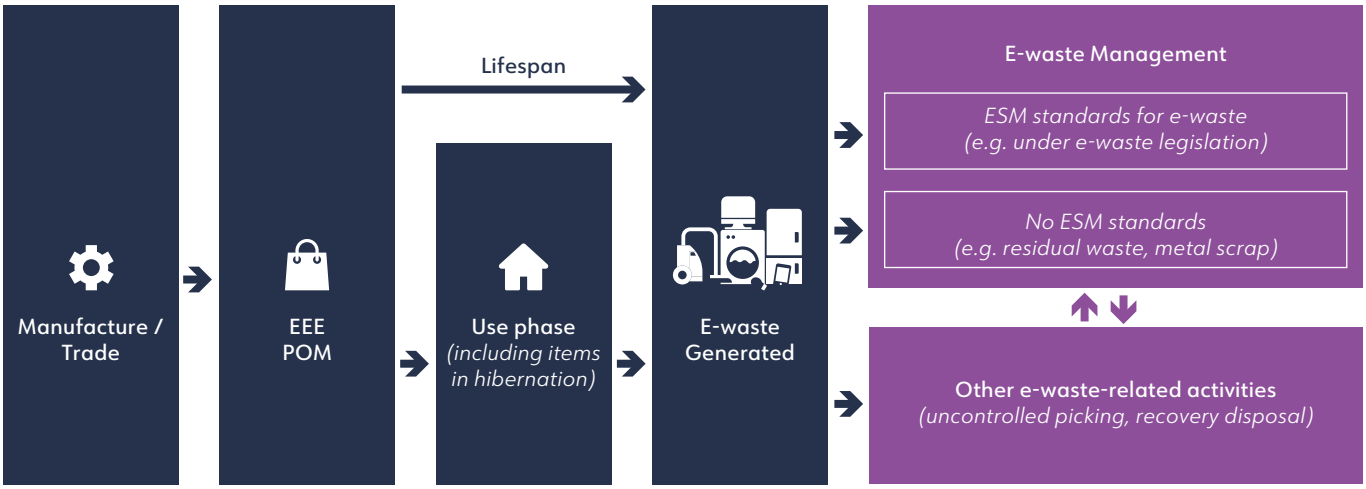
A. E-waste Statistics Framework

E-waste statistics follow a mass balance of the lifecycle of EEE and are calculated using a product-based classification, the UNU-KEYs.

The measurement framework of e-waste statistics follows a mass balance approach over the entire life cycle of EEE, including production, imports, placing on the market, e-waste generation, e-waste management, and other e-waste-related activities (Figure 3). As a first step, it quantifies the amount of EEE placed on market (EEE POM). The term EEE refers to any household or business item (excluding vehicles) with circuitry or electrical components and a power or battery supply [1].

EEE POM has been calculated for 54 products – the so called UNU-KEYs. The UNU-KEYs are a product-based classification in which each UNU-KEY has a homogeneous lifespan, average weight, material composition, and hazardousness profile. The UNU-KEYs can be linked to the six e-waste categories and are used to measure e-waste statistics (Annex A).

Figure 3. E-waste statistics framework



E-waste generation is calculated using the EEE POM and lifespans for each UNU-KEY. E-waste generated is the total mass of e-waste, prior to any e-waste management activity.

The EEE POM can be calculated from a variety of data sources. The most straightforward methodology is that of using the apparent consumption methodology, according to which EEE POM can be obtained with Eq. 1:

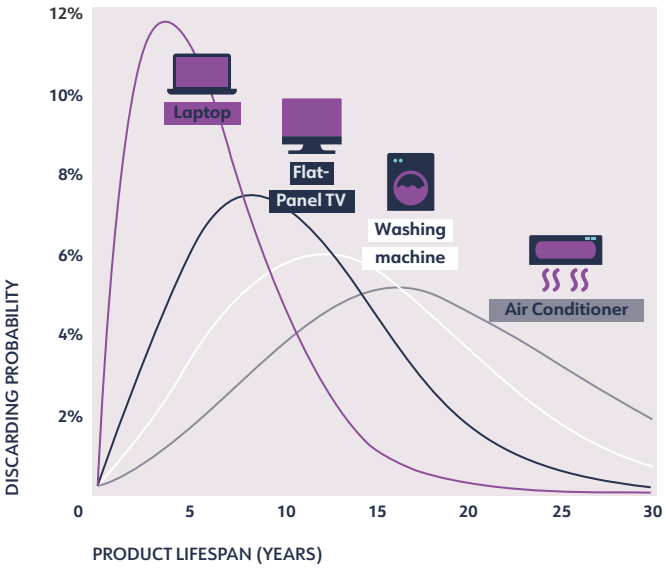
Equation 1:

$$POM = Import - Export + Domestic\ Production$$

The EEE POM includes imports of both new and used EEE, as well as domestically produced EEE. Since trade statistics and domestic production data are usually expressed in units, a unit-to-weight conversion factor per each UNU-KEY is calculated and applied in order to obtain the amount of EEE POM in mass.

After a product has been POM, it stays in use until it is discarded, and that period of time in between corresponds to the lifespan of the product. This includes the hibernation phase – such as the storing/stockpiling of the equipment until POM or the hoarding time of the equipment prior to actually being discarded at the end of its life – as well as the equipment being passed on from one owner to another (reuse). The lifespan of EEE is expressed as a Weibull function and varies per UNU-KEY, with the shape and scale parameters associated to the average lifespan for each UNU-KEY individually (Figure 4).

Figure 4. Examples of EEE product lifespans



The time series of EEE POM and lifespans are then used to calculate e-waste generated for each UNU-KEY. E-waste generated in a country refers to the total weight of e-waste resulting from EEE that had been POM in that country, prior to any other activity, such as collection, preparation for reuse, treatment, or recovery, including recycling and exporting[16].The mathematical description of this concept is explained in Annex B.

E-waste generation is the basis for conducting statistics on the e-waste flows and allows for the assessment of the amount of e-waste that undergoes environmentally sound management, as well as what follows other e-waste-related activities.

In general, environmentally sound management of e-waste involves the collection, transportation, storage, and disposal of waste, including after-care of disposal sites. It is of vital importance that e-waste undergoes depollution, that hazardous parts 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. Therefore, in the present report, this flow is referred to as 'e-waste formally collected' or 'environmentally sound management of e-waste'.

Other e-waste flows are also considered, covering other e-waste management practices, such as the e-waste that ends up in residual waste, mixed in with metal scrap, or managed by the informal sector.

E-waste can also be managed by waste managers involved in such various processes as collection, dismantling, and metals recovery, using operations that do not guarantee environmentally sound management, and which, due to inferior quality, may then cause damage to the environment as result of the e-waste's hazardous substances not being treated. An example is e-waste being mixed in with residual waste that ends up in landfills. The e-waste can also be mixed in with other waste, such as metal scrap, and recycled together with it. Not all recyclable parts are recycled, and hazardous components of e-waste are left untreated.

[16] https://ec.europa.eu/environment/waste/weee/pdf/16.%20Final%20report_approved.pdf.

Waste management can be undertaken within a legal framework, but waste handling carried out by informal economic units as well as illegal waste-handling also exist. In this context, 'waste management' and 'other waste-related activities', as proposed by the UNECE's Waste Statistics Framework, are distinguished. In 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 after-care of disposal sites [4]. The 'other waste-related activities' include waste-dumping, waste-picking, disposal, etc. and may include the informal sector[17].

For e-waste, 'other waste-related activities' may specifically involve the selective dismantling of the valuable parts, recovery of some metals, or dumping at uncontrolled landfills, with the hazardous components of e-waste left untreated, and such treatment is typically performed by informal waste operators. The activities performed by the informal sector usually do not imply minimum safety requirements, environmental standards, and depollution techniques. However, the informal sector can sometimes hand complete products of e-waste over to the formal sector.

In order to assess e-waste statistics, e waste importing and exporting must be measured as well.

Importation and exportation can occur for used-EEE and e-waste; this is called transboundary movement (TBM). TBM of e-waste occurs both with whole products and with parts/components. It is important that it be made clear whether the exported e-waste is designated according to the ESM criteria in the national legislation (and thus managed by e-waste-certified recyclers in the receiving countries) or not. Used-EEE products are not yet waste, but their data is needed to complete the mass balance of EEE and e-waste.

International indicators for e-waste and the SDG 12 are defined for EEE POM, e waste generated, e-waste formally collected (environmentally sound management), and the e-waste collection rate.

To capture the most important dynamics of e-waste, four indicators are defined for SDGs and international guidelines [2][3][5]:

1. **Indicator 1:** EEE POM
2. **Indicator 2:** E-waste generated
3. **Indicator 3:** E-waste formally collected (or e-waste environmentally sound management)
4. **Indicator 4:** E-waste collection rate (indicator 3 divided by indicator 2)

The performance of the entire e-waste management is expressed using the e-waste collection rate, defined as Indicator 4, which is expressed as a percentage. The collection rate can be an indication of the progress made by the country toward achieving a proper management of the e-waste sector.

[17] ILO definition of informal sector: 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 (2017) section 4.5 on informal economy workers.

B. E-waste Legislation and Management Assessment

Assessment of national e-waste policy coverage and e-waste infrastructure is done by distinguishing between three development stages: A (advanced), B (in transition), and C (basic).

Countries or regions may define their own standards for sound treatment of hazardous waste, based on their national context [5], which gives rise to differences in interpretation and the standard of ESM of waste, including e-waste. Therefore, this report provides a novel methodology for further interpretation regarding the progress of e-waste toward ESM in terms of developing legislation and development of e-waste management infrastructure, which allows for a cross-country comparison.

In practice, the implementation of ESM of e-waste requires a comprehensive approach and can only be successful when many factors such as socioeconomic development, governance structures, geography, trade links, infrastructure, and consumer behaviours are considered. The description of the stages is shown in Table 1, where A, B, and C can be approximately interpreted in A as advanced, in B as transition, and in C as basic.

Table 1. Features of the e-waste system matrix in various stages of development (adapted from [6][7][8][9])

Stages	Legal Framework	Infrastructure
A	E-waste legislation, including financing mechanisms, enforcement with efficient controls and monitoring; alternatively, strong voluntary system with governmental support and collaboration, legally mandated and compulsory nationwide environmental health and with internationally accepted safety (EHS) standards for all facilities.	Widespread network of formal collection channels; e-waste collection is mostly formalised, with only legally authorised e-waste collection taking place, either through legally obligated take-back systems, voluntary initiatives, or the informal sector handing over e-waste to a formal collector. Depending on the country, high-efficiency and advanced industrial facilities (large and small scale) are available for recycling and recovery of functions and materials from e-waste, including precious metals, rare earth metals, etc.
B	E-waste-specific draft legislation under discussion or recently enacted; in the early stages of enforcement regime development; potentially limited scope of legislation; voluntary EHS standards with basic minimum thresholds; greater individual awareness about environmental and health risks.	Informal and formal collection channels coexist; 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 separate recyclable parts; informal sector recyclers recover copper, gold, and other materials using rudimentary methods.
C	No e-waste-specific legislation and financing mechanisms: e-waste management depends on ad hoc local actors; limited or no awareness of EHS among e-waste processors, and therefore little protection from toxins and hazardous substances released during e-waste treatment and recycling.	Only informal collection and/or disposal with municipal waste. 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 and repair, reuse, and recycling.

In the indicator framework developed, each indicator available for the legal framework and collection infrastructure is scored as A, B, or C.

The approach taken in this report was to develop a framework of indicators that is relevant for e-waste legislation and e-waste management. Each indicator would have to be measurable and meaningful for e-waste management. The adopted choice of indicators comes from a pragmatic compromise between the data available and the ideal situation, and it sometimes results in proxies.

In the legal framework, five indicators that deal with national and international legislation are distinguished (see Table 2). These indicators cover the existence of national legislation concerning e-waste specifically, the introduction and implementation of the EPR, the presence of e-waste collection targets as well as of EHS standards, and the obligations under international treaties.

Two indicators are defined in the collection mechanism. One indicator addresses the e-waste collection points – whether e-waste collection points exist in all municipalities, exist in only the main cities, or are absent in the country. Collection points can be organised either through municipalities or through producer take-back schemes, both of which include pick-up and drop-off services. The second indicator is whether an e-waste management infrastructure exists in the country.

Table 2. Overview of indicators in the e-waste management system and minimum level for stages

	Number	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
	1.2	**EPR introduction and implementation**	Introduced in the legislation, but not established	Legislated and partially established	Legislated and established
	1.3	**Is there a national e-waste collection target?**	No	Voluntary/in development	Yes
	1.4	**Are there minimum standards for e-waste management?**	No	Voluntary/in development	Yes
	1.5	**Number of MEAs ratified or signed** (Basel, Minamata, Stockholm, Rotterdam)	1 Rratified or signed	2 ratified + 1 signed	3 ratified + 1 signed
Infrastructure	2.1	**Are there e-waste collection points in each municipality?**	Mostly absent	In the main cities	Yes
	2.2	**Are there management facilities in the country for ESM of e-waste?**	No	In developed	Yes
Per-formance	3	**E-waste collection rate** (%)			
E-waste quantity	4	**E-waste generated** (in kg/inh and kt)			

The e-waste management in the countries 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, both the outcomes of the e-waste management matrix (i.e. legal development and the development of the e-waste management infrastructure) and the e-waste statistics indicators provide an overview of whether the countries are legislating and building an effective e waste management infrastructure that can collect e-waste – as shown in the indicator, 'e-waste generation' (indicator 2). The 'e-waste collection rate' (indicator 4) indicates the effectiveness of the legislation and infrastructure. Together, indicators 2 and 4 provide a dashboard at the country level.

C. Data Sources

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

Statistical data on EEE POM and e-waste generated was obtained from the governments or national statistical offices that were part of the project. When data was not available, the datasets from The Global E-waste Monitor 2020 were used [10]. Data for EEE POM and e-waste generated has been obtained from official national data for Albania, Bosnia and Herzegovina, and North Macedonia. Data on e-waste formally collected has been obtained from national official databases and countries' authorities that were part of the study, as well as through direct consultation with private companies active in the field of e-waste collection (subsequently validated by the national authorities).

To determine the amount of e-waste and used-EEE imported and exported per country, data from The Global Transboundary E-waste Flows Monitor 2022 [11] has been used; the monitor includes the national reports of the Basel Convention for 2016-2020. The analysis of whether or not TBM corresponded with e-waste has been performed using a combination of the codes in List A (hazardous waste) and List B (non-hazardous waste), as well as the Y codes of the Basel Convention (Annex C).

The amount of raw materials found in e-waste was calculated by linking the data on EEE composition from the ProSUM project[18] to the estimated amount of e-waste generated [12].

The socioeconomic condition has been analysed through factors such as population and PPP, obtained from United Nations Department of Economic and Social Affairs (UNDESA), as well as the size of the informal sector, access to electricity and internet, and share of the population below the poverty line, the data of which were obtained from the United Nations Statistics Division (UNSD) SDGs[19] database.

Information regarding the current status of the legislative framework and the overall e-waste management system was acquired via questionnaires and direct interviews addressed to ministries and stakeholders of relevance for the e-waste sector.

Data on the Parties and status of the signatories of the Basel, Rotterdam, Stockholm, and Minamata Conventions was obtained from their individual websites of the Conventions.

Where first hand information could not be retrieved, literature research, reviews of existing papers, and national studies for the countries of interest were conducted.

[18] Jaco Huisman, Pascal Leroy, François Tertre, Maria Ljunggren Söderman, Perrine Chancerel, Daniel Cassard, Amund N. Løvik, Patrick Wäger, Duncan Kushnir, Vera Susanne Rotter, Paul Mählitz, Lucía Herreras, Johanna Emmerich, Anders Hallberg, Hina Habib, Michelle Wagner, Sarah Downes. Prospecting Secondary Raw Materials in the Urban Mine and mining wastes (ProSUM) - Final Report, ISBN: 978-92-808-9060-0 (print), 978-92-808-9061-7 (electronic), December 21, 2017, Brussels, Belgium. [19] UN SDGs https://unstats.un.org/sdgs/indicators/database/

3. REGIONAL OVERVIEW OF THE E-WASTE LEGISLATION AND E-WASTE MANAGEMENT SYSTEM

A. Status of Legislation

All Western Balkan countries analysed have specific e-waste legislation and legislated EPR on e-waste in place, but only two countries have EPR functioning, while others are working toward EPR implementation.

All five Western Balkan countries analysed in this report have legislations in place for e-waste management. In most of the countries, e-waste is considered 'special waste' in the waste management laws, and this designation warrants separate collection and special treatment as stipulated by the by laws. Such by laws also encompass batteries and, in some cases, mercury-containing waste materials (e.g. batteries).

All five countries mention the Extended Producer Responsibility (EPR) principle related to e-waste in their legislations, but implementation is at different stages. In the two entities of Bosnia and Herzegovina, the Federation of Bosnia and Herzegovina (FBiH) and the Republic of Srpska (RS), EPR legislations related to e-waste are in place, but not in the Brcko District (BD) of Bosnia and Herzegovina. Also, North Macedonia has functional e-waste-specific EPR legislation in place, while this is yet to be implemented in Albania, Montenegro, and Serbia. Montenegro anticipates a new Law on Waste Management being adopted in 2023 that will facilitate implementation of an EPR scheme by 2024. Albania started to prepare a draft law, creating the basis for an EPR system. In Serbia, EPR is discussed in the legislation, but a collective EPR scheme has not yet been introduced or implemented. However, based on the EPR principle, producers/importers are required to pay a certain fee (depending on the EEE type or weight), which is used in establishing an appropriate management scheme for e-waste. Thus, all Western Balkan countries have implemented, or have plans to implement, EPR systems in the near future (Table 3).

E-waste collection targets are provided for in all five countries, though the targets in Albania and Montenegro have expired. However, even in countries where collection targets exist, concrete implementation measures are lacking. Data and reporting on e-waste collected and treated is also limited even in some countries where licensed collectors and recyclers are legally obligated to submit annual reports. An e-waste management information system is present only in the FBiH entity of Bosnia and Herzegovina. So, statistical offices need to improve data collection and enlighten the e-waste collection and treatment companies about their legal obligations on reporting.

Table 3. Presence of e-waste-specific legislation, EPR, & EHS standards on e-waste management

Country	Legislation/ regulation specific on e-waste*	Extended Producer Responsibility (EPR) legislation relating to e-waste	E-waste environmental health and safety (EHS) standards	Collection target
Albania	✔	✖	✔	⏲
Bosnia Herzegovina	✔	✔	✔	✔
Montenegro	✔	✖	✔	⏲
North Macedonia	✔	✔	✔	✔
Serbia	✔	⚙	✔	✔

✔ present ✖ EPR legislated but not yet implemented ⚙ EPR legislated with implementation in progress ⏲ expired target

*Detailed information about the specific laws can be found in the respective country profiles (see Chapter 10).

All five countries have e-waste management standards, but information on implementation is not available.

All countries in the region have adopted specific e-waste management standards prescribed in the relevant e-waste laws. However, information is not available on the actual implementation, monitoring, and enforcement of the standards. So, what has been reported in Table 3 reflects only the actual existence of EHS standards within the legislative framework.

B. International Agreements

Countries in the region are parties to several international agreements, including MEAs related to e-waste and other regional agreements that promote circular economy (Table 4).

All countries have ratified the Basel, Rotterdam, and Stockholm Conventions, but not the Minamata Convention on Mercury, which Bosnia and Herzegovina is yet to sign.

All five countries are Parties to the Basel Convention on the Control of Transboundary Movement of Hazardous Waste and their Disposal. The same applies to the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, and the Stockholm Convention on Persistent Organic Pollutants. All countries except for Bosnia and Herzegovina have also ratified the Minamata Convention on Mercury (Serbia is at the signature stage); Bosnia and Herzegovina has not yet started the signature process.

Table 4. Overview of international agreements (signature/ratification)

INTERNATIONAL AGREEMENT	ALBANIA	BOSNIA AND HERZEGOVINA	MONTENEGRO	NORTH MACEDONIA	SERBIA
Basel Convention	✔	✔	✔	✔	✔
Rotterdam Convention	✔	✔	✔	✔	✔
Stockholm Convention	✔	✔	✔	✔	✔
Minamata Convention	✔	✖	✔	✔	⚙
Sofia Declaration on the Green Agenda	✔	✔	✔	✔	✔

✔ ratified ⚙ signed ✖ not ratified; not signed

The signing of the Sofia Declaration on the Green Agenda by the Western Balkan countries and other agreements could facilitate regional solutions to e-waste management.

There are regional agreements (e.g. Sofia Declaration on the Green Agenda) that could facilitate ESM of e-waste, if properly harnessed. Hazardous waste management is an issue of concern in the region[20]. For instance, stockpiled hazardous waste is often dumped directly into open spaces as opposed to being stored appropriately.

[20] https://www.clingendael.org/sites/default/files/2021-07/PB_The_Green_Agenda_3thproof.pdf.

C. Mapping of Stakeholders and E-waste Management Systems

In the Western Balkans, waste management, including e-waste, is overseen by government ministries (usually the Ministry of Environment). Other stakeholders active in e-waste management include the producers, importers, EPR Organization, consumers, e-waste collection and treatment/recycling companies, and several non-governmental organisations (NGOs).

The Ministry of Environment or related Agency is the leading government agency for legislating on e-waste, while other agencies and municipalities handle collection of fees and monitoring/enforcement.

The Ministry of Environment is mostly responsible for legislating on e-waste, licensing operators, policy formulation, and monitoring and enforcement, often assisted by some other agencies. In Montenegro, this is handled by the Ministry of Ecology, Spatial Planning and Urbanism. In Bosnia and Herzegovina, the waste management development and implementation of the policies is the responsibility of three ministries in the three territorial units: Ministry of Spatial Planning, Civil Engineering and Ecology in the Republic of Srpska, Ministry of Environment and Tourism in the Federation of Bosnia and Herzegovina, and the Department for Physical Planning and Proprietary Affairs in the Government of Brčko District. Monitoring and enforcement is handled by the State Environment Inspectorate in North Macedonia, the Environmental Protection Agency in Montenegro, and in Serbia, the Serbian Agency for Environmental Protection, which is also responsible for data collection and reporting. In the other countries in the region, it is usually the national statistics offices that collect and compile official data on waste.

Constitutionally, the municipal councils and local government authorities in some countries are responsible for organising the collection, transport, treatment, and disposal services of municipal waste, including e-waste. In some countries, they are responsible for building, owning and operating treatment centres, as well as collection of service fees and monitoring and enforcement. For instance, in North Macedonia, the municipal councils are obliged to establish e-waste collection centers and there is a special obligation for mayors to ensure at least one separate e-waste collection point in each municipality or one collection point for every 30,000 inhabitants [13].

In countries with EPR, producers/importers and retailers, along with the private recycling companies, are responsible for collection and treatment of e-waste through the PROs.

In countries with functional EPR, producers and importers are saddled with financing e-waste collection and recycling schemes. By law, producers are responsible for providing the necessary infrastructure for the collection and treatment/recycling of e-waste. Legislated EPR exists in all five countries, but the EPR has not been implemented in Albania and Montenegro. Serbia is planning to introduce a collective PRO scheme, which thus far is absent. North Macedonia has three main PROs (though there are also producers acting as independent handlers with a license)

while Bosnia and Herzegovina has two PROs in FBiH but none in the other two territories of Republic of Srpska and Brčko District BiH. Albania, Montenegro, and Serbia do not have system operators (PROs). In some countries (e.g. North Macedonia), e-waste disposal containers are located mainly in places where EEE is sold. Collection points are hardly numerous or sizable enough to meet the needs of the entire population in any of the countries.

While generating e-waste, consumers also make decisions to either store, repair, or discard the waste.

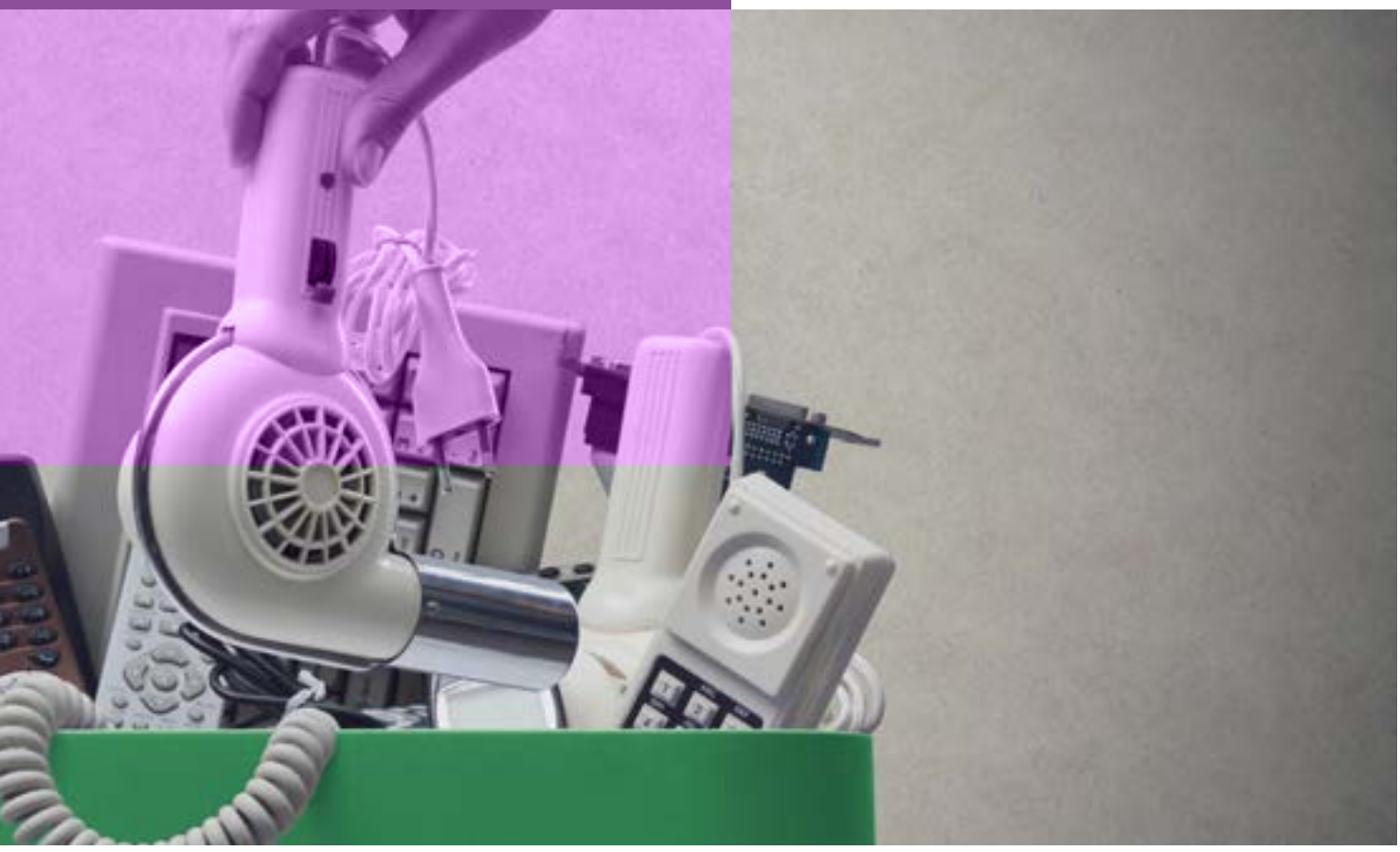
Most e-waste is generated by consumers, and their decision to store, repair, or discard (and their views on discarding waste) affects e-waste management. EEE is reported to have a higher lifespan in some of the countries compared to EU member countries due to the low purchasing power of consumers. In some countries (e.g. North Macedonia), consumers can return their old equipment to retailers or are required to hand over their e-waste to authorised e-waste management agencies or leave them at designated locations (e.g. collection points), whereas in others, e-waste is often disposed of together with household waste. In countries with functional EPR, since the cost of e-waste recycling has been paid at EEE purchase, some consumers often choose, or are driven to deal with, door-to-door informal collectors because of the monetary benefits when they hand over e-waste.

The five countries host both small and medium-sized recyclers, but the recyclers do not have adequate supply of input to operate optimally, which forces them to deal with informal operators.

The countries host both small and medium-sized e-waste treatment and recycling companies that also play the role of e-waste collectors. Some of the companies adopt dismantling and sorting with primary treatment of selected components, while other parts, especially hazardous parts, are exported for further treatment. Albania hosts three e-waste treatment companies, but e-waste collection infrastructure is weak and separate collection is hardly implemented. In Bosnia and Herzegovina entity FBiH, there are two PROs, nine other companies licensed to collect e-waste, and eight e-waste recycling companies. Montenegro has two treatment facilities, but infrastructure for separate collection of e-waste is lacking. North Macedonia has 10 companies licensed to collect, store, and pre-treat e-waste and two recycling companies. Serbia has seven e-waste recycling companies, while more than 500 companies have a permit for the collection of e-waste (not all of them are operational), though this number varies from year to year in accordance with the dynamics of issuing permits. Though this gives a picture of infrastructure, reliable information on the performance of some of the companies is not available.

In some countries in the region, the informal sector dominates, especially in e-waste collection and they focus on the valuable parts and supply the recyclers, often through brokers.

E-waste and its valuable parts are largely collected through informal activities and, to a lesser degree, through formal waste management paths in the region. In all countries, e-waste is collected either through private recyclers or informal operators. There is a large informal sector engaged in the collection and trading of recyclables such that some recyclers do not have adequate supply of input to operate optimally. The activities of the informal operators are going on behind the scenes, and they focus on scavenging valuable parts and then sometimes selling them to recyclers (often routed through brokers, which increases prices) or private companies that prepare them for export. The competition is stiff such that some recyclers started collecting e-waste from households using registered external independent collectors. Activities of the informal sector are not reflected in the official waste reporting, and in some countries, there is no official data on the e-waste collection rate. Consequently, the true situation of the e-waste collection and recycling capacity in the entire region is difficult to quantify.



Non-governmental organisations and international agencies also support e-waste management in all the countries.

NGOs and other public organisations are involved in creating public awareness, educational activities, and e-waste collection. In North Macedonia, environmental activists created the *'Give, do not throw'* and *'Do not throw, do not pollute'* groups to raise awareness about reduce, reuse, and recycling principles[21]. Zero Waste Montenegro[22] is facilitating a cultural change within Montenegro that is resulting in a marked improvement in waste reduction, reusing, and recycling while collecting fluorescent tubes, e-waste, and old batteries, among other waste types.

D. Campaigns for E-waste Collection and Recycling

Campaign strategies as well as country-specific and regional initiatives are available to create awareness on e-waste collection and recycling. A series of initiatives and campaigns could be mapped through the focal points involved in this project, though likely not providing a full picture of all that is ongoing in the region. Some of the projects and initiatives are conceived and driven by NGOs, the PROs, and foreign donor agencies. In Bosnia and Herzegovina entity FBiH, the PROs Zeos and Kim Tec have several initiatives in place[23] [14]. For example, Zeos has the *'Green revolution'* for schools and also *'Where I buy, there I recycle'* in partnership with some EEE retail shops. Some of the recycling awareness-raising initiatives have been extended to preschool children in Serbia at the Children's Cultural Center – with focus on recycling toys that run on electricity and batteries[24]. In North Macedonia, Zero Waste hosts *Zero Waste in Studio 10*, a one-hour discussion on *'Safe practices in e-waste disposal'* on TV[25]. Also, one of the PROs in North Macedonia agreed to offer schools containers for separate waste collection, and after a certain amount of waste has been collected, the operator gives the schools some reward (e.g., printing paper for collected paper and cardboard and monitors for collected e-waste). Series of small projects, funded by the GEF Small Grants Programme, have been initiated to create awareness and train the youth and women on reuse and repair of electronics to extend the lifespan and encourage waste separation and recycling of e-waste in the Western Balkans[26].

Some of other projects that were mapped focus on:

- the establishment of legal acts[27]
- initiatives for awareness, training on repair, and reuse of electronics[28]
- separate collection and treatment [15]
- initiatives for training and employment through recycling [16]
- initiatives that will promote recycling and re using products[29][30]

More details on the above-mentioned initiatives for ESM of e-waste, and some additional ones, can be found in the profiles of the respective countries.

[21] https://www.balcanicaucaso.org/eng/Areas/North-Macedonia/North-Macedonia-recycling-remains-a-mirage-210901
[22] https://www.zerowastemontenegro.me/zero-waste-montenegro-map [23] Kim Tec Eko - Info (elektrootpad.ba)
[24] https://www.ereciklaza.com/vesti/edukacija-u-decijem-kulturnom-centru.php (more on next page)

[25] Safe practices for handling electronic waste and waste batteries at TV24 - Zero Waste (nulaotpad.com.mk) [26] Welcome to The GEF Small Grants Programme (undp.org) [27] https://www.sida.se/en/sidas-international-work/countries-and-regions/albania [28] Welcome to The GEF Small Grants Programme (undp.org) [29] https://www.ereciklaza.com/vesti/edukacija-u-decijem-kulturnom-centru.php [30] https://www.giz.de/en/worldwide/62845.html

4. OVERVIEW OF E-WASTE STATISTICS

Albania, Bosnia and Herzegovina, and North Macedonia provided national statistics on the importing/exporting and domestic production of EEE to calculate the EEE POM and e-waste generated. Montenegro and Serbia had minimal reporting available to substantiate the statistics, so the EEE POM and e-waste generated are obtained mainly from *The Global E-waste Monitor 2020*.

National data on the environmentally sound management of e-waste could be obtained for Bosnia and Herzegovina, North Macedonia, and Serbia.

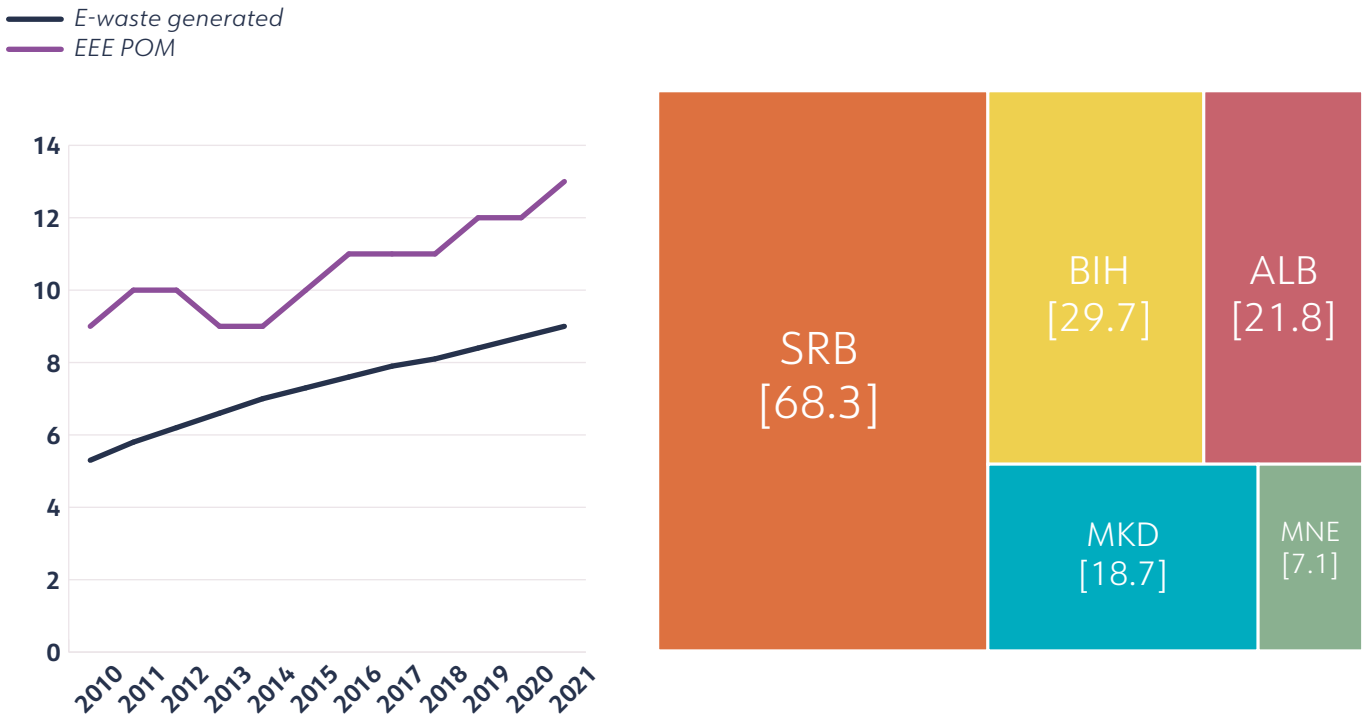
A. Electrical and Electronic Equipment Placed On Market and E-waste Generated

The regional EEE POM generally increased from 0.16 Mt (9 kg/inh) in 2010 to 0.21 Mt (13 kg/inh) in 2021. The regional e-waste generated increased from 0.09 Mt (5.3 kg/inh) in 2010 to 0.15 Mt (9.0 kg/inh) in 2021.

A general increase with slight fluctuations is shown for the total EEE POM between 2010 and 2021. It increased from 0.16 Mt (9kg/inh) to 0.2 Mt in 2011 (10 kg/inh) and remained at 0.2 Mt from 2012 to 2020 (12 kg/inh). Subsequently, the total EEE POM increased slightly to 0.21 Mt in 2021 (13 kg/inh) (Figure 5).

The e-waste generated increased steadily from 0.09 Mt (5.3 kg/inh) in 2010 to 0.15 Mt (9.0 kg/inh) in 2021, with an annual increase of 4 kt.

Figure 5. EEE POM and e-waste generated in the region (kg/inh) for 2010-2021 (left) and the absolute e-waste generated (kt) per country in the region (right)



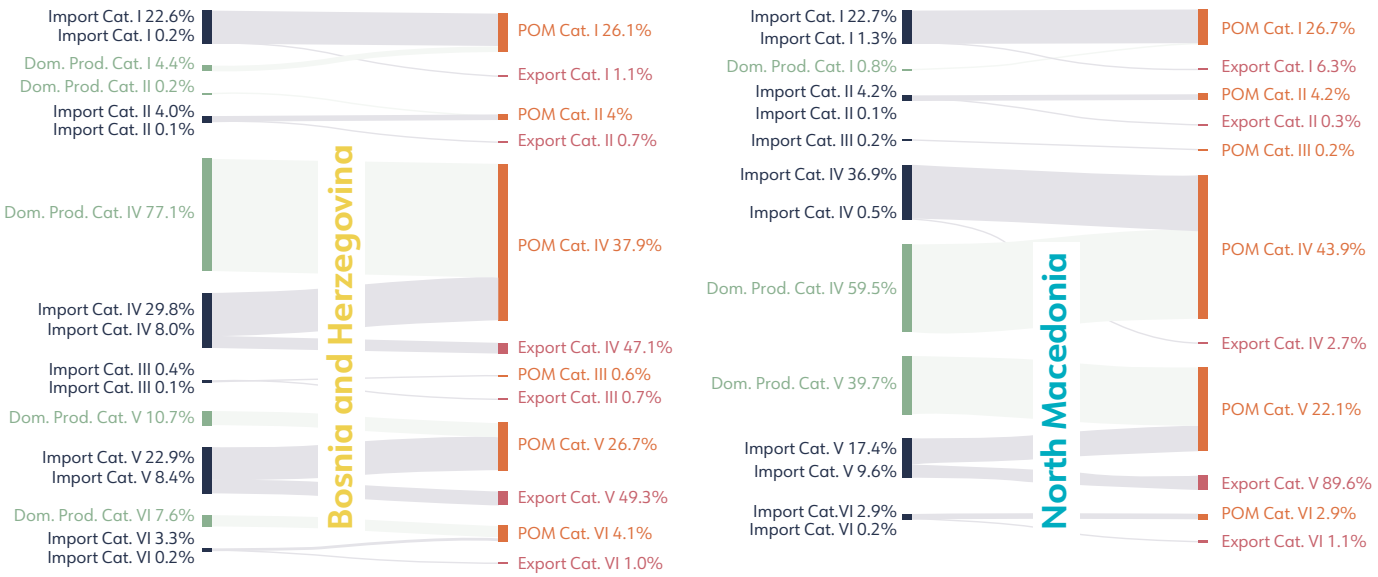
PV panels are placed on the market regionally at approximately 1.2 kt in 2019 and 2020, and most panels are placed in Bosnia and Herzegovina. However, PV panels waste generation is minimal; in 2021, 0.02 kt (0.001 kg/inh) of waste was generated regionally.

