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Toward a Circular Economy for the Electronics Sector in Central and Eastern Europe

Overview, Actions and Recommendations

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ACRONYMS

CE	Circular Economy
CEE	Central and Eastern Europe
CET	Countries with Economies in Transition
CoC	Chemicals of Concern
E-waste	Waste Electrical and Electronic Equipment
EEE	Electrical and Electronic Equipment
EoL	End-of-Life
EPR	Extended Producer Responsibility
EU	European Union
EU MS	EU Member States
IPR	Individual Producer Responsibility
PRO	Producer Responsibility Organisation
POM	Placed on the Market
RoHS	EU Directive 2011/65/EU on the Restriction of Use of Certain Hazardous Substances
SME	Small- and Medium-sized Enterprises
UEEE	Used Electrical and Electronic Equipment
WEEE Directive	EU Directive 2012/19/EU on Waste Electrical and Electronic Equipment

DEFINITIONS

Circularity focuses on shifting the current economic model toward a sustainable consumption and production, allowing for the transition to inclusive green economies. It aims to reduce and eliminate waste and pollution through smart design, by keeping products and materials in use, and by regenerating and growing natural wealth through economic and fiscal policies that nurture and embrace nature-based solutions.

Eco-innovation performance is based on the Eco-Innovation Index and captures different aspects of eco-innovation based on 16 indicators grouped into five subcategories: eco-innovation inputs, eco-innovation activities, eco-innovation outputs, resource efficiency outcomes, and socioeconomic outcomes.

Eco-innovation inputs comprise investments (financial or human resources) intended to trigger eco-innovation activities.

Eco-innovation activities illustrate to what extent companies in a specific country are active in eco-innovation.

Eco-innovation outputs quantify the outputs of eco-innovation activities in terms of patents, academic literature, and media contributions.

E-waste covers items of all types of electrical and electronic equipment (EEE) and its parts that have been discarded by the owner as waste without the intention of reuse.[1]

Electrical and Electronic Equipment (EEE) refers to equipment that is dependent on electric currents or electromagnetic fields in order to work properly and equipment for the generation transfer and measurement of such currents and fields and designed for use with a voltage rating not exceeding 1,000 volts for alternating currents and 1,500 volts for direct currents.[2]

Extended Producer Responsibility (EPR) in the context with waste legislation puts the responsibility for the financing of collection, recycling, and responsible end-of-life disposal of e-waste and waste batteries, accumulators, and end-of-life vehicles on producers. EPR is mandatory in the European Union, per the WEEE, Batteries, and ELV Directives.

Manufacturer means any natural or legal person or entity who is a **supplier.**

Producer means any natural or legal person who produces EEE under its own name or trademark or who has EEE designed or manufactured and then puts it on the market under its name or trademark, regardless of the selling technique used.

Producer Responsibility Organisation (PRO) means an organisation established by producers to comply with EPR obligations. PROs organise and finance for producers' collection of e-waste from private households (in some countries only), pickup of e-waste at recycling points, transport to treatment facilities, and treatment and disposal of e-waste and parts thereof. In most cases, PROs are generally established and financed by several producers, but they may also be organised by an individual producer (IPR).

[1] StEP-Initiative: One Global Definition of E-waste, https://www.step-initiative.org/files/_documents/whitepapers/StEP_WP_One%20Global%20Definition%20of%20E-waste_20140603_amended.pdf

[2] Directive 2012/19/EU (WEEE Directive, modified).

Recycling refers to the relevant operations that prevent waste disposal and allow material to re-enter the loop. These are defined in Annex IV B to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal.[3]

Reduce implies rethinking how individuals can best meet their needs and fulfill their lifestyle aspirations with minimal impacts on the planet and the people around them. It is a user's choice to use items and services for a longer period of time and buy new items less frequently.

Reduce by design leads to the design of products and services that use less materials per unit of production and/or during their use.

Refurbishment is the modification of EEE that is waste or a product intended to increase or restore performance and/or functionality or to meet applicable technical standards or regulatory requirements, with the result of making a fully functional product to be used for a purpose that is at least the one that was originally intended.[4]

Refuse refers to a user's choice to buy or use products less, or to avoid products containing hazardous substances by resisting individual desires or cultural pressures to purchase them. It implies shifting to more sustainable lifestyles, such as by rejecting packaging, shopping bags, or other products or services that are considered unnecessary.

Remanufacturing refers to a standardised industrial process that takes place within industrial or factory settings, in which cores (the product or module of which have been sold, worn, or are no longer functional) are restored to like-new (or better) condition and performance.[5]

Repair refers to fixing an identified fault in a waste object or product and/or replacing defective components in order to make the waste or product a fully functional product to be used for its originally intended purpose.

Repurposing targets reuses discarded goods or components adapted for another function so that the product/component can begin a distinct new life cycle[6] (e.g. chips from waste computers used in toys).

Resource efficiency outcomes refers to putting eco-innovation performance in the context of a country's resource (material, energy, water) efficiency and greenhouse gas (GHG) emission intensity.

Socioeconomic outcomes illustrate to what extent eco-innovation performance generates positive outcomes for social aspects (employment) and economic aspects (turnover, exports).[7]

Supplier means any natural or legal person who manufactures and supplies parts to EEE producers.

[3] See Basel Convention, http://www.basel.int/TheConvention/Overview/TextoftheConvention/tabid/1275/Default.aspx

[4] UNEP, https://buildingcircularity.org/refurbish/

[5] UNEP, https://buildingcircularity.org/remanufacture/

[6] UNEP, https://buildingcircularity.org/repurpose/ (modified)

[7] European Commission (2019): EU Eco-Innovation Index 2019. EOI Brief. https://ec.europa.eu/environment/ecoap/sites/default/files/eio_brief_eu_eco-innovation_index_2019.pdf

1. INTRODUCTION

Global economic growth alongside the world population's significant increase in recent decades increasingly challenges the planet's limits and poses questions regarding our production and consumption patterns. Climate change, stress on mineral and natural resources, loss of biodiversity, and rising volumes of waste and pollution are among the consequences that humankind must tackle.

Electrical and electronic equipment (EEE) demands special attention in this regard, since increasing production, consumption, and disposal of EEE are linked to emissions of chemicals of concern (CoC) and to losses of valuable resources. Considering EEE's ever-increasing consumption and rapidly growing streams of e-waste, 'hazardous substances within the life cycle of electrical and electronic products' was adopted as an Emerging Policy Issue under the Strategic Approach to International Chemicals Management at its second International Conference on Chemicals Management (ICCM). A life cycle approach on actions addressing this issue was endorsed by SAICM stakeholders. Since then, work on the GEF-funded project *Global Best Practices on Emerging Chemical Policy Issues of Concern under SAICM*, co-implemented by UNEP, has focused on developing tools and guidance for acting to better manage and control CoC along the value chain of EEE.

As the consumption of EEE has been increasing substantially in high-income countries for many years, the vast majority of these countries have at least established infrastructure and accumulated knowledge to facilitate the sound treatment of e-waste. In countries that are still, or until recently were, low- and middle-income countries, the consumption of EEE has been increasing rapidly in recent years, while the respective infrastructure for sound e-waste treatment is either still in its infancy or must be strengthened to adequately handle the higher volumes of e-waste.

Central and Eastern Europe (CEE)[8] comprises countries that still are[9], or until recent years were, low- and middle-income countries. In recent years, most of these countries have experienced considerable economic growth. These developments motivated this study's researchers to provide insights into the specific status of EEE production, consumption, and e-waste in the CEE region. However, sound treatment and disposal of e-waste is only one issue that needs to be considered. The development of the Circular Economy (CE) concept has been catalysed by urgent environmental problems and the ecological decline of ecosystems. CE extends far beyond the waste phase or recycling of products and targets measures addressing all life cycle stages of products and services. The present study aims to assess the status and conditions of CE in the EEE sector of the CEE region and provide recommendations and a roadmap to progress toward a more circular EEE value chain in the CEE region.[10]

This report is structured as follows: the next chapter (chapter 2) first details the concepts used in this study (section 2.1) and explains the study's approach and methods (section 2.2). Chapter 3 presents the results of the analysis and recommendations for each focus country. Finally, chapter 4 presents overall recommendations and a roadmap for the focus countries and the wider CEE region, detailing steps and measures that could support progress from the current status to becoming a fully functional CE.

[8] CEE in the context of this study comprises the new EU member states in Central Europe, the West Balkan countries, Caucasus and Eastern Europe, and the Russian Federation.

[9] Cf. The World Bank Group for categorization, https://data.worldbank.org/?locations=XP-XD

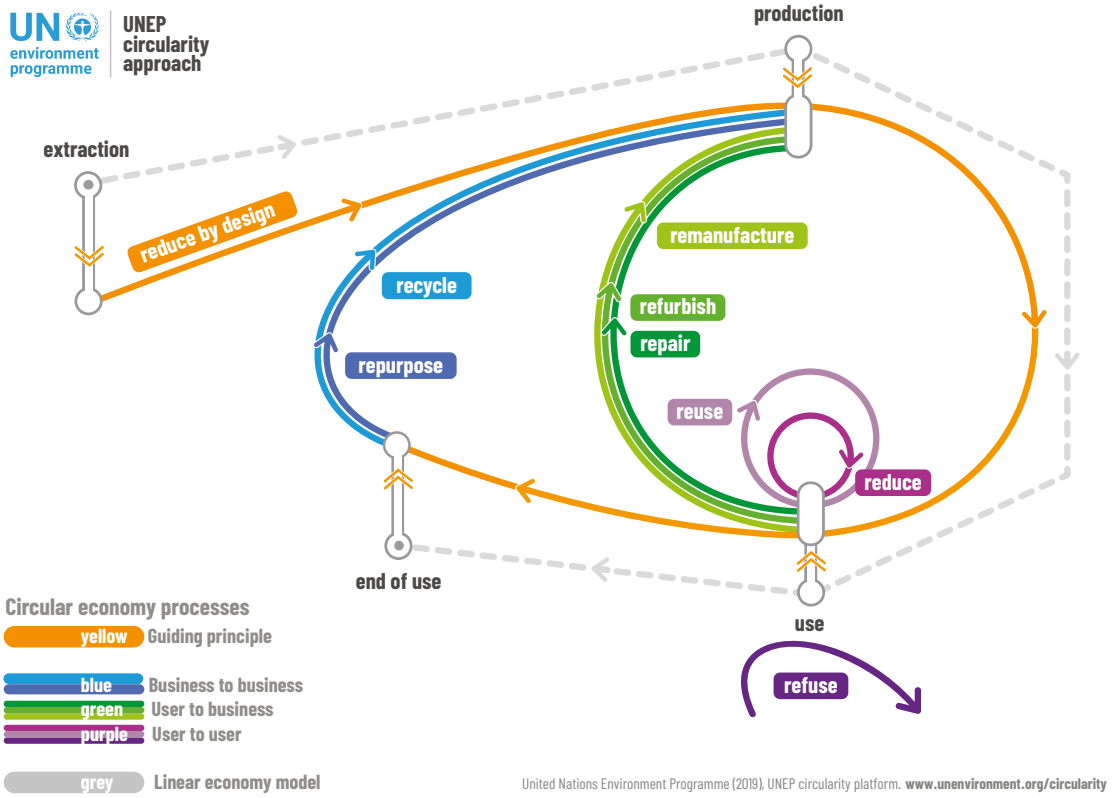
[10] The study was finalised in 2021 and therefore does not take into account potential effects that the geopolitical developments after February 2022 might have on the value chains and material flows in the CEE region.

2. CONCEPTS AND APPROACH

2.1 Concepts

The Circular Economy aspires to reorganise value chains from the current linear approach to a circular model. It enables disconnecting the use of natural resources and environmental impacts from economic activities by retaining the value of products and materials for as long as possible while maintaining or improving human well-being. Figure 2-1 illustrates the UNEP circularity approach, including nine value retention loops for realising such a system.

Figure 2-1. UNEP circularity approach



Source: UNEP - https://www.unep.org/circularity

The value retention loops include:

1. **Reduce by design**: Reduction of the amount of material used, especially raw material, should be applied as an overall guiding principle from the earliest stages of the product and services design process. Products and services are thereby designed to use fewer materials per production unit and/or during their use and are thus easier to reprocess and recycle. The use of CoC should be eliminated or reduced as much as possible. The processes in this group influence all stages of a product's life cycle.

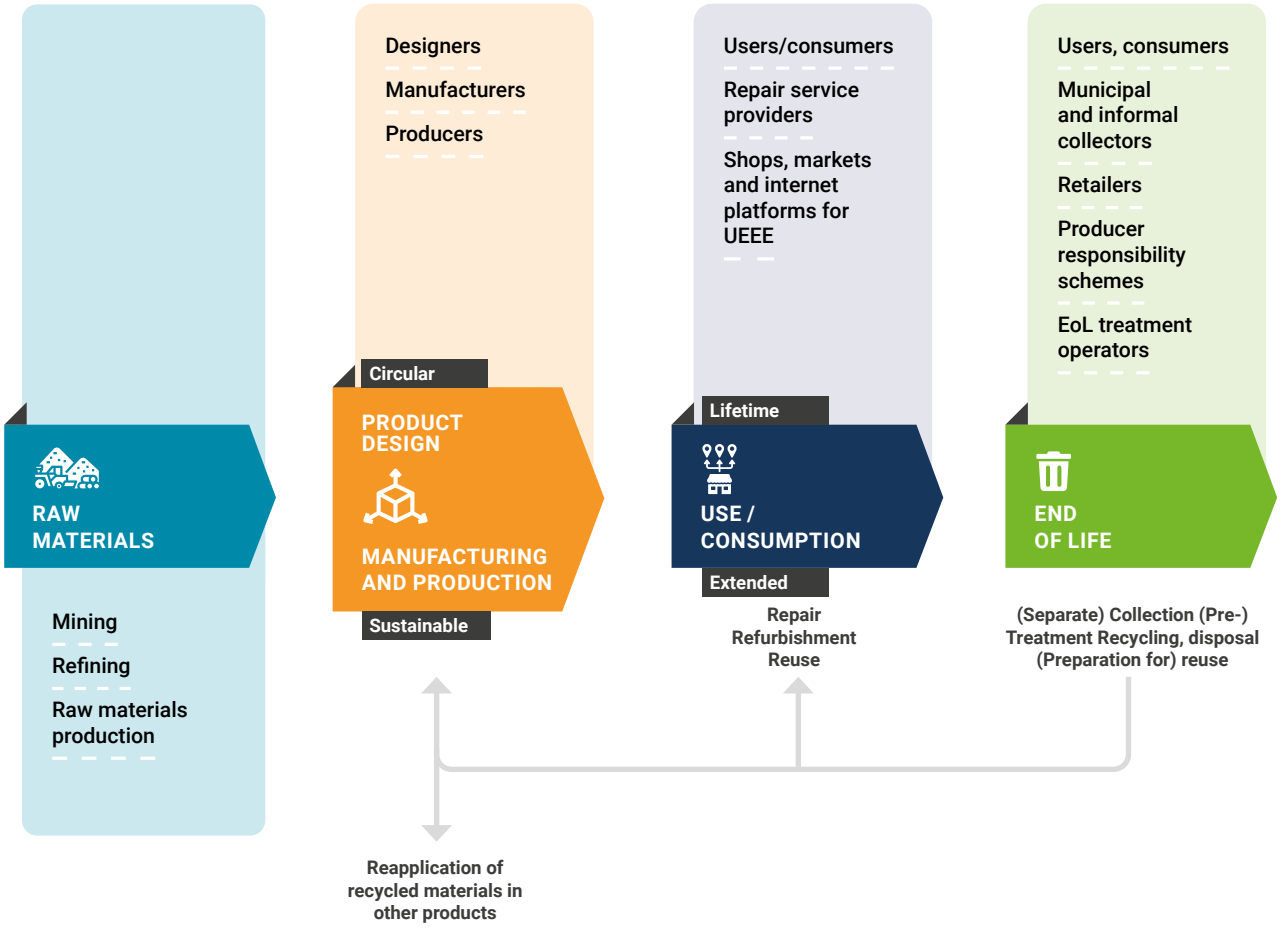
2. **Refuse, Reduce,** and **Reuse**: The processes in this group are driven by product users, who can either refuse to buy or consume a specific product, thereby sending a strong signal to the market; reduce their use of products, choosing a more sustainable way to better meet their consumer needs; or reuse the product for the same purpose for which it was designed, thereby retaining its value for an increased period of time.

3. **Repair, Refurbish**, and **Remanufacture**: The lifetime of used, damaged, or outdated products is extended by replacing defective components (i.e. repair), restoring a product's performance and/or functionality through maintenance operations (refurbish), or restoring the product's original as-new condition and performance (or improving it) through a standardised industrial process (remanufacture).

4. **Repurpose** and **Recycle**: Through businesses collaborating, discarded goods or components can be reused and adapted for another function, giving the material a distinct new life cycle. If goods or components cannot be reused, the waste materials are reprocessed into products, materials, or substances, though not necessarily for the original purpose. CoC already present in end-of-use (EoU) and EoL electronics should be eliminated.

EEE is a particular challenge in the context of CE. Figure 2-2 shows the EEE value chain from raw material production to the waste phase. The blue fields represent the linear economy value chain. Mining/raw material production (red shape outline) in the context of EEE manufacturing could not be identified in the focus countries, so this part of the value chain was not considered. The other blue fields represent the elements of the linear economy value chain that are, in principle, present in the focus countries, albeit to varying degrees. The green fields show elements of CE in the value chain, some of which may already be implemented, to a certain degree, in the focus countries.

Figure 2-2. Schematic representation of the electronics global value chain and associated key stakeholders accessed for the study



EEE consists of a multitude of components and chemical elements and are thus highly complex. They contain:

- Valuable and scarce materials, such as precious metals, as well as critical raw materials,[11] such as rare earth elements.
- Chemicals of Concern (CoC),[12] such as lead, cadmium, hydrofluorocarbons (HCFCs)[13], or certain halogenated flame retardants.

While CoC can, in principle, pose risks to human health and the environment at all stages of the life cycle of EEE, the complex composition and construction of EEE pose a specific challenge at their EoL once these products enter the waste phase. Separate collection of e-waste is required to enable its separate and specific treatment to save valuable resources and prevent CoC emissions into the environment. CE also requires the sound management and control of CoC to prevent their accumulation in material circles.

Due to their complexity, recycling and disposal of e-waste and parts thereof require knowledge and sophisticated procedures and processes. The related efforts cause costs that often cannot be covered from the sales of recycled materials, resulting in additional funding required for enabling sound collection, treatment, and disposal of e-waste.

[11] See the EU list of critical raw materials, https://rmis.jrc.ec.europa.eu/?page=crm-list-2020-e294f6

[12] Substances with the potential to harm human health and/or the environment.

[13] Also see UNEP: Addressing the Issue of Chemicals of Concern in Electronics: Challenges and recommendations for labelling initiatives, also see https://saicmknowledge.org/node/17673.

Furthermore, the complex structure of EEE is also a challenge for repair and refurbishment of EEE, which is often only feasible with specific expertise, provided spare parts are available. Similarly, the uncontrolled uptake of information technology (IT) in combination with continuous redesigns and new technologies has accelerated the obsolescence of products and restricts the availability of spare parts for older generations of EEE. As a result of this technology-driven paradigm, EEE often becomes obsolete at an early stage in its product life cycle, sometimes within merely a few months of its release.

The manufacturing of EEE includes globally organised supply chains. National governments can influence only parts of the EEE value chain in these globally organised networks of production and consumption in order to establish and enforce regulations as part of the transition to a CE, such as for sound production, avoidance of CoC and conflict minerals, or sound e-waste management. Transitioning toward and maintaining a CE requires national initiatives, regional support, and international cooperation.

Some of these challenges have already been addressed in part. The European Union (EU), for example, enacted and enforced Regulation (EC) No. 1907/2006 (REACH), covering the use of CoC in nearly all materials and products, and Directive 2011/65/EU (RoHS), restricting the use of CoC such as hexavalent chromium, lead, mercury, cadmium, and several phthalates specifically in EEE. Similar regulatory initiatives addressing chemicals in EEE have been established in nearly 20 other countries and regions, and in 11 more countries, similar regulatory initiatives are currently under development. (UNEP 2020) Directive 2012/19/EU (WEEE Directive) establishes targets for separate collection as well as sound treatment and disposal of e-waste, including minimum recovery and recycling rates and the extended producer responsibility (EPR) principle. EPR requires producers of EEE to finance the sound treatment and disposal of e-waste, either by joining collective producer responsibility organisations (PROs) or by setting up their individual producer responsibility (IPR) scheme to take back the e-waste generated by their own brand products that they placed on the market.

Directive 2009/125/EC (ErP Directive, EcoDesign Directive) entitles the European Commission to implement eco-design requirements for specific products and product groups, targeting, e.g., design for energy and material efficiency, design for repair, and minimum durability requirements for products or parts thereof. More recent efforts have targeted establishing a legal right to repair for consumers in the EU.[14]

The above efforts are important steps toward a more Circular Economy in the EU, but they also influence neighbouring countries, especially Eastern European countries. While some of these countries are already members of the EU, many of the other countries signed association agreements with the EU that require, among other things, the alignment of their national legislation to the EU's acquis. The CEE countries have in common that their economies were planned, as opposed to market, economies, and the majority of these countries were integrated into the Soviet-dominated Eastern Bloc. Following the collapse of the Soviet Union, most CEE countries began transitioning to market economies and political reforms. These changes have posed enormous challenges to the countries, and processes such as the transition to a CE and sound management of CoC are still ongoing. However, the states of CEs in the CEE countries generally varies substantially, despite the countries' common background.

2.2 Approach and Methods

To obtain information and insights into the status of CE and sound management of CoC in CEE, four focus countries were selected: Bulgaria, the Czech Republic, Georgia, and Moldova. The selection criteria included geographical and heterogeneous representation in the CEE region and availability of data. Some data were also initially collected in Belarus (see Annex C), but given the paucity of information and feedback from contacted local stakeholders, the matter was not pursued further.

This study takes a life cycle thinking approach covering the stages of the EEE value chain – from raw material acquisition through manufacturing, distribution, product use, and disposal – while simultaneously emphasising circular approaches, such as product lifetime extension, reuse, remanufacturing, refurbishment, and recycling, with a focus on the management of CoC used in the production of EEE and/or contained in EEE. To obtain the aspired information, the following stakeholders representing the various steps in the value chain were targeted:

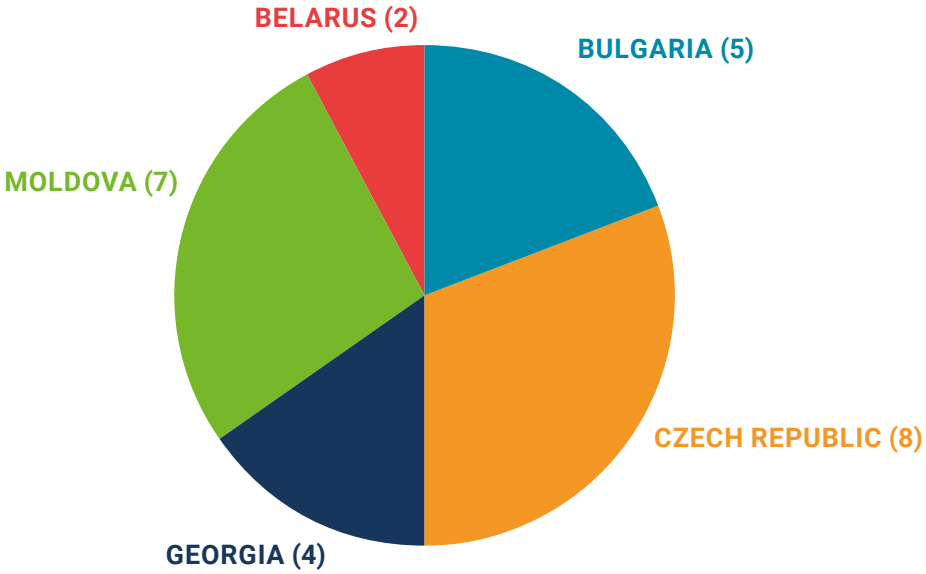
- Raw material producers, such as mining/refining companies, etc.
- Suppliers and EEE producers.
- Producer responsibility organisations.
- Repair and refurbishment service providers.
- End-of-Life (EoL) operators: collectors and treatment operators (recyclers, repairers, refurbishers).
- Auditors.
- National authorities.
- Civil society representatives (e.g., NGOs).
- Informal sector workers.

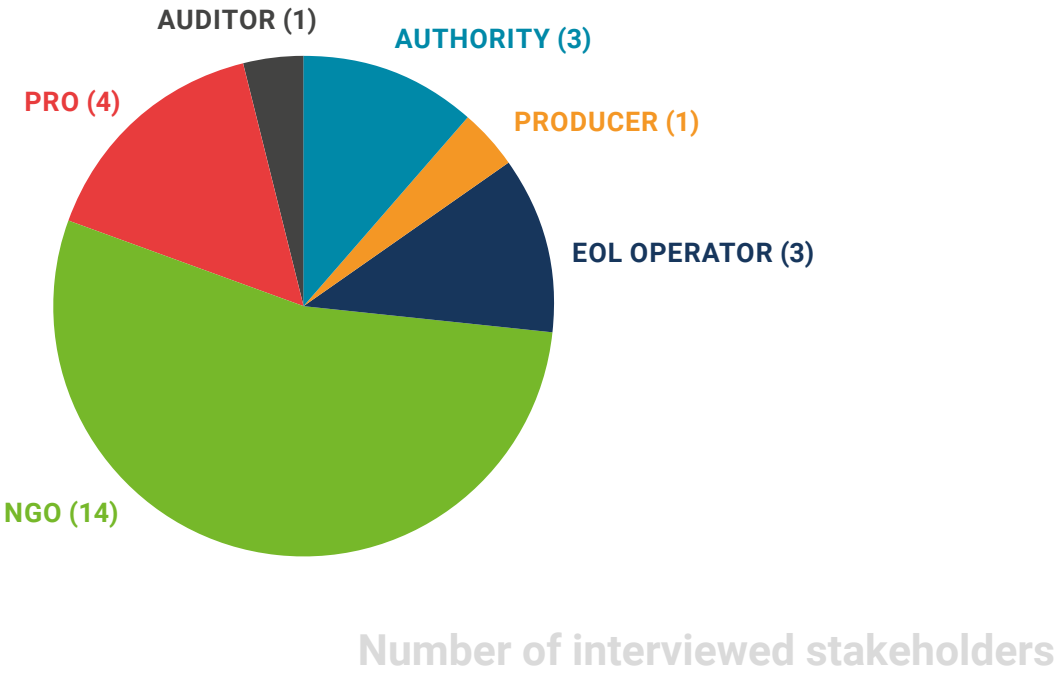
[14] C.f. https://www.europarl.europa.eu/news/en/press-room/20201120IPR92118/parliament-wants-to-grant-eu-consumers-a-right-to-repair

A specific stakeholder-oriented interview guideline was developed to ensure the completeness, accuracy, and homogeneity of the requested information. The interviews are the primary source of collected information, supplemented by a thorough literature review of reports, documents, and articles, as well as statistical data, for the EEE flows in the target countries/region.

Overall, a total of 26 stakeholders were identified and interviewed. Figure 2-3 shows their distribution throughout the focus countries and involved stakeholder groups. No access to informal sector workers or related associations was possible. Raw material producers/mining and refining companies with relevance for raw materials used in EEE could not be identified in the focus countries either.

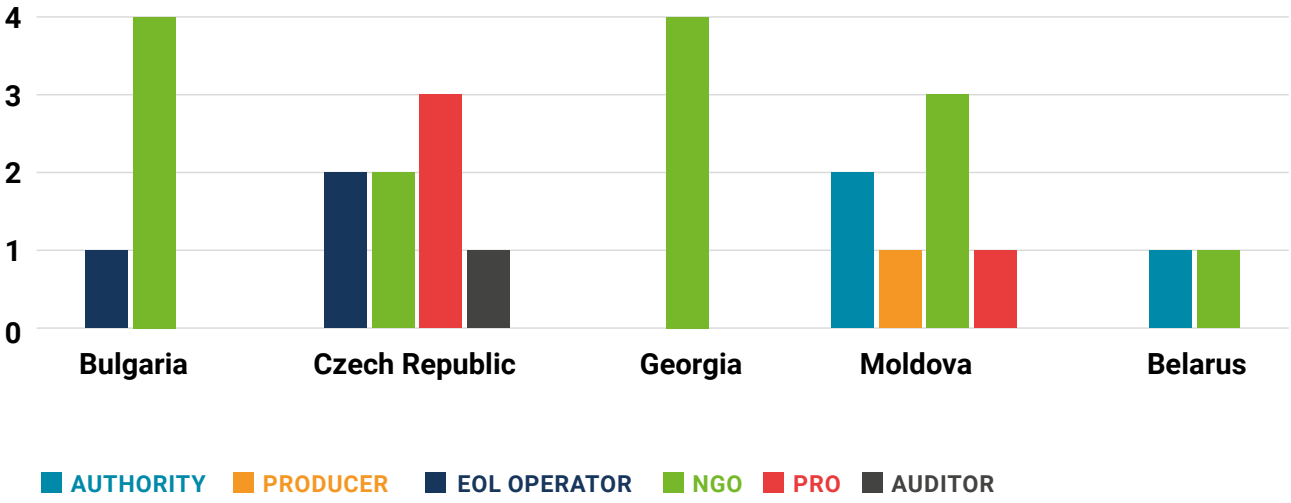
Figure 2-3. Number of interviews in focus countries (top) and of interviewed stakeholders (bottom)





Not all stakeholders in the focus countries could be accessed, and the degree of representation of the stakeholder groups in the interviews is not evenly distributed. Figure 2-4 shows the stakeholder groups and the number of related interviews in the focus countries.

Figure 2-4. Interviewed stakeholders in the focus countries



In addition to the interviews, statistics were collected and analysed. The statistical method used to quantify the EEE flow and the e-waste sectors followed the principles laid out in *E-waste Statistics: Guidelines on Classification, Reporting and Indicators (2018)*.[15] When official national data were not available, as in the case of Georgia, the datasets from UNU/UNITAR in *The Global E-waste Monitor 2020*[16] were used.

The information obtained from the stakeholder interviews, accessible literature, and EEE flow data were reviewed to assess the status and implementation details of CE value retention loops illustrated in Figure 2-1. The identified gaps were analysed, and recommendations with dedicated measures, including timelines for the various steps, were put forward for filling the gaps. This resulted in a roadmap for the four countries and region overall, with the latter based on the status and conditions applicable to at least most of the focus countries.

The results of the analysis were discussed with the interviewed stakeholders and other regional representatives in a workshop to consolidate and refine information, the recommendations, and roadmap. Additional information and feedback were received from the consultation, and a peer review was facilitated in order to amend and contextualise the interview results and account for the uneven representation of stakeholder groups in the interviews.