PV panels (Cat IV. B) have been placed on the market in the Western Balkans since 2011. The majority of PV panels have been placed regionally in 2014, 2017, 2019, and 2020 at approximately 1.2 kt (0.07 kg/inh) per year. In North Macedonia and Serbia, most PV panels were placed between 2011 and 2015, while in Albania and Bosnia and Herzegovina, most are placed between 2017 and 2020 and in Montenegro, PV panels were placed only in 2020. However, the largest quantity in tonnes over the last decade was POM in Bosnia and Herzegovina. No PV panels have been POM in 2021. Due to the long lifespan of PV panels, the waste generation is minimal over the last decade. In 2021, only 0.02 kt (0.001 kg/inh) of waste was generated from PV panels.

Domestic production of EEE takes place mainly in Bosnia and Herzegovina and in North Macedonia, having combined 5.8 kt of EEE produced domestically in 2020.

BiH and North Macedonia produce EEE annually. In 2020, Bosnia and Herzegovina manufactured 2.0 kt (0.6 kg/inh) of EEE and North Macedonia produced 3.8 kt (1.8 kg/inh) of EEE; both countries also export EEE (Figure 6). As illustrated in the Sankey diagram, the overall mass balance among importing, exporting, and domestic production for each of the 6 categories corresponds with the EEE POM. The diagram provides clarity in the shares of the total domestic production and total imports (45.8 kt in Bosnia and Herzegovina and 31.5 kt in MKD) that contribute to the EEE POM. Bosnia and Herzegovina and North Macedonia mostly produce products in Cat. IV (BiH 77.1%; MKD 59.5% of the total domestic production), which includes e.g. Professional Monitoring & Control (e.g. laboratory, control panels, and invertors) and Central Heating (household-installed). The countries also mainly produce products in Cat. V (BiH 10.7%; MKD 39.7%), which includes e.g. Household Luminaires (incl. household incandescent fittings). The domestic production of Bosnia and Herzegovina is approximately two tenfold smaller than the import and for North Macedonia it is a bit less than a tenfold smaller, so despite having a national market for domestic production, both countries generally rely on importation of EEE. The other countries in the region have no reported domestic production of EEE and rely solely on importing.

Figure 6. EEE import, domestic production, POM, and exportation in 2020 percentages for Bosnia and Herzegovina (left) and North Macedonia (right)

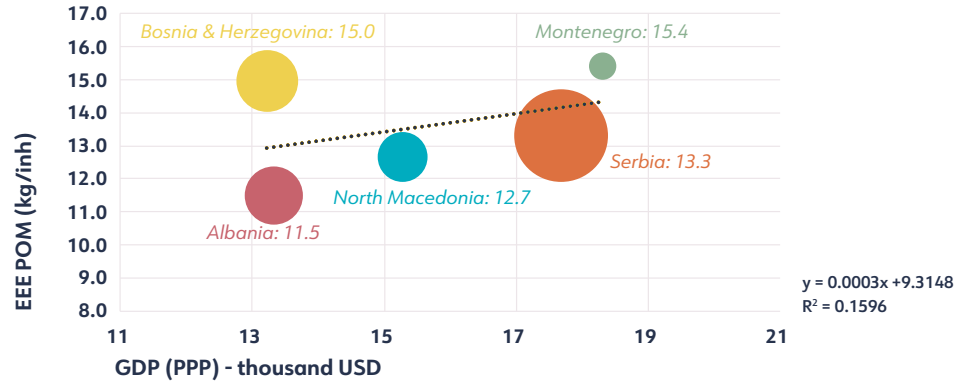


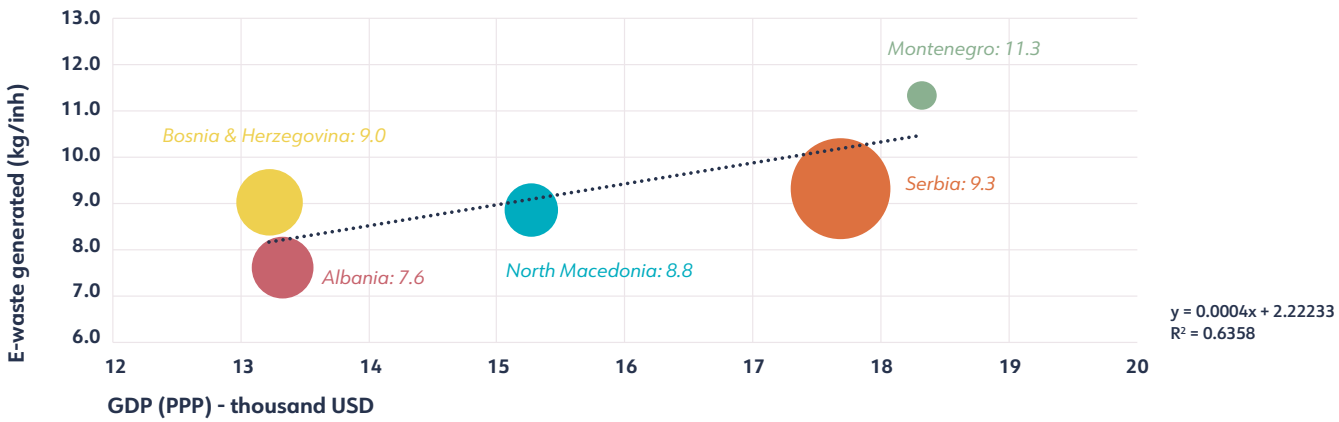
The shares are represented as a percentage of the total importing (BiH 45.8kt; MKD 31.5kt), domestic production (BiH 2.0 kt; MKD 3.8 kt), POM (BiH 40.0 kt; MKD 31.6 kt), or exporting (BiH 11.6 kt; MKD 6.3 kt) in the respective countries.

EEE POM and e-waste generated both show a positive correlation with the PPP, but the correlation is slightly stronger for e-waste generated. Serbia shows the greatest absolute amount of e-waste generation (68.3 kt), though it is second in terms of both e-waste generated per inhabitant and PPP.

The EEE POM varied between 11.5 kg/inh in Albania and 15.4 kg/inh in Montenegro (Figure 7). There is a very weak positive correlation (R^2 = 0.16) between EEE POM and the PPP per inhabitant of the countries, so the EEE POM slightly increases when PPP increases. The e-waste generated per inhabitant (Figure 7) ranged between 7.6 kg/inh for Albania and 11.3 kg/inh for Montenegro and, contrarily to the EEE POM, showed a stronger positive correlation (R^2 = 0.64) with PPP. The greatest e-waste generators of 2021 are Serbia with 68 kt, followed by Bosnia and Herzegovina (30 kt) and Albania (22 kt).

Figure 7. EEE POM (top) and e-waste generated (bottom) in the region (thousand USD/inh) for 2021. The bubble's size is indicative of the number of inhabitants



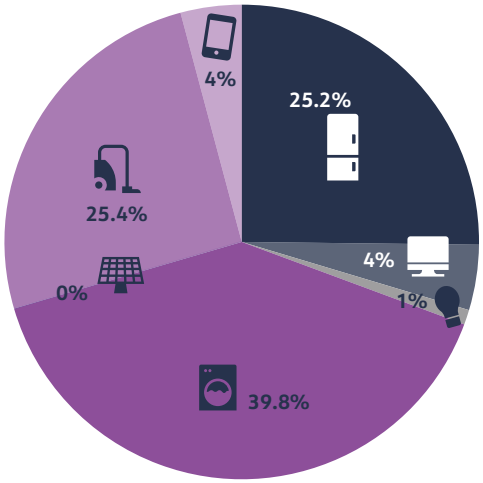


B. E-waste Categories

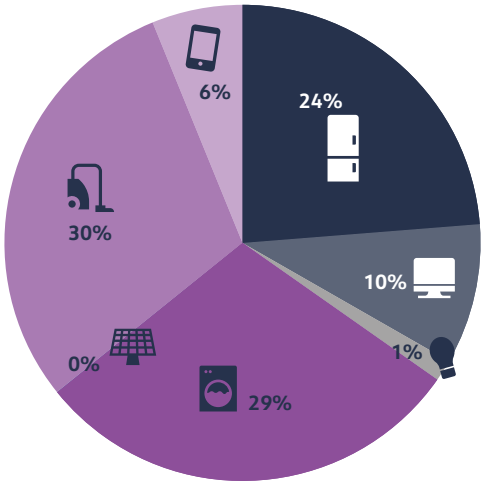
Large Equipment (Cat. IV a) and Small Equipment (Cat. V) are the largest categories of both EEE POM and e-waste generated at 65% (Cat. IV a 40%, Cat V. 25%) and 59% (Cat. IV a 29%, Cat. V 30%).

Disaggregating the EEE POM in the Western Balkans into six categories showed large equipment as the largest category (40%) in weight, followed by small equipment (25%) and Temperature Exchange Equipment (25%) (Figure 8). The smallest category is Lamps (1%), which are used with high numbers of units in all households but which have a small unit weight. Small equipment have relatively small units of weight with a short lifespan, while Temperature Exchange Equipment and Large Equipment have a high unit of weight with a long lifespan. The lifespan and weight correspond to the order with respect to weight found for the e-waste generated – with Small Equipment (30%) as the largest category, followed by large equipment (29%) and Temperature Exchange Equipment (24%).

Figure 8. EEE POM and e-waste generated disaggregated per six-category in the Western Balkans for 2021



REGIONAL EEE POM IN 2021 (%)

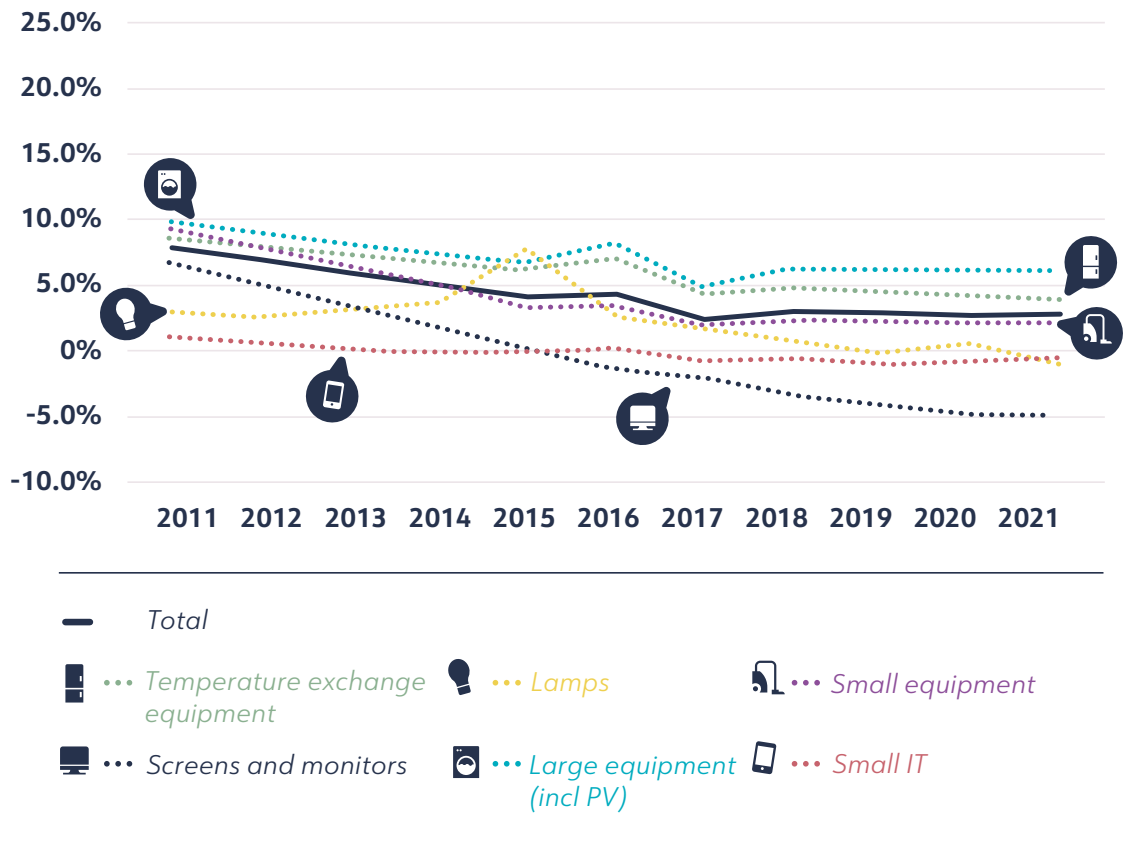


REGIONAL E-WASTE GENERATED IN 2021 (%)

The e-waste generation growth rates are positive for Temperature Exchange Equipment, Large Equipment, and Small Equipment and negative for Lamps, Small IT, and Screens and Monitors.

Annual e-waste growth rates are positive for three categories out of the six, namely Temperature Exchange Equipment, Large Equipment, and Small Equipment and are negative for Small IT, Screens and Monitors, and Lamps (Figure 9). Screens and Monitors have decreased in mass, due to a noticeable technological change in the computer and television screens in which all cathode ray tube (CRT) screens have been replaced by flat-panel displays. For Small IT equipment, the decrease in size can be clarified by a miniaturisation – the ongoing process in which manufactured electronics continue to be decreased in size. Though mostly positive growth rates are shown, a decreasing trend can be found for most products. For example, the year-to-year growth rates for Temperature Exchange Equipment was 8.5% in 2011, as compared to 3.9% in 2021. Similarly, for Large Equipment, it decreased from 9.8% in 2011 to 6.2% in 2021.

Figure 9. Year-to-year e-waste generated growth rate per six-category[31] in the region for 2010-2021



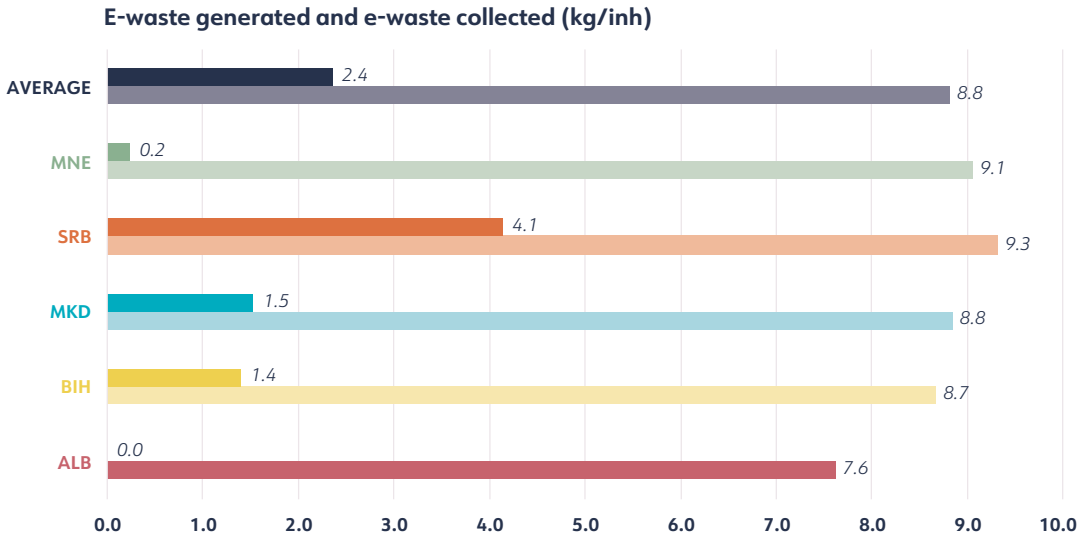
(31) Six treatment-oriented categories from the EU WEEE Directive.

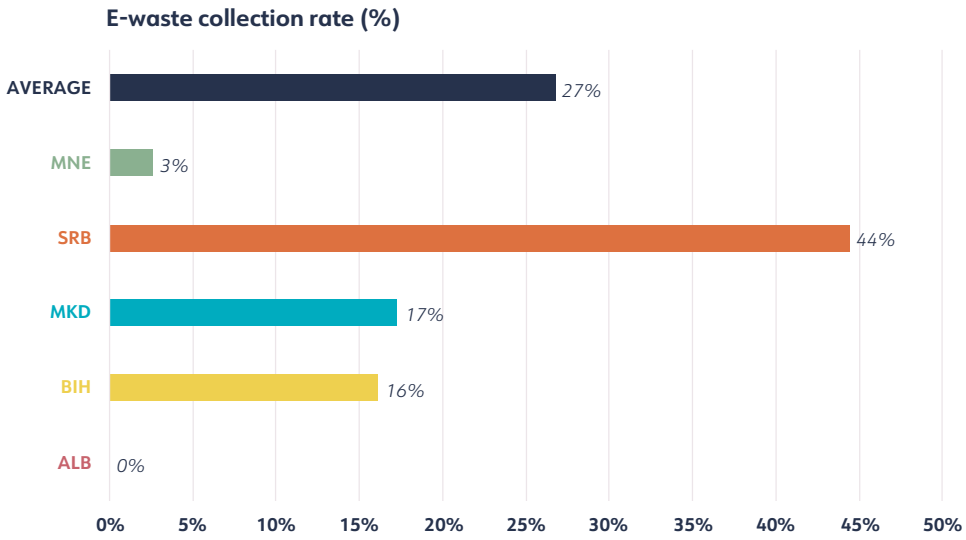
C. Environmentally Sound E-waste Management

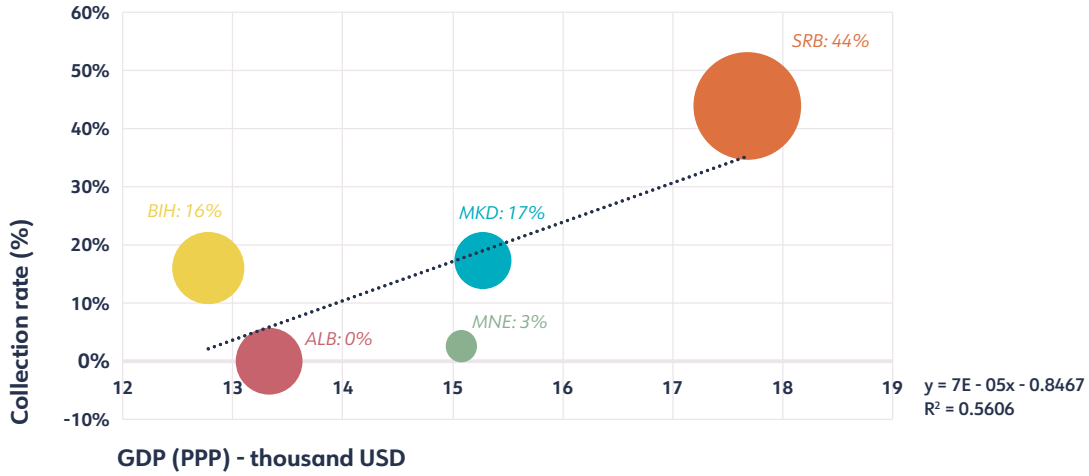
The Western Balkans collected and managed 38.4 kt (2.4 kg/inh) of e-waste in 2021, which gives a total collection rate of 27%. E-waste collection mainly occurs in Serbia, North Macedonia, and Bosnia and Herzegovina, and a (weak) positive correlation of e-waste collection to PPP is found in the region.

In total, the e-waste managed in an environmentally sound manner amounts to 38.4 kt (2.4 kg/inh) for 2021. Most of the managed e-waste is collected in Serbia (30.3 kt in 2021), Bosnia and Herzegovina (4.7 kt in 2020), and North Macedonia (3.2 kt in 2021). Per inhabitant, the collection is highest in Serbia with 4.1 kg of e-waste collected (Figure 10). Serbia also has the highest e-waste collection rate of 44%, in relation to the e-waste generated. North Macedonia collects 17% of e-waste, and Bosnia and Herzegovina collects 16%. Albania could not supply data due to the lack of a proper reporting system and to the fact that e-waste is not collected on a large scale. These collection rates indicate that infrastructures for e-waste collection are in place in the Western Balkans, but not for the countries' entire population. This e-waste is collected for environmentally sound e-waste management, but part of it is also exported, due to the lack of enough e-waste treatment facilities in this region. A weak positive correlation (R^2 = 0.56) is found between the collection rate and the PPP per inhabitant of the countries (Figure 10), showing that the collection rate increases with the increase in PPP in this region.

Figure 10. E-waste collected for ESM vs e-waste generated (kg/inh) (first) and e-waste collection rate (second) for 2021 (2020 for Bosnia and Herzegovina, 2015 for Montenegro); bubble chart of collection rate vs PPP in the region (k USD/%) for 2021 (third). The bubble's size is indicative of the number of inhabitants




E-waste collection rate (%)
AVERAGE
MNE
SRB
MKD
BIH
ALB
27%
3%
44%
17%
16%
0%
0%
5%
10%
15%
20%
25%
30%
35%
40%
45%
50%


Collection rate (%)
60%
50%
40%
30%
20%
10%
0%
-10%
SRB: 44%
BIH: 16%
MKD: 17%
MNE: 3%
ALB: 0%
12
13
14
15
16
17
18
19
y = 7E - 05x - 0.8467
R² = 0.5606
GDP (PPP) - thousand USD

5. TRANSBOUNDARY MOVEMENT OF E-WASTE

A. Overview of E-waste Import and Export Laws

Western Balkan countries are all party to the Basel Convention, but national reporting on transboundary movement of e-waste is still limited.

All countries signed the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal between 1997 and 2006 and have since become parts of multiple conventions. Therefore, all countries have legislations in place regarding the import, export, and transit of hazardous waste in the Western Balkans. Nevertheless, reporting on the e-waste exported quantities is limited, making it difficult to obtain a comprehensive overview on the transboundary movements in the region.

Most of the countries have implemented specific e-waste import bans, while e-waste export and transit are allowed.

Specifically, the import of e-waste and hazardous waste is explicitly banned in most of the countries in the Western Balkans. North Macedonia has introduced an import ban that refers to general waste used as energy source as opposed to e-waste, specifically. In some countries (e.g., Bosnia and Herzegovina), there is flexibility about waste import if it is imported for material or energy recovery according to the national waste management legislation. Exporting and transit of hazardous waste are allowed, and in fact hazardous waste, including e-waste, is often exported for final treatment abroad, especially in the western and eastern parts of Europe.

The import and export of UEEE are not legislated in most of the countries in the region, and the flows of UEEE are not restricted.

The high demand for UEEE generates a thriving market in the Western Balkans. Legislation regarding the import and export of EEE for reuse are not in place, but in some countries (e.g., Bosnia and Herzegovina and Montenegro, though in the latter the system is not implemented) importers and distributors of UEEE are mandated to join a PRO and fulfil their legal obligations. However, there are no monitoring and reporting systems on UEEE import and export, so information on these flows and on the real size of this market in the region is limited.

B. Overview of E-waste Import and Export Quantities

Four of the five countries report statistics to the Basel convention, though this does not provide the full picture of e-waste export in the Western Balkans.

Four of the five countries in the region have transmitted national reports to the Basel Convention between 2016 and 2020, though yearly reports are not always available for all of them. For Montenegro, the latest available report is from 2019, and no reports are available for North Macedonia.

Despite providing annual reports to the Basel Convention, not all countries show annual data in import and export flows of hazardous waste. For instance, Albania has not reported any statistics on hazardous waste since 2018. Bosnia and Herzegovina is the only country in the region that annually reports statistics. Thus, the reported quantities cannot be considered representative for all importing or exporting of e-waste occurring in the region. This is attributable to the minimal implementation of annual reporting statistics to the Basel Convention and possibly to the fact that the reporting obligation exists only for hazardous waste, thus excluding non-hazardous parts of e-waste from waste reporting.

All five countries are parties to the Basel Convention, and based on the reporting 14.6 kt of e-waste was exported abroad for treatment over the two years 2019 and 2020.

According to the Basel Convention, Bosnia and Herzegovina, Montenegro, and Serbia have exported 14.6 kt of e-waste over two years (2019-2020) for treatment and recycling abroad.

Bosnia and Herzegovina, Montenegro, and Serbia have reported e-waste statistics to the Basel Convention. Approximately 0.03 kt was exported in Bosnia and Herzegovina, which consisted mainly of refrigerators, printed circuit board (PCB), and fluorescent tubes exported to France, Slovenia, and Bulgaria. As well, 0.4 kt of PCB waste exports were reported in 2019 from Montenegro to France. In Serbia, 2.3 kt of e-waste import of CRTs from Bulgaria is reported, and 14.1 kt of e-waste is exported to e.g., Germany, the Netherlands, and Bulgaria. Based on the reporting, all e-waste is exported to EU countries, where e-waste is treated with all valuable parts recovered.

The results of the analysis of the TBM of e-waste in the Western Balkan region are presented in Table 5.

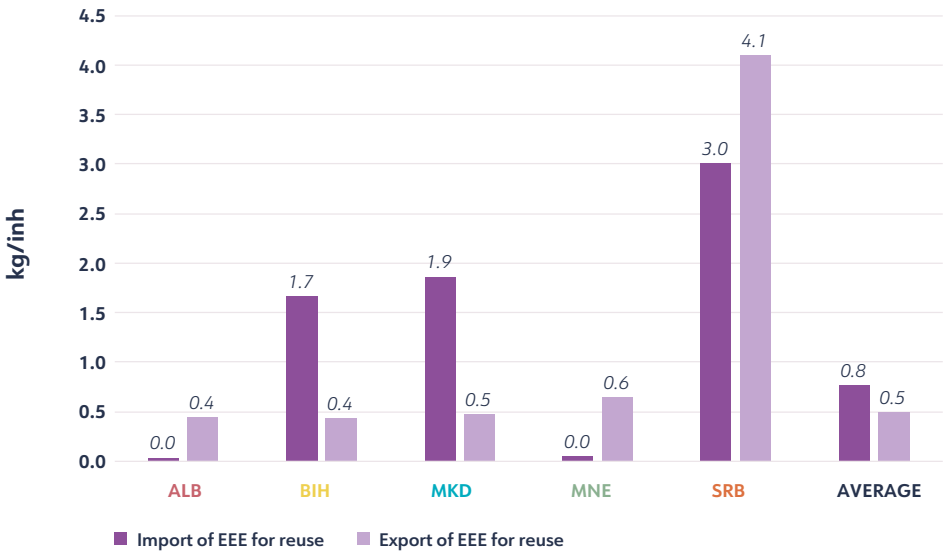
Table 5. Overview of the TBM of e-waste in the region

Country	National report available 2016 - 2020	Statistics available on hazardous waste	Estimate on e-waste reported under Basel Convention (2019 - 2020)	
			Import (kt)	Export (kt)
Albania	Yes	No	-	-
Bosnia and Herzegovina	Yes	Yes	-	0.03
North Macedonia	No	No	-	-
Montenegro	Yes, 2016 - 2019	Yes	-	0.40
Serbia	Yes, 2016, 2018 - 2020	Yes	2.32	14.12
Total	4 of 5	3 of 5	2.32	14.55

Importing and exporting of used EEE takes place in all countries in the Western Balkans-especially Serbia, North Macedonia, and Bosnia and Herzegovina.

Importing and exporting of UEEE is occurring in all five analysed countries of the Western Balkans. Serbia, specifically, imported 3.0 kg/inh and exported 4.1 kg/inh of UEEE in 2019, while North Macedonia imported 1.9 kg/inh of UEEE and exported 0.5 kg/inh. Importing and exporting of UEEE appears to be less frequent for Albania, with 0.03 kg/inh imported and 0.04 kg/inh exported, respectively. The importing and exporting of EEE for reuse in the Western Balkans for 2019 is shown in Figure 11.

Figure 11. Estimates of EEE imported and exported for reuse in 2019 (kg/inh)



C. Issues and Impacts of Imports/Exports of E-waste

Hazardous waste management laws are in place, but proper reporting and monitoring of e-waste TBM is not fully enforced in the region.

Despite being a member of the Basel Convention and applying the national legal framework and bans, reporting of e-waste TBM is limited. Consequently, the mapping and monitoring of e-waste TBM remains difficult. Official data on e-waste export from the Basel Convention is available in Bosnia and Herzegovina, Montenegro, and Serbia, but not in the two remaining Western Balkan countries. A consequence of scarce reporting is the uncertainty of whether e-waste is being exported from countries where ESM cannot be assured to countries where treatment using the best-available technology is guaranteed. As a result, TBM can directly result in a rise in illegal e-waste shipments. A particular example is the one of PCBs TBM, which can be traced back by analysing the average prices in national trade statistics. Through this analysis, it was possible to quantify PCBs TBM occurring in the region, which, per the Basel Convention reports, is mentioned only for Montenegro and Serbia, while, per the average prices analysis, it also involves Albania, Bosnia and Herzegovina, and North Macedonia.

There is TBM of UEEE in this region, and the reporting limitations don't allow differentiation between new EEE and UEEE, nor do they ensure that UEEE is not already e-waste.

Importing and exporting of UEEE is happening in all countries in the region. However, guidelines and legislations regarding these products are limited, as is the implementation of such regulations. This implies that the actual size of the UEEE market in the Western Balkans and the quantities of these flows are difficult to quantify. Furthermore, the distinction between UEEE and EEE is not shown in the HS codes, which makes it impossible to distinguish between new and used equipment, thus minimising the monitoring of these items. As a result, it is difficult to track whether the UEEE are used after importation or whether it can be considered as e-waste in the region. Also, the lack of restriction gives no indication of mentioning the UEEE's lifespan, which could help pertinent individuals understand whether the materials are worth importing as opposed to being considered undesirable importing of e-waste.

6. E-WASTE MANAGEMENT ASSESSMENT

The Western Balkans region is progressing in terms of e-waste policy framework and infrastructure, which is leading to an increase in the overall collection rate, though with relevant discrepancies across countries.

The e-waste management systems of the countries have been assessed and categorised as either advanced (A), in transition (B), or basic (C). All detailed scores for each country can be found in Annex D. The outcomes are summarised in Table 6, showing a dashboard of the number of indicators scoring an A, B, or C in legislation, the number of indicators scoring an A, B, or C in collection and infrastructure, the collection rate, and e-waste generation for each country in the region.

The highest e-waste collection rates are found in Serbia, North Macedonia and Bosnia and Herzegovina; these rates are attributed to the relatively well-developed e-waste management infrastructure and legislation.

All countries have legislative tools dedicated to e-waste and, in some cases, a functional and implemented EPR system, too. These tools were established only quite recently in most cases, though, so the impact on the collection rate will likely be higher in upcoming years, along with the infrastructure's development. EHS standards for e-waste are legislated in all countries, but monitoring is lacking. E-waste collection targets are prescribed in three of the five countries, though measures for failing to reach the targets are currently not in place, while in the remaining two they expired and have not been renewed. There is also good participation of the region in being party to the main multilateral environmental agreements.

The highest e-waste collection rates are found in Serbia (44%), North Macedonia (17%), and Bosnia and Herzegovina (16%). The high collection rate of Serbia can be attributed to the high number of actors licensed to collect and treat e-waste in the country, though a PRO system has not yet been established. North Macedonia also has the second highest collection rate in the region, though the collection network is mainly localised in bigger cities. The collection rate of Bosnia and Herzegovina is not representative of the entire country, but only of Bosnia and Herzegovina entity FBiH, where PROs and collection companies are active. The sorted collection network appears weaker in Albania and Montenegro, which also have much lower collection rates.

All countries in the region have e-waste treatment companies on the territory, though not in high numbers (e.g. two facilities in Montenegro). However, in most cases, e-waste is only partially treated in the region and then sent abroad for further processing.

The e-waste generation per inhabitant is relatively uniform across the region, while the collection rate shows much higher discrepancy.

Table 6. Dashboard of e-waste management system and performance. All reference years are 2021 apart from Montenegro (2015)

Country / Region	Legislation (5 indicators)	Infrastructure (2 indicators)	Collection Rate	E-waste Generated
EU-27	●●●●●	●●	●●●●●	●●●●●●●●●
Western Balkans	●●●●●	●●	●●◐○	●●●●◐
Albania	●●●○○	●○	○	●●●◐
Bosnia and Herzegovina	●●●●○	●●	●◐○	●●●●○
Montenegro	●●●○○	●○	◐	●●●●◐
North Macedonia	●●●●●	●●	●◐○	●●●●◐
Serbia	●●●●●	●●	●●●●◐	●●●●◐

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

From the dashboard, it is possible to see that the Western Balkans region is progressing toward the EU-27 in terms of legislative tools and infrastructure. The fact that the EPR is not fully established in some countries and that the infrastructure network is mostly located only in the main residential areas comprise some of the challenges preventing higher collection rates.

7. URBAN MINING POTENTIALS OF E-WASTE

With respect to the material design, EEE is a complex product. The materials used in EEE include precious metals (e.g. silver and gold), critical raw materials (e.g. aluminum, cobalt, and palladium), strategic raw materials (e.g. nickel and copper), and common metals such as iron. The current movement toward creating a circular economy is focused on recovering as many of the available materials in the e-waste urban mine as possible. As these materials are still valuable after separation and recycling, they can reenter the market and partially cover the present economy's supply demand. The recovery of these materials could also reduce the related greenhouse gas (GHG) emissions resulting from the mining of the same primary raw materials to employ in the production of new EEE. In this chapter, the amount of secondary raw materials recovered, its economic value, and the related GHG emissions avoided will be discussed on a regional basis.

The environmentally sound collection of e-waste in the Western Balkans for 2021 has avoided 76.4 kt of CO_2-equivalent emissions and the recovery of 4.2 kt of secondary raw materials for a value of $34 million USD.

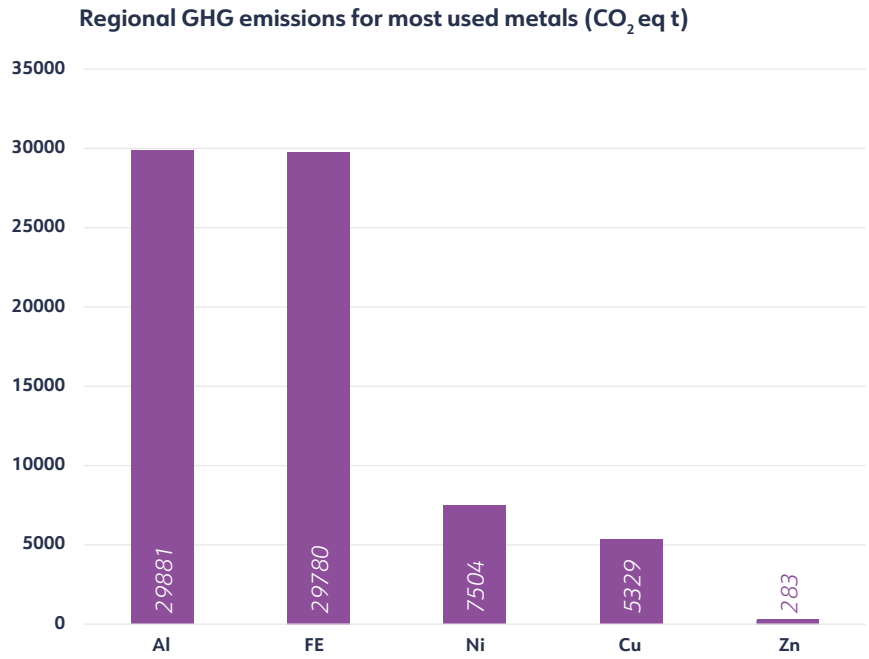
In this region, 27% of e-waste was collected formally to be recycled in 2021. For the analysis, it is assumed that all e-waste collected in an environmentally sound manner is also recycled, which allows us to get a proxy of the material content that could be recovered and made available for the economy again. However, for completeness, assessing recovery should also consider other aspects, such as technological barriers, process losses, and economic obstacles, which prevent all secondary raw materials in the e-waste collected from being recovered.

A. Emitted and Avoided GHG Emissions Related to E-waste

The environmentally sound collection of e-waste in the Western Balkans has avoided 76.4 kt of CO_2-equivalent emissions through the recycling of secondary raw materials, in contrast with primary raw material extraction.

Through e-waste collection and its environmentally sound management, 76.4 kt of CO_2-equivalent could be avoided regionally in 2021 from the secondary raw materials recycled. The emissions are avoided by recycling of secondary raw materials as opposed to the extraction of primary raw materials. In Figure 12, the emissions avoided linked to the five most used materials is displayed, accounting for 72.8 kt of the total 76.4 kt, with the assumption that all waste collected is also recycled. The commonly used materials highlighted are aluminum, iron, nickel, copper, and zinc, which are generally mostly used in Temperature Exchange Equipment (Cat. I), Large Equipment (Cat. IV a), and Small Equipment (Cat. V).

Figure 12. CO_2 emissions avoided through recycling against primary extraction from EEE commonly used materials in the region



Refrigerants of the EEE that are not properly collected and recycled in the Western Balkans were estimated to cause 483.7 kt of CO_2-equivalent emissions in 2021, while 136.8 t CO_2-equivalent emissions were linked to PBDEs.

The non-collection of EEE has an impact on the regional CO_2 emissions. EEE, which contains refrigerants (e.g. fridges and air conditioning), could cause release of these substances into the atmosphere when not treated appropriately. In 2021, 483.7 kt of CO_2-equivalent was released in the region, due to the non-collection of Temperature Exchange Equipment, especially fridges and air conditioning units containing refrigerants. Commonly used refrigerants include chlorofluorocarbons, hydrochlorofluorocarbons, and hydrofluorocarbons. Polybrominated diphenyl ethers (PBDEs), which are mostly found in screens and monitors (Cat II) and in smaller quantities in small equipment and small IT (Cat. V and VI), caused 136.8 t CO_2-equivalent emissions. However, the use of PBDEs is banned in the EU (Directive 2002/95/EC), and the Western Balkans have entered the Stockholm Convention and implemented amendments to eliminate their use of them[32][33][33]. This ban is in place due to their persistence and toxicity and their responsibility for kidney damage, skin disorders, nervous and immune systems effects, and effects to the nervous and immune systems. Mercury (Hg)-containing waste can also have a minor impact in terms of CO_2-equivalent emissions. In 2021, 0.11 t of CO_2-equivalent emissions were linked to the non-collection of mercury-containing e-waste. Mercury is generally found in lamps and light switches (Cat III) and in some large equipment (Cat IV). Due to its hazardousness, the use of mercury-containing EEE has been regulated by the Minamata Convention, to which some of the Western Balkan countries adhere.

[32] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32002L0095
[33] https://chm.pops.int/Countries/CountryProfiles/tabid/4501/Default.aspx
[34] https://chm.pops.int/Implementation/IndustrialPOPs/BDEs/Overview/tabid/5371/Default.aspx

B. The economic potential of secondary raw materials recovery from e-waste

Regionally, in 2021, $144 million USD (18 kt) of secondary raw materials embedded in e-waste were potentially available, out of which $34 million USD (4.2 kt) was collected and recovered.

In the Western Balkans, 18 kt of secondary raw materials was potentially available in the e-waste generated in 2021, corresponding to an economic value of $144 million USD. Of the e-waste generated, just 27% was collected and recycled (for the purpose of this report, it is assumed that all e-waste collected in an environmentally sound manner is also recycled), which corresponds to 4.2 kt of secondary raw materials with an economic value of $34 million USD.