[15] Forti, V., Baldé, C.P. and Kuehr, R. (2018). E-waste Statistics: Guidelines on Classifications, Reporting and Indicators, second edition. United Nations University ViE – SCYCLE, Bonn, Germany. 2018. Available: http://collections.unu.edu/view/UNU:6477

[16] Forti V., Baldé C.P., Kuehr R., Bel G. *The Global E-waste Monitor 2020*: Quantities, flows and the circular economy potential. United Nations University (UNU)/United Nations Institute for Training and Research (UNITAR) – co-hosted SCYCLE Program, International Telecommunication Union (ITU) & International Solid Waste Association (ISWA), Bonn/Geneva/Rotterdam. https://www.scycle.info/wp-content/uploads/2020/12/GEM_2020_def_dec_2020.pdf

3. STATUS OF THE CIRCULAR ECONOMY IN THE ELECTRONICS SECTOR

3.1 Bulgaria

Bulgaria has a declining population of 6.92 million (2020) and a gross domestic product (GDP) of $10,006 USD per capita (2020).[17] The country has roughly half the per capita GDP of the Czech Rep ublic, but slightly more than twice as much than Georgia and Moldova. As a result, Bulgaria has the second highest per capita GDP of the focus countries. Within EU member states, Bulgaria ranks last, with 55% of the average EU GDP per capita.[18]

Over the past three decades, Bulgaria has been shifting from a centralised and planned economy to an open, market-based economy. Bulgaria has strong traditions in the electrical engineering and electronics sector and in machine-building, mechatronics, and automation. In the 1970s and 1980s, Bulgaria was among the leaders of electronics manufacturing in Eastern Europe.[19]

Current clusters include 'Mechatronic and automation', 'Electromobiles', 'Automotive Cluster Bulgaria', and the 'Marine Cluster'.[20] The electronics sector is of key importance for the Bulgarian economy. It includes 950 companies employing approximately 52,000 people and contributes 11% to the country's exports. From 2008 to 2018, the export of the electronics industry has quadrupled, from 766 million Euro in 2008 to 3 billion Euro in 2018. The main export market is Germany.[21]

The competent authority responsible for the waste management at the national level is the Ministry of Environment and Water (MOEW). The MOEW provides for the implementation of EU provisions in national legislation and develops the national waste management plan (WMP). There are 16 regional authorities at the national level, representing administrative structures of the Ministry and ensuring the implementation of the state policy on environmental protection at the regional level. These authorities carry out their activities on the territory of one or several districts and have regulatory, information, and control functions.

The country also has in place a strategy and action plan for transition to a Circular Economy.[22] The Bulgarian Waste Management Act (WMA), which entered into force in July 2012, introduced the requirements of the Waste Framework Directive (WFD) (2008/98/EC), including the polluter-pays and extended producer responsibility (EPR) principles, as well as the waste management hierarchy. Furthermore, the Act defines the requirements for separate collection, transport, storage, pre-treatment, reuse, recycling, recovery, and/or disposal of e-waste. Accordingly, separate collection of e-waste shall be implemented together with the producers and importers of electrical and electronic equipment in applying the EPR principle. The producers/importers have established associations for joint implementation of their obligations – so-called Recovery Organisations. As of 2021, there are 7 recovery organisations operating in Bulgaria.

The EU REACH regulation is implemented into the national Bulgarian legislative framework. As well, the EU WEEE Directive and the RoHS Directive are fully transposed through the Ordinance for the placing on the market's requirements for EEE and for e-waste's treatment and transportation. The Ordinance has been in force since 1 September 2006. The lead organisation for the transposition and implementation is the Ministry of Environment and Water. According to Eurostat, with 7.7 kg per inhabitant in 2017, e-waste collection targets were fulfilled. For some product categories, the amount of e-waste collected is higher than the amount of EEE placed on the market because the amount of EEE POM is underestimated. Due to treatment by the informal sector, e-waste quantities are not always reported adequately, and e-waste management practices are not conducted according to minimum standards.

Annex B – EEE and E-waste Flows in the Focus Countries gives further insights into data along the value chain for the four focus countries. No information indicating that mining/refining and raw materials production for manufacturing of EEE would be of relevance in Bulgaria was accessible. Figure 3-1 illustrates data as to EEE flows in Bulgaria along the EEE value chain.

[17] Statista, https://de.statista.com/statistik/daten/studie/278230/umfrage/bruttoinlandsprodukt-bip-pro-kopf-in-bulgarien/

[18] C.f. Eurostat, https://ec.europa.eu/eurostat/statistics-explained/index.php?title=GDP_per_capita,_consumption_per_capita_and_price_level_indices

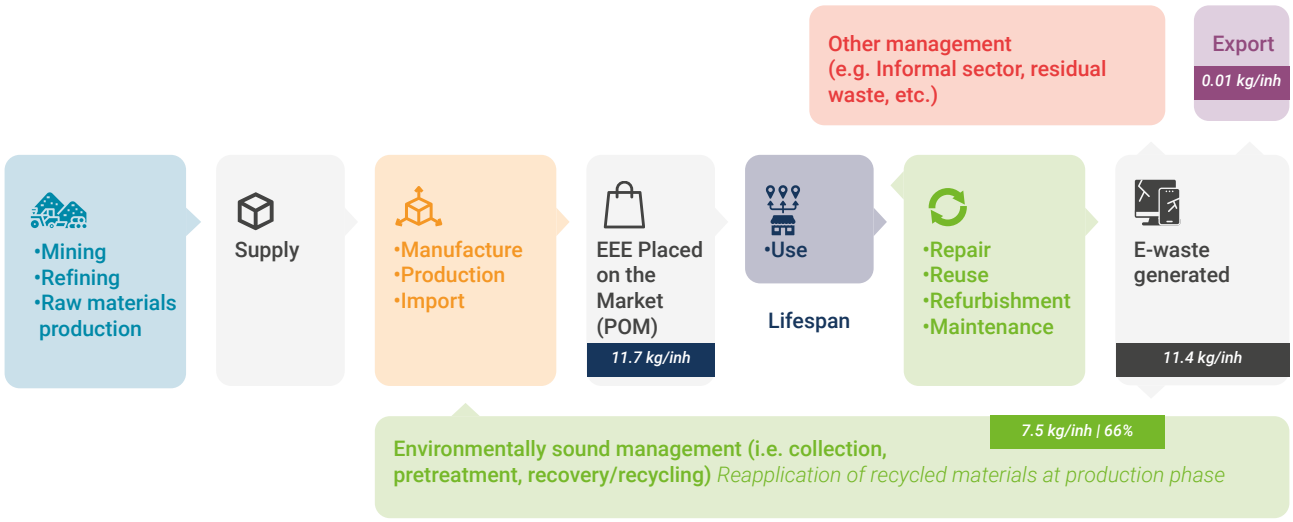
[19] South-East European Industrial Market (2017), https://www.see-industry.com/en/electronic-manufacturing-in-bulgaria/2/1634/

[20] STRATEGMA Agency (2016), Technology Roadmaps for The Thematic Areas, Defined in The Innovation Strategy for Smart Specialization of The Republic of Bulgaria 2014-2020. July. https://www.mi.government.bg/files/useruploads/files/innovations/trms_3rev_final_en.pdf

[21] Money BG (2019), https://money.bg/economics/proizvodstvoto-na-elektronika-za-desetiletie-se-prevarna-v-1-po-iznos-u-nas.html

[22] MOEW: https://www.moew.government.bg/bg/strategiya-i-plan-za-dejstvie-za-prehod-kum-krugova-ikonomika-na-republika-bulgariya-za-perioda-2021-2027-g-10910/

Figure 3-1. Quantitative information on EEE and e-waste along the value chain in Bulgaria[23] in 2018



Sources: Eurostat 2021 (based on 2018 data), The Global E-waste Monitor 2020[24] *Inh: inhabitant*

The rate of environmentally soundly managed e-waste in the above figure is calculated as a ratio of e-waste collected and e-waste generated in 2018.

3.1.1 Manufacture and Production of EEE

Resources

Bulgaria's circular material use rate, as an indicator for secondary raw materials substitution for primary raw materials to reduce the environmental impact, stands at 2.3% as of 2019.[25] Therefore, the material use rate is among the lowest within the EU, stressing the lack of a market for secondary raw materials in the country. The amount of recyclable raw materials that were exported to non-EU countries made up 867,902 tonnes (t), whereas the imports to Bulgaria made up 231,297 t and the intra-EU trade made up 533,702 t in 2020.

The performance of EU Member States (EU MS) in terms of environmental innovation is measured by the eco-innovation index, which is a composite indicator obtained by taking an unweighted average of 16 different indicators (see the definitions sections for more details). In 2019, Bulgaria's eco-innovation performance[26] ranked last among the EU28.

Bulgaria scores low in terms of resource efficiency outcomes such as water, energy, material, and greenhouse gas (GHG) emissions, as well as in eco-innovation inputs such as investments into eco-innovation activities and eco-innovation outputs. The country nonetheless performs better, though still below the EU average, in terms of eco-innovation activities. These include the performance of companies in material and energy-efficiency, as well as environmental management and socioeconomic outcomes – i.e. the employment rate in eco-industries and the exports of eco-industry goods.[27] Eco-innovation is a topic that will need to be addressed in Bulgaria in the future. Initiatives concerning the phasing out of CoC going beyond legal legislative requirements could not be identified.

[23] Data from 2018 are the latest figures, which include all quantitative information displayed in these figures for each of the focus countries.

[24] Eurostat: https://ec.europa.eu/eurostat/web/waste/data/database; The Global E-waste Monitor 2020: https://www.scycle.info/wp-content/uploads/2020/12/GEM_2020_def_dec_2020.pdf

[25] Eurostat (2021): European Commission. Eurostat. Circular Economy. Indicators. Monitoring Framework. https://ec.europa.eu/eurostat/web/circular-economy/indicators/monitoring-framework

[26] Eco-innovation Action Plan - Bulgaria (2019), https://ec.europa.eu/environment/ecoap/bulgaria_en

[27] European Commission (2019): EU Eco-Innovation Index 2019. EIO Brief. https://ec.europa.eu/environment/ecoap/sites/default/files/eio_brief_eu_eco-innovation_index_2019.pdf

Design

As an EU Member State, Bulgaria is bound by the mandatory provisions of Directive 2009/125/EG (Ecodesign Directive). While the Ecodesign Directive has primarily addressed energy efficiency of energy-related products in the past, in being driven by the Circular Economy agenda, the Directive has recently been amended to include material efficiency requirements. As such, Bulgarian producers of EEE will need to comply with the requirements for EcoDesign. Beyond that, no specific policy or industry approaches focusing on circular design strategies were identified in Bulgaria.

Manufacturing and Production

After the political changes in 1989, a deep restructuring of the Bulgarian economy, specifically of the industry, took place. The new context and the redistribution of international markets resulted in a new model of operation for Bulgarian companies, namely as sub-suppliers mainly to Western European producers of EEE. EEE is mostly imported, currently, as the local production levels are still very low. Used EEE (UEEE) is imported mainly from Austria and Germany, though a dearth of data exists as to the exact amounts. There are some Bulgarian companies that managed to establish themselves on the market with end products such as refrigerators, electric boilers, electric heaters, cooking appliances, cash registers, electricity meters, alarm and fire alarm equipment, electromedical equipment, accumulators, and electrical panels.[28]

The latest data available are for 2016, where the production of EEE contributed 5% to the value created by the manufacturing and production sector, an increase of 2.2% from 2005. Manufacturing and production consists mainly of electric motors, generators, transformers, and equipment for the distribution of electrical energy, batteries, wires and cables, lamps and lighting products, household appliances, etc. It is carried out by 565 companies. The leading companies operating are Liebherr-Hausgeräte Marica EOOD, Monbat AD, ABB Bulgaria EOOD, Schneider Electric Bulgaria EOOD, and Emka AD,[29] which are mainly international companies.

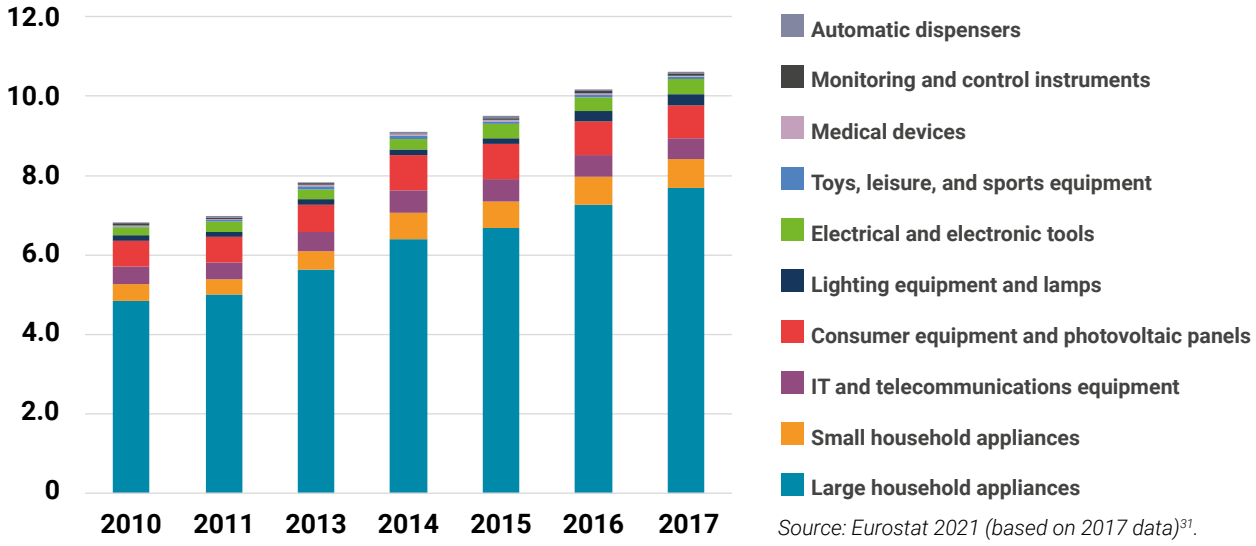
In Bulgaria, SMEs generate two-thirds of total value added and three quarters of total employment, exceeding the respective EU averages of 56.4% and 66.6% (EC, SBA Factsheet 2019). There are no publicly available data on the share of SMEs involved in the manufacturing of EEE or in the production of green products or services related to the EEE sector.

The proportion of SMEs that offer green products or services is still among the lowest in the EU.[30] According to an in-depth analysis of the business environment of Bulgarian SMEs, green products or services were offered by 15% of SMEs in Bulgaria in 2019, compared to 25% in the EU. The report does not break the sectors, products, and services down further.

Distribution

Based on data provided by Eurostat, Bulgaria's EEE placed on the market is equivalent to 74.8 kt (10.6 kg/inh) as of 2017, with the large majority (72%, 7.7 kg/inh) being large household appliances (category 1 of the WEEE Directive), as illustrated in Figure 3-2.

Figure 3-2. EEE placed on the market in Bulgaria, per category (2010-2018)



Source: Eurostat 2021 (based on 2017 data)[31].

[28] https://www.see-industry.com/en/electronic-manufacturing-in-bulgaria/2/1634/

[29] https://www.mi.government.bg/bg/themes/manufacture-of-electrical-equipment-27-526-276.html

[30] European Commission (2019), 2019 Small Business Act, Fact Sheet Bulgaria, https://ec.europa.eu/docsroom/documents/38662/attachments/4/translations/en/renditions/native

[31] https://ec.europa.eu/eurostat/databrowser/view/ENV_WASELEE__custom_1282251/default/table?lang=en

In 2018, EEE placed on the market in Bulgaria reached 11.7 kg/inh, a total of 81.9 kt. Since 2010, the EEE placed on the market in Bulgaria thus increased by 71%, but remains well below the EU average (21.7 kg/inh in 2018). According to information received from the authorities reporting to Eurostat, Bulgaria is also experiencing issues with free riders who do not report the volumes they placed on the market.[32]

3.1.2 Consumption, Use, Reuse, and Repair

In general, data on the Circular Economy in Bulgaria – such as consumption patterns, use, reuse, and repair – are lacking. A report on eco-innovation practices in Bulgaria indicates that there is minimal consumer pressure on the producers and service providers to offer more sustainable products and services. Despite encouraging new trends, the Bulgarian consumer is still primarily motivated by price. [33]

An analysis carried out in the framework of the Bulgarian strategy and action plan for transition to the Circular Economy[34] outlines that only 40% of consumers in the country recognise the mandatory energy efficiency labels and that they recognise only 10% of the voluntary eco-labels. The rules for their use, certification schemes, and control options are not known. This calls for further awareness-raising and training on the value of eco-labels, targeting different age and social groups. Consequently, the Bulgarian market for environmentally friendly products is underdeveloped, whereby consumers appear to show little interest in environmentally friendly products, resulting in a very low supply. High public attitudes toward the need to protect the environment can be used to enhance commitment to actions that contribute to a CE, such as buying UEEE and repairing, sharing, or renting products.