Iron is the secondary raw material present with the highest quantities in the e-waste urban mine, but there are also critical and strategic raw materials (e.g. palladium, nickel) in much smaller quantities though with high economic value.

A material breakdown of the e-waste collected in the Western Balkans region is shown in Figure 13 and Figure 14. The secondary raw materials mostly available from a quantitative perspective in the e-waste generated in 2021 are iron and aluminum, with 67 kt (worth $45 million USD) and 9.4 kt (worth $23 million USD). From this, in 2021 approximately 15 kt of iron and 2.3 kt of aluminum were collected. Besides materials with a relatively low economic value that are present in high quantities and thus have valuable recovery operations, there are materials present in e-waste at smaller quantities with greater monetary value. These high-value materials include precious metals such as copper and silver, which are mostly available with 5.5 kt of copper and 2.8 t potentially available for collection and recovery. Furthermore, the strategic material, nickel, is used in smaller quantities, of which potentially 1.5 kt could be recovered in 2021 – worth $26 million USD. By contrast, palladium is used at small quantities of 0.2 t, is worth $14 million USD, and is considered a critical raw material. Finally, rare-earth elements, which are also critical materials, are used in traceable quantities in e-waste.

Figure 13. Secondary raw materials (including critical raw materials, strategic raw materials, and common metals) collected in kt in 2021 versus their collection potential (top) and their monetary value (bottom) in thousands of USD in the region

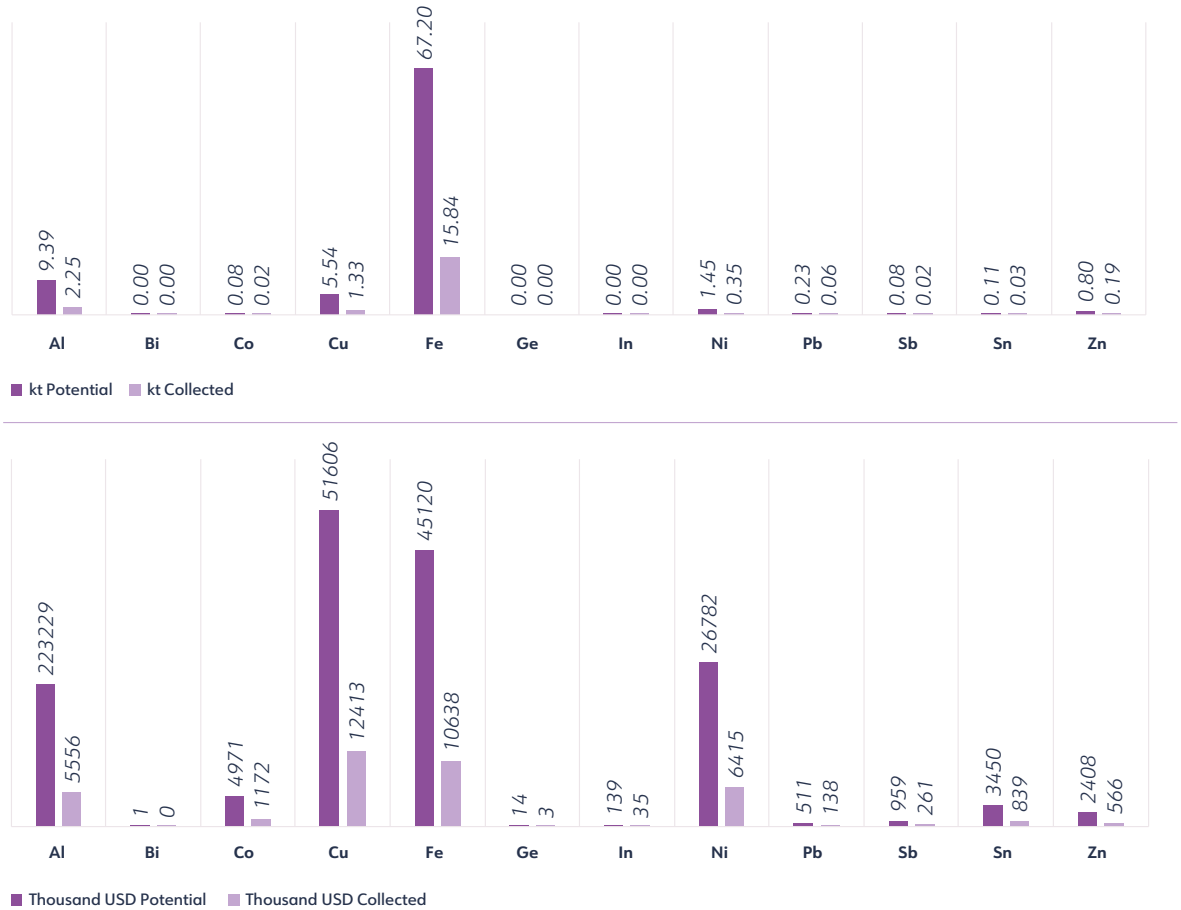


Figure 14. Precious metals collected in 2021 versus their collection potential in tonnes (top) and their monetary value (bottom) in thousands of USD in the region. Ir, Os, Pt, and Ru are clustered as others

To fully exploit the e-waste urban mine and improve the circularity of the sector, an increase in the e-waste collection effort in the region would be necessary. This would ultimately allow for getting economic revenue and avoiding environmental impact from secondary raw materials recycling. However, it would also require an investment increase toward collection and recovery facilities, as for some secondary raw materials (especially critical), there are economic and technological barriers imposed by the market.

8. COMMON ISSUES AND CHALLENGES WITH E-WASTE MANAGEMENT

Non-implementation of EPR and poor system monitoring/supervision

Although EPR for e-waste is legislated in all of the countries, it is only implemented in Bosnia and Herzegovina and North Macedonia. For Bosnia and Herzegovina, specifically, EPR is functioning well in the Bosnia and Herzegovina entity FBiH, but it is not in place in the Brčko District or the Republic of Srpska. North Macedonia is having challenges with fully implementing the EPR, due to the absence of a specific policy on e-waste and the delay in the adoption of secondary legislation, which is expected to be finalized in a year or two. In Albania, an EPR principle is only mentioned in the legislation, but has not yet been implemented. In Serbia, the EPR principle is mentioned in the legislation, and a financing mechanism is already functional, but implementation is not complete due to EPR schemes that are not yet in place. In Montenegro, similarly, EPR is legislated and covers all kinds of waste of the WEEE Directive, but it is not yet established due to challenges in fees collection (which a bylaw is expected to solve). These countries should consider amending the existing legislation to include articles or policies for facilitating implementation of fully functional EPR schemes. Though Albania, Montenegro, and Serbia all have EPR principles mentioned in the legislation but not full implementation due to missing secondary laws/bylaws and establishment of schemes, the e-waste management situation in Serbia is more advanced with the system boosting strong infrastructure and a collection system. Though there are provisions for system supervision/monitoring and enforcement of the regulations, this is not carried out frequent enough due to limited resources, and only a few PROs comply with submission of obligated annual reports.

Lack of reliable data

Effective waste data collection, compilation, and reporting are lacking, and available data is unreliable and incomplete because formal collection services do not cover the entire population. There is little or no data specific to e-waste formally collected and management routes in some countries. Also, statistics on the other flows, including e-waste entering landfills, activities of the informal sector, and imports/exports of e-waste within and outside of the region remain unavailable. Most countries (except the FBiH entity of Bosnia and Herzegovina) are not using any harmonised methodology in measuring the main statistics indicators (i.e. EEE POM and e-waste generated). North Macedonia and FBiH have data for EEE POM from PROs, but not from

independent producers and importers. In Serbia, data on e-waste collection and treatment is based on reports by recycling companies, but the monitoring of data collection and processing is lacking. As such, there is a significant gap between e-waste generated and e-waste collection in most countries in the region. The successes of EPR and the waste management information system (WMIS) of Bosnia and Herzegovina entity FBiH should be extended to other countries in the region.

Shortage of collection infrastructure and non-separation collection of e-waste

E-waste is not separated at the source, and there are little or no specific e-waste collection receptacles in some countries (e.g. Albania), and collection services in some others (e.g. Montenegro) do not cover the entire country. Environmentally sound (i.e. formal) collection of e-waste exists in a few countries, but there are not enough collection points and these are mainly located in the main cities (e.g. North Macedonia). Serbia is the country with the most dense collection infrastructure, which is also linked to a functional tax system (based on the type of EEE POM and their associated weight) that funds the establishment of appropriate management of e-waste, such as financing collection, transportation, and treatment of e-waste and also to subsidies paid to recycling companies. Some recyclers/PROs render home collection services for large e-waste quantities. Even in the countries where collection points are available, consumers are not always aware of them, so they often do not place e-waste in such receptacles and sometimes deal instead with informal operators. Countries having challenges with e-waste collection can introduce bylaws with obligations on the local community and public utility companies to participate in the collection system.

Insufficient network of treatment facilities

E-waste treatment facilities are available in the region, but not to a sufficient degree. Albania and Montenegro lack adequate e-waste treatment facilities. Serbia has the most advanced treatment infrastructure, but the overall e-waste management system in the region is still not fully developed and has challenges, partly due to the lack of a sufficient dedicated collection infrastructure and collection points. Most of the existing treatment facilities are active in manual disassembly and pre-processing. Recovered parts, including the hazardous components, are mostly exported abroad. Only Serbia has treatment facilities that delve into recovery of materials with extraction of not only the precious metals but also of the other useful parts. EHS standards are provided for in all countries, but there are no signs of effective implementation and monitoring in the region.

The Western Balkan region is progressing in terms of e-waste policy and infrastructure, leading to an increasing e-waste collection rate, although not uniformly across countries.

Dominance of informal sector

Environmentally sound formal e-waste collection is minimal in some countries where EPR is not implemented (e.g. Albania, Montenegro), but relatively low collection rates are also found in countries with functional EPR, with the exception of Serbia. A certain level of competition to access e-waste exists between the formal and informal operators, considering that the latter control a sizeable e-waste quantity. However, there seems to be a sort of partnership between them, as the formal recyclers often buy e-waste from the informal operators through middlemen, thus increasing the cost of materials. Getting the waste pickers to deliver their materials directly to licensed facilities, collectors, or recyclers as opposed to through middlemen is a challenge. Therefore, it is difficult to ascertain the actual quantities of e-waste handled in the formal and informal sectors. To face materials shortages and have enough volume to operate, some recyclers out-source e-waste collection to some registered companies that operate using different modalities, including a door-to-door collection system.

Environmental and health concern from informal activities

There are concerns that some informal operators could be engaging in some manual pre-processing within their backyard, as many operators use spaces within their accommodation for e-waste storage. This presents many environmental problems and poses a risk to the health of operators and their family members (and other residents), as there are no measures to protect their health.

Inflows of used EEE into the region and non-documentation of TBM of e-waste

The huge demand for used EEE in the region (especially large household appliances) drives inflow of used EEE from high-income countries. Many companies import UEEE, under codes 'furniture', and sell to end consumers. The flows are difficult to track due to the use of wrong or improper HS code and no declaration at all, while in some countries, both new EEE and used EEE are imported using the same HS code. These challenges create problems of documentation and adversely affect the generation of reliable data. Most countries have no regulation on used EEE imports. The trade is not monitored, and information on imports and market size is limited. In some countries (e.g. the Bosnia and Herzegovina entity FBiH and Montenegro), both importers and distributors of new and used EEE are recognised as a 'producer' in the EPR regime and are mandated to join a PRO and fulfil their legal obligation.
All the countries are signatories to the Basel Convention, and laws regulating flows of e-waste are also in place, but enforcement and reporting is still limited even though most pre-processed e-waste (including the waste's hazardous parts) is exported to recyclers within and out of the region.

Poor consumer awareness & knowledge of waste codes among operators

Awareness is lacking in most countries, especially in some of the rural, hard-to-reach places to facilitate e-waste collection. Multiple public awareness campaigns should be implemented, with special emphasis on schools, that focuses on separation of e-waste at sources especially in Albania and Montenegro, where most e-waste is disposed of together with household waste. In the waste sector, there is a lack of understanding/knowledge of waste codes (R or D procedures, etc.) especially among collectors and recyclers. FBiH, for instance, is laying emphasis on educating all those obliged to report on e-waste collection and recycling in 2023.

9. RECOMMENDATIONS

The mentioned assessment of e-waste management, statistics, and legislation, and on the related challenges, shows that it is evident that changes for the improvement of the thus-far-applied e-waste management systems would not vary too much from country to country in the region, though each country has its own specificities. Primarily, the countries of the Western Balkans will need to monitor and reinforce existing systems in order to make them more efficient and effective. Adequate financing of the systems as well as the monitoring and cooperation of all stakeholders are essential for ensuring that the policies setup for e-waste management is sustained.

Six general recommendations can be drawn from the analysis presented above, and an all-encompassing approach, involving all actors and stakeholders in each country, would be needed in order to implement them. A strengthened transnational cooperation is necessary to reduce the burden of large investments and secure the necessary turn-around.

1. Prevent More
2. Be More Aware
3. Collect More
4. Treat Better, Work Safely, Pollute Less
5. Pay Adequately
6. Train More E-waste Experts and Professionals

1. Prevent More

The 'waste hierarchy', where prevention is given primacy over other treatment options, is well-known. For example, the European Waste Framework Directive 2008/98/EC on waste management clearly states that 'waste prevention should be the first priority of waste management'. This is done 'with a view to breaking the link between growth and waste generation'. But most industrial groups and public policies currently are primarily focused on recycling and the safe disposal of e-waste rather than on reuse of EEE. Still, prevention and reuse are on top of the waste hierarchy because they are 'environmentally preferable to recycling due to energy savings in the production phase and raw material usage, except where inefficient products remain in service'. The principle, 'the best e-waste is the one that does not exist', applies to all countries globally, not just to Western Balkan countries. As such, more attempts are required in order to successfully minimise e-waste generation. But the decreasing longevity of products is driven by production and consumption patterns, whereby consumers are fascinated by the modernity of EEE, low prices for new technology, and new models and innovations that are frequently launched on the market. This is understandable but is also fueling the ever-growing e-waste mountain. So, more attempts should be made in the Western Balkans region for making consumers aware of the implications of EEE

production and that usage and final disposal steer behavioral changes – where, e.g., 1) reuse and refurbishment are favored over recycling, 2) services to repair become an important indicator in procurement and purchasing decisions, and 3) instead of purchasing product, more and more people purchase only the service that products provide. Here, ownership stays with the producer and service provider and in having an interest in easy collection, maximum reuse of materials and components, and supporting technological innovations. Reusing a product to extend its lifetime is a much more effective, environmentally sound option than discarding it.

2. Be More Aware

The e-waste problem is perceived very differently around the world, but mainly as an issue for the global South due to informal, partly primitive recycling practices having environmental and health consequences. This perception also applies widely to the Western Balkans. And though low collection rates and insufficient financing for e-waste management systems and missing infrastructure for appropriate recycling procedures are well-known among the countries' experts, awareness of the wider public is limited that the origin and source of the problem and its resulting consequences lie directly with the manufacturers and consumers, and not at a distance. People commonly desire the latest gadgets, whose production has enormous environmental footprints such that their lifespans should be increased, not decreased. There is a lack of awareness of how to appropriately dispose of EEE at its end-of-life, thus returning it as soon as possible to state-of-the-art treatment facilities. There is also a lack of awareness that low levels of collection and recycling result in a loss of resources vital for the manufacturing of EEE. As such, in the absence of appropriate substitutes, we are even running a risk for certain production chains. A substantially increased awareness of the e-waste challenge might also lead to changed consumer behaviours, especially considering the environmental aspects during purchasing and in comparing aspects between different brands and products. Consequently, increased awareness could also result in enhanced competition among manufacturers with respect to their environmental performance, which is evident these days in climate change. Women should also be actively targeted in awareness campaigns especially about the risks associated with e-waste and empowered to advocate for safer and more sustainable practices. All humans play crucial roles in the production and management of e-waste; they are often responsible for managing household waste as part of their daily chores, involved in the assembly of electronic products, and engaged in the informal sector (activities such as sorting, dismantling, and recycling e-waste) [17][18]. The necessary increase of awareness must come through gender-sensitive consumer campaigns in social media, TV, cinemas, radios, and newspapers, as well as in informational brochures coupled with initiatives such as door-to-door collection, placement of collection containers, and green-procuring of municipalities and governments. The potential of women and children as ambassadors for change should also be seriously considered, as well as representation of women in leadership positions within the e-waste sector, which can lead to more inclusive and equitable policies and practices.

3. Collect More

The establishment of an adequate number of easily accessible e-waste collection points, accompanied by an increased awareness among end users, would prevent landfilling, leakages, and the dominance of the informal sector in many parts of the Western Balkans. The number of collection points for separate collection of e-waste and the collection points' territorial density should be increased, and collection points should be made easily accessible and more visible. Collection should take place through municipal collection points and on-demand pickup services, and smaller e-waste should be collected at supermarkets. The engagement of the informal sector actors in e-waste collection should also be integrated with the formal systems. Improved security at collection points should be ensured as a way of preventing theft of valuable components. There is an information deficit for consumers, many of whom may not be aware of the policy and legal framework. This deficit should be reduced to prevent bad practices in discarding e-waste and ensure collection through registered collectors. E-waste collection rates need to be increased across countries in the region, just as they need to increase elsewhere across the world. This improvement can be realised through mandatory handover of e-waste to licensed facilities. In the Western Balkans region, more than 70 percent of e-waste is not collected and handed over to licensed e-waste facilities. This increased collection infrastructure should be supplemented by progressive target rates and continuous performance reviews in reaching these targets, for collection of e-waste as defined in all countries in the region.

Effective e-waste legislation should include a clear definition of 'electric and electronic waste' and a classification for ease of identification and monitoring. To monitor collection, Western Balkan countries should introduce a legal obligation on collectors and pre-processors to report and record the amounts and destinations of all types of input and output parts. Several targets and indicators are defined or are currently in the process of being developed as part of monitoring the progress in the region. The enforcement should accompany the monitoring through targeted inspections, intelligence-led risk assessments, and annual enforcement plans involving different actors in the compliance and enforcement chain. Sufficient and trained personnel should be provided to the respective authorities for fulfilling these enforced targets because in many parts of the world, including in the Western Balkans, attaining sufficient, trained personnel is a major shortfall.

Collection of annual statistics must be improved in a comparable format for easy appraisal of the system performance, and completion of an assessment of unmanaged flows must be done every five years. Western Balkan countries should integrate mandatory data reporting and monitoring into the national/regional e-waste systems covering all e-waste categories for ease of comparison both within the region and at the global level. The monitoring system should cover annual statistics on EEE POM and e-waste generation, based on the UNU-KEYs, as well as collection and treatment, preferably based on the UNU-KEYS or on the six e-waste categories.

Furthermore, import and export statistics of EEE and e-waste will need to be compiled. Every five years, there should be a provision of mapping unmanaged flows and lifespan revisions to allow for targeted and fact-based interventions as a means for improving e-waste collection. Measuring e-waste is important as a means for identifying where policy interventions are required in order to initiate the necessary policy formulations. Measuring progress in the sector both nationally and regionally is also important, as is measuring whether or not the countermeasures taken have the intended effect. Reliable statistics are essential tools for initiating policies toward minimising e-waste generation, preventing illegal dumping and emissions, promoting recycling, and creating jobs in the reuse, refurbishment, and recycling sectors. Also, progress toward attaining the SDGs and their 169 indicators is measured by indicators and official statistics. Performance of the system and accurate mass balance calculations (for determining progress toward meeting established targets or the amounts of e-waste that end up in the informal sector) depend on collection and storage of quantitative data. Additionally, collecting data on the participation and experiences of women, men, and diverse individuals in the in the e-waste sector can help inform policies and initiatives to further support and advance their contributions [17].

4. Treat Better, Work Safely, Pollute Less

E-waste management standards have been introduced in the Western Balkans, but whether or not they are enforced is unclear. The implementation of mandatory e-waste EHS standards while increasing awareness and compliance among all involved actors is essential for a successful e-waste management system.

It is essential to implement and enforce the prerequisites for environmentally sound management of e-waste that prioritise both environmental sustainability and the well-being of both women and men and other diverse groups [18]. It is also imperative that Western Balkan countries enforce their e-waste policies and legislative instruments that are clear and tailored to the national context but which should also focus on harmonisation at the regional level, especially with regard to product classification, e-waste management responsibilities, and penalty systems. Such a balance will help to avoid transitional shipments to countries with more lax systems in place.

The adoption of an extended producer responsibility (EPR) system – in which the consumer pays for EoL management of the products via either an advanced recycling fee (ARF) on purchases or a recycling/disposal fee – presents an effective approach to e-waste management. The product's producer or manufacturer has the legal obligation to take back their products at their end-of-life stage for proper disposal. In the absence of such a system with formal financial flows, cherry-picking is rampant, and only the valuable material is selected for treatment, with the rest, especially the hazardous parts, being dumped. In a formal system, the fees generated for e-waste management through EPR cover most of the hazardous/non-valuable parts.

Engaging the informal sector actors including women, men, and diverse individuals through incentives for collection and handover to licensed facilities is a good additional step for strengthening the system. Where informal collection systems exist, countries should engage them to collect e-waste, protect themselves with adequate personal protection equipment, and ensure that e-waste is sent to licensed recyclers. As well, a certain formalisation of the informal sector could be secured by providing recyclers with a fair share of the monetary value generated throughout the entire recycling chain. Non-formal recycling activities of e-waste and landfills could mean that hazardous waste parts are disposed of in a non-environmentally sound way and processed with a low degree of efficiency and effectiveness. Such ineffectiveness leads to both pollution of the environment and workers and to loss of resources. Illegal processors include open burning, direct plastics melting, toner extraction, and burial or dumping of less valuable parts, especially parts containing hazardous components such as lead, polychlorinated biphenyls, and chlorofluorocarbons that directly affect the soil or contaminate water sources.

5. Pay Adequately

Western Balkan countries could also benefit from integrating their informal sector into formal e-waste management. One way could be for pre-processing (i.e. separation at the source, collection, and dismantling of non-hazardous parts of e-waste) to be the informal sector's responsibility, as long as it is not satisfactorily formalised. Both end-processing (i.e. the technical steps that follow dismantling, such as recycling and disposal) and some operations linked to pre-processing of hazardous components (CRTs, mercury, phosphor) and the recovery of complex but valuable parts (such as Printed Circuit Boards [PCB]) should be left to the formal sector. In so doing, labor-intensive manual dismantling could be implemented locally, providing job opportunities via low-tech investments. Manual dismantling is more environmentally and economically efficient than mechanical dismantling because mechanical dismantling requires advanced technology, high-energy consumption, and high investment costs and has both a lower yield of material liberation and pure part separation potential. Western Balkan countries could enable shipments of recovered materials to expert end-processor facilities in the region or elsewhere, where the overall detoxification and recovery of valuable materials is most efficient and state-of-the-art. This approach regards utilising the existing end-processing infrastructures regionally and globally and presenting them as attractive to countries in terms of providing economies of scale technology and infrastructure and being the most economically viable for the country's value recovery stream.

6. Train More E-waste Experts and Professionals

EEE and resulting e-waste raise concerns about resource efficiency and the immediate concerns of the dangers to humans and the environment once the products become waste. There is a long and sometimes complicated chain of events in the e-waste problem, beginning with the idea that someone has for the creation of a new product and continuing through the item's production, ending in its purchase and eventual disposal by the end user. But there is limited capacity for understanding and managing this complex waste stream, whether in the Western Balkans region or elsewhere. Women are underrepresented in STEM (Science, Technology, Engineering and Mathematics) disciplines due to lack of technical skills and differences in labour marker participation, and as part of the solution, it is important to promote gender equality by addressing challenges and leveraging opportunities. For instance, women should be provided with dedicated vocational training programs, access to financial incentives, and support in the form of resources and mentorship that can trigger greater participation and unlock potential, thus creating a more inclusive and innovative community [18-21]. The E-waste Academies developed by UNITAR SCYCLE provide tailored and targeted training for different stakeholder groups. A strong emphasis on diversity in these trainings helps professionals inform and learn from each other – among disciplines, stakeholders, and countries. These academies and other trainings provide a platform to access experts and network. The more trainings Western Balkan representatives receive, the more access they have to models tailor-made for their specific needs in developing their own systems in their own countries. And a global network of alumni is an important reference resource.

10. COUNTRY PROFILES

Albania

Bosnia and Herzegovina

Montenegro

North Macedonia

Serbia

Country:

Albania

2,862,000 inhabitants in 2021
27,400 km²
GDP per capita PPP: $6,494.4 USD in 2021
Average household size: 3.3 members in 2017

Produced by United Nations Geospatial

National legislation on e-waste:

Extended Producer Responsibility:	⚙ Not implemented (only mentioned in the Law on Waste)
National Standards:	✔ Provided for in the legislation since 2012
E-waste Collection Target:	✖ 4kg/inh by 2015 (expired)
Products Coverage:	✖ None, 0% of the e-waste generated

International Conventions:

	Signature	Ratification/Accession	Entry into force
Basel Convention		26/06/1999	27/09/1999
Rotterdam Convention		09/08/2010	07/11/2010
Stockholm Convention	05/12/2001	04/10/2004	
Minamata Convention	09/10/2014	26/05/2020	

EEE POM (2021):	E-waste generated (2021):	E-waste import/export (2019):
36.2 kt **12.7 kg/inh**	**21.8 kt** **7.6 kg/inh**	**For reuse** **Import:** **0.09 kt, 0.03 kg/inh** **Export:** **1.3 kt, 0.4 kg/inh**

(Source: INSTAT 2022/UNITAR)

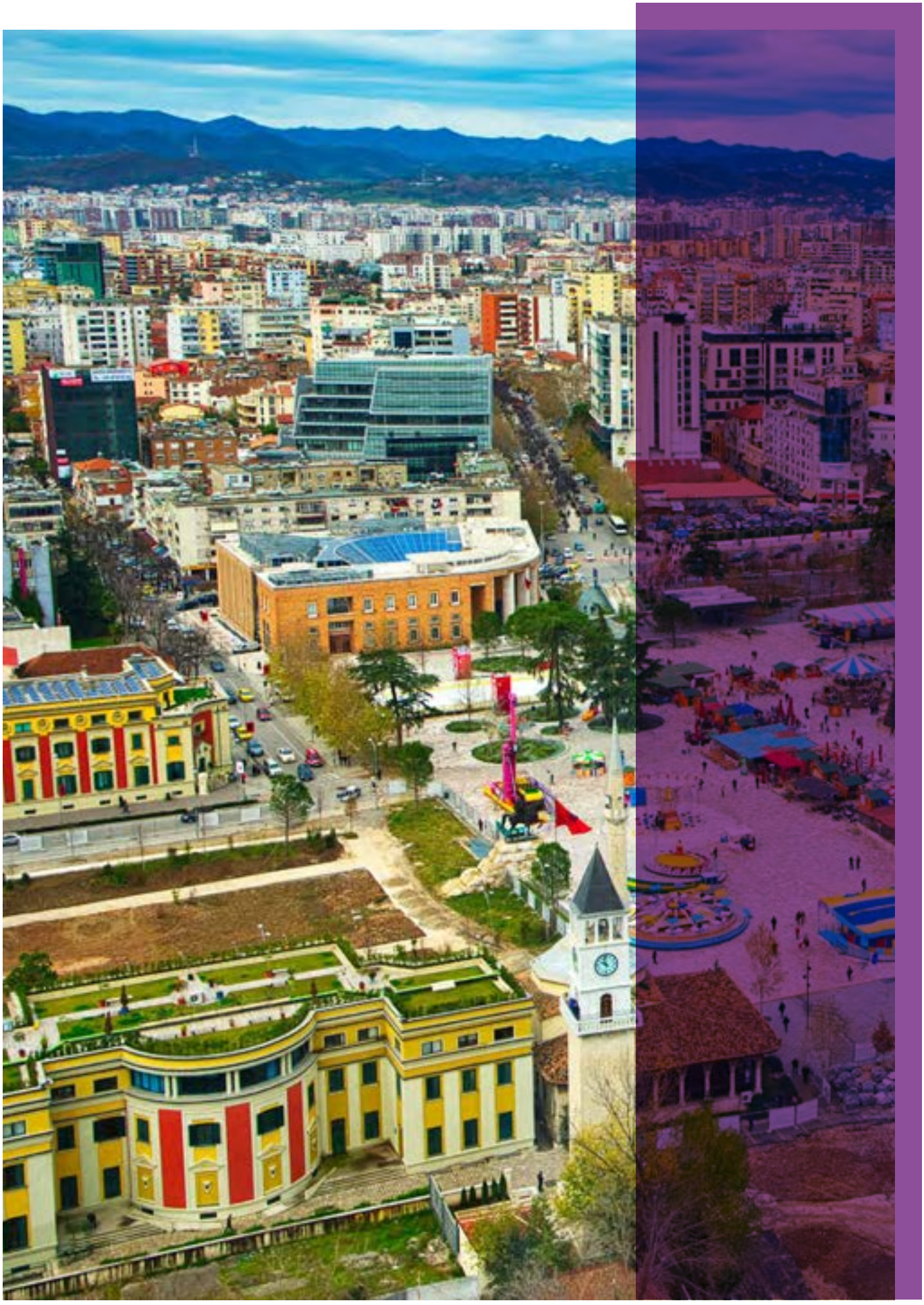
Formal/environmentally sound e-waste management system in place:

✖ E-waste collection infrastructure is weak and separate collection is implemented only minimally.
✔ Three private e-waste treatment companies.

E-waste Management Matrix

A advanced | B in transition | C basic
(more information on the assessment system can be found in chapter 2 and 6)

E-waste Collection Rate



National E-waste Legislation

Albania has a specific e-waste legislation introduced in 2012 with provision for e-waste collection and treatment using the best available techniques, but the legislation has not actually been implemented.

The legal framework on waste management in Albania consists of:

- Law No. 10463, dated 22.09.2011 'On Integrated Waste Management', amended by Law No. 156, dated 10.10.2013
- Law No. 10431, dated 09.06.2011 'On Environment Protection'
- Decision No. 418, dated 25.06.2014 'On Differentiated Waste Collection at Source'
- Decision No. 957, dated 19.12.2012 'For Waste from Electrical and Electronic Appliances'

The waste sector is mainly regulated by Law no. 10431, 'On Environmental Protection,' while the Law on Integrated Waste Management transposed the Directive 2008/98/EC of the European Parliament and European Council on waste (Waste Framework Directive). The e-waste-specific legal framework was implemented in 2012 (Decision No. 957) after the transposition (partial) into national law of the Directive 2002/96/EC (now repealed) by the Council of Ministers. E-waste Law No. 957 declares that all producers should be registered with the National Licensing Center and should set up a system for e-waste collection and treatment using the best available techniques for achieving the provided targets. The Law on Integrated Waste Management encourages the design and production of EEE that facilitates dismantling and recovery and, especially, the reuse and recycling of waste. It also stipulates that persons placing EEE on the market and dealing with e-waste in a manner that is not in accordance with the legislation shall be subject to a fine of 1 – 1.5 million ALL (€7,201 – €10,801). Though these fines are in place within the legislation, there has been little development of formalised systems for the collection and treatment of e-waste, due to a lack of monitoring and enforcement [22]. Neither the RoHS (recast) nor the new Directive 2012/19/EU have yet been transposed.

EPR is not implemented for e-waste, leading to chaotic and uncontrolled e-waste treatment across the country because the stakeholders are not carrying out their responsibilities.

The principles of Extended Producer Responsibility are provided for in the Law on Integrated Waste Management, but have not been implemented. As such, the current situation remains unstable, and there is uncontrolled e-waste treatment across the country – with the informal sector dominating, as the stakeholders are not carrying out their responsibilities of bearing the cost of e-waste management as mentioned in the legislation [23]. Also, a problem is arising from the perception that waste becomes public property following disposal [24].

There is a Framework that focuses on increasing recycling, but there are no clear financing mechanisms in place to meet the set targets while waiting for introduction of an EPR legislation, which is still in process.

Albania has a legislative framework for ESM of e-waste, but there are no clear financing mechanisms while EPR implementation and standards enforcement remains weak.

There is a policy with framework for e-waste management, but there are no clear financing mechanisms. Albania has a new National Waste Management Plan for 2020–2035 - which has key targets on waste management, including targets for increasing recycling and reducing landfilling, as well as targets specifically addressing e-waste [25]. Similarly, the Strategic Policy Document has been developed with the vision of the 'zero waste' concept so that waste is collected and treated as secondary raw material and management is done in accordance with the concept and principles of the circular economy system [23]. Albania has made some progress with the introduction of waste legislations and policy planning, but implementation and enforcement remains weak [22]. Nonetheless, there are plans to prepare acts that fulfil the requirements of the Law on Integrated Waste Management, with one act transposing the European List of Waste into Albanian legislation and another act transposing EPR obligations of packaging producers and likely other waste streams (including e-waste) as well. In 2020, the Ministry of Tourism and Environment, with support from the Swedish Agency for Development Cooperation, began preparing a draft law creating the basis for an EPR system. This work was delayed because of the COVID-19 pandemic, but the aim was to finalise the work by the end of 2021 and implement the new legislation in 2022. As of June 2021, the law was not yet drafted, and the scope has not yet been decided [25].

Standards for e-waste treatment are provided for in the e-waste law, but there are no mechanisms in place for monitoring and enforcement, and reporting is also lacking.

E-waste treatment standards exist in the Law for WEEE [22].The Local Government Units are mandated to collect and process data on EEE POM and e-waste in their territories and report this data to the National Environmental Agency, which keeps and publishes national data. However, there are no mechanisms (guidelines) in place for monitoring and reporting on e-waste, and cooperation between the central government and regional and Local Government Units is very weak [22]. There is currently no system for separate collection of e-waste in the country, and due to lack of capacities and tools, the local government units do not have reliable data. As such, data on e-waste is, in most cases, incomplete or missing [23].

The e-waste collection target of 4 kg per capita by 2015 has expired, and the National Waste Management Plan has provisions for ambitious collection and recycling targets, which have nonetheless not yet been enforced.

The target in the e-waste Law No. 957 of separately collecting a minimum of 4 kg of e-waste per inhabitant by 2015 has expired and needs review [26]. For now, the only e-waste targets in the country are mentioned in the new National Waste Management Plan, which has ambitious targets that partially approximate the respective targets set out in the Directive 2012/19/EU. The e-waste targets for 2035 include a separate collection > 4kg per capita of e-waste from private or individual homes each year, recovering between 70% and 80% of e-waste, and recycling between 50% and 75% of e-waste [25].

National E-waste Statistics

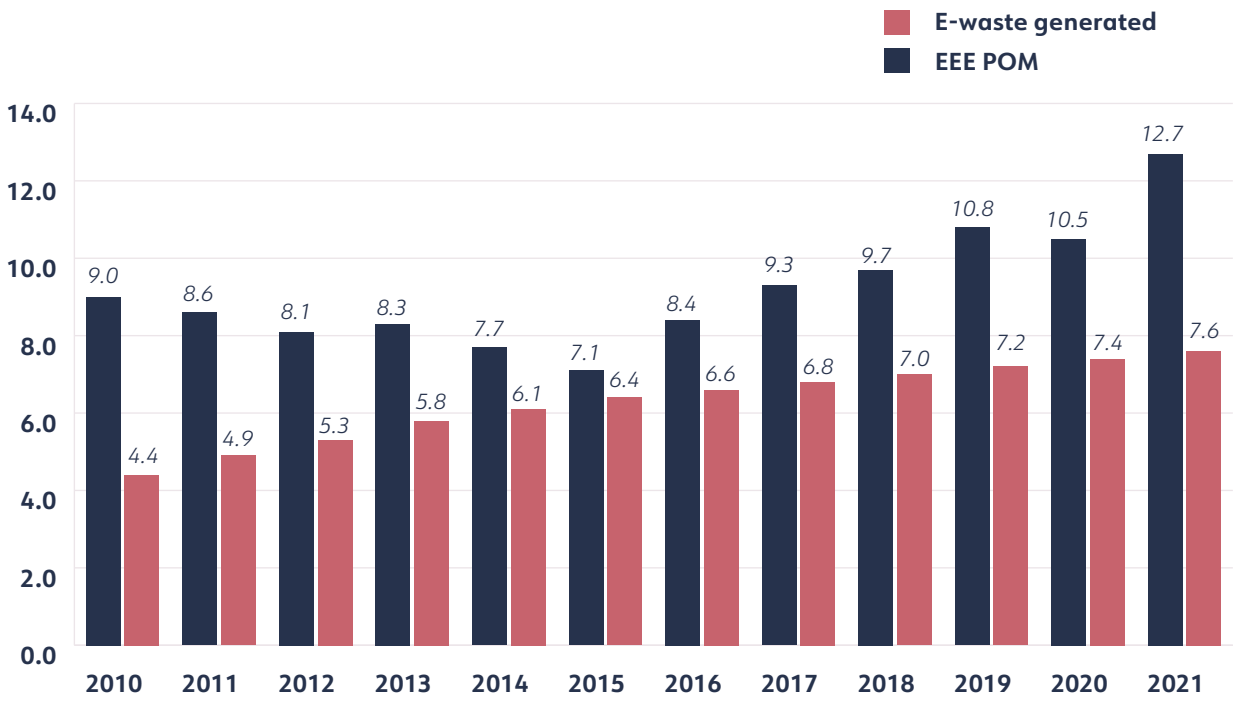
Information is not readily available on EEE POM and E-waste generated, collected, and treated.

Reliable data on e-waste is not available. Since 2013, the Statistical Institute of Albania (INSTAT) has been receiving data for waste from municipalities, but the data is given in total (as opposed to being specified by categories) and is often based on estimations by the municipalities and recycling companies [25][27]. Also, the data mostly refers to the amount of e-waste collected in municipal bins. No definite classification system for e-waste is in use in the country, and available data is not relatable to UNU-KEYs or the EU-6 categories. Nonetheless, through the Tools developed by UNITAR-SCYCLE and via the official country data on imports and exports, it was possible to determine the main statistical indicators on e-waste in the country. The official data provided by INSTAT has a time series available from 2015 until 2021, the latest year included in the analysis.

EEE POM fluctuated from 9.0 kg in 2010 to 12.7 kg/inh in 2021, with a significant decrease to 7.1 kg/inh in 2015, while e-waste generated gradually increased from 4.4 to 7.8 kg/inh from 2010 to 2021.

The EEE POM and e-waste generated of Albania from 2010 until 2021 are shown in Figure 15. As shown, the EEE POM of Albania decreased from 9.0 kg/inh in 2010 to 8.1 kg/inh in 2012. It increased slightly to 8.3 kg/inh in 2013 and then decreased to 7.1 kg/inh in 2015. The EEE POM increased from 2016 to 10.8 kg/inh in 2019. The increase was followed by a slight decrease to 10.5 kg/inh in 2020. It then increased to 12.7 kg/inh in 2021. The e-waste generated, by contrast, gradually increased from 4.4 kg/inh in 2010 to 7.6 kg/inh in 2021.