Figure 3-3. Donation initiative for reuse of old laptops, computers, and laptops (Ideas Factory)

Good practice example:
An initiative of the NGO Ideas Factory supported by the recycling company Ecologica was launched in 2020 to donate old office equipment (tablets, computers, smartphones) to organisations in need, e.g. schools.[35] The campaign has collected unused/old devices for children from villages and small towns and provided them with online learning devices.

Source: Ideasfactory, https://ideasfactorybg.org/bg/dari-ustroistvo-na-semeistvo-v-nujda/

Bulgaria has a long tradition of repairing products. Consumers are frequently willing to repair damaged items if the cost of repair is less than the cost of replacing the product. Expanding the market for repair and refurbishment services by incentivising companies with such activities, as well as by providing repair and refurbishment services in key locations in cities, in so-called reuse centers, would make this type of service more accessible and popular. Likewise, this is an opportunity to improve access to employment and training to acquire or improve vocational qualifications for repair work for people from vulnerable groups.

No data on UEEE quantities exists, either for UEEE entering the country or UEEE generated at the national level. According to one expert interview, Bulgarian households tend to keep their unused EEE (the 'hoarding effect') as opposed to handing it in for treatment. There are also a lack of public awareness-raising campaigns promoting collection and incentivising reuse and recycling behaviors.

There are no reliable data on how much waste enters the country. Each year, a substantial amount of EEE for secondary use enters via the Danube River, but there is no traceability of these EEE streams and no information as to when the streams become e-waste or what the EOL pathways are.

[32] Bulgaria has a "Public register of persons placing on the market EEE", which implies regular inspections of the companies selling EEE. These inspections verify whether the companies are included in the register and whether they have reported to the central authorities the correct quantities of EEE placed on the market.

[33] Eco-innovation in Bulgaria EIO Country Profile 2018-2019. https://ec.europa.eu/environment/ecoap/sites/default/files/field/field-country-files/eio_country_profile_2018-2019_bulgaria.pdf

[34] https://www.moew.government.bg/bg/strategiya-i-plan-za-dejstvie-za-prehod-kum-krugova-ikonomika-na-republika-bulgariya-za-perioda-2021-2027-g-10910/

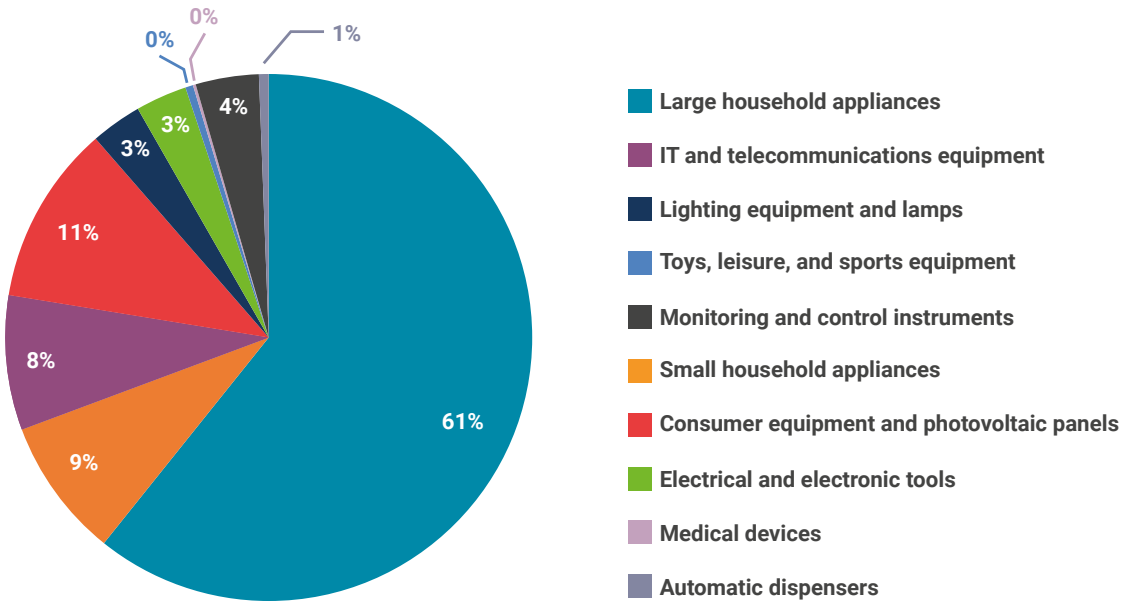
[35] Ideas Factory (2020), https://ideasfactorybg.org/bg/dari-ustroistvo-na-semeistvo-v-nujda/

3.1.3 End-of-Life of EEE

Generation of E-waste

The generation of registered e-waste per capita in Bulgaria has increased by 47%, from 7.8 kg/inh in 2010 to 11.4 kg/inh in 2018. In 2018, the country generated a total volume of 80 kt of e-waste.

Figure 3-4. Categories share in e-waste in Bulgaria (2018)



Source: The Global E-waste Monitor 2020.

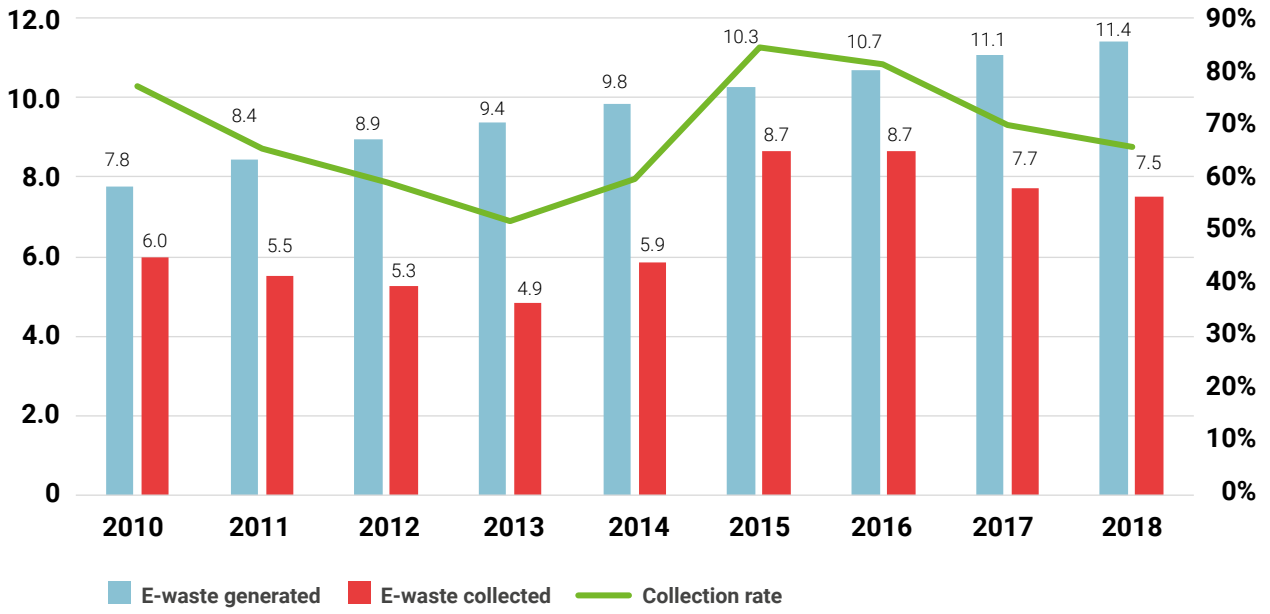
In 2018, the largest share in the amount of e-waste generated in Bulgaria was large household appliances, with 6.9 kg/inh (61%). Small household appliances, IT and telecommunications equipment, and consumer equipment comprised 28% of the e-waste (3.2 kg/inh), as illustrated in Figure 3-4 above.

E-waste Collection

As a member of the EU, Bulgaria must comply with the EU WEEE Directive, through its national transposition into Bulgarian national law. Each municipality has set up civic amenity sites for e-waste collection. Individuals can hand over all kinds of waste at such sites, free of charge. Besides civic amenity sites, retailers also take e-waste products back. According to the legislation, retailers must ensure the take-back of e-waste when new EEE in the same quantity and comparable type or usage is acquired. Furthermore, larger shops are obliged to take back e-waste even without the purchase of new EEE. The retailers is subsequently obliged to hand over the e-waste to the take-back system or to the processor of the e-waste without delay. Other e-waste collection channels, such as direct collection from households, have also been established from PROs or other e-waste pre-treatment companies. Collection from companies is also established through PROs. In the case of B2B, e-waste is collected by PROs or is taken back by the producer.

Bulgaria has one of the highest e-waste collection rates in Europe. Figure 3-5 shows its development since 2010. In 2018, the country registered 7.5 kg/inh of e-waste to be collected, a total of 52.6 kt. When referring to the amount of e-waste generated in the same year (2018), this corresponds to an e-waste collection rate of 66%. Based on the data reported by Eurostat, the quantity of e-waste collected has been even higher in the past, reaching 8.7 kg/inh in 2015 for a collection rate of 85%.

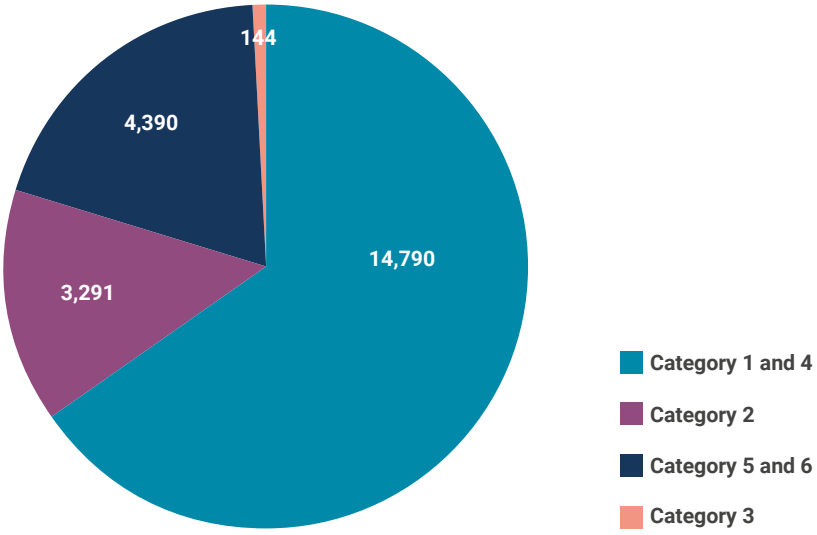
Figure 3-5. Development of e-waste collection rate in Bulgaria from 2010 to 2018



Source: The Global E-waste Monitor 2020 (E-waste generated); Eurostat 2021 (based on 2018 data) (E-waste collected).

Figure 3-6 below shows the distribution of collected e-waste from households in 2018, according to the six e-waste categories.

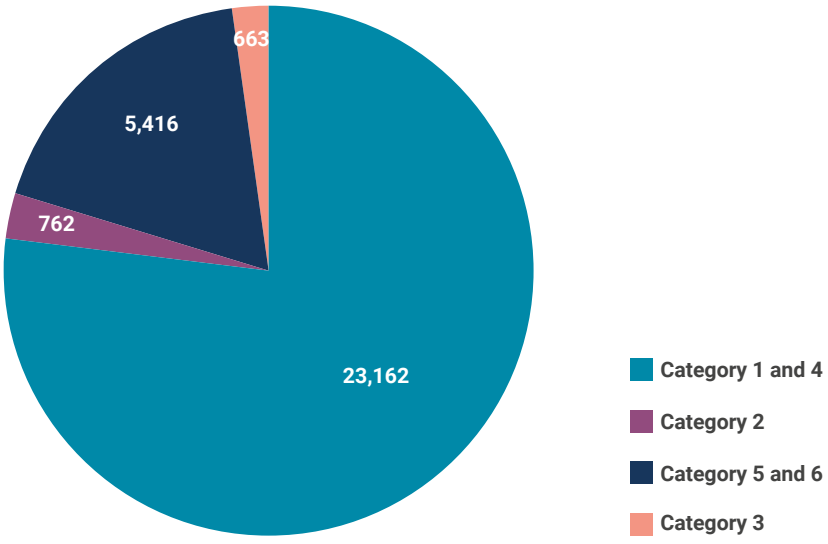
Figure 3-6. E-waste collected from Bulgarian households in 2018 (in tonnes)[36]



Source: Eurostat 2021 (based on 2018 data)[37]

Any person placing EEE for non-household use on the market is obliged to collect the amount of e-waste generated separately from the EEE placed on the market. Figure 3-7 below shows the distribution of collected non-household e-waste in 2018 by e-waste category.

Figure 3-7. E-waste collected from non-household use in Bulgaria in 2018 (in tonnes)



Source: Eurostat 2021 (based on 2018 data)[38]

[36] The 6 EEE categories of the WEEE Directive: category 1: Temperature exchange equipment, Category 2: Screens and monitors, Category 3: Lamps, Category 4: Large equipment, Category 5: Small equipment, Category 6: Small IT and telecommunication equipment.

[37] Eurostat (2020). Waste electrical and electronic equipment (e-waste) by waste management operations. https://ec.europa.eu/eurostat/databrowser/view/ENV_WASELEE__custom_1415482/default/table?lang=en

[38] Eurostat (2020): Waste electrical and electronic equipment (e-waste) by waste management operations. cit.

The Bulgarian authorities report that the increased quantities of e-waste collected in 2015 (c.f. Figure 3-5) were related to how the national coefficient used to determine the target in 2014 and 2015 was calculated. It resulted in a constantly increasing national collection target for the PROs, and in 2015, specifically, several additional collection campaigns were organised for meeting the national e-waste collection target. These campaigns were organised as collection for a fee handed out to citizens in the form of direct remuneration or vouchers. These 2015 measures were considered an exemption by the authorities since they resulted from organisational efforts and costs that exceeded the system's typical financial allocations and resulted in a much higher collection rate than legally necessary.

Bulgaria's generally high e-waste collection rate can be attributed to the fact that the country conducts regular campaigns for e-waste collection from private households, during which a large amount of 'hoarded' historical e-waste is collected. Another likely cause, based on the evaluation of the national authorities reporting to Eurostat, is that portions of e-waste collected from businesses and institutions are still reported as having been collected from households. There were no additional public reports or underlying information available to help comprehend the high collection in Bulgaria, except the official explanations from the national authorities as shown above.

While weekend collection campaigns are organised in different districts in the city of Sofia, as stated by one of the treatment operators interviewed, the campaigns do not entail regular collection points. The collection of e-waste is the duty of the municipality, but the municipalities often do not manage collection points for e-waste directly, relying instead on larger market chains (e.g. Technomarket, Zora, etc.) and their collection points.

No public data are available on the gender dimension in e-waste collection and treatment. According to interview respondents, there is an asymmetry between the equality of men and women, with males holding the majority of positions in e-waste collection and treatment.

Pre-treatment of E-waste

Several treatment operators are active in Bulgaria, such as Ecologica, Nadin, Makmetal, ElTech Bulgaria, Ecobultech, Teneco Recycling, and Nooro, indicating that both small and large recyclers exist in the country. Treatment operators of e-waste must hold an authorisation from the MOEW at the national level and from the respective local Regional Inspectorate of Environment and Water (RIEW). Treatment operators are not legally obliged to engage in awareness-raising activities. Nonetheless, one of the interviewed treatment operators mentioned being engaged in training programs for schools and in the organisation of waste collection and recycling for municipalities.

Treatment operators must report the amount of collected, pre-treated, and recycled e-waste to the executive environmental agency. One of the major obstacles is the accuracy of this information, emphasizing the need for stricter quality controls. Another concern is that the hard competition between PROs and end-of-life operators exerts downward pressure on prices, which hardly cover the treatment and recycling costs for ensuring state-of-the-art treatment.