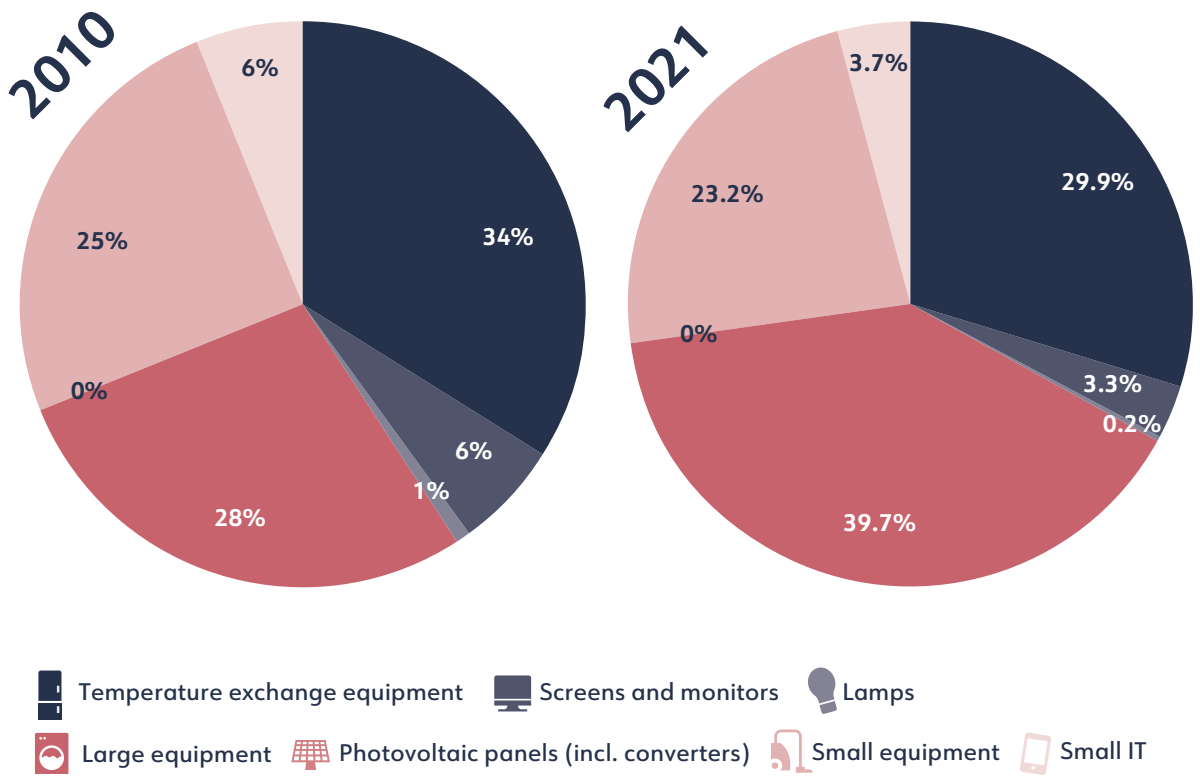
Figure 15. EEE POM and e-waste generated for Albania per kg/inh



The largest EEE POM shares were Large Equipment in 2021 and Temperature Exchange Equipment in 2010; Lamps is the smallest category, and no PV panels were POM in 2010 and 2021.

Figure 16 illustrates the EEE POM shares for 2021. In 2021, the largest share was Large Equipment, which increased from 28% in 2010 to 40% (5.0 kg/inh) in 2021. Temperature Exchange Equipment was second largest, with 30% in 2021 (3.8 kg/inh). The third largest share was for Small Equipment, with 23% (2.9 kg/inh). Small IT was fourth, with 0.5 kg/inh (4%), followed by Screens and Monitors with 0.4 kg/inh (3%). The smallest category was Lamps, with 0.02 kg/inh (0.2%). PV panels (Cat IVB) were not installed in 2010 or 2021, so both shares are 0%. In 2019 and 2020, approximately 2% of the EEE POM consisted of PV panels.

Figure 16. EEE POM category shares of Albania for 2010 and 2021



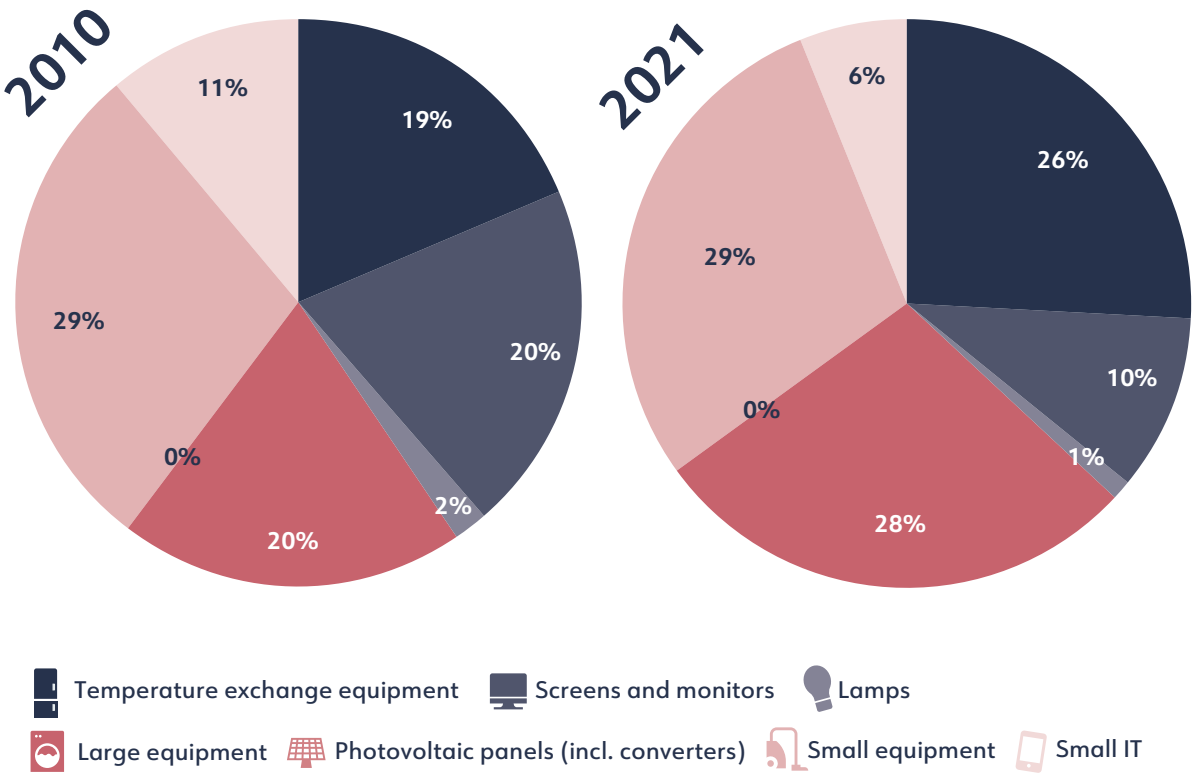
Albania has no EEE production facilities; thus, no EEE production statistics are available.

There are no reported production statistics available for EEE in Albania.

The E-waste generated share in 2021 was the largest for Small Equipment (Cat V), with 2.2 kg/inh (29%), and the smallest share was for Lamps, with 0.09 kg/inh (1%).

The e-waste generated shares for 2010 until 2021 have a similar trend, with the largest share being for Small Equipment (approx. 30%). In 2021, specifically, as illustrated in Figure 17, Small Equipment (Cat V) had a share of 29%, with 2.2 kg/inh. The second largest was Large Equipment (Cat IV), with 2.1 kg/inh (28%), which increased from 20% in 2010 to 28% in 2021. Temperature Exchange Equipment was the third largest with 2.0 kg/inh (26%). The fourth largest was Screens and Monitors (Cat II), with kg/inh 0.8 (10%), which decreased from 20% in 2010 to 10% in 2021. Small IT (Cat VI) was the fifth largest, with 0.5 kg/inh (6%) in 2021. Lamps (Cat III) had a share of 1% (0.1 kg/inh) in 2021.

Figure 17. E-waste generated category shares of Albania for 2010 and 2021



Data on e-waste collected is not available, but e-waste compositions of mixed municipal waste are available, showing an amount of 0.4% (3.0 kt, 1.05 kg/inh) related to e-waste in 2021.

No reported data is available for the sorted collection of e-waste. However, according to the Statistical Institute of Albania (INSTAT), e-waste corresponds to a certain percentage of the total mixed municipal waste of a specific year, which was reported from 2016 to 2021 and is shown in Table 7. According to INSTAT, approximately 0.1% of the total mixed municipal waste was composed of e-waste in 2020, amounting to 0.9 kt (0.3 kg/inh) [28]. And in 2021, roughly 0.4% of Albanian urban waste was composed of e-waste, which amounts to 3.0 kt (1.05 kg/inh) [28]. However, it is not clear whether this amount was destined to be processed and recycled appropriately or to be treated with the other parts of the mixed municipal waste.

Table 7. Municipal waste composition in Albania

	2016	2017	2018	2019	2020	2021
E-waste composition of total urban waste (%)	0.8	1.2	1.0	1.4	0.1	0.4
E-waste in municipal waste (t)	858	13313	10977	13230	868	3016
E-waste in municipal waste (kg/inh)	0.30	4.62	3.81	4.60	0.30	1.05

E-waste Management System

Though separate collection of waste is legislated, this practice is not implemented, and e-waste is disposed of with general waste before being collected, usually by waste pickers.

There is no dedicated formal e-waste management system, nor are there any e-waste collection points [26]. The existing general waste collection infrastructure is weak, and the number of containers is often insufficient. Though separate collection of waste is legislated (Decision No. 418), e-waste is not collected separately via legal activities anywhere in Albania [29]. Municipal solid waste collection is carried out by the municipalities through unsorted bins. Besides the amount that ends up in municipal waste, collection of e-waste remains mostly informal, usually carried out by waste pickers and sold directly to the private recycling companies [23].

Three companies treat e-waste in Albania, and they also handle other scrap metals, but information on their recycling capacities and the amounts of e-waste treated is not currently available.

Three private companies (IB Recycling, GER.ARD, and Green Recycling) are treating e-waste in Albania, though their activities are limited to the main cities. These companies are also involved in the collection and treatment of metals scraps and other waste types, as well as in trading recyclables (e.g. paper, plastics, ELV, etc.). In partnership with GER.ARD Ltd, IB Recycling offers services for recycling e-waste and vehicles parts [30]. The companies receive e-waste via invitation from businesses, hand over from individuals, and buy from informal operators. Though informal operators may have access to most of the e-waste and supply the formal operators, there is no information on partnerships or alliances between them. Data relating to the activities of the existing recyclers, such as capacity, amounts treated, and the categories treated, as well as the processes adopted by these recyclers, is not currently available.

Recycling facilities adopt dismantling and physical separation after removing hazardous parts before exporting most recovered parts.

Though the companies indicate compliance with European recycling standards, there are no confirmations from authorities that this compliance is monitored or that health and safety measures are implemented, especially on the management of hazardous parts. The various e-waste streams are manually dismantled to varying degrees and then are physically separated. Most parts are exported for treatment abroad (mostly to Europe) because processing and refining facilities are lacking, while some are handled locally by a small private Albanian smelter, and steel scrap is handled by the Elbasan metallurgical plant [25][31].

The informal sector is very active in Albania, but data on its involvement has not been provided.

The informal sector is quite active in Albania and has created a market that is self-regulated, whereby they supply the recycling industry with raw materials. They cherry-pick recyclable materials from communal containers and dump sites and also go door-to-door to collect or buy directly from households. There are informal collection points and some informal treatment facilities. However, official data is not available on the quantities of e-waste managed by the informal sector and the processes adopted.

Recycling of general waste in Albania is low despite the presence of a viable recycling sector, due to short supply of recyclables from the informal operators, who prefer to export because the prices of recyclables in Albania are relatively low in comparison with those in the EU.

The recycling of general waste is low despite the presence of a recycling industry because recycling companies fail to acquire enough raw materials, with proper quality from the domestic market to operate at full capacity. Recycling in Albania is not encouraged, considering the very low landfill fees, a dominance by the informal sector (which raises the value of recyclables while exporting some), and the government subsidy for incineration[35] (no subsidies apply for recycling). All these points force recyclers to relocate to other countries.

In Albania, the existing recycling industry fails to acquire enough recyclables due to a limited infrastructure for sorted collection of e-waste.

Collection points or scrap yards of informal operators are mainly family businesses, which are often located close to landfills. There are also individual collectors' workplaces, which supply recyclables to the collection centres because of their lack of adequate transportation means. These centres sell the materials to recycling companies in Albania or export them to the nearest countries [32].Though data on this trade is not available, informal operators may prefer to export (or sell to exporters) if it yields more profit, considering that the price of recyclables in Albania is relatively low in comparison with those of the EU [33]. There is no information on health and safety measures in place in the informal sector, but there is work ongoing to include them in municipal waste management. This is done primarily by providing safety equipment to waste pickers, while recycling companies give them priority when hiring staff for the resource centres (where collected recyclable waste is prepared for recycling) [25].

The informal sector also repairs some collected e-waste for reuse while parts are salvaged.

There are also some informal repair activities of collected e-waste occurring at the local level. Parts and components of EEE are also salvaged during dismantling activities, and these are used for such repair activities. After retrieving materials that have a net scrap value, the remainder are disposed of at dumpsites, whether regulated or unregulated, or simply left littered in the environment [26].

There are many obstacles hindering efficient e-waste collection and treatment in Albania, including the dominance of the informal sector, lack of implementation of EPR, and weak infrastructure.

Only recently, the Government of Albania, through the Minister of Environment while visiting one of the e-waste recycling facilities (IB Recycling), expressed satisfaction that investments have been made in the recycling of e-waste that was not provided for by Albanian law but which is nonetheless provided for by European law[36]. However, the Government needs to do more to

[35] https://exit.al/en/2021/09/23/albanias-recycling-rate-continues-to-fall-as-government-pushes-landfills-and-incinerators/
[36] https://www.ibrecycling.al/makineri/

encourage e-waste recycling, especially by implementing an EPR, which will ensure regular supply of materials and adequate financing for the operators. The implementation of an effective e-waste management system in Albania has many obstacles. There are insufficient investments in the sector, leaving a weak infrastructure for waste collection and treatment. There is poor enforcement of existing legislation on collection of service tariffs to cover waste management costs, low administrative capacities, inefficient data collection, and poorly defined roles. There is also poor consumer awareness of the hazards of inappropriate e-waste disposal and the need for separate collection of e-waste.

In Albania, there is a concern over potential mercury releases that could result from EEE and medical devices, for which there is no take-back or management system in place.

Mercury from waste medical devices and e-waste is a source of concern. According to the results of the Minamata Initial Assessment inventory (performed in accordance with UNEP's 'Toolkit for Identification and Quantification of Mercury Releases') for 2016, a total of 4.34 tonnes Hg/y may have been released; of that, 76% are from mercury intentionally used in products such as thermometers, blood pressure gauges, fluorescent light bulbs, etc. [34], which are not properly managed at the end-of-life stage.

Transboundary Movement of E-waste

Albania is Party to the Basel, Rotterdam, Stockholm, and Minamata Conventions and introduced a ban on imports of waste in 2013.

Albania signed the Basel Convention on the 29th of September 1997 and thereafter signed the Rotterdam, Stockholm, and Minamata Conventions. Since signing to the conventions, a ban for the import of hazardous waste and non-hazardous waste that will be stored or annihilated was introduced in 2013 (Law No. 156/2013, amending the Law on Integrated Waste Management No. 10463/2011). Before the ban on the import of waste was introduced, there were illegal shipments of hazardous wastes coming into Albania. The European inspection data on intra-EU movements showed that such shipments (e.g. tires, ELV, car parts, and e-waste) were arriving by road and sea [35]. This included imports totalling 19.02 tonnes of waste materials in 2012 [29] – including the importation of 200 kg of e-waste, 0.5 tonnes of lead batteries, 50 kg of fluorescent tubes, and other mercury-containing waste [36].

The introduction of a ban on waste imports led to a reduction in the activities of some recycling companies because of the lack of sufficient availability of raw materials.

The waste import ban (Law No. 156/2013) included all waste except aluminum with purity exceeding 90% and iron with purity exceeding 98%.

This import ban was imposed with the explicit intention of enhancing domestic separate waste collection and processing by the domestic industry. However, the ban proved to be counterproductive. Without an increase in separate waste collection, the ban equated to a significant reduction in the activities of recycling companies. The reduction in recycling was due to of the lack of adequate raw material, according to the Association of Recyclers of Albania and companies working in the field. Discussion on amending or eventually lifting the ban began in 2016 [29].

The authorised exporting of waste is allowed, but reporting on exported e-waste quantities is limited.

Exporting of general waste has been reported, and exporting waste is allowed if it is authorised by the local ministry. Reported recyclable waste streams included 29.2 kt of metal in 2013, 64 kt of metal in 2014 [37], and 3t of batteries to MKD in 2018[37]. By analysing the average price of EEE from the trade statistics, it was also possible to estimate that 56 tonnes of PCB were exported for recycling in 2019 (equal to 12% of the amount of PCB generated) [11]. However, no reports from the Basel Convention are available for e-waste.

Used EEE is available for sale, but no information is available on its import and export quantities or its market size.

Used EEE is readily available in Tirana and other cities of Albania, but information on imports and how large the market is are limited[38]. According to the available data, exports and imports of used equipment for reuse totalled 1.3 kt (0.4 kg/inh) of UEEE exported and 0.09 kt (0.03 kg/inh) imported in 2019 [11].

Campaigns for E-waste Collection and Recycling

There are a few projects in the waste sector, but none is e-waste-specific.

No actions for informing and involving citizens on hazardous waste management have yet been undertaken in Albania. A measure within the strategic goal (SG7: Human Resource and Participation) of the National Integrated Waste Management Strategy and Action Plan, 2018-2033 is for citizens to be engaged and consulted in the drafting of Waste Management Plans [27]. There are only a few projects and initiatives in place, but none of them focus specifically on e-waste.

Albania is partially implementing household waste collection, but increasing awareness creation is necessary in order to achieve the desired results.

Albania is currently implementing household waste collection; the plan is to cover 90% of residential buildings with weekly municipal solid waste

[37] BC 2018 Reports (basel.int).
[38] Shopping In Tirana, everything you need to know - Expats in Albania.

collection by 2022. This action will also span across the rural areas, where collection and recycling services are not currently provided [27]. Some donor projects also support municipalities for constructing and operating centres used for collection of recyclable wastes and pre-processing before the waste is sold to recycling companies [25]. A survey in Tirana showed that most residents (94% of all responses) are willing to separate waste at the source if the municipality would implement the initiative. Respondents cited placement of bins/containers as definitely the most important action that the municipality could take to motivate citizens. As for the obstacles hindering waste separation, respondents most often cited the lack of space at home. About 50% of the respondents within high- and middle-income groups were willing to pay for the additional service of collection of separated waste. This percentage was lower (36%) in low-income neighbourhoods [38].

Stakeholder Mapping

Stakeholder	Responsibility
Ministry of Tourism and Environment	Responsible for the formulation and implementation of laws and policies related with environment, nature protection, waste management, environmental monitoring, etc.
National Environment Agency	This is an agency in Albania under the supervision of the Ministry of Tourism and Environment. It is dedicated to improving, conserving, and promoting the country's environment and strives for environmentally sustainable development with sound, efficient resource management.
Institute of Statistics (INSTAT)	The Institute of Statistics is charged by law with the production of official statistics services in the Republic of Albania. It has Statistics Departments in Ministries and other central institutions.
Green Recycling	This company collects and treats empty toner cartridges for printers and e-waste (computers, printers, cell phones, fax machines, etc.). It also trades waste paper, plastics, and other recyclables. Green Recycling is the only company in Albania collecting and recycling glass waste and is also the only waste recycling plant to comply with EU regulation for dealing with cullet glass waste (EU 1179/2012).
GER.ARD. Ltd	This company owns the necessary equipment and latest technology to provide the total dismantling and treatment of e-waste and old cars. GER.ARD also offers used spare parts at the most competitive price possible.
AMA Recycling	AMA Recycling was founded in 2008 as a joint venture of pioneer entrepreneurs in the field of recycling in Albania and Italy. The company is active in the refinement and production of aluminum alloys. It also markets non-ferrous metal scraps: aluminum, copper, bronze, stainless steel, zinc, lead, brass, and battery in the domestic and international market.
IB Recycling	IB Recycling collects and processes electronic scrap and all e-waste types, end-of-life vehicles, and car exhaust catalysts. The company promotes reuse, recycling, and other forms of recovery of e-waste in order to reduce the amount of waste disposed.

Country:

Bosnia and Herzegovina

Produced by United Nations Geospatial

3,296,000 inhabitants in 2021
51,200 km²
GDP per capita PPP: $6,916.4 USD in 2021
Average household size: 3.5 members in 2017

National legislation on e-waste:

Extended Producer Responsibility: ✔ In place since 2013 for the Bosnia and Herzegovina entity Federation of Bosnia and Herzegovina (FBiH) and since 2022 for the Bosnia and Herzegovina entity Republic of Srpska. The implementation of EPR schemes in Brčko District BiH is under preparation.

National Standards: ✔ Introduced in 2012 with the Regulation on WEEE Management.

E-waste Collection Target: ✔ For the Bosnia and Herzegovina entity FBiH, the target has an annual growth of 5%, amounting to 40% of EEE POM for 2022. In the Bosnia and Herzegovina entity Republic of Srpska, the target was introduced in 2021 and is 4 kg/inh. No information is available on targets in place in the Brčko District BiH.

Products Coverage: ✔ All EU-10 categories for the Bosnia and Herzegovina entity FBiH (before 2023), all the EU-6 categories in BiH entity Republic of Srpska. Starting in 2023, a new legislation in FBiH adapted the EU-6 categories.

International Conventions:

	Signature	Ratification/Accession	Entry into force
Basel Convention		16/03/2001	14/06/2001
Rotterdam Convention		19/03/2007	17/06/2007
Stockholm Convention	23/05/2001	30/03/2010	28/06/2010
Minamata Convention			

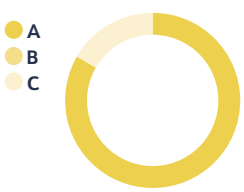
EEE POM (2021):	E-waste generated (2021):	E-waste formally collected (2021):	E-waste import/ export (2019):
43.9 k **13.3 kg/inh**	**29.7 kt** **9.0 kg/inh**	**4.7 kt** **1.42 kg/inh**	**For reuse** **Import: 5.6 kt** **Export: 1.5 kt** **For recycling** **Export: 0.03 kt**

(Source: BHAS 2022/Zeos/Kim/Tec 2022; partial data/UNITAR)

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

- ✔ 2 main collective collectors (PROs) and 9 other companies licensed to collect e-waste.
- ✔ 8 e-waste recycling companies.
- ✘ No PROs or collection systems.

E-waste Management Matrix



A advanced | B in transition | C basic
(more information on the assessment system can be found in chapter 2 and 6)

E-waste Collection Rate

(indicators refer to BiH entity FBiH)

National E-waste Legislation

The Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina is in charge of the ratification and access procedures of international treaties and guidelines, while the three territorial units of Bosnia and Herzegovina are responsible for drafting and adopting their own waste legislation.

The Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina is the national institution in charge of the ratification and access procedures of international conventions in the field of environmental protection, as well as for all operational matters within Bosnia and Herzegovina on the subject. The Ministry's competencies include defining policies, basic principles, coordinating activities, and harmonising plans of the government and institutions of the three territories in accordance with international obligations in the areas of agriculture, energy, environmental protection, development, and use of natural resources. The most significant policy-making activities in Bosnia and Herzegovina, in terms of environmental protection, belong to Bosnia and Herzegovina's territorial units.

The Bosnia and Herzegovina entity FBiH adopted a regulation for the management of e-waste in 2012, and the Bosnia and Herzegovina entity Republic of Srpska adopted one in 2020; the Brčko District BiH does not yet have one, and there is currently no special Agency or regulatory body in charge of enforcing e-waste laws.

The responsibilities for waste management in Bosnia and Herzegovina (BiH) is complicated, due to the country's two major administrative regions – the Federation of Bosnia and Herzegovina (FBiH) and the Republic of Srpska – which operate two almost entirely separate regulatory and infrastructural systems for waste management. Bosnia and Herzegovina's third administrative region, the Brčko District, also bears responsibility for its own waste system. The three territorial unit governments are responsible for drafting and adopting their own waste legislation, so there is no overarching waste legislation nationally, and each authority has developed their own laws and accompanying strategies and policies for implementation [39].

As such, the waste management is regulated by three main entity laws for the three different territorial units (with the respective bylaws):

1. The Law on Waste Management in FBiH (Official Gazette of FBiH, No. 33/03, 72/09, 92/17, 65/21).
2. The Law on Waste Management in the Republic of Srpska (Official Gazette of Republic of Srpska, No. 113/13, 106/15, 16/18, 70/20, 63/21, 65/21).
3. The Law on Waste Management in the Brčko District (Official Gazette of Brčko District, No. 72/09, 25/04, 1/05, 19/07, 2/08 and 9/09).

A regulation for the management of e-waste was adopted in 2012 in the Bosnia and Herzegovina entity FBiH and in 2020 in the Bosnia and Herzegovina entity Republic of Srpska, but no such regulations have yet been adopted in the Brčko District BiH.

The most relevant secondary e-waste legislations in the Bosnia and Herzegovina entity FBiH are:

- Regulation on Management of Waste from EEE, also referred to as the Rulebook on WEEE Management (Official Gazette of FBiH, No. 23/23)
- Regulation on Necessary Conditions for Transfer of Obligations from Producers and Sellers on Operators of Systems for Collection of Waste (Official Gazette of FBiH, No. 9/05) [40]
- Regulation on Criteria for Calculation and Method of Payment of Compensation for Products that Become Packaging and Electrical and Electronic Waste After Use (Official Gazette of FBiH, No. 104/22)
- Regulation on the Method of distribution and Investment of Collected Fees for Packaging and Electrical and Electronic Products (Official Gazette of FBiH, No. 104/22)

In February 2016, the earlier Regulation on WEEE Management (Official Gazette of FBiH, No. 87/12) was suspended and out of force for several months, creating a legal vacuum. It was reinstated in October 2016 in the same form and content by the decision of the competent ministry. The system continued to function in the same way, with the system operators (EPR) collecting fees and organising the e-waste management system through authorised collectors and recyclers.

In the Bosnia and Herzegovina entity Republic of Srpska, the Law on Waste Management contains general provisions related to e-waste and other specific waste streams (i.e. batteries, waste cars, medical waste, etc.) [41]. The Law provides for the adoption of bylaws, which shall prescribe the management of these waste streams within one year from the date of its entry into force (i.e. Dec. 2014) [42]. However, for e-waste, this was not the case until 2020 when the bylaw for e-waste went into force. The Republic of Srpska Law on Waste Management and the Regulation on the Forms of Reports on Management of Special Categories of Waste (Official Gazette of Republic of Srpska, No. 87/20, 65/21 p. 31) specified that producers or importers should pay a fee for the purpose of covering the costs of establishing a system for managing special waste flows[39]. Despite the complex regulatory framework, there is currently no special agency or regulatory body in charge of enforcing e-waste laws.

E-waste specific EPR is place in the Bosnia and Herzegovina entities of FBiH and Republic of Srpska but not in the Brčko District.

EPR laws for e-waste are in place in both Bosnia and Herzegovina entities (FBiH and Republic of Srpska) and are under preparation in the Brčko District BiH.

Extended Producer Responsibility laws specific for e-waste are in place in both Bosnia and Herzegovina entities, FBiH (2013) and Republic of Srpska

[39] Fund for Environmental Protection and Energy Efficiency of Republica Srpska - FEES - AMALASIVE WASTE (ekofondrs.org).

(2020), but not in the Brčko District. In the Bosnia and Herzegovina entity FBiH, e-waste management fees are collected and managed by system operators (the 2 PROs), whereas in the Bosnia and Herzegovina entity Republic of Srpska, the fees are collected by the Environment Fund, which then organises the waste management system. Manufacturers and importers are also obligated to submit, alongside the fee, a report on the quantity, weight, and type of EEE [40]. Funds gathered in this way are used to improve the collection options available for e-waste. In the Bosnia and Herzegovina entity Republic of Srpska, the EPR law went into force in 2020, but the application started only in 2022, and producers/importers are obligated to pay a fee on EEE POM directly to Environmental Protection and Energy Efficiency Fund of the Republic of Srpska. The implementation of a separate EPR system in the Brčko District is not considered an efficient solution because of the small population and the small quantities of e-waste generated. As such, available options include (i) the Brčko District BiH developing a legislation on EPR based on a shared responsibility model, with such a system working efficiently only if existing operators in both Bosnia and Herzegovina entities FBiH and Republic of Srpska apply and obtain a license to operate in the Brčko District BiH, or (ii) allowing producers/importers to sign contracts with the PROs licensed in FBiH and the Republic of Srpska [40].

EPR funds are used to improve e-waste collection and recycling in the Bosnia and Herzegovina entities of FBiH and Republic of Srpska, but not yet in the Brčko District.

Relevant Government policies and plans are in place to ensure environmental protection and sound waste management practices.

Strategic documents pertaining to environmental protection and waste management are developed at the territorial unit level. The main strategic and planning documents related to waste management in Bosnia and Herzegovina are:

- Environmental Strategy and Action Plan 2030+ of FBiH, which addresses waste management in its integral part
- The Waste Management Strategy of FBiH(40)
- Federal Waste Management Plan 2012–2017 of FBiH
- Waste Management Strategy (2017–2026) of Republic of Srpska, adopted in 2017
- Waste Management Strategy 2016–2026 of Brčko District, adopted in 2017 [43]

There is currently no specific policy on e-waste.

E-waste management standards are provided for in the legislation of FBiH, with supervision carried out by inspectors, while the recycling/recovery goals are monitored through the Waste Management Information System of 2021.

The standards are prescribed by both the Law on Waste Management and the Rulebook on WEEE Management (adopted by the Ministry of Environment and Tourism of FBiH and entered into force in 2012) as obligations of the system operators [44]. The development of an environmental protection

strategy and an environmental action plan is currently in process. Supervision, inspection, and enforcement of the regulations are carried out by inspectors at multiple levels, but not frequently enough, due to limited resources. Monitoring achievement of recycling/recovery goals is pursued by the competent ministry that issues licenses to system operators, and since 2021, the goals are monitored through the Waste Management Information System (WMIS) of FBiH.

An e-waste data reporting procedure is handled by the Agency for Statistics of Bosnia and Herzegovina and in compliance with the EU WEEE Directive.

The Agency for Statistics of Bosnia and Herzegovina carries out international representation and cooperation with organisations and other bodies and fulfils the international obligations of Bosnia and Herzegovina on the matter of statistics. The Agency for Statistics of Bosnia and Herzegovina collects and processes data for EEE POM and e-waste. The methodology adopted for measuring e-waste is based on the E-waste Statistics Guidelines on Classification, Reporting and Indicators [2], developed by UNITAR-SCYCLE. Reliable data for the entire country may not be available because a problem is that data was monitored in only one entity (i.e. FBiH). The Agency for Statistics of Bosnia and Herzegovina prepares the transmission of available data through the Questionnaire 'WASTE_WEEEDAT_A' and according to the EU legal framework (Directive 2012/19/EU of the European Parliament and of the Council). The PROs submit quarterly reports to the Ministry of FBiH and the Fund on all producers and importers included in the scheme [40]. As for reporting, in the FBiH, the EU-10 classification was used until 2023, whereas in the Republic of Srpska, it was the EU-6 (Annex III of the WEEE EU Directive). In 2023, a new Regulation on Management of Waste from EEE, Official Gazette of FBiH, No. 23/23 was implemented in FBiH, which changed the classification to the EU-6.

The two major Bosnia and Herzegovina entities (FBiH and the Republic of Srpska) have clear collection and recycling targets in place.

There are collection and recycling targets by equipment categories defined by the Rulebook on WEEE Management in the Bosnia and Herzegovina entity FBiH, which are aligned with Directive 2012/19/EU. The targets are defined as a percentage of the quantity of EEE POM and grow from 5% for the first year after the PRO (Producer Responsibility Organisation) obtained the license to 25% in the fifth year of its operation [40], and the targets subsequently continue to grow by 5%. The collection target for 2022 and 2023 is 40% of EEE POM. For recycling/reuse, the target has a range of 50% to 80%, based on the average weight of the device [42]. In the Republic of Srpska, the Waste Management Strategy (2017–2026) defined a recovery target of 4 kg/inhabitant/year and gave quotas for reuse and recycling of e-waste (in % of EEE weight) with a deadline of 2021, at 50% for reuse and 25% for recycling, while for 2026 it is 70% to 85% for reuse and 50% to 80% for recycling [40]. No information could be retrieved on the existence of any such targets in the Brčko District BiH.

(40) https://esap.ba/.

National E-waste Statistics

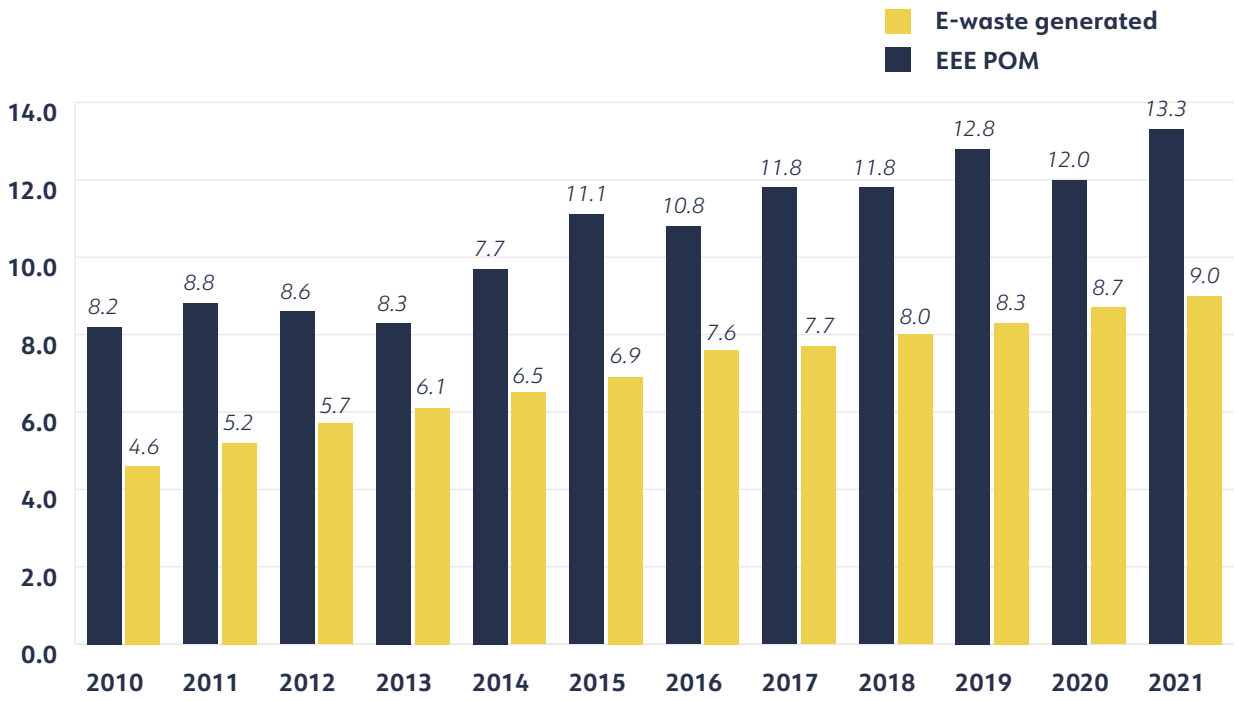
Officially collected data on e-waste in the Bosnia and Herzegovina entity FBiH is available from PROs, and statistics on the Waste Management Information System of the FBiH entity are expected starting in 2023, while official data collection and reporting for the Bosnia and Herzegovina entity Republic of Srpska are still in process.

Starting in 2021, specific data is kept in part through the Waste Management Information System of FBiH (expected to also be established in the Bosnia and Herzegovina entity Republic of Srpska by the end of 2022). Data is entered electronically, and a control system is in place that allows consistency in POM as well as the import and production through a data gap-filling process. The first data from the Waste Management Information System of the entity FBiH is expected to be available in early 2023. In the FBiH, all legal entities that manage waste are monitored through the Waste Management Information System, regardless of whether they are involved through PROs or independently. The Agency for Statistics of Bosnia and Herzegovina collects, processes, and distributes statistical data of Bosnia and Herzegovina in accordance with internationally accepted standards. Based on the tools and methodology developed by UNITAR, the Agency for Statistics of Bosnia and Herzegovina (BHAS) managed to compile the e-waste statistics indicators from 2010 to 2021 in compliance with the UNU-KEYs and the EU-6 classification system.

The EEE POM fluctuated between 8.2 and 13.3 kg/inh from 2010 to 2021, and the waste generated increased gradually from 4.6 kg/inh to 9.0 kg/inh from 2010 to 2021.

Figure 18 illustrates the EEE POM and the e-waste generated of Bosnia and Herzegovina from 2010 to 2021. The EEE POM increased slightly from 2010 to 2011, from 8.2 kg/inh to 8.8 kg/inh, and then decreased to 8.3 kg/inh in 2013. An increase then followed until 2015, amounting to 11.1 kg/inh in 2015, before stabilising at approximately 11 kg/inh in 2016. The EEE POM increased in 2017 and stabilised at 11.8 in 2018, and then increased again to 12.8 kg/inh in 2019. The EEE POM then decreased in 2020 to 12.0 kg/inh and increased to 13.3 kg/inh. By contrast, a gradually increasing trend developed for the e-waste generated from 4.6 kg/inh in 2010 to 9.0 kg/inh in 2021 with a brief stagnation in 2017 at 7.7 kg/ inh.

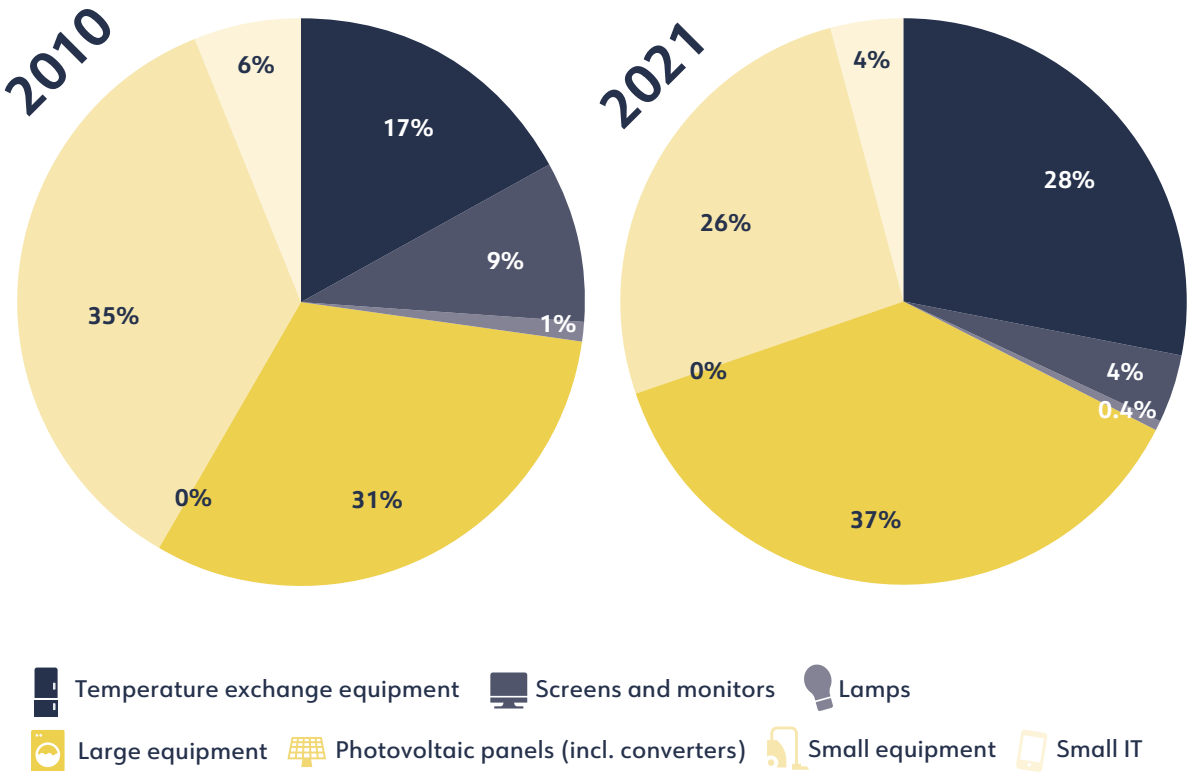
Figure 18. EEE POM and waste generated per kg/inh of Bosnia and Herzegovina (BHAS, 2022)



The EEE POM categorical shares of Bosnia and Herzegovina fluctuated from 2010 to 2021, with the largest shares being for Small Equipment, Temperature Exchange Equipment, and Large Equipment.

The EEE POM shares changed slightly from 2010 to 2021, as illustrated in Figure 19. The greatest share for 2021 is Large Equipment (Cat. IV) with 37% (5.0 kg/inh). Temperature Exchange Equipment (Cat I) was the second largest with 28% (3.8 kg/ inh), which has increased from 17% in 2010. Small Equipment (Cat V) is the third-largest category with 26% (3.4 kg/ inh), which was initially at 35% in 2010. The smallest categories consist of Screens and Monitors (cat II) with 4% (0.5 kg/ inh), Small IT (Cat VI) with 4% (0.5 kg/inh), and Lamps (Cat III) with 0.4% (0.1 kg/inh). No shares were available for PV panels (Cat IV B) in 2010 or 2021, though in 2017, 2019, and 2020, the PV share was approximately 2% of the EEE POM.

Figure 19. Shares of the EEE POM in Bosnia and Herzegovina (BHAS, 2022)



Bosnia and Herzegovina has an industry for domestic production of EEE.

Bosnia and Herzegovina has a market for domestically produced EEE, but as shown in Figure 20, the amount decreased from 1.3 kg/inh (4.7 kt) in 2011 to 0.6 kg/inh (2.0 kt) in 2020. In 2020, the domestic production of EEE equated to 16% of the entire amount of EEE POM in the country.

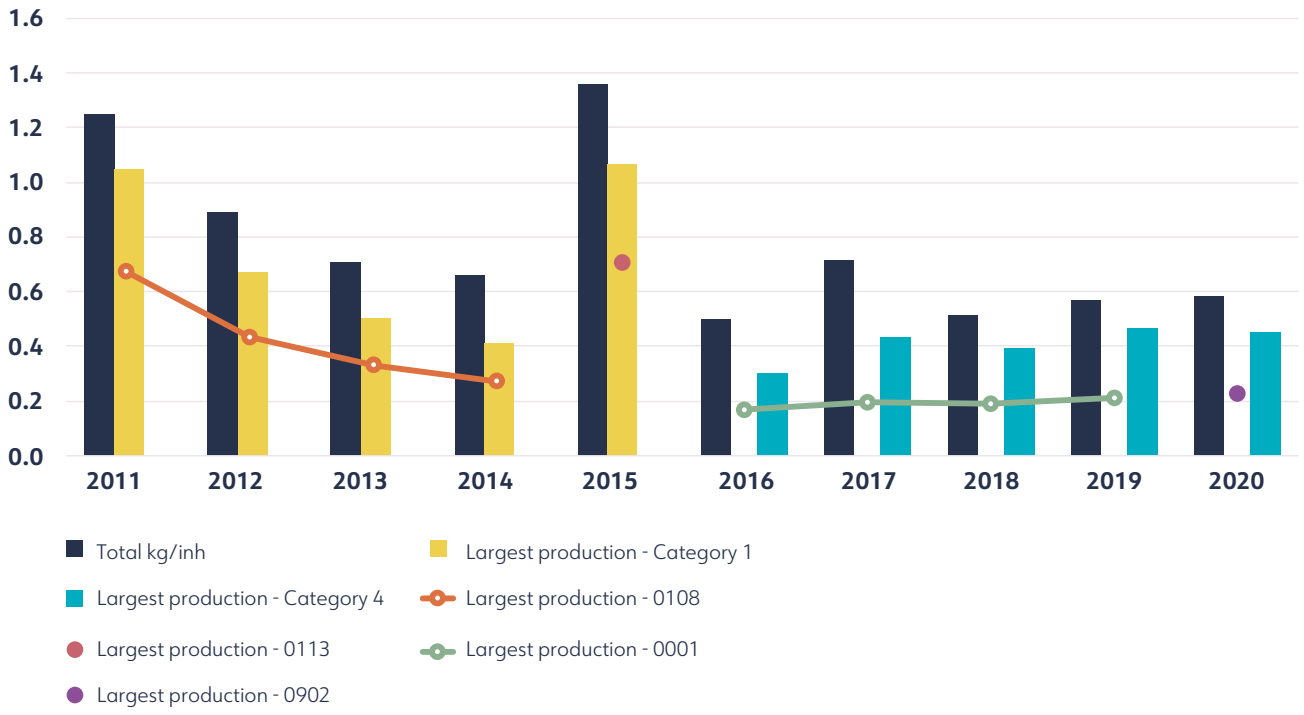
The four most produced EEE from 2011 to 2020 are products of Temperature Exchange Equipment (Cat I) and Large Equipment (Cat IV), which ranged from 0.2 to 0.7 kg/inh.

The largest production of both EEE categories and EEE products and the total production are illustrated in Figure 20. The largest production from 2011 to 2020 were for the following products:

- Central Heating (household-installed) (0001) (Cat IV)
- Fridges (incl. combi-fridges) (0108) (Cat I)
- Professional Cooling (e.g. large air conditioners, cooling displays) (0113) (Cat I)
- Professional Monitoring & Control (e.g. laboratory, control panels, and invertors) (0902) (Cat IV)

From 2011 to 2014, the largest production was for Fridges, with 0.3 kg/inh in 2014. In 2015, the largest production was for Professional Cooling Equipment, with 0.7 kg/inh. From 2016 to 2019, central heating was the largest, with a steady production of 0.2 kg/inh. Finally, the largest production in 2020 was found for Professional Monitoring & Control, with 0.2 kg/inh. The largest EEE production was in line with the greatest production of Temperature Exchange Equipment (Cat I), with approx. 0.7 kg/inh from 2010 to 2015. And the largest from 2016 to 2020 was for Large Equipment (Cat IV) with 0.45 kg/inh in 2020.

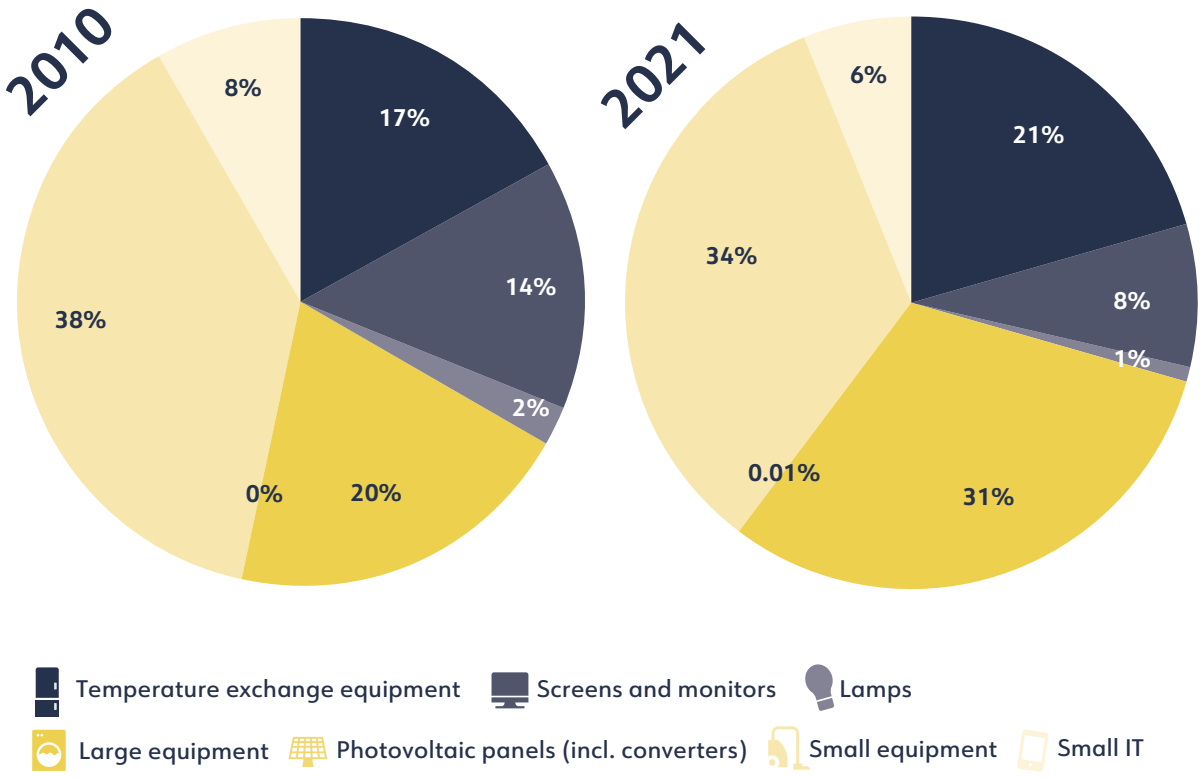
Figure 20. Domestic production of Bosnia and Herzegovina in kg/inh, including the largest UNU-KEY produced per year, largest category per year, and total (BHAS, 2022)



The E-waste generated shows a category share distribution for 2021, with Small Equipment as the largest category at 3.0 kg/inh and Lamps as the smallest category with 0.1 kg/inh.

The greatest share of e-waste generated is Small Equipment; in 2021, specifically, its share for was 34% (3.0 kg/inh). This is followed by Large Equipment at second largest, with 31% (2.8 kg/inh). The third largest share is for Temperature Exchange Equipment, with 21% (1.9 kg/inh) of e-waste generated. The fourth largest category is Screens and Monitors, with 8% (0.7 kg/inh). Small IT follows with 6% (0.5 kg/ inh) of generated e-waste (Figure 21). Lamps (Cat III) and PV (Cat VI B) are the smallest categories with 1% (0.1 kg/inh) and 0.01% (0.001 kg/inh) in 2021.

Figure 21. Shares of E-waste generated in Bosnia and Herzegovina (BHAS, 2022)



In 2021, 4.7 kt of e-waste was collected in FBiH, while the total amount of e-waste collected over the period 2014–2021 is 23.2 kt, partly from the two system operators and partly from public utility companies.

Data on e-waste formally collected for Bosnia and Herzegovina is incomplete and was provided by the Agency for Statistics of Bosnia and Herzegovina (BHAS), the Environmental Protection Fund of FBiH, and the two PROs active in the administrative region Federation, namely Zeos and Kim Tec. Zeos, the first PRO in FBiH and now an authorised e-waste management operator, reported collecting 1.1 kt of e-waste in 2014. Since Zeos started operations in 2013, it exceeded the collection milestone of 10 kt collection [40], with 10.02 kt of e-waste collected and disposed of [41] until 2019. As of August 2022, the total amount of e-waste collected by Zeos since 2013 is 18.9 kt[41]. Kim Tec, the other PRO of FBiH, started operations in 2014 and collected over 8 kt of e-waste over the period 2014–2021, with 2 additional kt in 2022. Based on reporting from BHAS, the total amount of e-waste collected by public utility companies, which collect municipal waste in the whole of Bosnia and Herzegovina, equals 0.24 kt from 2014 to 2021 [42][43]. In total, over the period 2014–2021, the amount of e-waste collected equals 23.2 kt, with 15.0 kt from Zeos, 8 kt from Kim Tec, and 0.2 kt from the public utility companies. It is important to point out that the operators' activity is expanded in relation to public utility companies, which collect municipal waste (competences and scope of work are defined for them by the Rulebook on Waste Management of Electrical and Electronic Products). This includes, for example, direct collection of e-waste from legal entities/companies. For this reason, the amount of e-waste collected as reported by the operators is higher than the ones related to public utility companies. The data on formally collected e-waste must be viewed as partial because data on formally collected e-waste from the other Bosnia and Herzegovina entity (the Republic of Srpska) and the Brčko District is unknown.

[41] https://zeos.ba/bs/35/awareness.

The collection rate for Bosnia and Herzegovina entity FBiH in 2021 is 16% of e-waste generated and is 11% of the average EEE POM in the three previous years.

For the reference year 2021, the total amount of e-waste collected, including data from the government as well as from the PROs, is 4.7 kt (1.4 kg/inh), equating to 16% of the e-waste generated, and is 11% of the average of EEE POM of the three previous years. The total annual amount of e-waste collected and the collection rate for Bosnia and Herzegovina entity FBiH is reported in Table 8.

Table 8. E-waste collected and collection rate in Bosnia and Herzegovina for 2014–2021

	2014	2015	2016	2017	2018	2019	2020	2021
E-waste collected (kt)	1.4	1.9	0.9	2.8	3.5	4.0	4.0	4.7
E-waste collected (kg/inh)	0.4	0.5	0.3	0.8	1.0	1.2	1.2	1.4
E-waste collection rate EEE POM (%)	4	6	3	8	9	10	10	11
E-waste collection rate WG (%)	6	8	4	11	13	14	14	16

A centralised and harmonised reporting system on e-waste formally collected is not currently available, so it is difficult to double-check whether there are any duplications in the data from the government and the PROs. Also, the total collection rates in Bosnia and Herzegovina are likely higher than the reported rates, but it is hard to know the exact amount [21], as estimations from the other administrative parts of Bosnia and Herzegovina – the Republic of Srpska and the territory of Brčko (district) – would be needed.

E-waste Management System

BiH entity FBiH has two PROs that are responsible for e-waste management.

There is a functional formal e-waste management system in place, and producer/importers are primarily responsible for e-waste management through two licensed PROs (in FBiH): Zeos Eko-sistem Ltd[42] and Kim Tec Eco Ltd[43]. The PROs provide collection facilities, while two small e-waste treatment companies process parts of e-waste before exporting recovered parts. Recently, the two e-waste PROs and the two PROs licensed to manage waste package materials in FBiH (Ekopak Sarajevo and Eko život Tuzla) formed an Association of System Operators in Bosnia and Herzegovina, whose aim is the improvement and development of a recycling system in FBiH [45].

[42] http://zeos.ba/.
[43] http://www.elektrootpad.ba/.

Consumers can dispose of e-waste in containers installed at collection points provided by the two PROs, hand it over to retail shops that have take-back obligations, or ask PROs for home pick-up collection for larger quantities of e-waste.

Citizens discard e-waste in installed e-waste containers at designated collection points, though there are relatively few such points and they are located only in urban areas. Individuals also hand e-waste over to the PROs. In 2019, Zeos received about 150 kg of individual handover of e-waste [46]. A project named *'Door-to-door collection'* provides citizens with a new free home e-waste collection service and is aimed at redirecting as much e-waste as possible to the recycling sector through the PROs. Organisations and businesses can contact the PROs and request for collection of larger quantities of e-waste; Zeos has had over 3,330 such requests in FBiH[44]. The PROs are also very active in creating awareness. The Environmental Fund is obliged to calculate the fees to be paid by producers/importers who did not join either of the 2 PROs (System Operators) on time for any given year. The Fund functions like a corrective measure, and the fees prescribed by the Fund are many times (even 10 times) higher than those charged by the System Operators. The two System Operators also work with some authorised collectors and recyclers (their clients) to treat the collected e-waste. For example, Zeos clients became part of the recycling network and possess waste management licenses issued by authorised ministries for handling e-waste pursuant to legal provisions [46].

Nine companies are licensed to treat e-waste in Bosnia and Herzegovina, and they take on manual dismantling, removal of hazardous parts, and valuable material recovery, with most recovered parts being exported.

In the territory of FBiH, the management of e-waste was reported through WMIS for 2021 by 17 companies, of which nine companies reported processing/recycling procedures and managing hazardous components, while the other nine companies performed collection. The two System Operators (PRO companies) do not manage e-waste directly and did report waste management through WMIS in 2021. However, Zeos and Kim Tec Eko, for instance, supervise and monitor the statistical data of e-waste inputs and outputs at authorised recyclers.

Some of the companies that treat e-waste in Bosnia and Herzegovina include Aida Commerce, Lucius d.o.o, Kemeko BH d.o.o., C.I.B.O.S. d.o.o., Harex d.o.o and SirovinePezić d.o.o. The e-waste types mainly treated are large and small household appliances (e.g. refrigeration appliances), IT equipment, and TV monitors. However, reliable data is not yet available on the recycling capacity of e-waste in the country. In the FBiH, there are some other smaller facilities that can process some e-waste parts. E-waste is managed primarily by manual dismantling (to varying degrees), hazardous part removal, and material recovery of valuable/profitable materials (metals, some types of plastics) and other actions necessary to complete the process. Such operations are steered by the manual effort of single dismantling

[44] https://zeos.ba/bs/22/pages/16/zasto-izabrati-zeos-eko-sistem.

operations and the material value of certain parts [26]. Some parts, because they have little value and exporting smaller quantities would be too expensive, are stored and accumulated before being exported. Hazardous components are exported mostly to EU countries, and there are several companies in Bosnia and Herzegovina that deal with the collection, treatment, and exporting of hazardous waste. Cooling appliances, bulbs, and CRTs from monitors are mostly exported for treatment after the first processing stage, due to the absence of appropriate treatment plants in Bosnia and Herzegovina[45]. E-waste not collected by the PROs is either managed by the informal sector, treated with other waste streams, or landfilled.

Bosnia and Herzegovina has two PROs and several companies that handle e-waste collection and treatment, while certain fractions including cooling appliances, bulbs, CRTs and hazardous components are mostly exported for treatment abroad.

Many producers and importers are registered with the PROs, but the existence of two PROs in Bosnia and Herzegovina with a small market is not an optimal solution, as it leads to high administrative costs for the PROs.

There is an obligation to pay a Waste Management Fee for EEE POM in Bosnia and Herzegovina territorial units on a semi-annual basis by producer/importers through the PROs. In addition to the stated fee, all importers, distributors, and producers are obliged to pay a general fee per kilogram of EEE POM (0.0016 KM/kg) to the Environmental Protection Fund of the FBiH for the administrative costs of implementing the e-waste regulations. The Fund has prepared the database of potential subjects to the rules (which contains approximately 4,500 companies) and receives the biannual reports submitted by the companies on the fulfilment of their obligation. In 2017, more than 350 companies were registered as subject to the fee. Non-compliant entities pay a (punitive) levy to the Environmental Protection Fund of the Federation, which is more than 10 times higher in the case of e-waste [47]. The existence of two independent PROs in a relatively small market in the country is not an optimal solution, as it leads to high administrative costs for the PROs. The non-availability of a clear framework for defining the responsibilities of different actors and how to finance the costs of separate collection, sorting, and treatment of e-waste is part of the challenges of EPR.

The informal sector exists in Bosnia and Herzegovina, and they sometimes dismantle e-waste and select valuable parts, which are then sold to dealers, while items of no value are disposed of at landfills.

A substantial proportion of e-waste is collected and treated in the informal sector, which is largely unregulated [26]. Studies have shown that waste pickers exist in practically all Bosnia and Herzegovinian towns, and the average number of waste pickers operating at major dumps on a daily basis reportedly ranges between 5 and 10 [40]. Significant quantities of recyclables are collected by informal individual collectors directly from the municipal waste containers or picked up at the landfills and then delivered to buy-back centres. The collection is focused on materials, where the revenues cover the collection and preparation costs – such as e-waste and metal scrap [40]. For e-waste, the informal operators use a door-to-door approach and cherry picking while their personal vehicles (of different types and mostly

[45] Kim Tec Eko - Export of hazardous waste to recycling (elektrootpad.ba).

of small capacities) are used for transporting materials, which are stored in their backyards for accumulation. They often dismantle e-waste and select valuable parts, which are then sold to dealers, while materials of no value are disposed of in landfills. Processing e-waste in backyards presents many environmental problems and poses a risk to the health of operators and their family members, as there are no measures to protect their health.

Some unstructured partnerships between the formal and informal operators exist, as the latter often delivers the collected waste to the formal sector, making it difficult to ascertain the actual quantities of e-waste handled in the formal and informal sectors.

A certain level of competition for accessing e-waste exists between the formal and informal operators, considering that the latter control a sizable amount of e-waste. However, there seems to be a sort of partnership between the formal and informal operators, as the formal recyclers buy e-waste and valuable materials from the informal operators. Oftentimes, the informal sector delivers the collected waste to the formal sector at some point. This makes it difficult to ascertain the actual quantities of e-waste handled in the formal and informal sectors. There is no official data on either the number of informal waste collectors in Bosnia and Herzegovina or the amount of e-waste they manage every year.

Surveys carried out in Bosnia and Herzegovina have assessed the EEE consumers' disposal attitude, which revealed that functional end-of-life devices are mostly reused.

From household survey results, 40% of devices no longer used in households are sold or handed over to waste traders, while about 25% are sold to companies or persons dealing with the trade of second-hand devices – which thus shows that they are intended for reuse as functional devices to other consumers [48].

Transboundary Movement of E-waste

The import of e-waste in Bosnia and Herzegovina is regulated by the Basel Convention, prohibiting the import of hazardous e-waste components into the country.

Bosnia and Herzegovina accessed the Basel Convention in June 2001[46] and is Party to the Rotterdam and Stockholm Conventions, but has not yet signed the Minamata Convention. Since signing to the conventions, an import ban of hazardous waste has been implemented [26]. Furthermore, according to the waste management legislation in the FBiH, RS, and BD, importation of waste into Bosnia and Herzegovina for the purpose of disposal is prohibited, but there is some flexibility for waste importing if it is imported for material or energy recovery, according to the national waste management legislation (Official Gazette of FBiH, No. 33/03 and 71/09) [40].

In Bosnia and Herzegovina, due to lack of recycling facilities, most recovered materials, including the hazardous parts, are exported abroad for processing.

Export of e-waste, however, happens at fluctuating amounts – especially for refrigerators that contain hydrofluorocarbon, chlorofluorocarbon, and hydrochlorofluorocarbon gases, neon bulbs, lead glass from CRTs, and other hazardous parts from e-waste. Zeos exports Freon and monitor/TVs screens (CRTs) for treatment abroad, e.g. to Austria and Germany [49]. The amount of e-waste exported from the two PROs, Zeos and Kim Tec, from 2014 to 2021 is reported in Table 9.

Table 9. Quantities of e-waste exported from Zeos and Kim Tec (PROs in Bosnia and Herzegovina) during the period 2014–2021

E-waste exported (t)	2014	2015	2016	2017	2018	2019	2020	2021
Refrigerators, freezers	63	84	20	180	48	13		
TV screens/ monitors					25			
Lamps		5	5		4	9		5

[46] http://www.mvteo.gov.ba/Map?lang=en.

The total quantity of e-waste exported from the start of Zeos's operation in 2014 to 2019 is 443 t (Zeos information), while Kim Tec exported a total of 19 tonnes between 2018 and 2021 (10 tonnes of refrigerators and 9 tonnes of lamps).

The e-waste exports reported by the Basel Convention from 2017 to 2019 are shown in Table 10. The e-waste exporting shows a decrease from 300 tonnes to 32 tonnes in 2019. It is likely that the reporting to the Basel Convention also includes the quantities of e-waste exported from the two PROs active in FBiH and possibly also from other Bosnia and Herzegovina territorial units. However, with the information available, it is not possible to know their respective share or to assess whether the reporting is complete. On behalf of the state of Bosnia and Herzegovina, the Federal Ministry of Environment and Tourism has been appointed to be the operational focal point for the Basel Convention. Since 2019, the state Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina has taken over that responsibility.

No import of e-waste was reported by the Basel Convention, so imports are not considered.

Table 10. E-waste export reported in the Basel Convention in tonnes of the available waste collection reports of Bosnia and Herzegovina

	2017	2018	2019	2020
Export for recycling (tonnes)	300	88.3	32.4	-

By analysing the average price of EEE from the trade statistics, it was estimated that 118 tonnes of printed circuit boards (PCB) were exported for recycling in 2019 (equal to 19% of the amount of PCB generated) [11]. It seems that this amount of exported PCBs is not reflected in the Basel Convention reporting.

The demand for UEEE is huge, and importers and distributors of new and used EEE are mandated to join a PRO and fulfil their legal obligation, while national reporting on import and export quantities is limited.

There is high demand for used EEE, especially large household appliances, which are mostly imported in trucks with other furniture. Many companies import UEEE, coded as 'furniture', and sell to end consumers. Importing of UEEE is not regulated, and there is significant demand and a sizable market in the country. So, the importing of UEEE is a relevant issue in Bosnia and Herzegovina because it cannot be tracked, due to the use of wrong or improper HS codes or declarations or no declarations at all. There is currently no monitoring of e-waste, and used EEE flows into Bosnia and Herzegovina. The existing system in Bosnia and Herzegovina recognises importers and distributors of both new and used EEE as obliged to join the e-waste management system. This means

that they fulfil their legal obligation by signing an agreement on the transfer of their obligations to a PRO and pay a certain fee in accordance with the EEE POM. There is a limit in records of the quantities of used EEE imported or exported from Bosnia and Herzegovina and the status of such equipment and if they are disposed of using sound waste management practices [48]. According to the *Global Transboundary E-waste Flows Monitor*, exports and imports for reuse of used equipment in 2019 were 1.5 kt (0.4 kg/inh) of UEEE exported and 5.6 kt (1.7 kg/inh) imported [11].

National data on EEE lifespans is not available, while the use of the same HS code for new EEE and used EEE affects proper documentation and generation of reliable data.

For international and regional comparability, the common methodology and tools for calculating the mass of EEE POM and e-waste generated developed by UNITAR-SCYCLE were used by BHAS, including the correlation between the UNU-KEYs with the codes for EEE exporting/importing. Since new EEE and used EEE are mostly imported in the country using the same HS code, it is difficult to distinguish data for new and used equipment, which leads to documentation issues and affects the generation of reliable data and evaluation of EEE lifespans.

Campaigns for E-waste Collection and Recycling

There are projects and initiatives for creating awareness on e-waste by NGOs and the PROs. Zeos have several awareness projects [46], including (i) 'Green revolution' for schools (more than 200 schools and over 100,000 children educated on collecting e-waste), (ii) 'Collecting e-waste door to door' for consumers to send e-waste over by Express post, (iii) 'Ecology', which focuses on changing citizens' attitudes toward disposal of e-waste and is also used to take back e-waste especially from households, and (iv) '*Where I buy, there I recycle*' in partnership with some EEE retail shops [14]. Kim Tec have similar projects, including a partnership to launch the action '*Taking care of the environment starts from us!*' to raise awareness on the dangers of e-waste and its proper disposal[47]. Though the Fund does not collect fees for e-waste management, it co-finances, through its activities, the construction of infrastructure for the management of special categories of waste, including e-waste (e.g. the 'Cathode Pipe Separator' for treatment of CRTs).

FBiH recognises a lack of knowledge (e.g. on waste codes, R or D procedures, etc.) as a challenge in the e-waste sector, especially among collectors and recyclers. As such, the Fund is putting an emphasis on educating all those obliged to report on e-waste collection and recycling in 2023. The training is planned for the more than 400 persons obliged to report and make the necessary adjustments on reports based on the needs of the Agency for Statistics, which is then required to report to Eurostat.

[47] Kim Tec Eko - Info (elektrootpad.ba).

Stakeholder Mapping

Stakeholder	Responsibility
Ministry of Foreign Trade and Economic Relationships	Defines policy and coordinates activities and harmonisation of plans in the fields of environmental protection, use of natural resources, and waste management.
Ministry of Environment and Tourism FBiH	Responsible for ecological protection and monitoring and control of air, water, and land; develops environmental strategies and policies and waste management standards.
Ministry of Spatial Planning, Construction and Ecology	The Ministry manages integrated protection of environmental quality and its enhancement through research, management, and safeguards planning; protection of public interest assets, natural resources, natural and cultural heritage.
Environmental Protection and Energy Efficiency Fund of the Republic of Srpska	Responsible for fundraising and financing the preparation, implementation, and development of programs, projects, and similar activities in the field of conservation, sustainable use, protection, and improvement of the environment, as well as in the field of energy efficiency and use of renewable energy sources.
Agency for Statistics of Bosnia and Herzegovina	Performs tasks of collecting, processing, analysing, and disseminating statistical data for the country. The agency provides reliable, high-quality, understandable, timely, and internationally comparable statistical data that meet needs of decision-makers, researchers, etc.
Environmental Protection Fund	Established to ensure additional funds for financing programs and projects relating to protection and improvement of the environment. They are responsible for collecting data on the placement of EEE on market, as well as data on the movement of e-waste. The Fund is also responsible for the establishment and management of the WMIS of FBiH. The same task is given to the Environmental Fund of the Republic of Srpska.
ZEOSEko-sistem	The first e-waste PRO in Bosnia and Herzegovina. It has 256 system payers, 27 collectors, 225 storage locations, and 218,829 awareness programme participants. Zeos is now an authorised operator for e-waste management[48].
Kim Tec Eko d.o.o.	Kim Tec is a PRO that works with about 59 importers and distributors, about 20 collectors, and processors, including a specific 'Cathode Pipe Separator' for treatment of CRTs, and with several licensed exporters. The project is supported by the Federal Environmental Fund as well as E Recycling (E Reciklaža) from neighboring Serbia (with expertise in the area).
Aida Commerce	Collects and recycles e-waste and secondary raw materials (aluminum, copper, batteries, plastics, etc.). Aida has a modern recycling yard, 'Eco world-Eco World', within which recycling of e-waste is carried out through institutional incentives[49]. They also handle disposal of hazardous waste (incl. medical waste).
LUCIUS d.o.o.	Provides dismantling and recycling services, with emphasis on e-waste. The company owns recycling machines and facilities for motherboards, cables, electric motors, etc.
KEMEKO-BH d.o.o.	The company deals with the collection, storage, and disposal of hazardous waste, including used tires, electronic and electrical waste, waste freon, and other hazardous gases, PCB capacitors and transformers, batteries, etc.
C.I.B.O.S. d.o.o.	C.I.B.O.S. is the largest company in the field of metal waste recycling in Bosnia and Herzegovina. The company purchases all secondary raw materials, including e-waste, and also sets up street containers for e-waste.
RREUSE	A network of social enterprises active in reuse, repair, and recycling. They collect and redistribute 24 material streams, including textiles, electronics, and furniture, and operate second-hand retail outlets, etc.

[48] https://www.fena.news/bih/bih-disposes-more-than-7-5-tons-of-e-waste-in-six-years-video/.
[49] https://www.scrapmonster.com/company/aida-commerce-doo/126594.

Country:

Montenegro

628,000 inhabitants in 2021
13,450 km²
GDP per capita PPP: $9,367 USD in 2021
Average household size: 3.29 members in 2018

Produced by United Nations Geospatial

National legislation on e-waste:

Extended Producer Responsibility: Introduced in 2011, but the system is not established
National Standards: Introduced in the Decree on WEEE (OG Montenegro, 24/12)
E-waste Collection Target: Transposed 2015 targets of EU WEEE Directive (to be achieved by 2020; now expired)
Products Coverage: Everything that complies with the EU Directive EU-10 categories (not yet compliant with the EU-6)

International Conventions:

	Signature	Ratification/Accession	Entry into force
Basel Convention		23/10/2006	03/06/2006
Rotterdam Convention		30/12/2011	29/03/2012
Stockholm Convention	23/10/2006	31/03/2011	29/06/2011
Minamata Convention	24/09/2014	10/06/2019	08/09/2019

EEE POM (2021):	E-waste generated (2021):	E-waste formally collected (2015):	E-waste import/ export (2019):
9.4 kt **15.0 kg/inh**	**7.1 kt** **11.3 kg/inh**	**0.2 kt** **0.2 kg/inh**	**For reuse** **Import: 0.03 kt** **Export: 0.4 kt** **For recycling** **Export: 0.4 kt**

(Source: UNITAR/UNECE 2015)

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

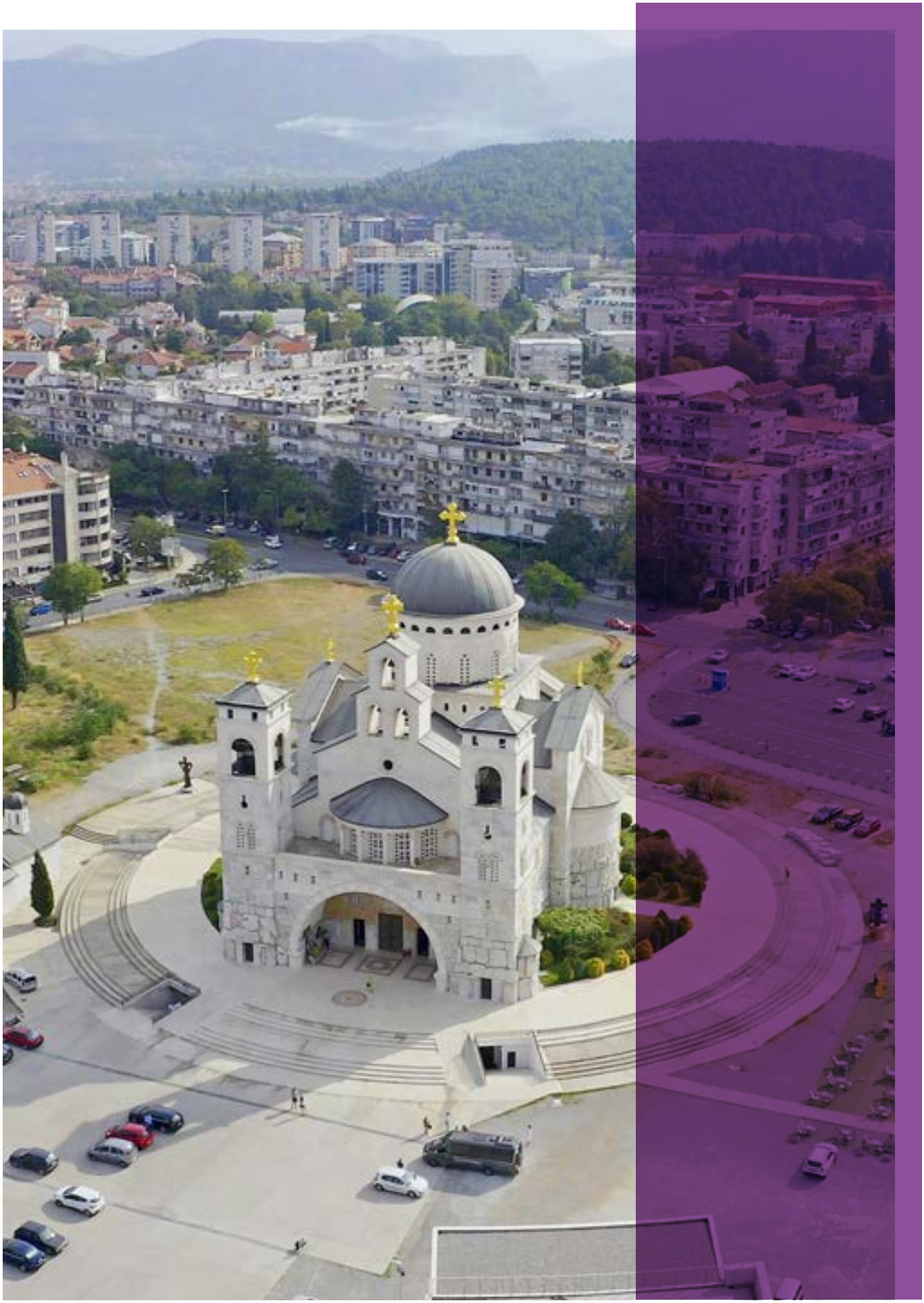
Separate collection infrastructure for e-waste is lacking
2 treatment facilities for e-waste

E-waste Management Matrix

A advanced | B in transition | C basic
(more information on the assessment system can be found in chapter 2 and 6)

E-waste Collection Rate

(collection rate refers to 2015 data)



National E-waste Legislation

Montenegro has e-waste-specific legislation that transposed only part of the old EU WEEE Directive, while alignment with the new EU WEEE Directive and the RoHS is in process.

The legal framework for waste management in Montenegro consists of the following:

- Law on Waste Management (Official Gazette of Montenegro, No. 64/11 of 29 December 2011, and 39/16 of 29 June 2016)
- Decree on the Method and Procedure for Notification of Placing Electrical and Electronic Products on the Market, Establishing the System of Acquisition, Collection, and Treatment of Waste from Electrical and Electronic Products and Operation of the System (Official Gazette of Montenegro, No. 09/10).

The Law on Waste Management provides the basis for EPR, while a detailed definition of best practices for the acquisition, collection, and treatment of e-waste is contained in the Decree on WEEE (Official Gazette of Montenegro, No. 09/10) [50]. The Secondary Acts includes:

- Decree on the Manner and Procedure for the Establishment of the System of Taking, Collecting, and Treating Waste from Electrical and Electronic Products and on its Operation (Official Gazette of Montenegro, No. 24/12).
- Decree on Detailed Criteria, Amount, and Manner of Payment of Special Fees for Waste Management (Official Gazette of Montenegro, No. 39/12).

The EU Directive 2012/19/EU on WEEE is partially transposed by the Law on Waste Management and the Decree on WEEE (Official Gazette of Montenegro, No. 24/12), while the Directive on the RoHS has not yet been transposed [50]. According to Montenegro, the remaining provisions of the EU Directive 2012/19/EU will be transposed by amending the Decree on WEEE (Official Gazette of Montenegro, No. 24/12) and by adopting a new regulation on the limit values of hazardous substances in EEE and amending the Law on Waste Management [50]. The adoption of a new Law on Waste Management was scheduled for the second quarter of 2023, and a new Decree on e-waste will be drafted based on the law. Similarly, the document 'Program of Accession of Montenegro to the European Union' should lead to the drafting of a new Decree on EE waste for the fourth quarter of 2023.

An EPR legislation is in place (that covers all categories of the EU WEEE Directive), but the system has not been established, due to obstacles encountered in the collecting of fees.

The Extended Producer Responsibility has been in place since 2011, and the obligation of EPR has been provided for by the Law of Waste Management,

but the system has not yet been established. The Law on Waste Management introduced EPR for packaging, e-waste, batteries and accumulators, vehicles, tires, and motor oils. Producers and manufacturers who place these products on the Montenegrin market are obliged to pay a fee to the central government in accordance with the requirements set out in the Decree on Payment of Special Fees for Waste Management (Official Gazette of Montenegro, No. 39/12). The funds form part of Montenegro's central budget and are used to fund systems to collect, manage, and process e-waste and other special waste streams [50]. According to the Ministry of Ecology, Spatial Planning, and Urbanism, one of the reasons that EPR was not properly implemented previously is because of the way the collecting of fees was set up. The idea was to collect the EPR fees directly from customs on the arrival of the goods in the country, but since product and waste codes don't match, the system never worked. It is expected that in the new Law on Waste Management, this responsibility, and fees collection will be organised by PROs [51].

A new law is expected to implement EPR between 2022 and 2024, as Montenegro identified 2020 as a target for setting up a system for separate collection of e-waste and full implementation of the WEEE Directive, though the goal was not achieved.

Montenegro identified 2020 as a date for setting up a system for separate collection of e-waste and the full implementation of the WEEE Directive [50], but the goal was not achieved. A new Law on Waste Management was anticipated to be adopted in 2021, and an EPR scheme was anticipated to be implemented between 2022 and 2024 [51]. These goals were not achieved, though, and the new law is now expected to be adopted by the end of the second quarter of 2023. Consequently, all planned activities have been postponed due to the non-adoption of the new Law on Waste Management, so these activities are now planned for 2024. When implemented, the Inspection Directorate, through the Market Inspection Authority, would be responsible for checking whether the producers and importers are registered in the EPR scheme and for monitoring the implementation of their waste management plans. As well, the Inspection Directorate is responsible for verifying the existence of labels for the mandatory separate collection of waste generated from products for which an EPR is prescribed. However, information is not currently available on the existence and number of PROs or individual take-back schemes and their performance/activities [26].