Bulgaria's recycling targets are based on the EU WEEE Directive. In 2018, 66.7% of the materials contained in e-waste[39] were recycled,[40] scoring above the EU28 average of 42.1%.[41]

Final treatment and Disposal of E-waste and Parts Thereof

In Bulgaria, most of the operators treat e-waste through manual dismantling up to mechanical treatment. After depollution, parts such as printed circuit boards and plastic parts are exported to other countries for further treatment.

Treatment of CoC

Currently, treatment operators shall report the annual mass balance of hazardous substances and parts thereof to the Government.

A cooperation with neighboring countries, especially Romania, exists for the treatment of CoC, since adequate treatment capacities are absent in the country. Treatment of CoC is still an obstacle that will need to be addressed in the future.

The General Labor Inspectorate, as well as the regional environmental inspectorates, are responsible for the monitoring of the working conditions, as well as the measures taken when working with hazardous chemicals. The major treatment operators in the country are reported to be compliant with the occupational health and safety standards (OHSAS 18001 and the newer ISO 45001).

Role of the Informal Sector

An informal sector exists in Bulgaria, consisting of scavengers and ragpickers who gather recyclables in urban settlements and from landfills, but reliable data on the informal sector is lacking.

Exports of UEEE and E-waste

Based on the official reports of the Basel Convention, Bulgaria exported 40.4 tonnes of fluorescent and mercury-containing lamps in 2018, mainly to Romania. In 2019, that amount decreased to 30.3 tonnes. No data concerning e-waste imports were registered and reported.

[39] Calculated as product of collection rate and recycling/reuse rate.

[40/41] Eurostat (2021): European Commission. Eurostat. Circular Economy. Indicators. Monitoring Framework. https://ec.europa.eu/eurostat/web/circular-economy/indicators/monitoring-framework

3.1.4 Extended Producer Responsibility and Certification

EPR

Currently, seven producer responsibility organisations (PROs) (called 'Recovery Organisations' in Bulgaria) are operating in the country:

- Greentech Bulgaria, Sofia
- Eltechresource, Sofia
- National Organisation for Waste Disposal and Recycling, Sofia
- Transins – Recycling company for e-waste, Varna
- Ecobultech, Sofia
- Electroopolzotvoriavane, Burgas
- Teneko Recycling, Sofia

In principle, all of these Recovery Organisations may operate at the national level but may choose the method of collection and the settlements where they collect e-waste from, provided that they achieve the targets for collection and recycling/recovery, according to their market share. The usual manner of collection is through take-back systems at stores or collection points that are operated by private companies and financed by the Recovery Organisations through payment for each tonne of e-waste collected.[42]

IPR

As of 2018 (latest data available), there are no individual schemes on the territory of Bulgaria.

Standards and Certification

In Bulgaria, there are no treatment operators certified to operate in compliance with the WEELABEX[43] requirements. One of the interviewed treatment operators stated that they perform work according to ISO 9001:2015, ISO 14001:2007 and OHSAS 18001:2015 standards. In Bulgaria, the goal would be to have more treatment operators certified according to the EN 50525 series of standards[44] developed by the European Committee for Electrotechnical Standardization (CENELEC).[45]

3.1.5 Policies on EEE and E-waste

International Agreements

Bulgaria is Party to the main multilateral environmental agreements related to waste management. The country joined the Basel Convention[46] in 1996 and the Ban Amendment in 2019. Bulgaria has been Party to the Rotterdam and Stockholm Conventions since 2004 and 2005, respectively, and is also Party to the Montreal Protocol. Bulgaria also signed the Minamata Convention on Mercury[47] in 2013 and completed its ratification in 2017.

The Bulgarian Ministry of Environment and Water (MOEW) is the responsible authority implementing the multilateral agreements within the country. The Executive Environmental Agency (EEA) and a network of 15 Regional Inspectorates of Environment and Water (RIEW) are specialised control bodies of the ministry. The Customs Agency controls the fulfillment of the requirements for importation, exportation, and transit of wastes.[48]

EU Regulations

As is obligatory for EU member states, Bulgaria follows the REACH Regulation, and it transposed the WEEE and RoHS Directives into national legislation (Ordinance for the placing on the market's requirements for EEE and the treatment and transportation of e-waste).

National Regulations, Enforcement, and Financing

Bulgaria's regulatory and policy framework is not very different from that of other EU member states. There is a high number of strategies, roadmaps, and action plans that tackle innovations, energy, and resource efficiency. Currently, the main national strategies and action plans are[49]:

- National Development Program: Bulgaria 2030

The National Development Program[50] BULGARIA 2030 is a strategic framework document of the highest order in the hierarchy of national programming documents, determining the vision and general goals of the development policies in all sectors of general government, including their territorial dimensions. The document lays out three strategic goals, grouping the government intentions into five areas (axes) of development and setting 13 national priorities.

[42] https://www.acrplus.org/images/project/R4R/Good_Practices/GP_Sofia_WEEE-collection.pdf

[43] WEEELABEX standards, c.f. https://weee-forum.org/projects-campaigns/weee-labex/ for more information.

[44] For more details see https://www.weeelabex.org/

[45] Note: The WEEELABEX standards as well as the EN 50625 series of standards are certified by the WEEELABEX Organisation.

[46] Secretariat of the Basel, Rotterdam and Stockholm Convention (2021): Stockholm Convention. Countries. Status of Ratifications. Parties and Signatories. http://www.pops.int/Countries/StatusofRatifications/PartiesandSignatoires/tabid/4500/Default.aspx

[47] Minamata Convention on Mercury, https://www.mercuryconvention.org/en/parties

[48] For details c.f. http://www.basel.int/Portals/4/Basel%20Convention/docs/centers/proj_activ/tctf_projects/017.pdf

[49] https://www.interregeurope.eu/fileadmin/user_upload/tx_tevprojects/library/file_1594631784.pdf

[50] https://www.minfin.bg/en/1394

Transition to a Circular Economy is one of the national priorities, with three areas of impacts: material efficiency, waste management, and eco-innovations. The main goal of the sub-priority is to reduce the resource intensity of the country's economy and increase the efficiency of the materials used. Action will be taken to increase resource productivity throughout their life cycle as well as to increase the rate of circular (secondary) use of materials in the economy, stimulate product life extension, reduce waste, and control the need to extract new resources. The measures will be aimed at supporting enterprises in the introduction of low-carbon and non-waste technologies, reducing the amount of waste generated in the production process and the development of industrial symbiosis. Implementation of innovative business models promote interaction between products and services throughout the supply chain, including design, reuse, and recycling strategies, thus ensuring longer product use. A special focus will be on research and development, innovation related to the Circular Economy, and support for the development and implementation of circular business models.

- Strategy and Action Plan for Transition to a Circular Economy, 2021-2027

The strategy is still under development, coordinated by the Ministry of Environment and Water, and follows the EU Circular Economy Action Plan. The Bulgarian National Assembly's work plan for 2021 includes legislative changes regarding the Circular Economy. The timeline for passing those laws is unclear. Measures are envisioned for promoting the reuse of EEE, generating economic incentives for producers to put sustainable products on the market, and supporting recovery and recycling schemes (e.g. for packaging, batteries, electrical and electronic equipment, cars, etc). However, it is not yet clear what the specific measures will be.[51]

- National Waste Management Plan

In June 2021, the Government adopted the new National Waste Management Plan, 2021-2028. The Plan plays a key role in achieving a resource-efficient and sustainable waste management, as the analysis of the current situation shows significant potential for improving waste prevention and its management, better use of resources, development of new markets, and new jobs, while also reducing the harmful effects of waste on the environment. With respect to e-waste, the Plan confirms the collection targets of the WEEE Directive, stipulating the separate collection of at least 65% of the average weight of EEE placed on the market over the previous three years.

3.1.6 Science and Innovation

In Bulgaria, the cooperation between business and the world of science and technology, constituted primarily by universities and research institutions, is still low.

In 2016, however, Bulgaria adopted the strategy 'Better Science for a Better Bulgaria – Vision for a research policy strategy in support of society and economy'. The strategy is focusing on areas such as clean technology, energy-efficient technologies, green technologies, biotechnologies, waste technologies, environmental protection, utilisation of raw materials, bio-resources, and environmental monitoring.[52]

Furthermore, a Centre of Competence 'Clean technologies for a sustainable environment' has been launched in the field of water, waste, and energy for a Circular Economy (Clean & Circle), co-financed by the European Union.[53]

3.1.7 Recommendations for CE in the EE Sector in Bulgaria

- Based on the above findings and on proposals of involved stakeholders, the below recommendations may support the transition to CE specifically in Bulgaria. The country has approximately 565 manufacturers of EEE and parts thereof, including international companies with main offices outside Bulgaria. The transition to a Circular Economy is one of the national priorities but so far has not yet resulted in larger scale activities and implementations on the ground. **More sustainable production processes with minimal use of CoC** and partnerships between companies to achieve **industrial symbiosis** are one focus, which the Government and producers should pursue with the EEE producers in the country.
- The transition to CE requires research and development for innovating, developing, and implementing sustainable business models and technologies. So far, however, the exchange between **science and economy** is weak. Improvement options seem to be envisaged and should be followed up on to **provide the economy with ideas and insights** into CE measures and opportunities and to **allow researchers insights into economic practices** and realities for mutual understanding.
- Only 40% of consumers in Bulgaria recognise the mandatory energy efficiency labels, and consumers recognise only 10% the voluntary eco-labels. The Government, civil society, and producers should cooperate to **better inform consumers** so as to **motivate them to purchase more sustainable EEE**.

[51] Interview with Bulgarian Association of Electrical Engineering and Electronics.

[52/53] European Commission (2019): Eco-innovation in Bulgaria. EIO Country Profile. 2018-2019. https://ec.europa.eu/environment/ecoap/sites/default/files/field/field-country-files/eio_country_profile_2018-2019_bulgaria.pdf

- Bulgarian consumers are usually willing to repair damaged products. The respective **market for repair and refurbishment services should be incentivised**, as well as providing **repair and refurbishment services in key locations** in cities, in so-called reuse centers, making this type of service more accessible.
- The volumes of EEE placed on the market have been steadily increasing in recent years. Bulgaria indicates one of the highest e-waste collection rates in Europe (66% and up to 85% in the past), though the reliability of these figures is not clear. Regular **campaigns for e-waste collection** from private households, during which a good deal of hoarded historical e-waste is collected, may also partly explain this high collection rate. If so, these campaigns should be continued to maintain or further increase the collection rate.
- The Bulgarian authorities should avoid relying exclusively on data provided from collection schemes and waste managers. The **Government and PROs/ producers as well as EoL treatment operators** should **improve data reporting and substantiate the data** by applying additional data verification methods (e.g. surveys, site inspections and sampling, and regular statistics collection methods). **Data from importers of UEEE should be registered** as well to establish a reliable database. Such registrations would also help to avoid free riders in Bulgaria's EPR system, where crucial volumes in particular of UEEE placed on the Bulgarian market are not covered by registered producers' EPR obligations. Modernisation and integration of **digital technologies for e-waste-related data** (PoM, collection, reuse, repair, recycling quantities, amounts of CoC removed and processed, and imports/exports of UEEE/e-waste) may be helpful in this context.
- The ensure that the strongly competitive environment in Bulgaria's e-waste sector increases the efficiency of e-waste treatment instead of initiating a continuous downward trend on quality of treatment, **Certification of EoL operators** according to the EN 50625 standards is recommended, which will help to create a **level playing field** for high-quality treatment of e-waste.

3.2 The Czech Republic

The Czech Republic is member of the European Union. With a population of 10.7 million – which is expected to increase in the coming years – the country achieved a GDP of $22,943 USD per capita[54] in 2020, such that the Czech Republic is now regarded as high-income country.[55]

There is production of EEE in the country by some local producers, but most EEE production is dominated by large international producers.

The competent authority for waste management at the national level is the Ministry of Environment (MoE) in the Department for Waste Management. The MoE provides for the implementation of EU provisions in national legislation and develops the national waste management plan (WMP). Furthermore, there are competent authorities at the level of the country's 13 regions and in Prague. Each region draws up a regional WMP in compliance with the national WMP.

The WEEE Directive was transposed into national legislation in 2005 and includes the EPR system. The country has a well-functioning e-waste collection system with a dense network of collection points at the municipal level and services provided to consumers, which enabled the country to reach a collection rate of 57% of the e-waste generated in 2018.

E-waste treatment in the Czech Republic can rely on modernised technologies and infrastructures. The country has pre-treatment capacities for most e-waste categories. Most of the certified operators process the e-waste from manual dismantling up to mechanical treatment and either sell it for use or further treatment in the country or send it abroad.

In general, the end-of-life management system in the Czech Republic is advanced in the region. Repair activities have diminished in recent years due to economic constraints. However, several reuse centers have been realised or revitalised in the country through public funds. Social initiatives and specific cooperations on electronics repair with PROs or pre-treatment operators also have been launched.

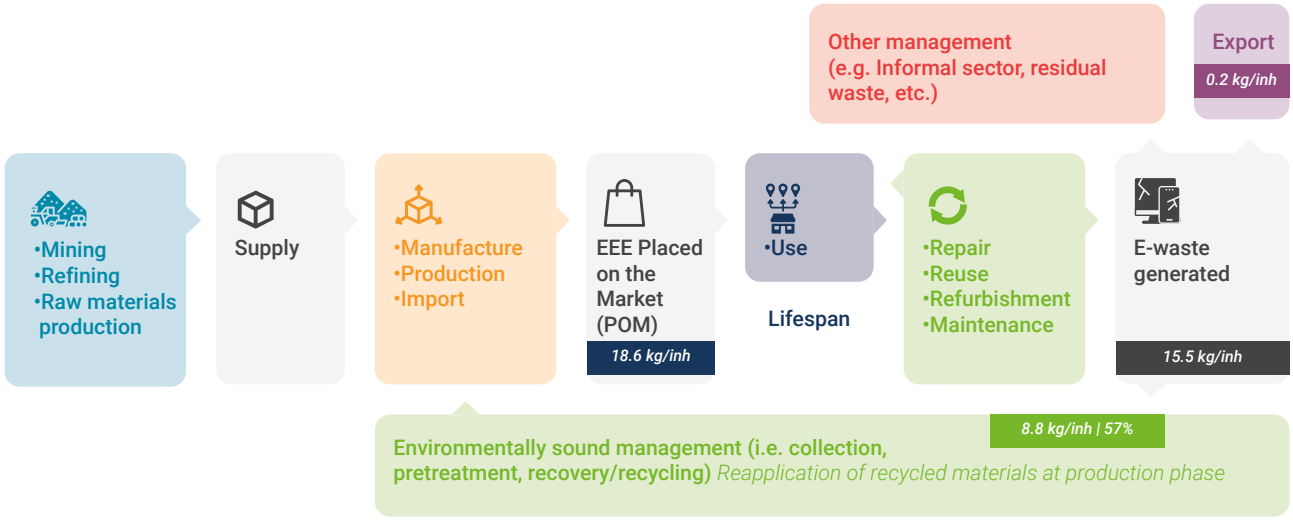
As in most countries, an informal waste management sector exists in the Czech Republic. Its activity mainly consists of scrap dealers dismantling e-waste, scavenging metals, and landfilling the remaining portion. However, the number of informal actors present in the country and the quantities of e-waste they manage is unknown.

[54] Statista, https://de.statista.com/statistik/daten/studie/14429/umfrage/bruttoinlandsprodukt-bip-pro-kopf-in-tschechien/

[55] C. f. The World Bank, https://data.worldbank.org/income-level/high-income

Figure 3-8 illustrates data as to EEE and e-waste flows in the Czech Republic along the EEE value chain.

Figure 3-8. Quantitative information on EEE and E-waste along the value chain in the Czech Republic[56] in 2018



Sources: Eurostat 2021 (based on 2018 data), The Global E-waste Monitor 2020[57] *inh: inhabitant*

The rate of environmentally soundly managed e-waste in the above figure is calculated as the ratio of e-waste collected and e-waste generated in 2018.