Though legislated, EPR was not properly implemented in Montenegro because the EPR fee was structured to be collected directly from customs on the arrival of the goods in the country, but this process did not work and it is expected to be corrected by a new upcoming law.

The National Waste Management Plan focused on the establishment of EPR schemes and on a mobile waste collection system for special waste streams, but no financing mechanism is in place. A new State Plan that could resolve the issue is now underway.

The revised National Waste Management Plan of Montenegro 2015–2020 adopted economic instruments with incentives and penalties to promote waste separation and recovery, the construction of recycling centres and sorting plants, the elimination of illegal dumping of waste, and the rehabilitation of

old landfills [52]. The overall objectives of the National Waste Management Plan were to establish a sustainable waste management system and ensure its continuous improvement. Some of the key objectives include the treatment of recyclable materials as resources, the establishment of EPR schemes, and the introduction of a mobile waste collection system for special waste streams. The basic objective of the National Waste Management Plan for all types of waste was the establishment of a well-organised collection, temporary storage, and transfer of waste to authorised recyclers [50], though no financing mechanisms are yet in place. The adoption of a new State Plan is underway, within which issues related to e-waste will be developed further.

Though there are challenges, the outlook for Montenegro is promising, as the National Strategy for Sustainable Development by 2030 has fully transposed the UN Agenda 2030 and recognised the importance of the transition to a circular economy.

Amendments to the 2015–2020 National Waste Management Plan were adopted in May 2018, but the details of the country's waste management model and the modalities of its implementation remain unclear [51]. According to the Ministry of Ecology, Spatial Planning, and Urbanism, the adoption of the new National Waste Management Plan was planned for the end of 2022 and will, in accordance with the Law on Waste Management, be valid for a period of at least five years [51]. Other planning and strategy documents that are of great importance for waste management in Montenegro include the National Waste Management Policy of 2004 and the Strategic Master Plan for Waste Management of 2005 [50]. The outlook in moving toward a circular economy in Montenegro is positive, as relevant laws and policies are in place. The National Strategy for Sustainable Development by 2030, which fully transposes the UN Agenda 2030, recognised the importance of the transition to a circular economy. One of the main goals of this strategic document is to 'improve waste management by applying circular economy-based approaches' [53].

Montenegro is slowly transiting towards a circular economy with plans to improve waste management including an ambitious target of collecting 65% by weight of EEE POM in the three preceding years.

Montenegro transposed the 2015 targets of the WEEE Directive to be achieved by 2020, but the targets have expired.

The targets that have been set for e-waste are in the Decree on WEEE (Official Gazette of Montenegro, No. 24/12). Montenegro has transposed the 2015 targets from the WEEE Directive to be achieved by 2020, but they are now expired. The country still needs to transpose the 2018 targets that are set out in the EU WEEE Directive [26] – i.e. the targets based on collecting 65% of the average weight of EEE POM in the three preceding years [50]. This is anticipated to be achieved in 2024 as part of the goals related to e-waste, which should align with the objectives of the Montenegro Accession Program to the European Union.

The national standards for improving e-waste management are provided for in the e-waste law.

There is an environmental e-waste standard in the Decree on WEEE (Official Gazette of Montenegro, No. 24/12). Based on the Decree, recycling plants are obliged to prepare an Environmental Assessment Study for potential installations.

Waste data is collected through the Statistical Office of Montenegro, but data on municipal waste in Montenegro is unreliable and inconsistent because formal collection services do not cover the entire population.

Montenegro implemented the EU waste classification system, and industries report their generated industrial waste to the Statistical Office of Montenegro [54]. The Statistical Office of Montenegro collects and processes data on waste and handles reporting to Eurostat. Data must be recorded and reported to the Environmental Protection Agency of Montenegro by licensed waste management companies [50]. However, data on municipal waste in Montenegro is unreliable and inconsistent because formal collection services for waste have yet to reach some households (11% or so of the total population), thereby exacerbating the problem of improper disposal, limited separate collection of waste, capacity gaps in terms of both resourcing and technical competence, absence of appropriate incentives, enforcement of legislation, etc. This is not an issue only for e-waste but also for waste reporting in general. These data-related shortfalls are recognised in the National Waste Management Plan (2015-2020) [50].

National E-waste Statistics

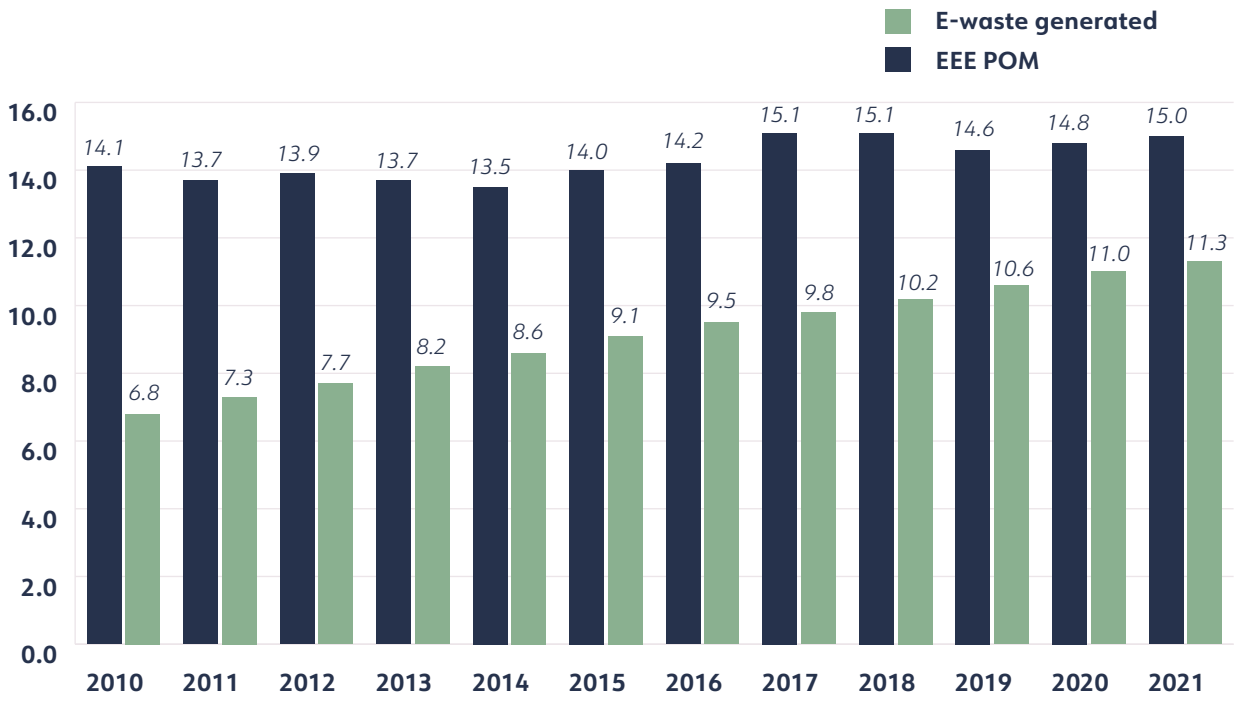
Statistics on industrial waste generation are collected and processed but are partly based on estimates, so no reliable data is available on e-waste generation and management.

Reliable data on e-waste is not available. The Statistical Office of Montenegro collects and processes statistics on industrial waste generation and management, though data-gathering tends to focus on the amount of (general) waste generated, exported, imported, or transferred through the territory of Montenegro. Municipalities report data on municipal waste management to the Statistical Office of Montenegro that are partly based on estimates that could be inaccurate due to inadequate weighing and registration procedures [52]. As well, data on e-waste generation, collection, and treatment is scarce. Since no official statistics on EEE POM and e-waste generated were retrieved from authorities, UNITAR internal data has been used to estimate the main e-waste statistics indicators for Montenegro.

EEE POM fluctuated from 14.1 kg/inh in 2010 to 15.0 kg/inh in 2021, while the e-waste generated gradually increased from 6.8 kg/inh in 2010 to 11.3 kg/inh in 2021.

EEE POM and e-waste generated of Montenegro from 2010 to 2021 are shown in Figure 22. The EEE POM slightly fluctuated and decreased from 14.1 kg/inh in 2010 to 13.5 kg/inh in 2014. It then increased from 2015 to 15.1 kg in 2017 and stabilised at 15.1 kg in 2018. The EEE POM then decreased to 15.0 kg/inh in 2021. By contrast, the e-waste generated steadily increased from 6.8 kg/inh in 2010 to 11.3 kg/inh in 2021.

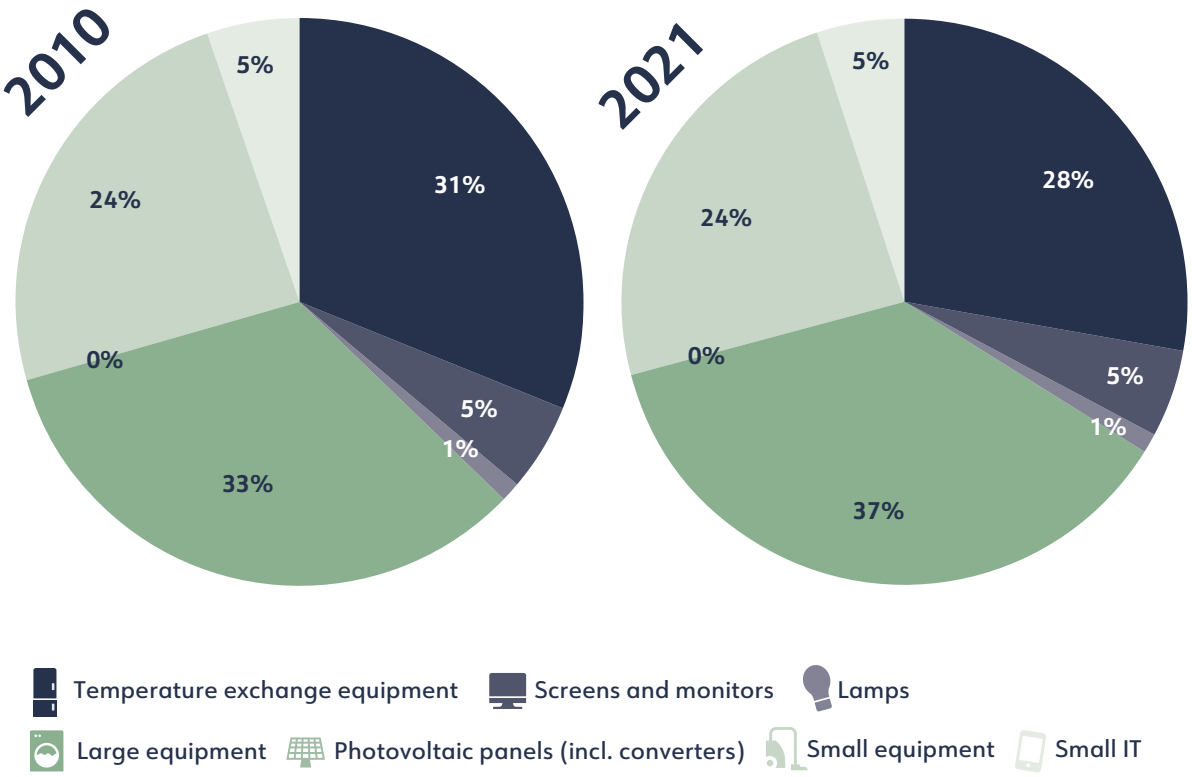
Figure 22. EEE POM and e-waste generated in Montenegro per kg/inh



Large Equipment has the largest share of EEE POM in 2010 and 2021, and Lamps have the smallest share, while no PV panels were POM in 2010 and 2021.

Figure 23 illustrates the EEE POM shares of 2010 and 2021. The largest share in 2020 is shown for Large Equipment (Cat IV A) with 37% (5.5 kg/inh) in 2020, which increased from 33% (4.7 kg/inh) in 2010. Temperature Exchange Equipment (Cat I) is the second-largest with 28% (4.1 kg/inh) in 2021. Small Equipment (Cat V) is the third-largest with 24% (3.6 kg/inh). Screens and Monitors (Cat II) is at 5% (0.8 kg/ inh). Small IT (Cat VI) then follows with 5% (0.7 kg/inh). Lamps (Cat III) are the smallest, with 1% (0.2 kg/inh). PV panels (Cat IV B) were POM in 2020 at 0.5% (0.1 kg/inh) and were not installed in 2021 or from 2010 to 2019.

Figure 23. EEE POM shares of 2010 and 2021



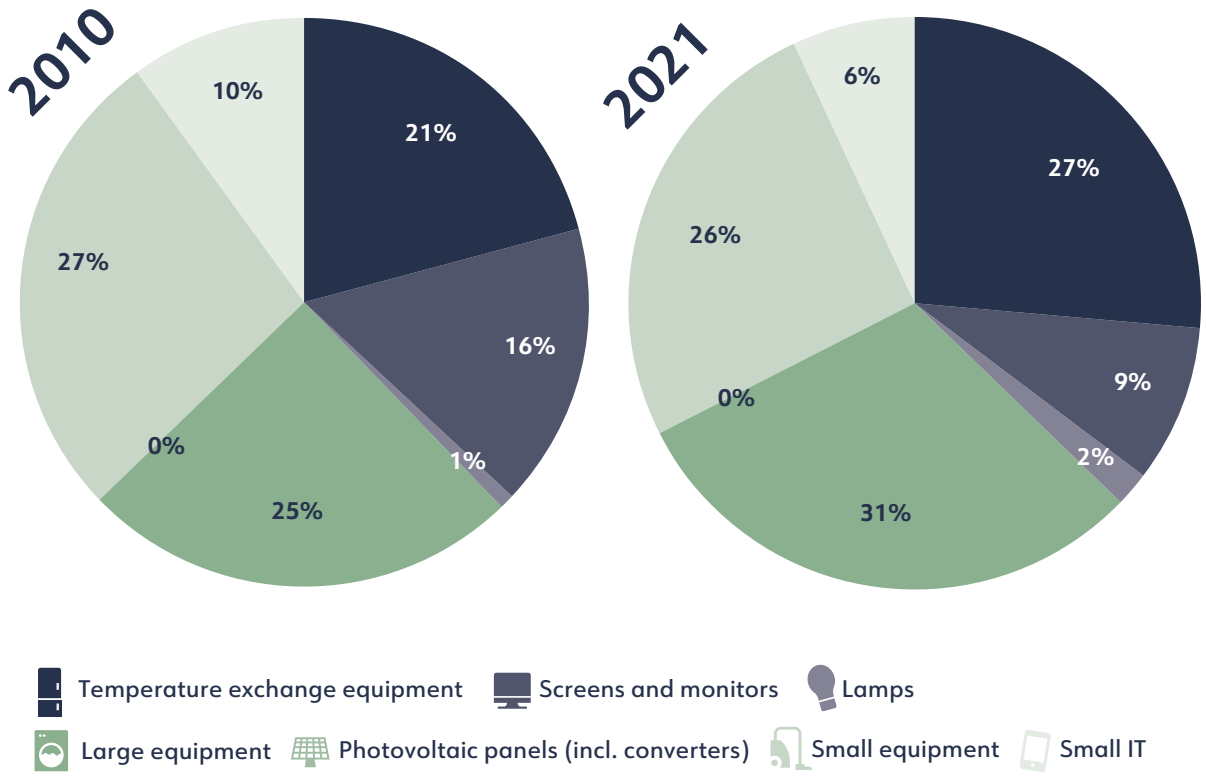
No EEE production statistics are available.

There are no reported production statistics available for EEE in Montenegro, as the country does not have EEE production facilities.

Of the e-waste generated shares, Large Equipment has the largest share of 31% in 2021, while Lamps have the smallest share of 2%, and no PV panels were reported from 2010 to 2021.

The e-waste generated shares are shown in Figure 24. Large Equipment (Cat IV) has the largest share with 31% (3.5 kg/inh) in 2021, which increased from 25% (1.7 kg/inh) in 2010. The second- and third-largest are Temperature Exchange Equipment and Small Equipment, with 27% (3.04 kg/inh) and 26% (2.9 kg/inh). Screens and Monitors (Cat II) follow, with 9% (1.0 kg/inh), and then Small IT (Cat VI) with 7% (0.8 kg/inh). The final category is Lamps (Cat III), with 2% (0.2 kg/inh). No PV panels were reported in the e-waste generated from 2010 to 2021.

Figure 24. E-waste generated shares of Montenegro in 2010 and 2021



Data on e-waste collected is limited and far from the targets that were prescribed by the legislation.

The only recorded amount of e-waste collected is by an NGO, Green Heart, in cooperation with Hemosan when they launched the action '*collecting the EE waste*' in 2015. Within this initiative, a total of 150 t (0.2 kg/inh) of e-waste was collected and exported[50][51], [31]. The country obviously did not meet the targets prescribed by the legislation by 2020, as it does not currently have the infrastructure capacity to reach the targets.

[50] Recycling materials | Each can counts (svakalimenkaseracuna.me).
[51] www.reciklirajte.me.

E-waste compositions of mixed municipal waste, showing an amount of 0.3 kt (0.4 kg/inh) related to e-waste in 2021, are available.

Aside from that, municipal composition statistics of e-waste are available up to 2021. The reported e-waste composition of the Statistical office is reported in tonnes, and the reported data of 2016 to 2021 is shown in Table 11[52]. According to the Statistical Office, approximately 0.3 kt (0.4 kg/inh) of Montenegrin municipal waste was composed of e-waste in 2021. This is likely to be disposed of with other municipal waste, whether landfilled or incinerated.

Table 11. Municipal waste composition of e-waste in Montenegro

	2016	2017	2018	2019	2020	2021
E-waste in municipal waste (t)	141	85	250	197	144	254
E-waste in municipal waste (kg/inh)	0.22	0.13	0.40	0.31	0.23	0.40

E-waste Management System

EPR is not established, though it has been legislated; so, e-waste is not separately collected, resulting in mixed waste being sent to landfills.

There is no functional EPR system for the collection and treatment of e-waste in practice [26]. The EPR, as presently structured, mandates producers/importers (for all EEE types according to the EU WEEE Directive) to pay a Special Waste Management Fee (e.g. EUR 140 per tonne for IT and computer equipment POM – Regulation 39/12) to the central government and to report quarterly on the volumes of EEE POM and on e-waste collected and treated to the Environmental Protection Agency of Montenegro. The fee accrues to the state budget and is used to fund systems to collect, manage, and process e-waste streams [55]. However, this system is not functional. E-waste is not separately collected, resulting in mixed waste being sent to landfills, due to the lack of sorting facilities.

The Government reserves the right to delegate private or public utility companies to collect and treat e-waste through the Concession Act, but there is no evidence of concessional e-waste management.

In Montenegro, public utility companies are responsible for communal services such as the collection, transfer, and disposal of municipal waste. For waste collection, they use several approaches such as door-to-door collections (for low-rise properties) and communal collection points (for collection from flats or multi-occupancy dwellings). However, for e-waste and other special waste and according to the Law on Waste Management, the Government (through

[52] Retrieved from Table 7 (Composition of generated waste 2011-2021) of the national Waste statistics data.

the Concessionary Act) reserves the right to delegate public utility companies or enterprises that are engaged in waste treatment activities to handle the collection activities [26]. This system is not operational, though, as there is no evidence of concessions facilitating e-waste collection and management, as the Concession Act was abandoned over time. As a result, there is not yet any organised e-waste management system in Montenegro.

The e-waste treatment companies pre-treat e-waste after manual dismantling and mostly export the waste abroad for end processing, and they have access to e-waste mostly through contracts with big companies and in partnership with NGOs, or through door-to-door dealers.

Montenegro is yet to establish a separate formal e-waste collection and recycling system while in the interim NGOs periodically launch e-waste collection initiatives.

In Montenegro, there are no formal specific e-waste collection points or services in place, no collective handlers (PROs), and no private collection initiatives dedicated to e-waste [26]. E-waste is handled by two private companies (Hemosan and Montepel) that pre-treat e-waste after manual dismantling. Most recovered parts (including hazardous components) – besides some metal parts, which are further processed in Montenegro's steel factory – are exported, [51], as there are no domestic facilities for their safe treatment or disposal, due to the low collected amounts. The majority of e-waste generated in Montenegro is handled by the door-to-door dealers and cherry pickers, who either sell the waste to private companies domestically or export it. These companies are also active in the collection and treatment of other waste types. The annual e-waste recycling capacity in the country is 4 kt (as estimated by the Government). NGOs play an important role in waste management in Montenegro[53], and they periodically launch e-waste collection initiatives. Kerbside collection is in place in some areas (e.g. Gusinje) with a plan to improve it by switching from a single-bin system to a five-bin one by the end of 2022 [56]. Big establishments have signed an agreement with Hemosan on the collection of e-waste upon request, free of charge[54]. Some retailers receive end-of-life mobile phones (e.g. 'Telenor') and send collected items to a branch office in Podgorica[55]. However, a separate e-waste collection and recycling system has still not been organically implemented.

The informal e-waste sector is very active and operate informal collection points while focusing and selecting only on the valuable parts, while non-valuable parts are discarded.

There is widespread collection of e-waste by the informal sector, comprised mostly of door-to-door dealers and cherry pickers. As well, households frequently sell end-of-life products that have a net scrap value to scrap metal merchants [26]. Most of the people working in the informal waste sector are disadvantaged individuals, among whom people from the Romani community are the majority [51]. They focus on and select only the valuable parts, while the non-valuable parts are disposed of. They have informal collection points but no informal recycling facilities. There is some form of partnership between the formal and informal sector, such that the informal collectors often hand over the e-waste to the two formal treatment companies, and this also

[53] About Us - Zero Waste Montenegro. [54] https://issuu.com/regionalnivodovod/docs/vode_5_engleski/s/11500732PRIMORJE" BUDVA AND "HEMOSAN" D.O.O. ON THE COLLECTION OF ELECTRONIC AND ELECTRICAL WASTE - Issuu. [55] https://yrecompetition.exposure.co/montenegro-37.

facilitates training on the proper handling of e-waste for informal operators. There are concerns that some treatment (e.g. dismantling) of e-waste may be undertaken by the informal sector at unlicensed facilities (e.g. in backyards). Organising and integrating the informal network into manufacturing value chains could play a crucial role in transitioning manufacturing to a more circular model in Montenegro and reducing dependence on imports of virgin materials [57].

There is high demand for used EEE from consumers, while the Government is implementing strategies for raising awareness on separate collection of waste.

There is a high demand for used EEE in Montenegro, depending on a consumer's economic level. Low-income consumers prefer to buy used EEE because they are cheaper. A verbal survey conducted by Zero Waste Montenegro focused on analysing the perception of waste showed that nearly all (98.6%) of the sampled population believe a community should strive for important goals like recycling and waste reduction. The results also showed that 50.7% of the respondents were interested in buying second-hand items, such as electronics, that were previously donated and repaired at local reuse centres. Most respondents (96.5%) also said they would donate old items they no longer need, showing good potential and appetite for more waste prevention policies locally [56]. Additionally, Montenegro is introducing strategies for increasing the population's willingness to participate in separate collection of waste [52].

The informal sector is very active on e-waste collection in Montenegro and some partnership facilitates their hand over of e-waste to formal operators while they in return get trained on the proper handling of e-waste.

Transboundary Movement of E-waste

Montenegro regulates e-waste transboundary movements through the Basel Convention, which has been in force since 2006.

Montenegro has been Party to the Basel Convention since 2006 and to the Rotterdam Conventions since 2012. The Stockholm and Minamata Conventions were also ratified in 2011 and 2019, respectively, but have not been put into force. Since signing to the conventions, regulations for the transboundary movements of hazardous waste were put into place.

In addition to the Basel Convention, Montenegro also has a ban on the importation of hazardous waste and e-waste provided by the legislation, but no illegal imports or exports are reported.

There is a ban on the importation of hazardous waste in Montenegro, according to the Law on Waste Management [26], more specifically for discarding and as fuel or for generation of energy. The import of equipment containing polychlorinated biphenyls is also prohibited. Furthermore, the import, export, and transit of waste can be carried out only with a license, which, at the request of the waste management company, is issued by the Environmental Protection Agency of Montenegro (in line with the Official

Gazette of Montenegro, No. 71/10). Licensing of waste management and transboundary movement of waste and permits for the treatment and/or disposal of waste are the responsibilities of the Licensing Department. According to what is reported by the government, there are no illegal imports or exports happening in the country.

Most of the small amount of e-waste collected and pre-processed in Montenegro, including most e-scrap, is exported abroad for resource recovery and recycling.

There is no legislation or policy banning e-waste exports, so legal exporting of e-waste for treatment abroad is happening, due to lack of proper infrastructure in the country. Most e-waste collected in the country is exported, including the e-waste collected by an NGO, Green Heart, in cooperation with the e-waste recyclers, Hemosan and Montepel. The National Waste Management Plan contains data on the generation and exportation of industrial wastes by European Waste Code for 2013. The data amounted to approximately 0.13 kt of e-waste collected and 0.1 kt of e-waste components exported in 2013 [26]. Around 600 t of hazardous waste from EEE were collected, prepared for recycling, and exported in 2021 (additional information are in the 'Report on the implementation of the National Waste Management Plan'). According to the Basel Convention, 400 t of PCB waste were exported in 2019. Apart from this, no e-waste import/export data is available in the Basel Convention reports.

There is a market for used EEE in Montenegro, with the Law on Waste Management recognising dealers in used EEE as 'producers' under the EPR scheme.

In Montenegro, consumer demands for UEEE created a thriving market for used-EEE. In fact, the new waste management law recognises any company or entrepreneur that engages in the production, improvement, processing, sale, or import of products (new, used, repaired, or remanufactured) that become waste after use as a 'producer' in the extended producer responsibility regime. According to the available data, exports and imports of used equipment for reuse corresponded to 0.4 kt (0.6 kg/inh) of UEEE exported and 0.03 kt (0.05 kg/inh) imported in 2019 [11].

Campaigns for E-waste Collection and Recycling

There are some projects and national initiatives on e-waste. The NGO Green Heart, in cooperation with the company Hemosan, launched the action '*collecting the EE waste*' in 2015. Within this initiative, a total of 150 t of e-waste were collected and exported[56]. Zero Waste Montenegro and other NGOs are active in awareness-raising to reduce waste production and increase reuse and recycling of discarded materials[57] [31]. At the regional level, the EU is funding a program for cross-border cooperation between Montenegro and Albania titled '*Montenegro and Albania towards Zero Waste*' [56]. The Municipality of Bijelo Polje, with the support of the Ministry of Sustainable Development and Tourism, has approached the European Bank for Reconstruction and Development with a request to assess the possibility of financing the building of a landfill and the modernisation of the solid waste management system, including a facility for storing and dismantling e-waste. The proposed e-waste facility is specially designed for sorting, processing, dismantling, and the temporary storage of e-waste and its parts after dismantling[58].

[56] http://www.svakalimenkaseracuna.me/materijali-za-reciklazu.
[56] https://zerowasteeurope.eu/member/zero-waste-montenegro/.
[56] www.ebrd.comhttps://www.ebrd.com/documents/procurement/76670-tor.pdf?blobnocache=true.

Stakeholder Mapping

Stakeholder	Responsibility
Ministry of Ecology, Spatial Planning and Urbanism	The custodian of natural resources, biodiversity, and space of Montenegro. They specialise in environmental protection and care for clean air, water, land, and climate change.
The Environmental Protection Agency of Montenegro	The Agency issues permits for transboundary movement of waste, processing, and/or disposal of waste and also issues approvals for waste management plans, keeping records on production and waste management, etc.
Statistical Office of Montenegro	Produces official statistics and is mandated to perform data collection, processing, and dissemination. Undertakes an annual survey to gather data on the amount of waste produced by the municipalities.
Hemosan	Handles hazardous and non-hazardous waste by organising collection, transportation, storage, and recycling of e-waste (and other waste) generated by businesses and households[59].
Zero Waste Montenegro	An NGO active in raising awareness on the concept of Circular Economy, promoting Zero Waste, lobbying against waste incineration, providing technical expertise to recycling facilities as a way of increasing their recycling rate, and establishing an active Zero Waste community.
Montepel	Collects and processes waste including paper/cardboard, plastic, brass, electronic, and glasses. Handles almost 100 tonnes of recycled waste monthly.
Cistoca d.o.o. (Purity Ltd)	Organises regular collection and transport of communal waste, etc. The company has dedicated containers for different waste types (old batteries, packaging, oil filters, fluorescent tubes, e-waste, etc.) and six recycling yards for disposal of all waste types, without charge.
Inter Trejd Reciklaža	Active in non-hazardous and hazardous waste management through the Inter Trade Doo Recycling Center.

[59] Activities – Hemosan Eco Service.

Country:

North Macedonia

2,108,000 inhabitants in 2021[60]
25,220 km²
GDP per capita PPP: $6,720.9 USD in 2021
Average household size: 3.45 members in 2018

Produced by United Nations Geospatial

National legislation on e-waste:

Extended Producer Responsibility:	✔ Introduced in 2012 and re-enacted in 2021
National Standards:	✔ Introduced in 2021 with the Law on Management of WEEE
E-waste Collection Target:	✔ Ranging from 25% for 2022 to 65% for 2028
Products Coverage:	✔ All the EU WEEE Directive products are covered by the EPR

International Conventions:

	Signature	Ratification/Accession	Entry into force
Basel Convention		16/07/1997	14/10/1997
Rotterdam Convention		12/08/2010	10/11/2010
Stockholm Convention	23/05/2001	27/05/2004	25/08/2004
Minamata Convention	25/07/2014	12/03/2020	10/06/2020

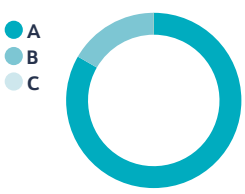
EEE POM (2021):	E-waste generated (2021):	E-waste formally collected (2021):	E-waste import/ export (2019):
32.5 kt 15.4 kg/inh	18.6 kt 8.8 kg/inh	3.2 kt 1.5 kg/inh	For reuse Import: 3.9 kt Export: 1.0 kt For recycling Import: 0.5 kt Export: 2.2 kt

(Source: SSO 2022/MoEPP 2022/UNITAR)

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

✔ 10 companies have licenses to collect, store, and treat e-waste
✔ 3 main PROs and 2 recycling companies

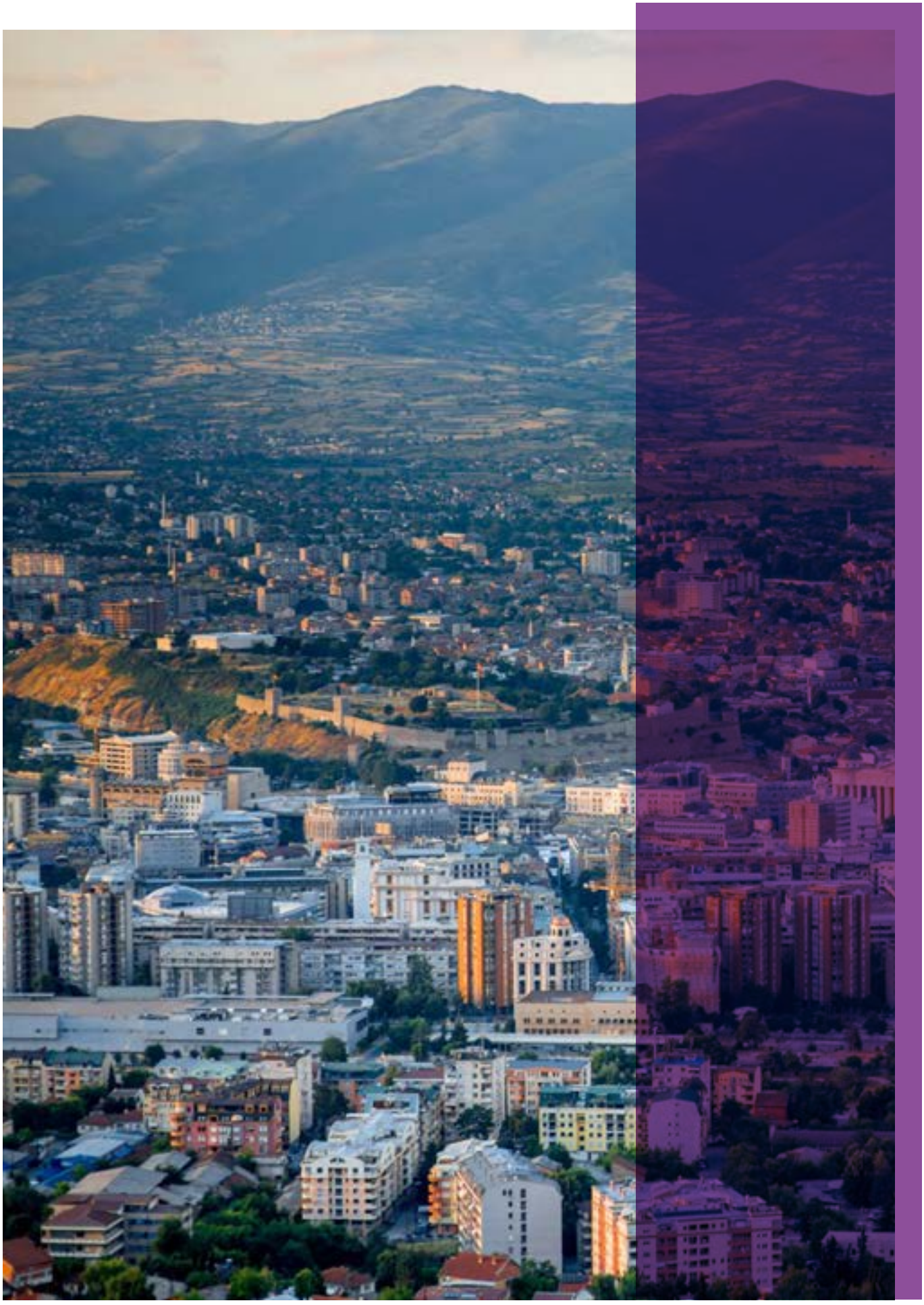
E-waste Management Matrix



A advanced | B in transition | C basic
(more information on the assessment system can be found in chapter 2 and 6)

E-waste Collection Rate

[60] According to the State Statistical Office of North Macedonia, the information on population differs slightly from the World Prospect Population of the United Nations Department of Economic and Social Affairs, which was 1.8 million in 2021; Area of 25.436 km²; average size of household of 3.06 members in 2021.



National E-waste Legislation

E-waste legislation and policy of North Macedonia are aligned with the EU Environmental *Acquis* after some laws relating to e-waste were reenacted to resolve some lapses.

North Macedonia's waste management policy is aligned with the EU Environmental *Acquis* and the Waste Framework Directive. Existing waste management practices are developed based on the Law on Environment, on National Environmental Programmes, and, most importantly, on the Law on Waste Management, which provides a management framework for all types of waste and specifies requirements for different permits for service providers [58].

Since 2012, e-waste has been regulated by a specific regulation, which was repealed and reenacted in 2021 to overcome mutual unfair competition and low civic awareness, resulting in partial fulfillment of the set collection and recycling targets.

The Law on Waste from Electrical and Electronic Equipment Management (Official Gazette of Republic of Macedonia, No. 6/12), which entered into force in 2014, mandated for collective (PROs) or individual take-back or, alternatively, for the payment of a fee on EEE POM. It provided that e-waste must be collected separately, and consumers can return their old equipment to retailers. This system had some challenges because the PROs in the field encountered mutually unfair competition, and in combination with the low civic awareness, this didn't allow them to fulfil the e-waste collection and recycling targets.

The 2021 Law on WEEE Management implemented the EPR, clarified the rights and obligations of the PROs and other stakeholders, and established the same rules and procedures for all collective and independent actors.

Due to some observed lapses, the Law on WEEE Management and other related laws were repealed and a new package of laws was enacted. One of the main aims of revising the law was to clarify the rights and obligations of the PROs and establish the same rules and procedures for all collective and independent stakeholders [59][60]. In 2019, the Ministry of Environment and Physical Planning prepared the new legislations that were then adopted by the Parliament[61]:

- Law on Management of Electric and Electronic Equipment and Waste Electric and Electronic Equipment (Official Gazette of Republic of Macedonia, No. 176 /21)
- Law on Extended Producer Responsibility for Management with Special Waste Streams (Official Gazette of Republic of Macedonia, No. 215/21)
- Law on Waste Management (Official Gazette of Republic of Macedonia, No. 216 /21)
- Law on Management of Special Waste Streams (Official Gazette of Republic of Macedonia, No. 216 /21)

[61] https://www.bmeia.gv.at/fileadmin/user_upload/Zentrale/Europa/EU-Twinning/April-Juni_21/Twinning_Fiche_MK_20_IPA_EN_01_22_final_clean.pdf.

The new waste legislative framework respects the circular economy principles and the provisions of the EU legislation and complies with the European Directive (CELEX No. 32012L0019), also transposing the RoHS Directive.

The newly legislated EPR adjusted the collection targets and also included household e-waste, but implementation is still incomplete, due to a missing secondary law.

The newly legislated EPR adjusted the collection and recycling targets to better fit the economy, and a gradual improvement in e-waste management is expected in the coming years. With this, it is expected that producers/importers will focus on their clearly defined responsibilities to ensure a better collection rate. The new EPR also includes household e-waste; before the reenacted legislation, there had been no collective scheme for the management of e-waste originating from households, and only business-to-business e-waste was covered [60]. The EPR covers the EU-10 categories, which is the classification system used by the Ministry of Environment and Physical Planning. However, EPR enforcement is still limited, due to the missing secondary law[62].

There is a policy that encourages collection and management of e-waste and general waste, including the definition of realistic targets.

Concerning waste, the policy framework includes the National Strategy for Waste Management (2008–2030) and the National Waste Management Plan (NWMP 2020–2026). The National Waste Management Plan aims at improving the collection and management of waste and enhancing the institutional set-up for waste management, including a National Programme for WEEE [58]. The National Waste Prevention Plan (2021–2027) presents a coordinated approach to waste prevention, delineating targets and policies. The adoption of this plan commenced at the start of 2022 [61]. With the new framework, the responsibilities of the parties are much clearer, and there is a differentiation of the special waste streams, such as e-waste, into the new legislation based on the EPR scheme (Official Gazette of Republic of Macedonia, No. 176 /21). New adjusted and more realistic targets are now adopted within the National Programme on WEEE. Challenges include the absence of a specific policy on e-waste and the delay in the adoption of secondary legislation, which is anticipated to occur in a year or two.

EHS standards for the e-waste collection and treatment chain are prescribed in the legislative framework adopted in 2021, but there is no evidence on the actual implementation status.

The Law on Waste Management and Management of EEE and WEEE adopted in 2021, in harmonisation with parts of the EU WEEE Directive 2012/19/EU and the RoHS Directive 2011/65/EU, provide requirements for environmental protection, human health, and safety within e-waste management activities. They also set the conditions under which the collection, transportation, reuse,

[62] https://unece.org/sites/default/files/202104/Highlights3rdEPR_North%20Macedonia.pdf.

treatment, storage, processing, disposal, import, export, and transit of waste and e-waste may be performed. The State Environmental Inspectorate would be in charge of monitoring the minimum treatment standards at licensed facilities. However, there is no clear evidence on the actual implementation of the required environmental standards or the health and safety measures within the e-waste collection and treatment sector, which is probably still in progress since it was only recently introduced.

E-waste operators submit an annual report on e-waste collected and treated, while the PROs are also obliged by law to submit reports on their e-waste awareness campaigns.