No information indicating that mining/refining and raw materials production for manufacturing of EEE would be of relevance in the Czech Republic was accessible.

3.2.1 Manufacturing and Production of EEE

Resources

The Czech Republic's circular material use rate, as an indicator for secondary materials substitution for primary raw materials to reduce the environmental impact, stands at 8.3% as of 2019.[58] Therefore, the Czech Republic's rate is below the EU28 average of 12.4% in terms of secondary raw material usage. The amount of recyclable raw materials exported to non-EU countries made up to 79,060 t, whereas the imports into the Czech Republic were 86,494 t, and the intra-EU trade totaled 2,082,338 t in 2020.[59]

The Czech Republic's eco-innovation performance ranked 15th in the EU28 in 2019. In eco-innovation activities (i.e. the performance[60] of companies in material and energy-efficiency as well as environmental management) and in socioeconomic outcomes (i.e. the employment rate in eco-industries and the exports of eco-industry goods), the country performs well and is above the EU average. Its performance is lower on eco-innovation outputs (i.e. patents, publications and media coverage related to eco-innovation). In terms of resource efficiency outcomes relating to material, water, and energy productivity as well as GHG emissions intensity, the Czech Republic's overall resource efficiency outcome is below the EU28 average,[61] which means that eco-innovation already has a relevant role in the Czech economy but should still be further developed in the near future.

Design

Requirements for EcoDesign of products are in place in the Czech Republic beyond those arising from EU legislation, such as Directive 2009/125/EG (Ecodesign Directive). For instance, the principles of 'eco modulation'[62] have been introduced in the new Waste Act, Act No. 542/2020 Coll., on end-of-life products of 2021, though the actual implementation is still in progress. Initiatives for phasing out CoC going beyond legal requirements exist, mainly in cases of large international producers setting up lists of substances to be avoided for their products and respective requirements for their suppliers ('restricted substances lists'). Local smaller producers do not have the financial capacities for such initiatives.

[56] Data from 2018 are the latest ones which include all quantitative information displayed in the figure.

[57] Eurostat: https://ec.europa.eu/eurostat/web/waste/data/database; *The Global E-waste Monitor 2020*: https://www.scycle.info/wp-content/uploads/2020/12/GEM_2020_def_dec_2020.pdf

[58] Eurostat (2021): European Commission. Eurostat. Circular Economy. Indicators. Monitoring Framework. https://ec.europa.eu/eurostat/web/circular-economy/indicators/monitoring-framework

[59] Eurostat (2021): European Commission. Eurostat. Circular Economy. Indicators. Monitoring Framework. cit.

[60] https://ec.europa.eu/environment/ecoap/sites/default/files/field/field-country-files/eio_country_profile_2018-2019_czech_republic.pdf

[61] European Comission (2021): European Commission. Environment. Eco-innovation Action Plan. The Czech Republic. https://ec.europa.eu/environment/ecoap/czech-republic_en

[62] Modulation of e-waste treatment fees so that producers of products with inadequate or no eco-design pay higher prices than others.

One of the interviewed NGOs in the Czech Republic is calling for a cleaner circular economy and a push to go beyond legal requirements and follow the example of some of the international frontrunners in the production of EEE, changing the design and avoiding CoC.

Manufacturing and Production

Manufacturing and production have a long tradition in the Czech Republic. The largest industry is the automotive industry. In 2019, a total of 4,791 manufacturers were registered on the list maintained by the Ministry of the Environment under the EPR[63]. Most producers of EEE in the country are large international producers. Consumer electronics producers in the Czech Republic include international companies such as Panasonic, Foxconn, Vishay, Acer, and Bang & Olufsen.

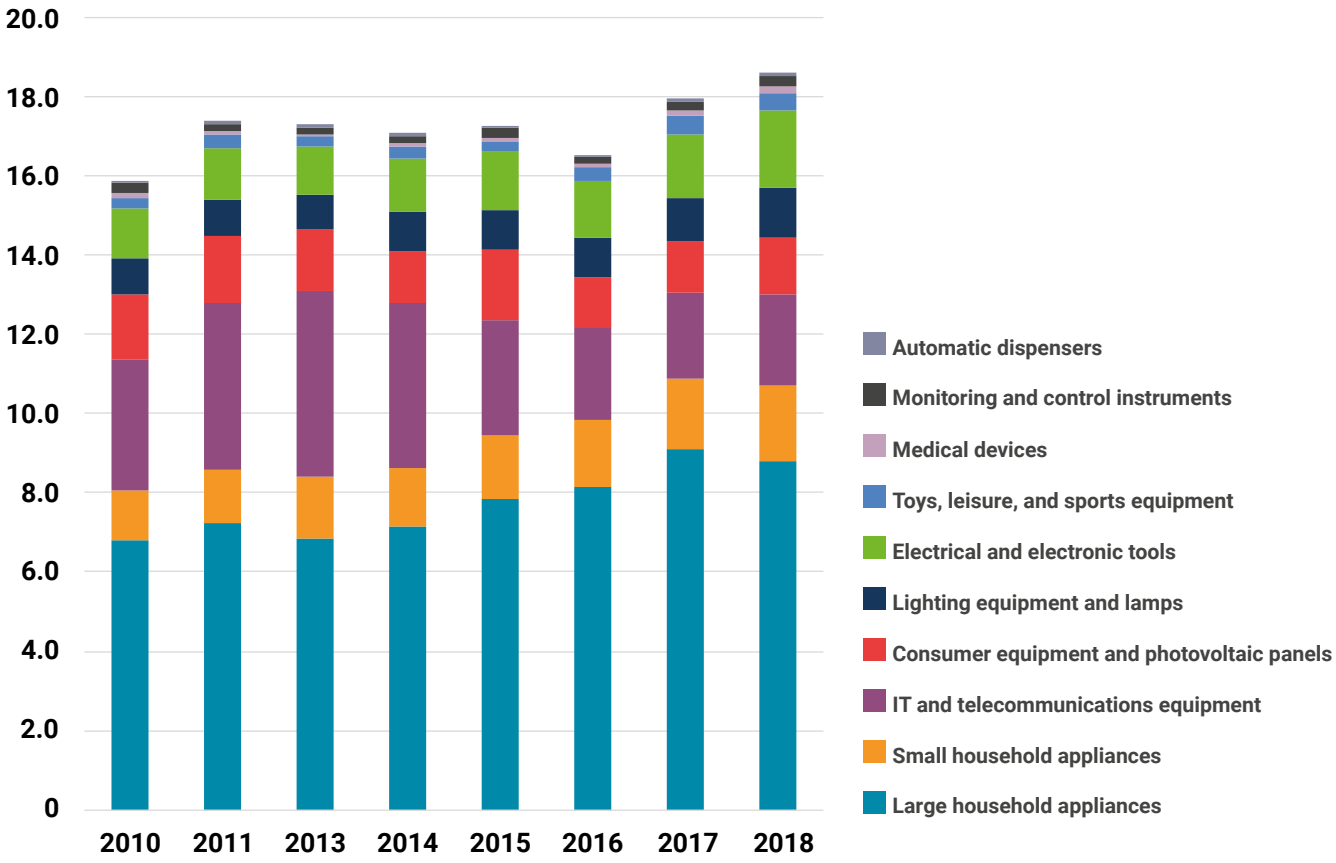
Regarding the working conditions of the sector, an NGO active in the Czech Republic confirmed that they are strictly controlled by the State Labour Inspection Authority in terms of health, safety, and cleanliness. It was also mentioned that the EEE production sector had to face a shortage of employees who are now mainly coming from outside the EU. Efforts were also made to ensure adequate working conditions for those migrant workers, and housing services were provided.

No specific information on the gender dimension in e-waste collection and treatment was provided during the interviews. However, according to an NGO, there is asymmetry between men and women, and men are most involved in the e-waste sector.

Distribution

The amount of EEE placed on the market in the country moderately increased over the past decade. In 2018, the country placed 196.9 kt (18.6 kg/inh) of EEE on the market, a notable increase from 174.2 kt (16.5 kg/inh) in 2016 (Figure 3-9). Large international producers dominate the market for EEE.

Figure 3-9. EEE PoM in the Czech Republic, 2010-2018



Source: Eurostat 2021 (based on 2018 data)[64].

The largest portion of EEE in 2018 in terms of mass was for large household appliances (47%, category 1 of the WEEE Directive, or 8.8 kg/inh).

[63] https://www.mzp.cz/C1257458002F0DC7/cz/odpadni_elektronicka_zarizeni_nakladani_cr/$FILE/OODP-vybrane_ukazatele_2019-20210419.pdf

[64] Eurostat (2020): Waste electric and electronic equipment (e-waste) by waste management operations. https://ec.europa.eu/eurostat/databrowser/view/ENV_WASELEE__custom_1282251/default/table?lang=en

3.2.2 Consumption, Use, Reuse and Repair

Repair activities have diminished in recent years, as replacement components are sometimes not available and repair is usually more expensive than buying newer and cheaper products. Most retailers and producers provide options for the return of used/waste products but do not provide repair services. However, some initiatives for electronics repair (e.g. Opravarna/Repairsys[65]) exist. The country also has a small market for spare parts, but not many Czechs are aware of it. Also, several reuse centers have been built or reactivated by the State Environmental Fund[66] around the country. It is likely that the implementation of some tax incentives for repair shops provided by the Government could help the survival of these economic activities.

Specific repair programs have been launched by PROs in cooperation with pre-treatment operators. The PRO Asekol and Opravarna, for example, provide free repairs of EEE from households on the first Saturday of every month.[67] Other projects are still in the early stages, mainly due to the legal implications experienced in most of the focus countries of repairing and placing back on the market products once they had entered the waste stream. Repair activities of electrical and electronic appliances are also performed by associations[68] that involve people with mental disabilities. These activities are currently minor and are oriented more toward a social inclusion perspective than on representing a scalable business case.

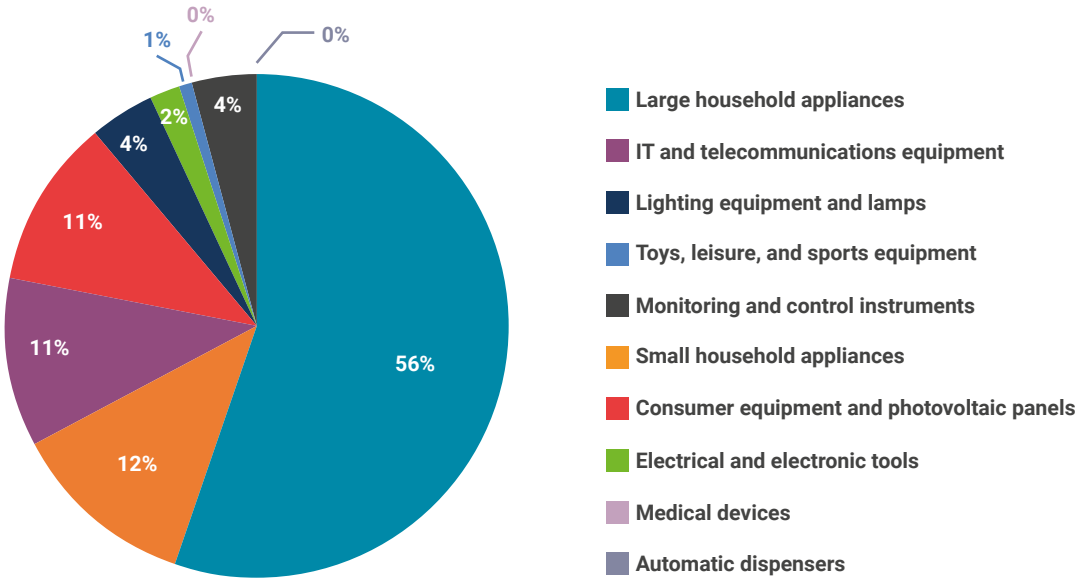
A UEEE market in the Czech Republic exists only for certain products – usually for costlier brands, such as high-priced mobile phones. An extension of the lifetime of the equipment at production phase would possibly increase the number of items that can benefit from a UEEE market. Nonetheless, consumers tend to buy new products, and functional aspects are preferred over environmental aspects. As well, consumers' awareness of lifetime-prolonging activities is still lacking.

3.2.3 End-of-Life of EEE

Generation of E-waste

E-waste generation has increased by 30% from 2010 to 2018, from 119.7 kt (11.5 kg/inh) to 164.0 kt (15.5 kg/inh).

Figure 3-10. Share of e-waste categories in e-waste generated (2018)



Source: The Global E-waste Monitor 2020.

Figure 3-10 above demonstrates that the highest share in the e-waste generated in 2017 was for large household appliances at 8.6 kg/inh, or 56% (by weight) of the total.

[65] C.f. Opravarna, https://www.opravarna.cz/ and Repairsys, https://www.repairsys.cz/en

[66] The State Environmental Fund of the Czech Republic (SEF), founded in 1992, is a major state institution of the environmental sector which has substantively contributing to investments aimed at protecting and improving the environmental condition in Czech Republic. https://www.sfzp.cz/en/

[67] C.f. https://www.asekol.cz/aktuality/projekt-opravarna-setri-zivotni-prostredi-i-penezenky/

[68] C.f. Charitaopava, https://www.charitaopava.cz/clanek/mate-pokazeny-elektrospotrebic-prijdte-v-sobotu-do-opravarny-/2576, or Marketa Reomone, https://www.marketaremone.cz/zpracovani-elektro-odpadu, whose focus is, however, on pre-treatment.

Collection of E-waste

As a member of the EU, the Czech Republic must comply with the EU WEEE Directive through its transposition into Czech national law (Act no. 185/2001 Coll.-Waste Act). Under Act 352/2005 on the details of management of e-waste, the collection targets are also defined. Also in 2005, the Czech Republic also introduced the EPR. Municipalities with populations above 2,000 must set up civic amenity sites for waste collection, where individuals can hand over all kinds of waste free of charge. The resulting 2,000 civic amenity sites are well-distributed throughout the country geographically, with nearly a third of all villages and towns in the country covered.