Licensed operators submit reports on e-waste collection, treatment, and exporting annually to the Ministry of Environment and Physical Planning, and the reports are monitored by the Department of Waste [59]. E-waste data is collected for the types of waste with codes (category) 16 02 (discarded equipment containing hazardous components) and 20 01 35 and 20 01 36 (discarded EEE) in accordance with the European list of waste. The State Statistical Office is in charge of the collection, processing, and dissemination of e-waste statistics. Data is also regularly reported to Eurostat. The PROs are also obliged by law to raise awareness campaigns and activities and report every year on the progress.

North Macedonia has a new e-waste framework dedicated to e-waste with a special waste stream, with more realistic collection targets and well-defined responsibilities for stakeholders.

There are ambitious e-waste collection and treatment targets, but there is no evidence of the targets' fulfilment by the stakeholders, as no national comprehensive report on activities in the e-waste sector is compiled.

The target by 2020 was 4 kg/inh[63] of e-waste separately collected. The new national collection targets adopted on 3 August 2021 for e-waste compared with the average weight of EEE POM in the previous three years are: a target of 25% for 2022; 30% for 2023; 35% for 2024; 40% for 2025; 45% for 2026; 55% for 2027, and 65% for 2028. There is currently no evidence of targets being achieved by the stakeholders, and no national comprehensive report based on and summarising the individual annual records of the PROs is compiled and published annually by the Ministry. Such a report would serve as a good basis for assessing performance, identifying the free-riders, and for planning measures to involve more companies in the system [13]. Due to the lack of comprehensive reporting on e-waste management, it is difficult to analyse the current e-waste management practices in the country and assess whether the legal targets are being met [60].

National E-waste Statistics

Some data is available on EEE POM from PROs and e-waste collected, but North Macedonia is not using any special tool in measuring e-waste generated, due to the absence of secondary legislation.

Data is available on EEE POM from the PROs, but the data for POM does not

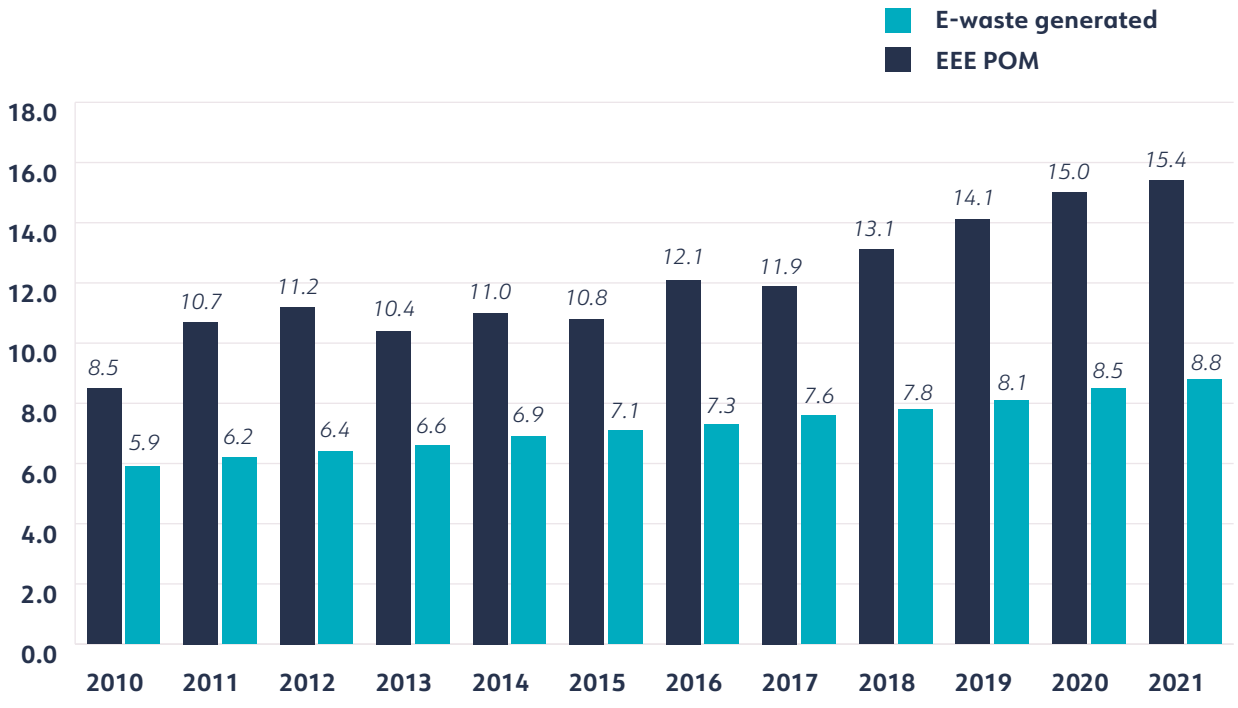
[63] MK – NI 102 | MJSPP (moepp.gov.mk).

distinguish between new EEE and used EEE (as both use the same HS code). Data is also available on e-waste collected, while a time series on e-waste generated is not readily available. North Macedonia is not using any special tool or methodology for measuring e-waste flows, as the relevant agencies are waiting for a secondary legislation to facilitate this process. The Republic of North Macedonia State Statistical Office (SSO) also collects data through questionnaires, but many personnel are not trained on data collection, processing, and submission. Therefore, the available data is of poor quality. E-waste data was first included in the report for Environmental Indicators in 2020, and the data goes back to 2015. E-waste data is also recorded by the Ministry of Environment and Physical Planning. The Tools developed by UNITAR-SCYCLE and the official country data on importing and exporting were used to determine the main statistical indicators on e-waste in the country. SSO provided official data with a time series available from 2010 until 2021, which is the latest year included in the analysis.

The EEE POM fluctuated from 8.5 kg/inh in 2010 to 15.4 kg/inh in 2021, while the E-waste generated gradually increased from 5.9 kg/inh in 2010 to 8.8 kg/inh in 2021.

The EEE POM and E-waste generated from 2010 to 2021 are shown in Figure 25. From 2010 to 2012, the EEE POM increased from 8.5 kg/inh to 11.2 kg/inh. The EEE POM then decreased to 10.4 kg/inh in 2013, followed by an increase to 11.0 kg/inh in 2014 and then to 10.8 kg/inh in 2015. From 2016 to 2021, the EEE POM increased from 12.1 kg/inh to 15.4 kg/inh, with a slight decrease in 2017 to 11.9 kg/inh. By contrast, the e-waste generated has increased from 5.9 kg/inh in 2010 to 8.8 kg/inh in 2021.

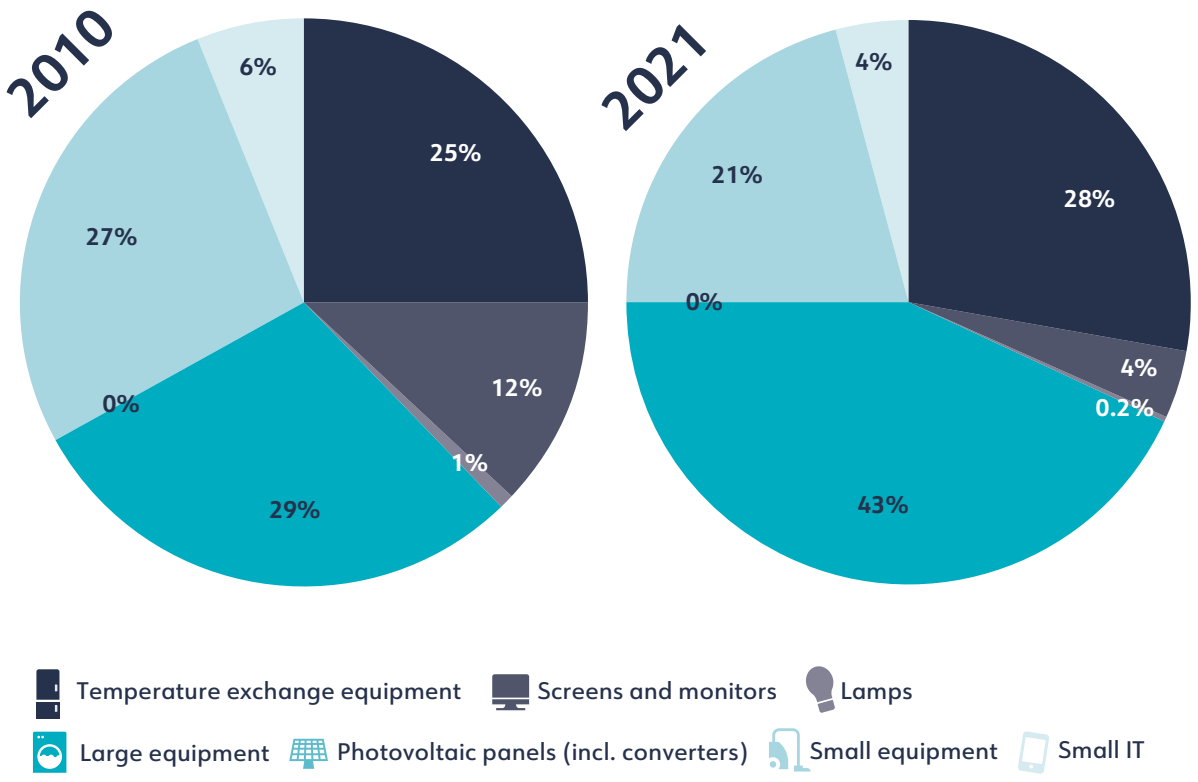
Figure 25. EEE POM and e-waste generated in North Macedonia per kg/inh



The EEE POM shares changed over time, but Large Equipment is the largest share from 2010 to 2021 with 43% in 2021, and Lamps is the smallest share with 0.2% in 2021.

The EEE POM shares have changed over the years, as shown in Figure 26. Large equipment (Cat IV) was the largest in 2021, with 29% (2.4 kg/inh) in 2010 and increasing to 43% (6.7 kg/inh) in 2021. The second largest share is Temperature Exchange Equipment (Cat I), which has the largest share with 28% (4.3 kg/inh) in 2021. The third largest is Small Equipment (Cat V) with 27% (2.3 kg/inh) in 2010, which decreased to 21% (3.2 kg/inh) in 2021. Small IT (Cat VI) in 2021 is 4% (0.6 kg/inh). Screens and Monitors (Cat II) was 12% (1.0 kg/inh) in 2010 and decreased to 4% (0.6 kg/inh) in 2021. Finally, Lamps (Cat III) is the smallest category with 0.2% (0.03 kg/inh) in 2021. There are no shares of PV panels (Cat IV B) in 2010 or 2021, but the shares on the EEE POM have been approximately 1% from 2011 to 2015.

Figure 26. EEE POM category shares of North Macedonia for 2010 and 2021



The domestic production of EEE has decreased slightly from 2011 to 2020, with Large Equipment being the largest of all produced EEE categories, and the most produced UNU-KEY is Household Heating & Ventilation.

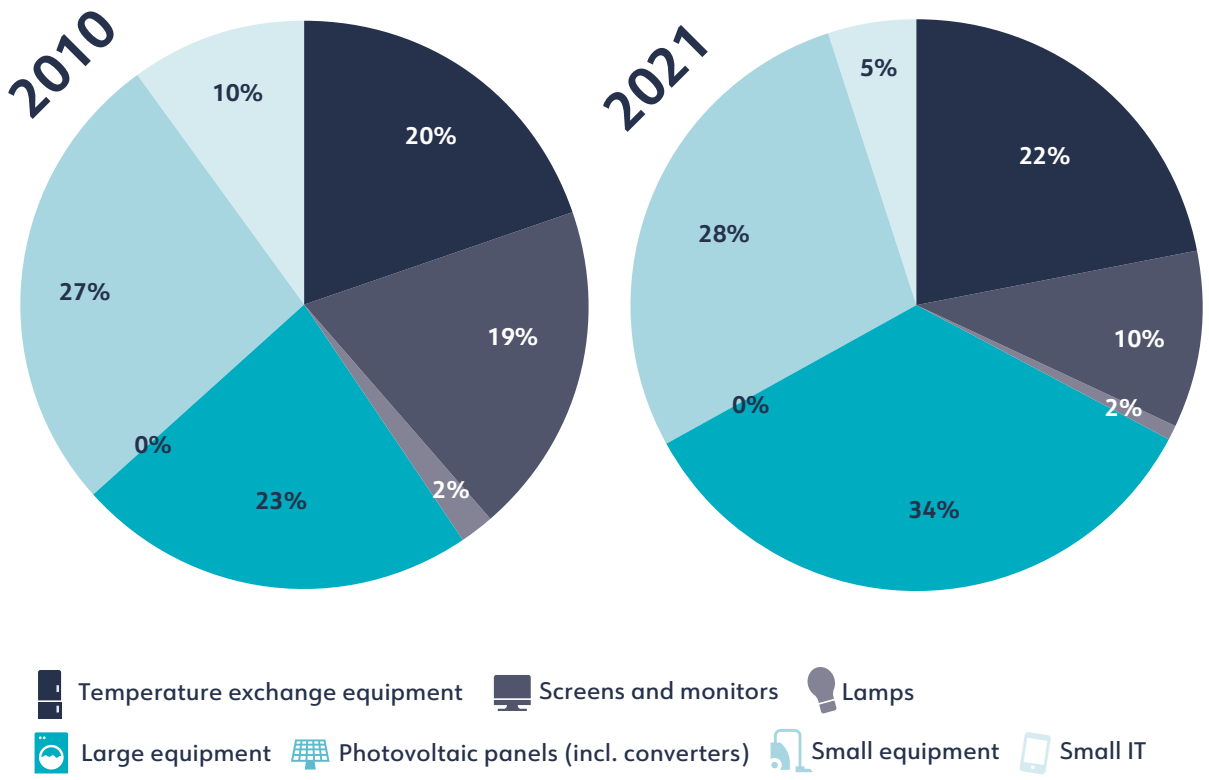
The domestic production of EEE of North Macedonia is quite low, though it still has a market in the country. The trend from 2.4 kg/inh (5.0 kt) in 2011 to 1.8 kg/inh (3.8 kt) in 2020 is shown in Figure 27. The largest production category from 2011 to 2020 is Large Equipment (Cat IV), which decreased from 1.4 kg/inh in 2011 to 1.1 kg/inh in 2020. The largest produced EEE is the UNU-KEY Household Heating & Ventilation (e.g. hoods, ventilators, space heaters) with 1 kg/inh in 2011, which decreased to 0.7 kg/inh in 2020. The domestic production has considerable share compared to the EEE POM; in 2020, specifically, 12% of the EEE POM is produced domestically.

Figure 27. Domestic EEE production of North Macedonia in kg/inh, including the largest UNU-KEY produced per year, largest category per year, and totalled

E-waste generated shares changed slightly over the years, with Large Equipment being the largest in 2021 and Lamps being the smallest.

The e-waste generated of North Macedonia had minimal changes over the years and is illustrated in Figure 28. In 2021, Large Equipment was the largest category with 34% (3 kg/inh), which increased from 23% (1.3 kg/inh) in 2010. Small Equipment was the second largest in 2021, with 28% (2.5 kg/inh). Temperature Exchange Equipment was the third-largest with 22% (1.9 kg/inh), followed by Screens and Monitors with 10% (0.9 kg/inh), which has decreased from 19% (1.1 kg/inh). Small IT is 5% (0.5 kg/inh). Lamps is the final category with 1% in 2021 (0.09 kg/inh). No PV panels are reported in the e-waste generated of 2010 to 2021.

Figure 28. E-waste generated shares of North Macedonia for 2010 and 2021



The e-waste collected has increased from 0.1 kg/inh in 2015 to 1.5 kg/inh in 2021, and the collection rate has increased from 2% of e-waste generated in 2015 to 18% in 2021.

The e-waste collected and the respective collection rate from the three PROs in North Macedonia for the years 2015 to 2021 is illustrated in Table 12. E-waste collected increased from 0.13 kg per capita in 2015 to 1.5 kg per capita in 2021 , which is also confirmed by the data provided by the SSO. The collection rate based on the e-waste generated in the same year increased from 2% in 2015 to 18% in 2021[64]. The collection rate calculated with the EEE POM average of the three previous years has increased from 1% in 2015 to 11% in 2021 (Table 12). Data from the PROs shows that large household equipment, including refrigerators, and cooling/heating equipment, are most frequently collected.

Table 12. E-waste collected and collection rates in North Macedonia for 2015-2021

	2015	2016	2017	2018	2019	2020	2021
E-waste collected (kt)	0.3	0.6	0.7	2.2	2.2	3.6	3.2
E-waste collected (kg/inh)	0.1	0.3	0.3	1.1	1.0	1.7	1.5
E-waste collection rate EEE POM (%)	1	3	3	9	8	13	11
E-waste collection rate WG (%)	2	4	5	13	13	20	18

Despite the willingness to meet the EU targets for recycling, reuse, and recovery of e-waste, it is currently considered unrealistic for the country to achieve them [62]. However, North Macedonia has made major improvements in e-waste collection and has one of the highest collection rates in the Western Balkans.

[64] The state of the waste battery system and electrical and electronic waste in the Republic of Macedonia | MJSPP (moepp.gov.mk).

E-waste Management System

North Macedonia has a formal e-waste collection and management system in place, with e-waste collection being carried out mainly through PROs.

There is an organised formal e-waste collection and management system in the country. It is mainly carried out through the PROs, but there can also be producers acting as independent actors with a license. Data is not available on the specific recycling capacity of such operators or on the types and categories of e-waste they collect and treat. However, there is evidence that the general public is not placing e-waste in the bins provided specifically for e-waste and that the majority of it is ultimately picked up by the informal sector and sold as metal scrap [62].

Ten companies have been licensed to collect, store, and treat e-waste, including three functional PROs and two private e-waste recycling companies.

Private licensed companies provide infrastructure for the collection and treatment of e-waste. Ten companies have been licensed to collect, store, and treat e-waste, including four PROs. One of the PROs (Electro Eco System) lost its permit. The three functional PROs licensed by the Ministry of Environment and Physical Planning[65] are (i) Zero Waste, (ii) El Collect Import-Export (El Kolekt), and (iii) Ekon Electron. About 500 producers and importers have been registered, and some (about 48%) are already members of the three licensed PROs [63]. However, a recent report by the European Commission indicated that only two PROs are active [61]. Some of the licensed collectors cover only business-to-business (B2B) e-waste and focus on capturing large quantities of e-waste from businesses and institutions [60]. The PROs collect e-waste using established collection points or pick the waste up from businesses and institutions [13]. They do not place containers out for regular collection [26]. Only the major cities have e-waste collecting networks put in place by the PROs, and these are mainly located near places where EEE are sold.

In addition to the collection points put in place by the PROs, the municipalities are also obliged to establish collection centres.

In cooperation with the producers and PROs, the municipalities must arrange collection points and transport the separately collected e-waste. They place containers for separate collection on the streets or in public or private buildings (e.g. major markets, malls, schools, municipal buildings, institutions), and they contract communal companies to regularly empty and transport the e-waste from those containers for recycling. The responsibility of the producers is to cover the expenses and ensure that e-waste is collected, sorted, recovered, and recycled according to targets set in the legislation [59]. Municipalities are obliged to establish collection centres, and there is a special obligation for mayors to ensure at least one separate e-waste collection point in each municipality or at least one collection point for every 30,000 inhabitants [13].

[65] Fourth permit granted for collective treatment with waste from electrical and electronic equipment | MJSPP (moepp.gov.mk).

The recyclers organise door-to-door collection for large quantities of e-waste and use 'Old for New' action to take back e-waste in partnership with some retail shops, while e-waste is processed mainly by physical treatment, which results in exportation of most recovered parts.

For large quantities of e-waste, higher than 300 kg or 10 large devices, consumers can send out requests for collection, and some recyclers (e.g. Ekocentar 97) are organised to pick up the e-waste door-to-door via vans. Recycling companies also organise '*Old for New*' action for take-back of e-waste in cooperation with some retail shops. Formal e-waste recycling and refining facilities are not present in the country. Formal operators manage e-waste mainly by dismantling, physical treatment, and separation, while the recovered parts are exported to neighboring countries for further treatment and refining [30]. The two e-waste recyclers operating in North Macedonia are F-Grupacija (EE Recycling) and Ekocentar 97.

The e-waste management system is financed with fees paid by producers/importers, but the system faced challenges relating to stakeholders' duties, which led to the repeal of the 2012 EPR and legislation of a new EPR with clearly assigned roles.

Producers pay a fee that is used for financing and implementing activities for e-waste management as underlined in the legislative framework. The old EPR scheme (Official Gazette of Republic of Macedonia, No. 06/12) was set up in such a way as to ensure some level of competition among the PROs and, consequently, better operation and fulfilment of legal obligations [13]. Unfortunately, the system encountered some challenges, especially with respect to assigning responsibilities to stakeholders. In fact, PROs could not perform any e-waste management activity and had to partner with a company licensed to collect and treat e-waste (which are almost exclusively public companies) [13]. This implies that PROs could not collect the e-waste and did not own the e-waste at any moment. They could only indirectly promote separate collection and recycling of e-waste by providing and placing bins for e-waste collection and realising actions for awareness raising. This separation of the activities between PROs and actual waste operators hindered the provision and development of separate collection and recycling activities because the PROs could not directly affect and enhance the efficiency of such activities, having no means to do so, except for public awareness-raising campaigns and the extension of the infrastructure and collection points. The old system hindered and discouraged the PROs (and recyclers) from over-performing on the national targets for separate collection and recycling because there was neither an incentive to attain higher recycling rates, nor could they sell and make revenue from the collected waste [13]. This was resolved in the amended legislation that established the new EPR. Before the new legislation, there were also several free riders – companies not complying with the e-waste laws and EPR as stipulated [64]. It is expected that the new EPR will improve full compliance.

The informal sector uses a door-to-door and cherry-picking approach to collect e-waste, which is often dismantled and sorted before the recovered parts are sold to recyclers or exported.

The informal sector, represented mainly by members of the Romani community, is also active in e-waste collection and management, but there are no informal collection points or informal recycling facilities. The sector mainly consists of door-to-door dealers and e-waste cherry-pickers. Households frequently sell e-waste and other products, which have a net scrap value to scrap metal merchants [26], who select only the valuable parts of e-waste (e.g. metals) to be sold to recyclers or exported, while the rest is disposed of.

Increasing efficiency of the EPR led to a reduction in the involvement of the informal sector, but the amount of e-waste that is still managed through this route is unknown.

The introduction of EPR legislation and the separate collection of e-waste has significantly improved the formal collection and recycling system. This has reduced the role of the informal sector [52][59]. However, information on the amount of e-waste that is still managed by the informal sector is lacking. Also, no clear information is available on measures adopted to protect the health and safety of informal operators.

Transboundary Movement of E-waste

North Macedonia is Party to the Basel, Rotterdam, Stockholm, and Minamata Conventions and introduced a ban on imports of waste as an energy source in 2019.

North Macedonia has been a signatory to the Basel Convention since the 14th of October 1997 and has since also signed to the Rotterdam, Stockholm, and Minamata Conventions. Since becoming Party, actions were implemented regarding the import, export, and transit of hazardous waste according to the Basel Convention (Regulation of Management of Hazardous Waste (Official Gazette of Republic of Macedonia, No. 47/97, 49/04)[66]. North Macedonia also initiated a ban in 2019 on the importing of waste as an energy source and implemented a ban in 2020 on the import and export of combustible waste with Bulgaria [65].

Though North Macedonia is a signatory to the three MEAs related to e-waste, legal import of e-waste is still happening without a specific ban, and with a currently limited reporting to the Basel Convention.

There are legal imports of e-waste in North Macedonia, but no reporting on these quantities is available from the Basel Convention.

An additional rulebook has been implemented on the import and export of non-hazardous waste since 2003 (Official Gazette of Republic of Macedonia, No. 37/03, 38/03)[67]. However, no laws are thus far in place for e-waste, specifically. Therefore, legal import of e-waste occurs. The import of e-waste uses the HS code 85499900 in the Combined Nomenclature Customs Tariff

[66] Waste Policies country fact sheet Macedonia (FYR) (moepp.gov.mk).
[67] Waste Policies country fact sheet Macedonia (FYR) (moepp.gov.mk).

number. Data retrieved from the National Programme on e-waste (data provided by the Customs) shows imports of e-waste of 0.44 kt for 2018, 0.53 kt for 2019, and 0.33 k t for 2020.

Exporting waste is allowed, and most collected e-waste and the recovered parts are exported for final treatment abroad, but reporting on e-waste's exported quantities is limited.

Most collected e-waste and recovered parts are exported for final treatment abroad, as the country has very few recycling facilities. The export of e-waste happens under the same HS code as the import (85499900). According to Customs, 2.2 kt of e-waste was exported for treatment in 2019 [65]. By analysing the average price of EEE from the trade statistics, it was also possible to estimate that 23 t of printed circuit boards (PCB) were exported for recycling in 2019 (equal to 6% of the amount of PCB generated) [11]. However, no reports from the Basel Convention are available for the import and export of e-waste.

Used EEE is available for sale, but minimal information is available on the import and export quantities or the market size.

North Macedonia has a market in place for used EEE[68], but there is no indication on the market size in the country. Also, HS codes are in place for some UEEE, i.e. for refrigerators, air conditioners, and monitors and projectors[69], so Customs have recorded some reports of used EEE. According to the available data, exports and imports for reuse of used equipment corresponded to 1.0 kt (0.5 kg/inh) of UEEE exported and 3.9 kt (1.9 kg/inh) imported in 2019 [11].

[68] https://www.pazar3.mk/ads/home-family/home-appliances/for-sale.
[69] Machinery, mechanical appliances and equipment | Import Licensing Procedures (wto.org).

Campaigns for E-waste Collection and Recycling

There are several national projects and initiatives for creating awareness of separate collection and recycling of e-waste, especially by the PROs that are obliged to do so by law and also by some NGOs (e.g. Go Green, Eko-svest). Zero Waste conducts an environmental educational campaign '*Where I buy, there I recycle*' alongside other socially responsible companies. The campaign aims to raise awareness and inform the general public about the possibility of disposing e-waste with incentives. Zero Waste hosts *Zero Waste in Studio 10*, a one-hour discussion on '*Safe practices in e-waste disposal*' on TV[70]. There are also small GEF-funded projects for training and capacity-building ongoing in North Macedonia, aimed at reducing e-waste by repair and reuse of EEE and at the collection of e-waste and batteries for sustainable management[71]. An ongoing EU-funded project '*Development of Environmental Monitoring and Information System*' is helping North Macedonia improve data collection processes and is supporting the introduction of electronic systems for reporting [59]. REDI Recycling, a social enterprise, hosts 'Open Day with REDI Recycling' to support the efforts and recycling work of Romani people across North Macedonia while highlighting their importance in the Green Economy[72]. There is also a project contributing to the collection and reuse or recycling of e-waste through the social inclusion of young people, as one of the vulnerable groups in the labour market of North Macedonia, through trainings with specific skills that are focused on young people's subsequent employment[73][74]. Citizens' perception and attitudes toward e-waste in North Macedonia have also been investigated, and surveys showed that most respondents (45%) prefer to donate used EEE, 28% would rather give/sell used EEE to a reseller, 15% would be inclined to leave used EEE near containers along a street, while about 13% considers the most suitable way to dispose of the e-waste to be to leave it in the specially designated areas in the municipality [66].

[70] Safe practices for handling electronic waste and waste batteries at TV24 - Zero Waste (nulaotpad.com.mk). [71] https://sgp.undp.org/all-documents/country-documents/1417-north-macedonia-op7-cps-approved/file.html. [72] https://redi-ngo.eu/open-day-with-redi-recycling/. [73] Project Detail (undp.org). [74] https://sgp.undp.org/spacial-itemid-projects-landing-page/spacial-itemid-project-search-results/spacial-itemid-project-detailpage.html?view=projectdetail&id=31075.

Stakeholder Mapping

Stakeholder	Responsibility
Ministry of Environment and Physical Planning	Responsible for policy development, planning, and licensing on solid waste management and treatment, including data collection.
State Environmental Inspectorate	Responsible for the monitoring of e-waste and other waste within the country. Currently modernising and strengthening the capacity, accountability, and efficiency of the Inspectorate.
State Statistical Office	Responsible for the collection, processing, and dissemination of statistics on demographic, social, and economic indicators in North Macedonia. Coordinates the country's statistical system and is responsible for defining statistical methodologies and standards.
Elkolekt (El Collect)	A PRO for e-waste and waste batteries that assists members in fulfilling their obligations through collection, treatment, and recycling of e-waste batteries. The PRO is active in raising public awareness and in organising technical assistance to its members.
Zero Waste (Nula Otpad)	A PRO that provides access to permanent and secure services for collecting, selecting, transporting, and recycling e-waste and batteries. They are also active in awareness creation on separate collection.
F-Grupacija d.o.o/EE Recycling	A subsidiary of F-Grupacija that processes all types of e-waste. The company works in cooperation with municipal authorities, NGOs etc. and organises free take-back of e-waste. The company can process up to 5 tonnes of e-waste per day (1.33 kt/y).
Ecocenter 97 (Ekocentar)	Collects and treats e-waste, waste cables, waste batteries, end-of-life vehicles, etc. with a network of reliable partners for hazardous waste management across Europe.
Evrosurovina PA d.o.o.	Buys and processes secondary raw materials, including non-ferrous metals, wires, cables, copper wires, and other scraps.
Eko Metal 16	Performs activities such as collecting, storing, and recycling various waste materials, including scrap metal, batteries, and used vehicles.
Novometal	Buys and recycles waste, including scrap metal, end-of-life vehicles, batteries, etc. They have recycling centres.

Country:

Serbia

7,332,000 inhabitants in 2021
87,460 km²
GDP per capita PPP: $9,215 USD in 2021
Average household size: 2.85 members in 2019

Produced by United Nations Geospatial

National legislation on e-waste:

Extended Producer Responsibility:	Introduced in Serbian legislation in 2010
National Standards:	✔ Provided for in the Official Gazette of Rep. of Serbia, No. 99/2010
E-waste Collection Target:	✔ 4 kg/inh for 2019; 45% of EEE POM by 2031, according to the Waste Management Program
Products Coverage:	✔ EU-10 is in use, EU-6 introduction is planned for 2024 by SEPA

International Conventions:

	Signature	Ratification/Accession	Entry into force
Basel Convention[75]		18/04/2000	17/07/2000
Rotterdam Convention[76]		31/07/2009	29/10/2009
Stockholm Convention[77]	02/05/2002	31/7/2009	29/10/2009
Minamata Convention[78]	09/10/2014		

EEE POM (2021):	E-waste generated (2021):	E-waste formally collected (2021):	E-waste import/ export (2019):
84.2 kt **11.5 kg/inh**	**68.3 kt** **9.3 kg/inh**	**30.3 kt** **4.3 kg/inh**	**For reuse** **Import: 3.0 kt** **Export: 4.1 kt** **For recycling** **Export: 8.8 kt**

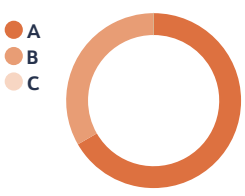
(Source: GEM 2020/UNITAR/SEPA 2022/GTF 2022)

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

- ✔ 500 companies have a permit for the collection e-waste, but not all of them are operational[79]
- ✔ 7 major e-waste recycling companies (mostly pre-treatment)

(These numbers vary during the year in accordance with the dynamics of issuing permits)

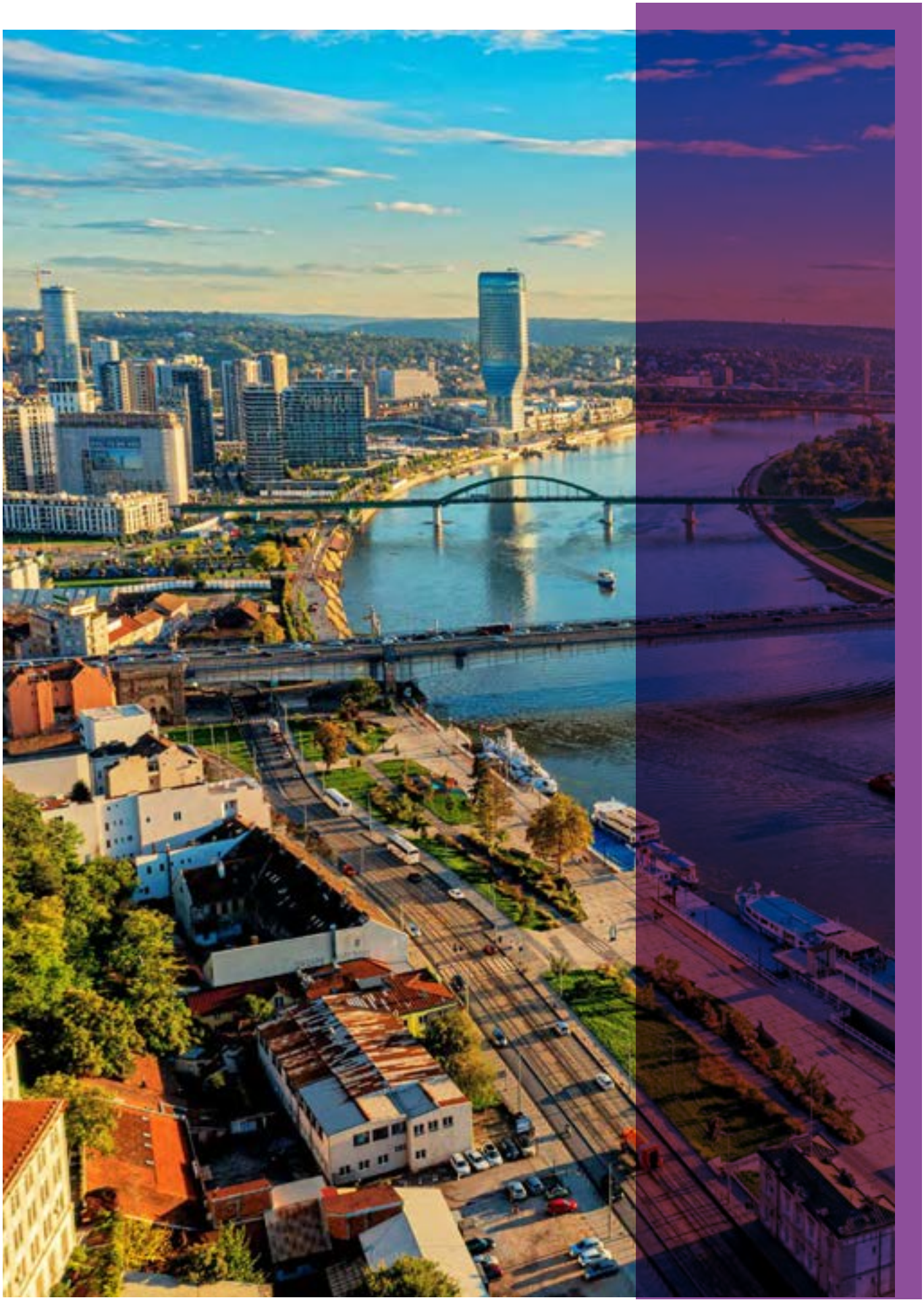
E-waste Management Matrix



A advanced | B in transition | C basic
(more information on the assessment system can be found in chapter 2 and 6)

E-waste Collection Rate

[75] Parties to the Basel Convention. [76] Parties and Signatories of the Rotterdam Convention (pic.int). [77] Status of ratifications of the Stockholm Convention (pops.int). [78] Parties (mercuryconvention.org). [79] program_upravljanja_otpadom_eng_-_adopted_version.pdf (ekologija.gov.rs).



National E-waste Legislation

Serbia has a Rulebook specifically dedicated to e-waste and also includes e-waste in the general Law on Waste Management, which both transposed only the old WEEE Directive 2002/96/EC, while alignment with the new WEEE Directive 2012/19/EU and the RoHS Directive is in process.

The main legal acts regarding the management of e-waste in Serbia are:

- The Law on Waste Management (Official Gazette of Republic of Serbia No. 36/09 and 88/10).
- The Rulebook on the List of Electric and Electronic Products, Measures of Prohibition, and Restriction of Use of EEE Containing Hazardous Substances, Methods, and Procedures of Managing Waste from Electric and Electronic Products (Official Gazette of Republic of Serbia No. 99/2010).

These legal documents transposed the old WEEE Directive 2002/96/EC, while alignment with the new 2012/19/EU and the RoHS Directives is still in process. They contain provisions on e-waste management, measures to prohibit and restrict the use of hazardous substances in EEE, and methods and processes for managing e-waste, etc. The PLAC III project (Policy and Legal Advice Centre III) is facilitating the full transposition of the Directives regulating the management of e-waste in the EU into the Serbian legislation[80].

An EPR system is in place in Serbia, and there is an ongoing plan to introduce a collective EPR scheme according to the provisions of the revised Waste Framework Directive.

In Serbia, EPR applies to e-waste and other special waste streams (batteries, tires, oil, etc.) and is implemented through laws that define the payment of taxes by producers and importers. The tax rates are based on the type of EEE POM and their associated weight. The EPR is based on a number of laws, including the Rulebook on Adjusted Amount Fees for Management of Specific Waste Streams (RS Official Gazette, no. 44/2016) and the Regulation of products that after usage become special waste streams, forms of the daily record of the quantity and type of produced and imported products and annual report, cut-off dates for submission of the annual report, compensation payment, criteria for calculation and amount of compensation payment (Official Gazette of RS, no. 54/2010, 86/2011, 15/2012, 41/2013 - other regulation, 3/2014 and 81/2014 - other regulation). The funds collected are used to establish appropriate management of e-waste – such as financing collection, transport, and treatment of e-waste – and also to pay subsidies to recycling companies. The Rulebook is updated every year with new prices established by the Ministry of Agriculture and Environmental Protection. To improve the management of special waste streams in the Republic of Serbia, the country is planning to introduce a collective EPR scheme that accords to the provisions of the revised Waste Framework Directive.

[80] https://euinfo.rs/plac3/en/news/waste-electrical-and-electronic-equipment-management/.

E-waste management policies are in place, and provisions for environmental standards exist in the legislation, but need to be more strictly implemented.

Serbia has e-waste management standards and a framework on e-waste, while the policies on e-waste management are described in the National Waste Management Strategy and Waste Management Plan, developed in 2020, but have yet to be approved by the Government. E-waste policies are also provided for in the WEEE directive-specific implementation plan. The Rulebook on EEE (Official Gazette of Republic of Serbia No. 99/2010) describes the legal provisions for health and safety perspective in e-waste management. Literature states that occupational health and safety measures are applied in the formal recycling facilities of Serbia and that staff can benefit from full social security coverage [67].

Data on EEE POM, and e-waste collection and treatment is based on reports by recycling companies, but data reporting is lacking.

E-waste operators and all companies that produce or import EEE report to the Serbian Environmental Protection Agency. Data on e-waste treatment is based on reports by recycling companies, submitted as the basis for obtaining government incentives; the reports are periodically published by the Serbian Environmental Protection Agency. E-waste data is gathered by the Serbian Environmental Protection Agency, but there appears to be no monitoring of the system [26]. There is a need for improvement in the data collection system, possibly establishing an e-waste management information system, and ensuring that companies have enough knowledge about their legal obligations on reporting.

Serbia is working on improving data reporting on e-waste, and has a collection target of 45% on EEE POM to be reached by 2031.

Serbia has a collection goal of 45% for EEE POM by 2031, with planned construction of 169 e-waste collection points from households, which will become operational by the end of 2028.

The goal of separate collection of 2 kg/inh of e-waste by the end of 2015 and 4 kg/inh for 2019 (Official Gazette of Republic of Serbia No. 99/2010) expired. The new goal for e-waste collection as given in the Waste Management Program of the Republic of Serbia for the period 2022–2031 is to increase the e-waste collection rate from households to 45% by 2031 (for EEE POM in the three previous years) [68]. These goals will be achieved by increasing e-waste collection through construction of centres for e-waste collection from households, and in fact, 169 of such centres are planned, which will become operational by the close of 2028.