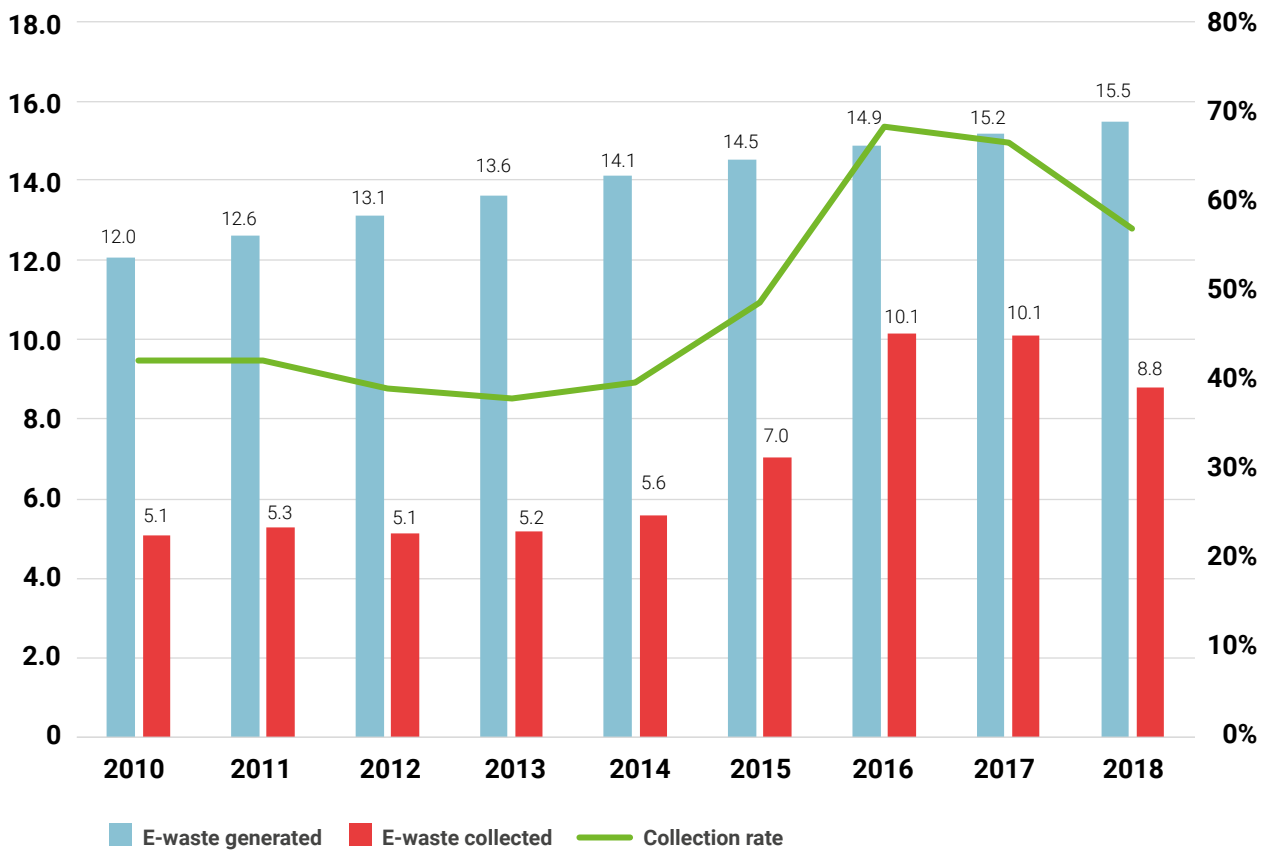
According to the legislation, retailers shall ensure the take-back of e-waste when new EEE is purchased, in the same number and similar type or use. Furthermore, larger shops are obliged to take back e-waste even without the purchase of new EEE. The retailers must hand over the e-waste to a take-back system or to the processor of the e-waste without undue delay. Non-compliance may entail fines upon controls by enforcement authorities, i.e. a division for waste management of the Czech Environmental Inspectorate[69] or regional and local authorities with inspection competences in the area of waste management.

Other e-waste collection channels, such as direct collection from households, are also established by PROs, as well as collection and take-back from companies including B2B.

As is the case in most EU member states, reaching the current 65% collection target, as stipulated in the WEEE Directive (EUR-Lex 2018),[70] remains a significant barrier for the Czech Republic. The collection of lightweight e-waste, such as mobile phones and small household appliances, is a particular challenge. Private initiatives[71] promote and offer collection and/or reuse of mobile phones.

Based on the data reported to Eurostat, the Czech Republic collected 8.8 kg/inh of e-waste out of the 15.5 kg/inh generated in 2018, for a collection rate of 57% (Figure 3-11).

Figure 3-11. E-waste collected and collection rate in the Czech Republic (2010-2018)



Source: The Global E-waste Monitor 2020 (E-waste generated); Eurostat 2021 (based on 2018 data) (E-waste collected).

[69] Czech Environmental Inspectorate, https://www.cizp.cz/en

[70] EUR-Lex (2018): Europa. EUR-Lex home. EUR- Lex. - 32012L0019 – EN. Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (e-waste). Text with EEA relevance, http://data.europa.eu/eli/dir/2012/19/oj

[71] C.f. Remobil, https://remobil.cz/, venujmobil, https://venujmobil.cz/

The e-waste collection rate in the country has registered a sharp rise, from 49% in 2015 to 68% in 2016, followed by a slight decrease in 2017 and 2018. One reason for the steep increase, as reported by the authorities, could be that not all the e-waste collected in a certain year was also treated in the same year. Some of the e-waste is collected and stored to be treated and recovered in a following year (e.g. due to infrastructure capacities). In 2015, PROs likely reported what was collected during that calendar year as 'e-waste collected and treated', but also what was collected previously and treated in 2015. Eurostat asks for data of e-waste that is both 'collected and treated' as opposed to e-waste that is merely 'collected', which may have caused a partial double counting.

One of the main issues highlighted by NGOs in the Czech Republic is the lack of knowledge among consumers about the fact that EEE must be collected separately. Consequently, it may end up in unanticipated channels, e.g. in general municipal waste bins, and end up in landfills; such paths are still reported as common practice in the Czech Republic or in potentially substandard treatment. Activities have been organised by the PROs in recent years to intensify e-waste collection and motivate people, include workshops, charity initiatives, school education, and recruitment of people with disabilities for employment.

Pre-Treatment of E-waste

The recycling targets are based on the WEEE Directive. In 2018, 43.6% of the materials contained in e-waste[72] were recycled.[73]

Both small manual recycling operators and modernised large recyclers exist in the Czech Republic. The country has pre-treatment capacities for most e-waste categories, but there is a sole shortage for treatment capacities of lighting equipment.

Pre-treatment operators are involved in the separation and treatment of CoC from e-waste and components thereof, such as PCB capacitors, mercury, and plastics containing brominated flame retardants (BFRs). Some parts such as printed circuit boards and BFR plastics are exported for final processing or incineration with emission control and potential energy recovery. Treatment operators are obliged to report the annual mass balance of hazardous substances and parts thereof to the Ministry of Environment.

One major challenge in the Czech Republic expressed by interviewees is the processing of rising quantities of e-waste and continuously rising labor costs. Another issue mentioned by several interviewed recycling operators is the recycling of plastic parts from e-waste and the lack of markets for such material. Treatment operators are involved in minor awareness-raising activities, such as publishing information about the possibilities of recycling and the benefits of a separated collection.

According to an NGO operating in the country, the waste sector is one of the lowest-paying sectors in the country. However, this information was referred to the general waste sector, so it might not apply to the e-waste sector.

Final Treatment and Disposal of E-waste and Parts Thereof

In the Czech Republic, most of the certified operators process the e-waste from manual dismantling up to mechanical treatment and either sell the e-waste for use or further treatment in the country or send it abroad (Novotny 2021). The latter applies specifically to printed circuit boards and plastics, which are usually pre-processed in the country and then exported either for recycling or incineration (brominated plastics). Once collected separately, the e-waste is professionally treated. For e-waste that ends up in household bins or that is not collected, landfilling is still reported as a common practice, which applies mainly for small equipment such as kitchen appliances. In general, considering the e-waste collection rate and the treatment infrastructure and standards, it can be concluded that the end-of-life management system in the Czech Republic is advanced in the region.

There are associations[74] in the Czech Republic with the mission of providing professional services to socially and medically disadvantaged people, including their employment on the labor market. The electronic sector is among those where these associations are active to include marginalised workers, such as through sheltered workshops.

Treatment of CoC

In the Czech Republic, use and treatment of CoC must comply with the European Union regulations – RoHS Directive, REACH regulation, and WEEE Directive. Based on the information received from a WEEELABEX representative, all requirements on occupational health and safety (OHS) that are mandated by the legislation are in place, with specific measures to be implemented for highly hazardous substances. Also, the treatment of hazardous substances in the country is verified by regular monitoring and supervision. Nonetheless, according to an interviewed stakeholder (NGO), one of the main challenges for the adequate treatment of hazardous substances and components in e-waste is the high labor costs for separating and treating/disposing them. Hazardous substances diluted in parts from e-waste treatment may be a stumbling block to achieve a full and clean Circular Economy in the sector. If not properly separated, hazardous substances can contaminate parts and accumulate in recycled materials, thus affecting the quality of recycled materials.

Nonetheless, starting in 2023, all treatment operators in the Czech Republic will be obliged to treat e-waste according to EN 50625 standards and to be certified, which can be expected to improve the treatment of CoC in the near future.

[72] Calculated as product of collection rate and recycling/reuse rate.

[73] Eurostat (2021): European Commission. Eurostat. Circular Economy. Indicators. Monitoring Framework. https://ec.europa.eu/eurostat/web/circular-economy/indicators/monitoring-framework

[74] https://www.charitaopava.cz/

Role of the Informal Sector

As in the other countries discussed herein, an informal sector is active in the Czech Republic, consisting mainly of scrap dealers. Usually, they have the permission to collect and treat metal waste in metal scrap yards and collection points (quite common in the Czech Republic and authorised by the legislation) and metal processing plants. They sometimes also collect e-waste, which is illegal.

The informal sector's interference with e-waste is also influenced by the introduction of the open scope by the WEEE Directive a couple of years ago, which now covers additional products as e-waste that were already on the market but have different and well-established collection channels from the time when they were still outside the scope of the WEEE Directive. This means that producers are required to develop new channels to intercept the products that recently entered in the scope. Until this process is completed and structured, and until producers and consumers are educated and become fully aware of the new products they are responsible for, the informal actors can more easily access the e-waste outside the formal system.

The activity of the informal sector consists mainly of dismantling, metals scavenging, and landfilling of the remaining portion. The number of informal actors present in the country is unknown. Moreover, it is quite challenging to understand the entire size of the sector of e-waste that is treated with substandard techniques. This is due to the fact that some recyclers can also have permits for treating e-waste, be in accordance with collection schemes, and be integrated in the management cycle, but in practice they can apply substandard treatments (bad formal treatment operators) and not be in compliance with the legislation. In such instances, it should be the responsibility of PROs/producers to apply due diligence in contracting their treatment operators and ensuring that their agreements are respected. The obligatory certification to the EN 50625 standards, starting in 2023, should help increase the transparency and quality of the e-waste treatment market.

Based on a study conducted in 2020[75], in Eastern Europe, 1.7-2.7 kg/inh of e-waste, or approximately 20% of the e-waste generated, is treated with substandard techniques as metal scrap or by informal actors. It can also be assumed that the Czech Republic stands close to that figure, though the data was not confirmed by any firsthand information.

Exports of UEEE and E-waste

Based on the data reported to the Basel Convention, the Czech Republic exported 2.0 kt of e-waste to Germany and the Netherlands in 2018, whereas in 2019 that amount decreased to 0.8 kt. Most exports were related to CRT screens and glass waste from CRT screens and computer monitors. This exported e-waste is mainly destined to final treatment after having been pre-processed in the Czech Republic. Also in 2018, the Czech Republic imported 2.1 kt of e-waste, mainly from Croatia, Germany, and Slovakia. Data for 2019 show that the import increased to 5.5 kt of e-waste from the Czech Republic to Germany, Denmark, and Slovakia. The biggest portions of these imports were for computer monitors, TV screens, and refrigerators.

However, despite monitoring e-waste exports, like in many EU member states and other countries, there is still no full tracking system for equipment/parts leaving the Czech Republic and their subsequent fate. For example, based on what was stated during an interview with an NGO, the e-waste is sometimes exported under the Basel Convention to be repaired and recycled, but it is also possible that it is being exported to Germany (e.g. toward big harbors, such as in Hamburg) and then exported to lower income countries, e.g. countries in Africa.

3.2.4 Extended Producer Responsibility and Certification

EPR

The EPR system has been well-established for e-waste in the Czech Republic since 2005. PROs are mandatory. According to the national transposition of the WEEE Directive, take-back of e-waste must be ensured without payment. Awareness-raising activities in terms of collection of e-waste, e.g. in schools or for other consumer groups, is part of the producers'/PROs' EPR obligations. During an interview, Remobil reported that PROs in the country are legally obliged, through provisions, to engage in raising awareness of consumers.

Via PROs, producers finance the pickup of the separately collected e-waste from the amenity sites as well as the transportation, handling, treatment, and disposal of the separately collected e-waste. PROs collect and administer EPR fees from producers, which are refinanced by consumers at the time of EEE purchase. Since 2021, it has been mandatory in the Czech Republic to make this fee transparent for customers as a 'visible fee' at the time of purchase.

In the Czech Republic, there are five PROs operating in all 14 Czech regions, which by law could collect all EEE categories: Asekol, Elektrowin, Ecolamp, Rema, and Retela (acquired by Asekol).[76] Historically, they were more commonly focused only on some EEE categories. Most of them are strictly independent these days, forming a very competitive market where they try to obtain more clients (producers) and fulfil their EPR obligations. Some are mainly working with some selected EEE categories (e.g. Electrowin with large appliances), whereas others, such as Asekol, collect all categories. Furthermore, the country also has ten PROs related to PV panels only.

[75] C.P. Baldé, M. Wagner, G. Iattoni, R. Kuehr, In-depth Review of the e-waste Collection Rates and Targets in the EU-28, Norway, Switzerland, and Iceland, 2020, United Nations University (UNU) / United Nations Institute for Training and Research (UNITAR) – co-hosting the SCYCLE Program, Bonn, Germany.

[76] https://www.mzp.cz/C1257458002F0DC7/cz/kolektivni_systemy_oeez/$FILE/OODP-kolektivni_systemy_kontakty-20202805.pdf

IPR

Most producers fulfil their EPR obligations through PRO schemes. There are also 45 IPR schemes[77] reported to be active in the country, which are usually set up by producers of specific EEE, such as for medical devices.[78]

Standards and Certification

In the Czech Republic, several standards and certifications exist relating to production and e-waste, such as the ISO 9000 and ISO 14000 series, the EN 50625 series, the EN 50614 (requirements for reuse[79]), and the R2 standard developed in the U.S. Audits are carried out by the WEEELABEX Organisation (EN 60625 series) or by other notified bodies (ISO standards).

There are currently ten treatment operators certified by WEEELABEX in the Czech Republic for selected waste streams – mostly temperature equipment (WEEELABEX 2021[80]). Apart from WEEELABEX standards, R2 standards are also implemented. This is the case mainly for treatment operators that cooperate with U.S.-based IT equipment producers. The PROs/producers, as well as market pressure or legal requirements, cause operators to become certified. Some treatment operators are still in the process of achieving the compliance with the new technical standards (EN 50625 series), mainly due to limited size of the plants and the high costs implied. However, starting in 2023, it will become obligatory for treatment operators to be certified according to EN 50625 standards, due to the new Czech legislation on end-of-life products.

3.2.5 Policies on EEE and E-waste

International Agreements

The Czech Republic is Party to the main multilateral environmental agreements related to waste management. Specifically, the country became Party to the Basel Convention in 1993 and the Ban Amendment in 2019; has been Party to the Rotterdam and Stockholm Conventions since 2004 and 2005 respectively; and is Party to the Montreal Protocol. The Czech Republic also signed the Minamata Convention on Mercury in 2013, the ratification process of which was completed in 2017.

EU Regulations

As an EU member state, the REACH regulation applies in the Czech Republic. Specifically for EEE, the recast RoHS Directive (*Directive (2011/65/EU)*) 'Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (EEE)' was adopted into the national legislation in 2013. The Government Regulation No. 481/2012 Coll. bans the placing on the EU market of new EEE containing more than 0.1% of lead,[81] mercury, hexavalent chromium, polybrominated biphenyls (PBB) and polybrominated diphenyl ethers (PBDE) (both brominated flame retardants), and four phthalates.[82] For cadmium, the allowed threshold level is only 0.01%.

The Czech Trade Inspection Authority (CTIA) is the responsible authority for enforcing the RoHS regulation within the Czech Republic under auspices of the Ministry of Industry and Trade, which is the authority liable for proper implementation of the RoHS regulation. Based on the analysis of NGOs in the Czech Republic, the electronic sector should be the primary sector in which hazardous substances are regulated more strictly and where regulations should push for alternatives, since there are many hazardous substances involved.

National Regulations, Enforcement, and Financing

There are several national legislations incorporating EU regulations into national law. The current Act no. 185/2001 Coll., Waste Act, emphasises waste prevention, defines the hierarchy of waste handling, and promotes the fundamental principles of environmental and health protection in waste handling, also in relation to CoC. A new act, Act No. 542/2020 Coll. on end-of-life products, was implemented in 2021. The Act on End-of-life Products stipulates details applying to the take-back of electrical and electronic equipment and ways of disposing both electrical and electronic equipment and waste electrical and electronic equipment. It is based on the principle of the producer's individual duty to assure the treatment of a product after its useful life expires, motivating to apply Circular Economy approaches such as sustainable design, banning of hazardous substances, reuse, and recycling. Most of those principles are mentioned and described only qualitatively in the legislation and are not fully enforced or incentivised. Details about EEE placed on the market, e-waste collected, information campaigns, financing, etc. must be reported to the Ministry of Environment. The producers and PROs are obliged to provide these details on an annual basis. The registry for these data is publicly available. The Czech Environmental Inspectorate is responsible for the monitoring of related activities, and high penalties can be charged in cases of violations. A national strategic framework, 'Circular Czechia 2040'[83] is currently being developed to promote Circular Economy in the Czech Republic.