National E-waste Statistics

E-waste data is collected and processed by the Serbian Environmental Protection Agency, and there is a feasible long-term approach and strategy for e-waste data generation and reporting.

The Serbian Environmental Protection Agency collects, updates, and validates e-waste data using the European Waste Catalogue codes and the EU-10 classification system. Serbia has an information system for all flows of waste and is planning a feasible long-term approach and strategy including the introduction of the UNITAR-SCYCLE Tools by 2023. However, reporting in the field of waste management needs to be improved by establishing a more efficient waste movement system and introducing electronic record-keeping. Further adjustment of the national reporting methodology in line with EU requirements in the scope of waste regulations, complemented by a circular economy package, is also needed [68].

The Serbian Environmental Protection Agency has a reporting framework in place on EEE POM, but the current system does not allow for calculating the entire amount of EEE POM or, thus, for setting appropriate targets.

According to the current reporting framework in Serbia, EEE POM is expressed, apart from mass units, also in pieces (Table 13), and as a percentage of the value added tax charged[81]. To obtain the total amount of EEE POM each year, it would be necessary to total what is reported in mass units and what is reported in pieces, through appropriate conversions, and by making sure that there is no double counting. The system currently in use can still function to collect fees from producers and importers, but it hampers the ability to correctly calculate the total number of devices POM and, therefore, to set appropriate national goals.

Table 13. EEE POM in Serbia (source: SEPA 2021)

	2019	2020	2021
EEE POM (kt)	15.4	19.7	18.6
EEE POM (pieces)	21344443	24230150	27106002

[81] http://www.sepa.gov.rs/download/Posebni_tokovi_2021.pdf.

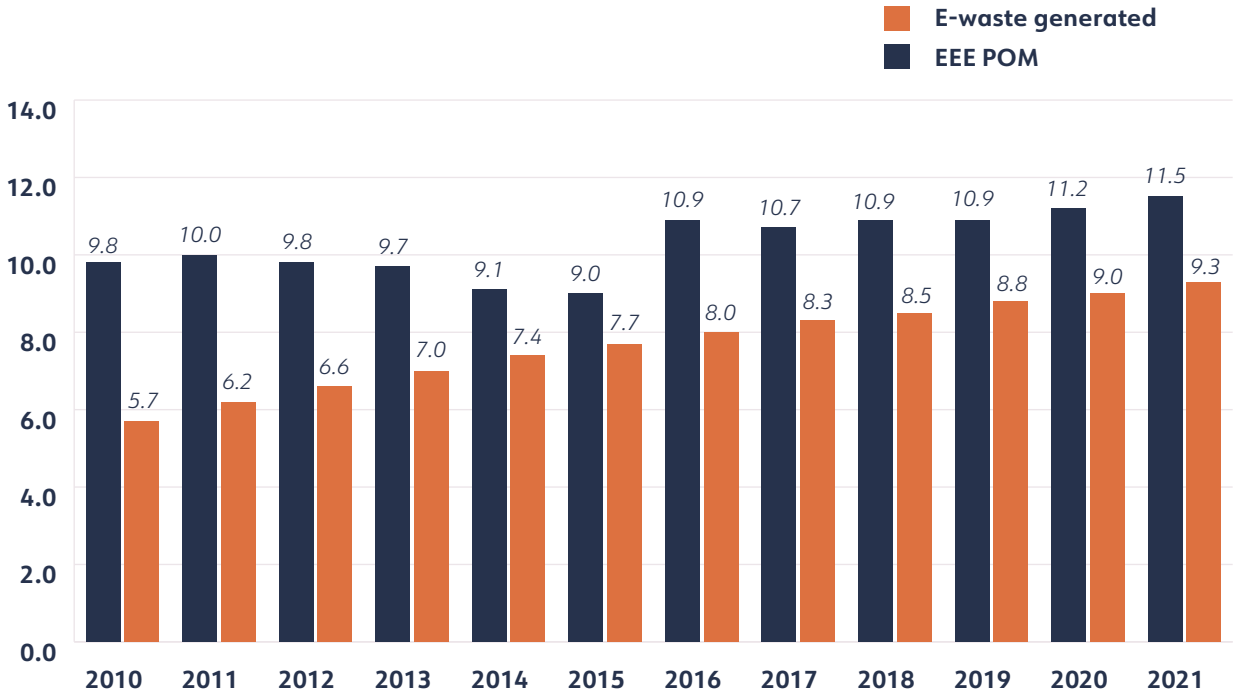
For completeness in the time series and consistency with the other countries included in the Monitor, the data on EEE POM and E-waste generated from the Global E-waste Monitor 2020 for Serbia are also reported and used to perform the calculations at the regional level.

According to the *Global E-waste Monitor 2020*, the EEE POM in Serbia decreased from 9.8 kg/inh in 2010 to 9.0 kg/inh in 2015, then increased to 11.5 kg/inh in 2021, while the E-waste generated increased from 5.7 kg/inh in 2010 to 9.3 kg/inh in 2021.

The EEE POM and e-waste generated from 2010 to 2021 are shown in Figure 29. As shown, the EEE POM amounted to 9.8 kg/inh in 2010, increased to 10.0 kg/inh in 2011, and then decreased to 9.0 kg/inh in 2015. The decrease was followed by an increase to 10.9 kg/inh in 2016 and then slightly decreased to 10.7 in 2017 and stagnated at 10.9 kg/inh until 2019. The EEE POM then increased to 11.5 kg/inh in 2021.

EEE POM depends primarily on the needs and possibilities of the national economy for importing or producing EEE. Based on experts' opinion from the Serbian Environmental Protection Agency, fluctuations in quantities can also be caused by changes in the market and the economic crisis in Europe, including in Serbia. The difference between the data on EEE POM from the Serbian Environmental Protection Agency and the Global E-waste Monitor 2020 can be linked to the limitations of the current reporting framework in the country or to the presence of free riders in the market, which are normally outside of the national reporting. The E-waste generated increased steadily from 5.7 kg/inh in 2010 to 9.3 kg/inh in 2021.

Figure 29. EEE POM and e-waste generated in Serbia per kg/inh



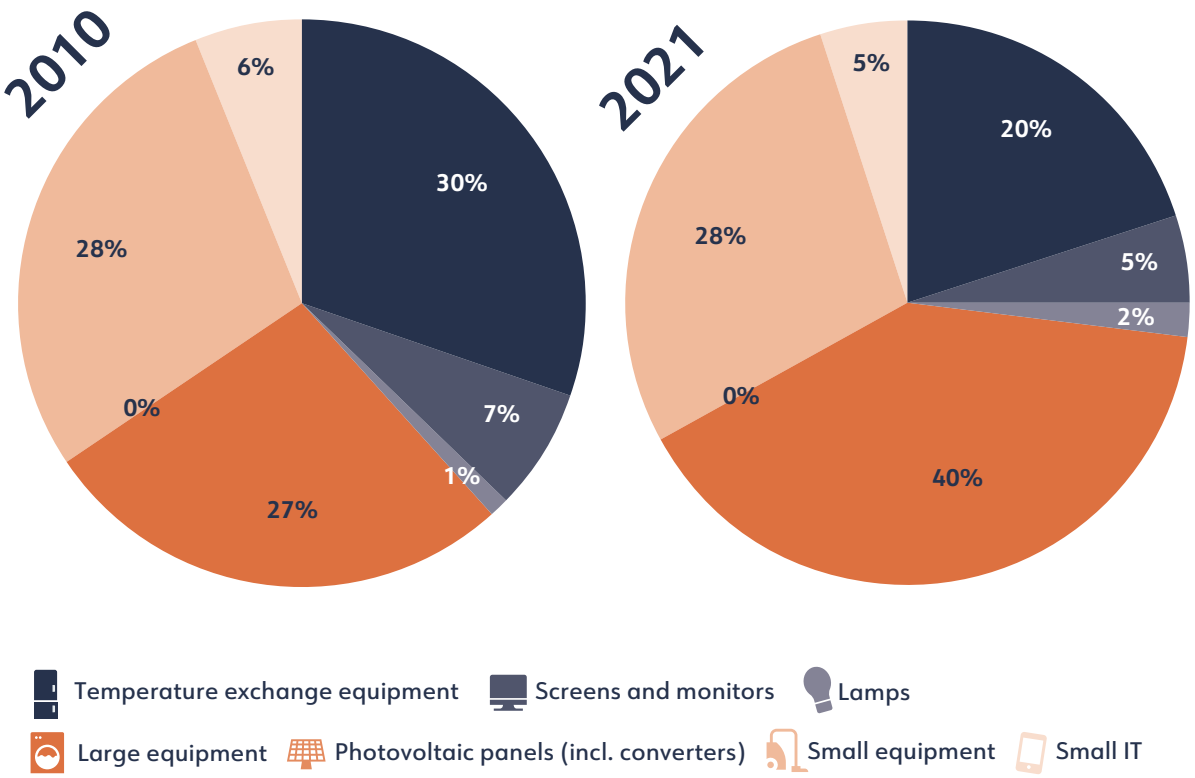
Based on the data from the *Global E-waste Monitor 2020*, Large Equipment had the largest share of EEE POM in 2021, while Lamps had the smallest share.

The EEE POM shares of 2010 and 2021, based on the EU-6 categories according to Annex III of the Directive 2012/19/EU[82], are illustrated in Figure 30. Data is provided in the EU-6 categories for consistency with the other countries included in the report, as well as for ensuring alignment with the present recast of the WEEE Directive. However, since the Environmental Protection Agency is currently using the EU-10 categories internally, the experts' team has been provided with a correspondence table that makes converting the EU-10 categories into the EU-6 possible.

The largest share of 2021 was found for Large Equipment (Cat IV A) with 40% (4.6 kg/inh), which increased from 27% (2.7 kg/inh) in 2010. Small Equipment (Cat V) was the second largest with 28% (3.2 kg/inh) in 2021. Temperature Exchange Equipment (Cat I) was the third-largest with 20% (2.3 kg/inh), which decreased from 30% (2.9 kg/inh) in 2010. This was followed by Screens and Monitors (Cat II) with 5% (0.6 kg/inh) in 2021. Small IT (Cat VI) was 5% (0.5 kg/inh) in 2021, followed by Lamps (Cat III) with 2% (0.2 kg/inh) (Figure 30). PV panels were not installed in 2010 or 2021, but were installed from 2014 to 2016, in 2018, and in 2020 at roughly 0.3% of EEE POM.

[82] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:02012L0019-20180704.

Figure 30. EEE POM categorial shares of Serbia in 2010 and 2021



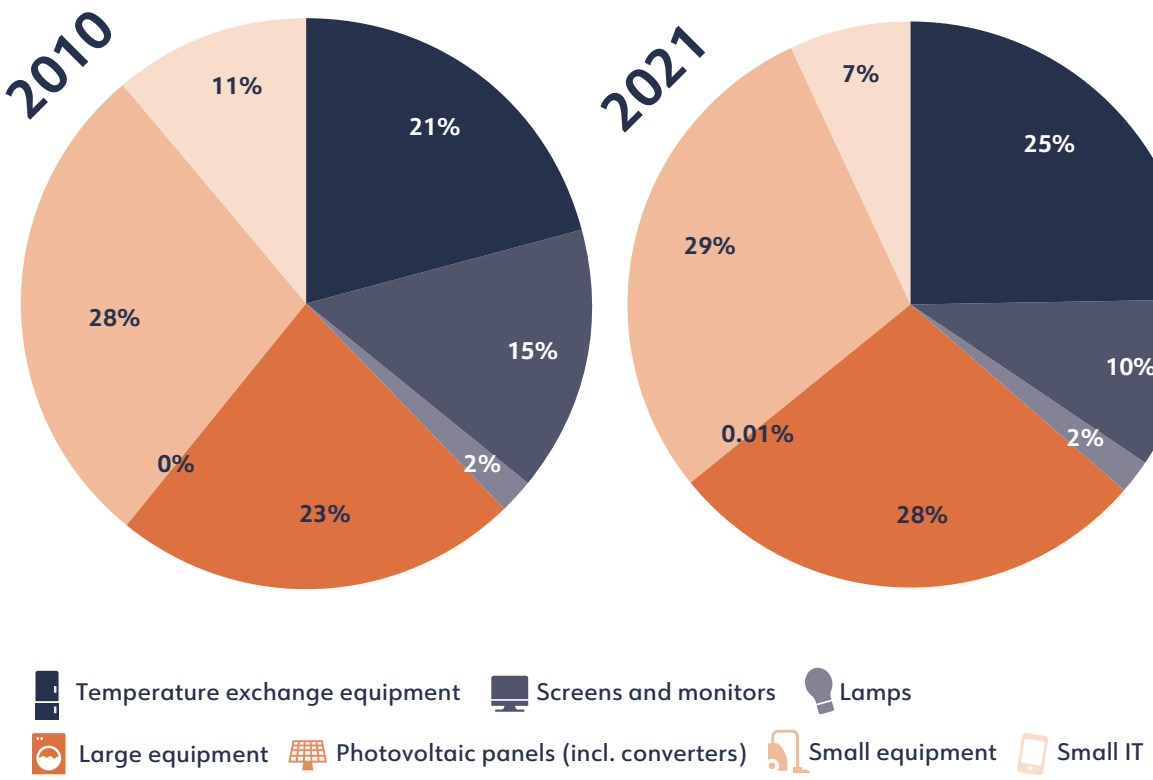
There are no specific statistics on EEE domestic production in Serbia.

Serbia has no EEE production facilities, so no EEE production statistics are available.

Data from the *Global E-waste Monitor 2020* shows that the e-waste generated shares changed slightly over the years, with Small Equipment (Cat. V) being the largest in 2021 and PV panels (Cat. IVB) being the smallest.

The e-waste generated shares of 2010 and 2021 are shown in Figure 31. The largest share of e-waste generated is Small Equipment (Cat. V) with 29% (2.7 kg/inh). Large Equipment (Cat. IV) has the second-largest share with 28% (2.6 kg/inh), which increased from 23% (1.3 kg/inh) in 2010. Temperature Exchange Equipment (Cat I) is the third largest with 25% (2.3 kg/inh), which increased from 21% (1.2 kg/inh) in 2010 (Figure 31). Screens and Monitors (Cat II) is next with 10% (0.9 kg/inh), followed by Small IT (Cat. VI) with 7% (0.6 kg/inh) and Lamps (Cat. III) as one of the smallest categories with 2% (0.2 kg/inh). PV panels is the smallest category with 0.01% (0.001 kg/inh). No PV panels were reported in the e-waste generated from 2010 to 2021.

Figure 31. E-waste generated categorial shares of Serbia in 2010 and 2021



E-waste collection is not specifically reported, but Serbia annually collects the recycling quantities of discarded EEE, which can approximate the e-waste collected annually.

There is no official data on Serbia's e-waste collection rate, but based on the information provided by the Serbian Environmental Protection Authority[83], we can assume that the amount of e-waste collected each year is similar to what is reported as being recycled. Data from the Serbian Environmental Protection Authority shows that nationally, around 30–40 kt[84] of e-waste is treated each year, which can be assumed to be indicative of the amount of e-waste collected, given that Serbia does not receive imports of e-waste for treatment. In 2020, 41.7 kt (5.6 kg/inh) of discarded equipment was recycled, while in 2021, Serbia collected and recycled 30.3 (4.1 kg/inh)

[83] http://www.sepa.gov.rs/download/Posebni_tokovi_2021.pdf.
[84] program_upravljanja_otpadom_eng_-_adopted_version.pdf (ekologija.gov.rs).

of e-waste (Table 14). Over a 10-year period, the quantity of the treated e-waste increased considerably, from around 7 kt in 2011[85]. Considering the amount of e-waste recycled as an approximation for the e-waste collected, this would lead to a collection rate of 44% on e-waste generated and 37% on EEE POM. However, this might be an overestimated amount for the e-waste collected annually, since e-waste is sometimes treated the year after it has been collected, and it might also include e-waste components from end-of-life vehicles and polychlorinated biphenyls containing waste[86], which are reported together. Currently, a bylaw to mandate official reporting on polychlorinated biphenyls and polychlorinated biphenyls containing waste to the Serbian Environmental Protection Authority is in the preparation phase.

Table 14. Reported data on discarded EEE recycled in Serbia

	2019	2020	2021
E-waste recycled (kt)	35.6	41.7	30.3
EEE recycled (kg/inh)	4.8	5.7	4.1

EEE probably have longer lifespans in Serbia than in EU member countries. EEE is reported to have greater lifespan in Serbia than in EU member countries, which is probably linked to a strong reuse culture and repair practices in the country. Based on research from the International Labour Organization, the average lifespan of most EEE and household appliances in Serbia is about 10 years [67].

E-waste Management System

Waste management permits are issued to private e-waste operators for e-waste collection, storage, transportation, and recycling, and they are mostly active in the main cities.

E-waste in the country is taken care of by private collectors and private recyclers, which are mostly active in the main cities. There is no organised e-waste collection system in place by producers/importers or through PROs. The collection of e-waste is currently based on the selective collection of profitable components/parts. Waste management permits are issued to operators for e-waste collection, storage, transportation, and recycling. Recycling companies have subsidiary collection companies working with them (to handle e-waste collection, storage, transportation), and they must at least hold a permit [67]. Some recyclers also receive e-waste through old-for-new programmes. Likewise, the informal sector is also involved in e-waste collection. Formal recyclers do not have a regular supply of materials and mostly depend on the informal operators.

[85] eKapija | How Company Bozic isinovi Made a Facility That Can Treat 30 Million Lightbulbs a Year.
[86] https://data.stat.gov.rs/Home/Result/2502010201?languageCode=en-US.

In Serbia, infrastructure exists for collection and treatment of e-waste, and there are about 500 companies with permits to collect and treat non-hazardous e-waste parts.

Formal recycling companies usually treat e-waste from both households and businesses. The system for organised collection of e-waste from households has not been established by local governments, except sporadically, and there is the plan to incentivise it according to the Waste Management Program. About 500 companies have a permit for the collection of e-waste, but not all of them are practically operational. Formal collection is also undertaken by the recycling companies, their external independent collectors, or private collectors. Some recyclers have collection contracts with large companies and municipalities, which receive payment for the e-waste collection and treatment services they carry out[87]. Recyclers occasionally collect from schools, universities, and municipalities [67]. In most cases, collection points are also organised through educational activities and projects run by NGOs.

E-waste collected by licensed collectors or informal operators are taken to the recyclers to obtain a certified waste transfer document, which allows the collector to earn government subsidies.

For households, e-waste is mostly collected directly by door-to-door collections with focus only on valuable materials, either by licensed operators or unlicensed collectors (the informal sector). In some cases, consumers adopt voluntary disposal by taking e-waste to informal collection points or recycling centres themselves, especially when the product has a net scrap value, just for the financial incentive. Due to this incentive, households and institutions tend to store e-waste and sell to collectors [67]. Collectors, formal and informal, need to take e-waste to the recyclers to obtain a certified waste transfer document. This document records the amount of e-waste collected and enables collectors to receive a subsidy for collection, transport, and recycling, from the environmental levies [26]. According to a study from the International Labour Organization, there are almost 1,500 formal employees working in the e-waste collection and recycling chain [67], but more recent data is not available, and these numbers might currently be different.

Serbia has a dense e-waste collection network comprising approximately 500 companies depending on the dynamics of issuing permits, and some external registered independent collectors affiliated with recycling companies.

There are seven major e-waste recycling companies operating in Serbia, and they adopt dismantling and physical separation, while most recovered parts are exported.

There are seven major recycling companies in Serbia that treat all e-waste categories. These facilities have a treatment capacity of nearly 30–40 kt per year[88]. The companies perform manual dismantling, sorting of components, and removal of hazardous parts. Mechanical treatment in a universal cross flow shredder is the most common method adopted for treating e-waste in Serbia. These pre-processing activities obtain valuable parts of metals, plastics, and plastics/metal mixtures, which are sold in the domestic market or exported. There are several plants for manual disassembly of CRTs, treatment

[87] (99+) S.E.Trade; SET- Zero Waste: About | LinkedIn.
[88] http://www.sepa.gov.rs/download/Posebni_tokovi_2021.pdf.

of refrigeration devices and freezers, treatment and removal of cables, discharge of fluids from refrigeration devices and freezers, and treatment of gas bulbs. Recycling facilities are available for some pure parts of plastic, while certain types of plastic are exported for treatment (e.g. computer cases). Hazardous computer components, such as CRT monitors or fluorescent dust, are currently being stored and exported. The remaining non-hazardous parts are disposed of in landfills or incinerated in cement plants.

Recycling companies are subsidised through an environmental tax by the Ministry of Environmental Protection.

The formal operations of e-waste management in Serbia are financed through environmental tax paid for EEE POM by manufacturers and importers (Official Gazette of Republic of Serbia No. 54/2010; on Products that after use Become Special Waste). However, not all recycling companies (approximately only 20 of them, based on information from the Environmental Protection Agency) ask for subsidies. By receiving the subsidies, operators can pay collectors, export hazardous components, and dispose of some of the non-hazardous and non-reusable waste in landfills. The implementation of this financially stimulating policy resulted in the increase of e-waste collection and treatment rate year by year and the further development of the recycling industry [69] [70]. Additionally, operators profit from selling ferrous metals, aluminum, and copper in the market of secondary raw materials [67]. However, information is not available on how producers/importers comply with the tax payment.

Despite the high number of companies and private operators active in the collection and treatment of e-waste, the overall e-waste management system in Serbia is still not fully developed and has challenges.

There are many companies and private operators involved in the collection and treatment of e-waste. Nonetheless, e-waste management in Serbia is still not well-developed, partly due to insufficient dedicated collection infrastructure and collection points [71]. E-waste in Serbia is currently not systematically collected (separately), and e-waste can be found littered at several black spots, mainly around large Serbian cities[89]. On a national level, so far, the principle of environmentally sound management of e-waste is not being fully implemented yet even though it is envisaged in the Waste Strategy.

In Serbia, the informal sector plays an important role in the e-waste value chain, including supply for repair and reuse.

In Serbia, the informal sector plays an important role in the e-waste value chain such that they are already integrated with the formal e-waste management system [26]. There is a significant informal e-waste collection network in Serbia (through cherry pickers or door-to-door collectors), though there are no informal collection points and no informal recycling facilities. Informal collectors engaged with e-waste are mainly interested in recovering any type of metal-containing waste. They are very active, especially in collecting and

[89] (99+) S.E.Trade; SET- Zero Waste: About | LinkedIn.

handling large household appliances and cooling/freezing appliances. Such devices are often dismantled manually, with recovered valuable parts sold to scrap dealers in the thriving scrap metal market. In dismantling collected e-waste, informal operators retain EEE parts and supply local repair and second-hand outlets with spare parts for repair activities.

Formal recyclers rely mostly on informal operators, who usually hand over the waste through brokers, which increases the prices.

The formal recyclers do not have a regular supply of materials and therefore rely consistently on the informal collectors. The informal sector reportedly supplies about 70% of e-waste handled by a major recycling company in Serbia [26]. However, the informal collectors often route the collected waste through brokers that are operating in the scrap metal market, which increases prices. As a result, recycling industries purchase large amounts of secondary raw materials directly from brokers rather than individual waste pickers, allowing the brokers to earn much larger profits [67]. The challenge, thus, is getting the waste pickers to deliver their materials directly to licensed facilities, collectors, or recyclers, as opposed to through brokers.

There have been some studies of the informal e-waste sector of Serbia, but no data on the quantities managed or on health and safety measures implemented is available.

Some studies have focused on the activities of the informal e-waste sector, including those of the United Nations Development Programme – Partnership for Action on Computing Equipment ('*National E-waste Assessment in Serbia*') and the International Labour Organization (ILO) study[90]. However, reliable data is not available on quantities of e-waste handled by the informal operators, and these activities are not reflected in the official waste statistics. There is also no evidence of implemented health and safety measures in the informal sector.

Transboundary Movement of E-waste

Though Serbia is Party to the Basel Convention, it also has legislations that prohibit e-waste imports.

Serbia signed to the Basel convention on July 17, 2000 and has since then accessed the Rotterdam and Stockholm Conventions. It has yet to ratify the Convention on Mercury, which was signed in 2014. Besides implementing the regulatory framework of the Basel Convention, e-waste importation is prohibited according to the Regulation on Waste List for Cross-Border Movement, Content and Layout of Documents Accompanying Cross-Border Movement of Waste with Instructions for Completing Them ('Off. Gazette RS', br. 36/2009, 88/2010, 14/2016 i 95/2018 - dr. law) and the Ministry Order on Transboundary Movement of Wastes (Official Gazette of Republic of Serbia No. 6/21)[91]. A policy was also issued in 2006 that bans importing e-waste,

[90] https://www.ilo.org/wcmsp5/groups/public/---ed_dialogue/---sector/documents/publication/wcms_315228.pdf.
[91] https://www.ekologija.gov.rs/dokumenta/upravljanje-otpadom/zakoni.

except for equipment for personal use [67]. In 2020, operators reported that after dismantling e-waste and recovering components that were channeled toward re-use operations, the remaining 3,831 tonnes of materials were exported.

Some hazardous e-waste parts recovered in Serbia are exported for treatment.

There is legal exportation of recovered parts from e-waste treatment (including hazardous components) for end-processing [72]. Waste plastics parts are mostly exported to China, polyurethane foam and freon are exported to Germany, and chlorofluorocarbons are exported to the Netherlands for final treatment [73]. In 2020, 4.67 t of IT equipment waste was exported to Bosnia and Herzegovina and 0.21 t of waste solvents from fluorescent tubes have been exported to Austria[92]. Exportation of e-waste is reported by the Basel convention, as shown in Table 15. In 2020, 5.8 kt (1.1 kg/inh) of e-waste was exported for treatment. The amount of e-waste exported for recycling that could be obtained by the Basel Convention reports might be subjected to how national institutions interpret the reporting codes. The list of A and B codes, which have been considered relevant in the e-waste field for this study, is reported in Annex C to this report. The importation of e-waste is not reported by the Basel convention, since it is banned in Serbia.

By analysing the average price of EEE from the trade statistics, it was also possible to estimate that 0.5 kt of printed circuit boards (PCB) were exported for recycling in 2019 (equal to 33% of the amount of PCB generated) [11].

Table 15. E-waste exported in Serbia reported to Basel Convention

	2016	2017	2018	2019	2020
E-waste exported (kt)	6.3	-	4.2	8.4	5.8
E-waste exported (kg/inh)	0.8	-	0.6	1.2	1.1

Demand for used EEE drives the import of used EEE from high-income countries.

There is no regulation on used EEE import, and there is currently significant importation of used EEE. Demand for used EEE in Serbia drives the import of used EEE from high-income countries, and there is a thriving used EEE market in the country [69][70]. However, available data on EEE imports does not differentiate between new and used EEE, which makes it difficult to monitor the quantities. According to the available data, exports and imports for reuse of used equipment corresponded to 4.1 kt (0.6 kg/inh) of UEEE exported and 3.0 kt (0.4 kg/inh) imported in 2019 [11].

[92] Report on Waste Management in the Republic of Serbia in 2011 - 2020 (Document in Serbian).

Campaigns for E-waste Collection and Recycling

There are some national projects and initiatives on e-waste. Serbia has been implementing awareness-raising campaigns on the separation of waste and the importance of recycling[93]. The Ministry of Labour, Employment, Veteran and Social Affairs proposed trainings for socially disadvantaged people for repairing EEE [74]. Technology Parks, which accommodates and fosters the growth of tenant firms that focus on science, technology and innovation, will provide a very interesting opportunity for attracting electronics refurbishing and the sale of components as well as repair operations to Serbia, which could serve all of the Balkans [75]. Recycling, partnering with the companies Božić and Sons and Recyclers Association of Serbia, are implementing a project (February 2020–February 2023) aimed at increasing the recycling rate of batteries and light bulbs[94] by 20% within the scope of the 'Development Partnerships with the Private sector' (develoPPP program) funded by the German Federal Ministry of Economic Cooperation and Development (GIZ)[95]. Some recycling companies are also supporting social initiatives to raise funds with humanitarian purposes, purchasing, and recycling e-waste, which were voluntarily returned by consumers[96].

[93] http://env-net.org/wp-content/uploads/2021/03/Circular-Economy-Status-Report_EASD_Serbia.pdf. [94] https://www.naled.rs/en/projekti-povecanje-stope-reciklaze-za-baterije-i-sijalice-3000. [95] Increasing the recycling rate of batteries and light bulbs (naled.rs). [96] "Cash for Cherry" action raises about 600,000 FOR ANNIKA – GMinfo.

Stakeholder Mapping

Stakeholder	Responsibility
Ministry of Environmental Protection	The Ministry is in charge of the environmental protection in Serbia. It is the responsible entity for the legislation and policies concerning e-waste within the country.
Serbian Environmental Protection Agency	An agency under the Ministry of Environment and Protection that carries out activities toward the development, harmonisation, and management of the national information system for environmental protection. They collect, consolidate, process, and report on the state of the implementation of environmental protection policy, etc.
Udruženje Reciklera Srbije	The purpose of this association is to protect interests of recyclers and collectors, as well as to continue development of the recycling industry through a partnership dialogue with the Government of Serbia. The association is actively working on the education of citizens in order to raise social awareness about the environment and the importance of recycling.
Ekolozi Bez Granica	An NGO that contributes to the improvement of environmental protection by encouraging changes through campaigns, projects, public participation in decision-making, etc.
Jugo-Impex E.E.R. d.o.o., Niš	The company is the owner of a subsidiary named E-RECIKLAŽA 2010 d.o.o. It treats e-waste and has a plant for processing refrigerators that can process 1,000 refrigerators per day (15 kt per year). Approximately 80 tonnes of e-waste are recycled in the company's newest installations[97].
E-RECIKLAŽA 2010 d.o.o. (E Recycling)	Specialised in recycling cooling devices. So far, the company has recycled 1,081,582 refrigerators (as at August 2022). The company treats 15 kt of e-waste per year – including all categories of e-waste. E-Reciklaza has recycled more than 100 kt of e-waste (2012–2022), resulting in 72 different high-purity recyclates that are sold to domestic and foreign markets.
SET Reciklaža (Strategy of Ecological Trade d.o.o or SETrade)	SET Reciklaža has integrated permit for the collection, transport, storage, and treatment of e-waste. SETrade uses zero-waste technology in treating e-waste, including CRT glass. The company has 15 kt/year capacity[98].
Božić i sinovi	Company licensed to process all types of e-waste, as well as magnetic tape and fluorescent bulbs. E-waste pre-treatment (disassembling and separation) is performed manually. BiS retrieves between one and four cargo trucks of e-waste per week from its suppliers (external collectors). In 2021, Božić i sinovi treated 5.3 kt of e-waste, but has 25 kt/year capacity.
Scan Metals Ltd	The company has permits for waste management, including collection, transport, and further sale of processed raw materials to foundries. The company commenced e-waste collection and treatment in 2010.
Jugopan Ltd	Jugopan is into recycling of secondary raw materials, especially recycling of waste cables, with a processing capacity of 2.5 tonnes of waste cables per shift.
Eko-Metal d.o.o.	Collects and recycles e-waste, cables, and photo-chemicals waste, and exports most parts (e.g. printed circuit boards, batteries, CRT screens, hard discs, floppy discs and other optical devices). Monthly recycling capacity is 100–150 t (12 kt/year capacity).

[97] https://ec.europa.eu/environment/enlarg/pdf/pilot waste/Serbia_en.pdf.
[98] https://ec.europa.eu/environment/enlarg/pdf/pilot waste/final_report_en.pdf.

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Note: For the country profiles, information on population, area, borders, GDP per capita PPP, average size of household, and maps for the five countries were obtained from the following sources (respectively): UNDESA, 2022[99]; World Bank[100]; World Bank[101]; UNDESA, 2022[102]; United Nations Geospatial Information Section[103]. Information on signature and ratification of the Basel, Rotterdam, Stockholm and Minamata Convention by the five countries was obtained from the respective websites/homepages of the Convention Secretariat[104][105][106][107].

[99] https://population.un.org/wpp/Download/Standard/Population/ [100] https://data.worldbank.org/indicator/AG.LND.TOTL.K2?locations=AL
[101] https://data.worldbank.org/indicator/NY.GDP.PCAP.CD?locations=AL [102] https://www.un.org/development/desa/pd/data/household-size-and-composition
[103] https://www.un.org/geospatial/content/albania-1 [104] Parties to the Basel Convention [105] Parties and Signatories of the Rotterdam Convention (pic.int)
[106] Status of ratifications of the Stockholm Convention (pops.int) [107] Parties (mercuryconvention.org).

12. ANNEXES

A. UNU-KEYs and Six E-waste Categories

UNU-KEY	Full Name	Six Categories
0001	Central Heating (household-installed)	IV
0002	Photovoltaic Panels	IV
0101	Professional Heating & Ventilation (excl. cooling equipment)	IV
0102	Dishwashers	IV
0103	Kitchen (e.g. large furnaces, ovens, cooking equipment)	IV
0104	Washing Machines (incl. combined dryers)	IV
0105	Dryers (wash dryers, centrifuges)	IV
0106	Household Heating & Ventilation (e.g. hoods, ventilators, space heaters)	IV
0108	Fridges (incl. combi-fridges)	I
0109	Freezers	I
0111	Air Conditioners (household-installed and portable)	I
0112	Other Cooling (e.g. dehumidifiers, heat pump dryers)	I
0113	Professional Cooling (e.g. large air conditioners, cooling displays)	I
0114	Microwaves (incl. combined, excl. grills)	V
0201	Other Small Household (e.g. small ventilators, irons, clocks, adapters)	V
0202	Food (e.g. toaster, grills, food processing, frying pans)	V
0203	Hot Water (e.g. coffee, tea, water cookers)	V
0204	Vacuum Cleaners (excl. professional)	V
0205	Personal Care (e.g. toothbrushes, hair dryers, razors)	V
0301	Small IT (e.g. routers, mice, keyboards, external drives & accessories)	VI
0302	Desktop personal computers (excl. monitors, accessories)	VI
0303	Laptops (incl. tablets)	II
0304	Printers (e.g. scanners, multi-functionals, faxes)	VI
0305	Telecom (e.g. [cordless] phones, answering machines)	VI
0306	Mobile Phones (incl. smartphones, pagers)	VI
0307	Professional IT (e.g. servers, routers, data storage, copiers)	IV
0308	Cathode Ray Tube Monitors	II
0309	Flat-Panel Display Monitors (LCD, LED)	II
0401	Small Consumer Electronics (e.g. headphones, remote controls)	V

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

B. Mathematical Equations

The mathematical description of 'e-waste generated' is a function of the lifespans and EEE POM of the previous years. Specifically:

- *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 years *t* prior to 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 sold in year *t*, which reflects its probable obsolescence rate in evaluation year *n*. The discard-based lifespan profile for a product could be modelled using several probability functions. The Weibull distribution function is considered most suitable for describing discard behavior for EEE and has been applied in the European Union and in scientific literature.

Due to social and technical developments, a product's lifespan could be time-dependent. For instance, the CRT monitor rapidly grew outdated, due to the technological developments of flatscreen monitors. In such a case, 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 sufficiently describe actual behavior. In those cases, the variations of the shape and scale parameter over time are minor, and variations can be disregarded. The distribution of product lifespans can then be simplified as follows:

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

C. List of Waste and Substances Under the Basel Convention That Are Relevant for E-waste

A,B Code	Description	Type of E-waste or Component Containing Hazardous Substances	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, polychlorinated biphenyl) 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 containing hazardous substances.	e.g. Printed circuit boards categorised as A1180 can also be categorised according to Annex I constituents: Y31 ('Lead; lead compounds'), Y20 ('Beryllium, beryllium compounds'), Y27 ('Antimony, antimony compounds'), Y45 ('organohalogen compounds other than substances referred to' elsewhere in Annex I).
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, polychlorinated biphenyl) 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 containing hazardous substances.	
B4030	Used single-use cameras, with batteries not included on list A.	UNU-KEY 0406.	

A,B Code	Description	Type of E-waste or Component Containing Hazardous Substances	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.	
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), Y25 (selenium; selenium compounds), Y27 (antimony; antimony 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 are found in fluorescent and backlight lamps + mercury-added waste.	Y29 (mercury; mercury compounds).
A1190	Waste metal cables or insulated with plastics.	Waste metal cables or insulated with plastics.	All.
A2010	Glass waste from cathode ray tubes and other activated glass.	Screens of cathode ray tubes.	Y31 (lead; lead compounds).
A3180	Wastes, substances and articles containing, consisting of or contaminated with polychlorinated biphenyls, 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.	Can contain brominated flame retardants (in plastics) and persistent organic pollutants fractions of e-waste.	Y10 Waste substances containing or contaminated with PCBs, polychlorinated terphenyl, polybrominated biphenyls Y27 (antimony; antimony compounds).

D. E-waste Statistics and Management Assessment Scores per Countries

Country	Legislation					Infrastructure	
	1.1 Existence of e-waste-specific legislation	1.2 EPR implementation	1.3 Is there an e-waste collection target?	1.4 Are there minimum standards of e-waste management?	1.5 Number of MEA's ratified or signed	2.1 Are there collection points in each municipality?	2.2 Are there treatment facilities in the country for ESM of e-waste?
Albania	yes	introduced in the legislation, but not established	no	yes	4 ratified	mostly absent	yes
Bosnia and Herzegovina	yes	legislated and established	yes	yes	3 ratified	yes	yes
Montenegro	yes	introduced in the legislation, but not established	no	yes	4 ratified	mostly absent	yes
North Macedonia	yes	legislated and established	yes	yes	4 ratified	main cities	yes
Serbia	yes	legislated and partially established	yes	yes	3 ratified, 1 signed	main cities	yes

Country	Year	EEE POM		E-waste generated		E-waste collected for ESM		Collection rate
		kg/inh	kt	kg/inh	kt	kg/inh	kt	%
Albania	2021	12.7	36.2	7.6	21.8	NA	NA	0
Bosnia and Herzegovina	2021	13.3	43.9	9.0	29.7	1.4	4.7	16
Montenegro	2015	15.0	9.4	11.3	7.1	0.2	0.2	3
North Macedonia	2021	15.4	32.5	8.8	18.7	1.5	3.2	17
Serbia	2021	11.5	84.2	9.3	68.3	4.3	30.3	44

13. ABOUT THE AUTHORS

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Giulia Iattoni is Assistant Programme Officer within the Sustainable Cycles Programme (SCYCLE) under the Division for Planet of the United Nations Institute for Training and Research. Giulia is involved in various projects on e-waste data collection and quantification, as well as ones concerning the analysis of e-waste management models and related environmental impacts at the national and regional level. She is also designing and conducting workshops to build institutional capacity on e-waste statistics, management, and legislation for several countries worldwide. Giulia is author of three previously published *Regional E-waste Monitors*: ones for the Commonwealth and Independent States plus Georgia, for the Arab States, and for Latin America. Giulia holds a MSc in Environmental Engineering (curriculum Earth Resources Engineering) from the Alma Mater Studiorum - University of Bologna, where she graduated cum laude in 2019.

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Dr. Ruediger Kuehr is the Head of the UNITAR Bonn Office and Manager of the Sustainable Cycles (SCYCLE) Programme. He is also an Adjunct Professor at the University of Limerick (Ireland) in the Department of Electronics & Computer Engineering in recognition of his distinctions and achievements. As a political and social scientist by education, Ruediger has worked for more than twenty years on the e-waste challenge. He co-founded the StEP Initiative, co-initiated the development of an e-waste coalition among the various UN organisations and the SCYCLE Programme, and initiated the permanent E-waste Academies and E-waste Monitors at the global, regional, and national levels. But the foundation of Ruediger's work is in establishing strategic approaches to sustainability, which renders life-cycle thinking indispensable in his activities; as such, he is also a frequent speaker for forward-thinking at conferences and in media appearances.

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