[77] https://www.mzp.cz/C1257458002F0DC7/cz/odpadni_elektronicka_zarizeni_nakladani_cr/$FILE/OODP-vybrane_ukazatele_2019-20210419.pdf

[78] https://www.mzp.cz/C1257458002F0DC7/cz/odpadni_elektronicka_zarizeni_nakladani_cr/$FILE/OODP-vybrane_ukazatele_2019-20210419.pdf

[79] C.f. https://www.en-standard.eu/bs-en-50614-2020-requirements-for-the-preparing-for-re-use-of-waste-electrical-and-electronic-equipment/

[80] WEEELABEX (2021): Our vision. Our mission. Our Organisation. https://www.weeelabex.org

[81] 100%: weight of the homogeneous material, not the entire component or product.

[82] Bis(2-ethylhexyl) phthalate (DEHP), butyl benzyl phthalate (BBP), dibutyl phthalate (DBP), diisobutyl phthalate (DIBP).

[83] OECD (2021), 'Towards a national strategic framework for the circular economy in the Czech Republic: Analysis and a proposed set of key elements', *OECD Environment Policy Papers*, No. 27, OECD Publishing, Paris, https://doi.org/10.1787/5d33734d-en

3.2.6 Science and Innovation

In general, most innovation at the EEE level is happening abroad, as the majority of EEE volumes is being imported. One major obstacle hampering the scientific contribution to the electronics sector is the low cooperation in CE aspects between business and the world of science and technology, constituted primarily by universities, NGOs, and research institutions. Some interviewees also highlighted a lack of targeted communication about CE toward consumers; the average consumer does not know about the life cycle of products and has no precise idea what CE means. On the other hand, consumers are generally positive about comprehensible environmental information. There are, however, examples of new entities that are constantly emerging in the Czech Republic and that may improve the situation:

- The Alliance for Women in a Circular Economy[84] was created in the Czech Republic in 2019. It aims to help project managers interested in the topic get together, discuss, and implement Circular Economy initiatives. The alliance was founded by women but is also open to men.
- According to their website[85], CIRA Advisory is a consulting and advisory firm specialising in CE across all major industries and sectors. They undertake specific projects to implement a Circular Economy within Czech companies, supporting their adoption of circular business models. The ELWIS Waste Registration System[86] operated by the company JRK[87] has the objective to increase efficiency in the cities' waste management systems by helping to reduce the amount of mixed waste.
- The EduZWaCE platform,[88] Education for Zero Waste and Circular Economy, presents itself as a virtual learning platform for interested stakeholders to interact and collaborate. Cyrkl,[89] founded in the Czech Republic, consider themselves to be the largest digital waste marketplace in Europe, applying CE principles to the waste management of companies across all industries.

The Institut Cirkulární Ekonomiky[90] (Institute for Circular Economy) is a Czech non-profit organisation working on projects that they consider to further the transition to a circular system, such as analytical and educational programs and project management tools for various organisations and individuals.

3.2.7 Recommendations for CE in the EEE Sector in the Czech Republic

As a member of the EU, the Czech Republic implements the EU regulations for eco-design, CoC, e-waste, transboundary movements of waste, general waste management, and CE.

- Initiatives for phasing CoC out beyond legal requirements exist, mainly in cases of large international brands. Ecodesign is not yet implemented in the Czech Republic, despite being mentioned in the law, and the EPR system does not provide incentives for it. The country could **initiate and/or support ecodesign initiatives in the CEE region or, even better, on the EU level** and could **implement and enforce** respective requirements in the country.
- The amount of EEE placed on the market in the country moderately increased, on average, in the past decade. UEEE markets exist in the Czech Republic only for certain products, normally from more expensive brands. Repair shops are active in the country, and there are initiatives of PROs for repair. High costs for repair and lack of spare parts hamper the sector, as do legislative difficulties with reuse of EEE that had already entered the waste stage. **Tax incentives** for repair shops provided by the Government could help the survival and increase of these economic activities, along with **Governmental actions to eliminate the legal barriers for reuse** of devices that had already entered the e-waste status formally. The right of repair planned at the EU level, and a potential **extension of the minimum warranty period for EEE**, could improve the availability of spare parts and improve the overall circularity of the sector.

[84] Alliance for Women in a Circular Economy, https://circulareconomy.europa.eu/platform/en/dialogue/existing-eu-platforms/alliance-women-circular-economy

[85] CIRAA, https://www.ciraa.eu/en/home/

[86] ELWIS waste Registration System, https://circulareconomy.europa.eu/platform/en/good-practices/elwis-electronic-waste-registration-system-more-responsible-approach-towards-waste-households

[87] https://www.menejodpadu.sk/

[88] https://www.eduzwace.eu/

[89] https://cyrkl.com/en/

[90] https://incien.org/

Credits from producers for consumers having EEE repaired for purchases of new EEE might further promote repair of EEE. In this perspective, the **Government** should pay attention on the **'optimal replacement moment'**[91/92], in defining such support and incentives to tackle trade-offs, e.g. with the energy efficiency and energy consumption of older devices versus new ones.

- The collection and transport for CRT TVs and older flat-panel TVs containing mercury backlights needs to be improved in order to avoid breakages and emissions of toxic substances. **Stricter regulations for the transport and handling of equipment** could be helpful, e.g. the **certification according to EN 50625 standards** in any way necessary, starting in 2023, and stricter measures if this standard is not sufficient for solving these handling and transport problems.
- The Czech Republic has a good e-waste management system in place. Nonetheless, until now the Czech Republic has not achieved the collection targets set by the WEEE Directive and still landfills a high quantity of e-waste. NGOs highlight the lack of knowledge among consumers that EEE must be collected separately, which further contributes to landfilling and which is still a common practice in the Czech Republic. As such, **awareness-raising campaigns** among consumers are recommended, targeting those **types of e-waste which are small enough to fit into household waste containers to ensure their separate collection and treatment** as e-waste.
- The small manual and more mechanised large recyclers operating in the country can treat most e-waste categories, except lighting equipment. The main obstacles for the adequate treatment of hazardous substances and components in e-waste are the high labor costs. Improperly separated hazardous substances may affect the quality of recycled products and the circularity of the recycled parts. Treatment operators report annual mass balances of hazardous substances and parts thereof to the Government. An upgraded **obligatory data reporting system** as extension of the already practiced mass balance reporting could **improve the situation of CoC management**. Such an improved system should include the amounts of hazardous substances expected due to the quantities and types of e-waste treated, hazardous substances actually retrieved, and, especially, the fate of these hazardous substances with certificates of their proper treatment and/or disposal. A **tracking system** should also be installed to **monitor EEE/UEEE and hazardous e-waste parts entering and leaving the country and to track their final destinations** to avoid illegal exports outside the EU.
- The recycling of e-waste plastic parts and the lack of markets for this material was identified as a problem for Czech EoL operators. Recycling capacities in the EU and markets may increase in the future if more post-consumer recycled (PCR) plastics are used in new EEE. Research projects[93] and initiatives are also underway on the EU level. The Czech Republic should **support the knowledge transfer** for the use of recycled plastics and **support research particularly of smaller companies** with regard to how they can use PCR plastics in their products to **encourage companies based on the country's territory to use PCR plastics** for creating market pull.
- The five PROs in the Czech Republic are highly involved in awareness-raising activities in terms of collection of e-waste e.g. in schools or for other consumer groups. There are general legal provisions about consumer information and campaigns in the country. Further **awareness-raising campaigns** should be organised (e.g. by the **PROs, Government, NGOs, academia**, etc.). They should touch on **the importance of separate collection and recycling of e-waste**, as well as on the opportunity of **EEE repair** and how consumers can benefit from it.
- As a contribution to **increasing the country's e-waste collection rates** toward the WEEE Directive's 65% target – or its national transposition respectively – **PROs should be supported in the reorganisation of disposal paths** for e-waste arising from products that came into the scope of the WEEE Directive in 2018 due to the so-called 'open scope'. Awareness-raising campaigns should **inform users of such products as well as end-of-life operators who used to process these waste products** before they came into the scope of the WEEE Directive as to the new legal situation and adequate disposal paths. Additionally, **stringent controls by authorities of the traditional processors** to prevent them from collecting and treating this waste EEE may be helpful for enabling their separate collection and the processing as e-waste.
- One major obstacle for CE innovation is the low degree of cooperation in CE aspects between business and the world of civil society, science, and technology, consisting mostly of universities, NGOs, and research institutions. **Tailored educational activities should also be developed for producers**, through the support of academia and research bodies, on the **alternatives available to substitute and phase-out CoC** and to ensure the **application of the Eco-design principles**. Such activities could be a starting point for closer cooperation between research and the private sector. The Government could further promote these activities by supporting initiatives in the country that work on connecting businesses, CE initiatives, science, and technology institutions.

[91] The UN Environment's review of lifecycle assessment (LCA) studies investigated the optimal replacement moment of several EEE, such as washing machines, refrigerators, televisions, mobile phones, laptops, and vacuum cleaners. The results suggest that washing machines and refrigerators should be used for at least 10 years before they are replaced with a more energy-efficient models, while vacuum cleaners, mobile phones, and laptops are typically replaced prematurely and should be used for longer, though it is difficult to suggest an exact replacement moment for these products. See UN Environment (2017). The Long View – Exploring Product Lifetime Extension. https://www.oneplanetnetwork.org/sites/default/files/from-crm/the_long_view_2017.pdf

[92] One Planet Network, The Long View - Exploring Product Lifetime Extension, https://www.oneplanetnetwork.org/knowledge-centre/resources/long-view-exploring-product-lifetime-extension

[93] C.f. H2020 PolyCE project, https://www.polyce-project.eu/

3.3 Georgia

In 2021, Georgia had a population of 3.7 million inhabitants, a population which has been decreasing. The fast economic growth in recent years resulted in a GDP of $5,016 USD (2021) per capita,[94] which is roughly equivalent to Moldova, around half of Bulgaria's, and approximately 25% of the Czech Republic's.

The country has only a very small local production of small-size EEE, even though local production is rising. Consequently, EEE is mostly imported from European countries, and UEEE is also imported from EU and neighboring countries.

The Ministry of Environmental Protection and Agriculture oversees the development and implementation of the national policy on waste management. The Waste and Chemical Management Service under this Ministry is responsible for a database on waste and for the development of the national waste management strategy, while municipalities are in charge of waste collection.

The country has a well-established legal framework around waste and chemicals management. In 2014, Georgia ratified the Association Agreement with the European Union, which requires the harmonisation of national legislation with the EU Directives 2008/98/EC on waste and 1999/31/EC on the landfill of waste. In September 2020, Georgia introduced an EPR system applying to specific waste streams, including e-waste, used batteries, and accumulators. The actual operationalisation of this system will start by mid-2022, according to the WEEE Directive.

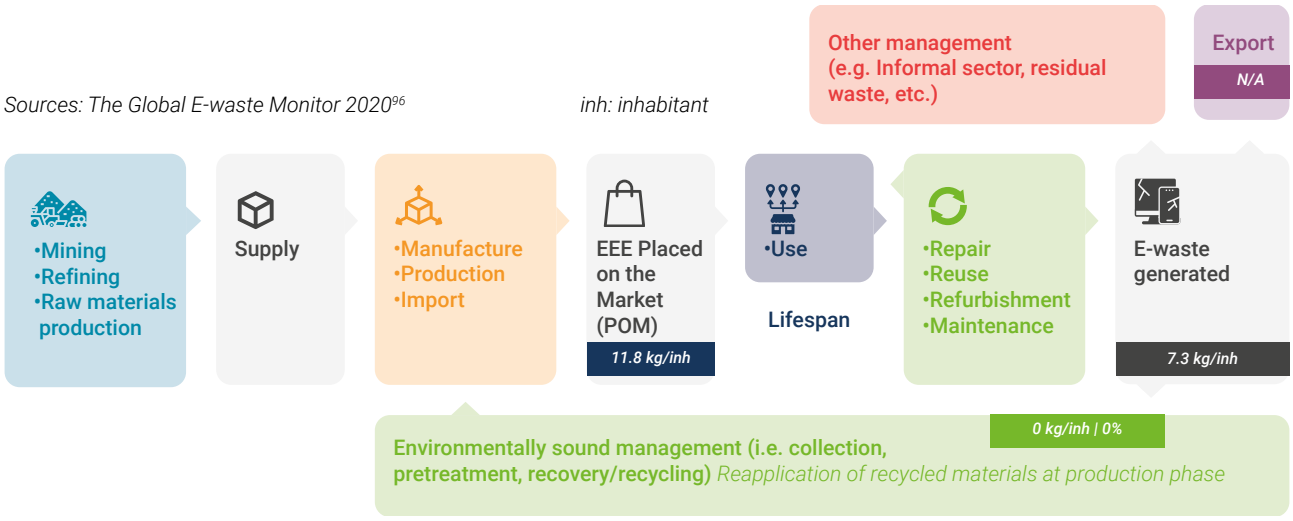
The establishment of a modern waste management system is one of the Government's priority goals. The National Waste Management Strategy 2016–2030 and the National Action Plan 2016–2020 were adopted in 2016, setting target dates for the collection and recycling of certain materials. Municipalities have been responsible for separate collection of recyclable waste since 2019. However, municipality plans to implement these requirements remain a challenge, as some municipalities are still in process of finalizing the plan, while others are struggling with the actual implementation of the adopted plans.

In 2018, Georgia generated 25.5 kt of e-waste (6.9 kg/inh), an amount which had doubled since 2010. Since no infrastructure for e-waste collection exists, most of the waste ends up in landfills. Except for the informal sector, which is involved in the collection and recovery of most valuable parts, only a few small companies are active in the field. No shops with electronics or other shops that could serve for take-back of e-waste exist in the mountain regions. Specific bins for used batteries exist, but they are not reachable and distributed equally across the territory.

Reuse and repair are common practices in Georgia, as repair and refurbishment costs are low. The UEEE market is also fairly large in the country. Proper infrastructure for final treatment of e-waste is lacking in Georgia, and the few companies involved in pre-treatment are in contact with processing companies in other countries, where they ship pre-treated e-waste for final treatment.

Figure 3-12 illustrates data on EEE and e-waste flows in Georgia along the EEE value chain.

Figure 3-12. Quantitative information on EEE and e-waste along the value chain in Georgia[95] in 2019



Sources: The Global E-waste Monitor 2020[96] *inh: inhabitant*

The rate of environmentally soundly managed e-waste in the above figure is calculated as the ratio of e-waste collected and e-waste generated in 2018.

No information indicating that mining/refining and raw materials production for manufacturing of EEE would be of relevance in Georgia was accessible.

[94] Statista, https://de.statista.com/statistik/daten/studie/384267/umfrage/bruttoinlandsprodukt-bip-pro-kopf-in-georgien/

[95] The 2019 data sets are the latest ones, which include all quantitative information displayed in the above figure. 2018 data sets used in the equivalent figures for Bulgaria and the Czech Republic did not contain all relevant information and thus could not be used to maintain the consistency of data across the focus countries.

[96] *The Global E-waste Monitor 2020*: https://www.scycle.info/wp-content/uploads/2020/12/GEM_2020_def_dec_2020.pdf

3.3.1 Manufacturing and Production of EEE

Resources

No data are available for the country's eco-innovation performance and material reuse rate.

Design

Eco-design principles are not yet part of the national legal framework, nor were any initiatives of the private sector in applying eco-design in relation to electronics identified by the interviewees or by desk research.

Manufacturing and Production

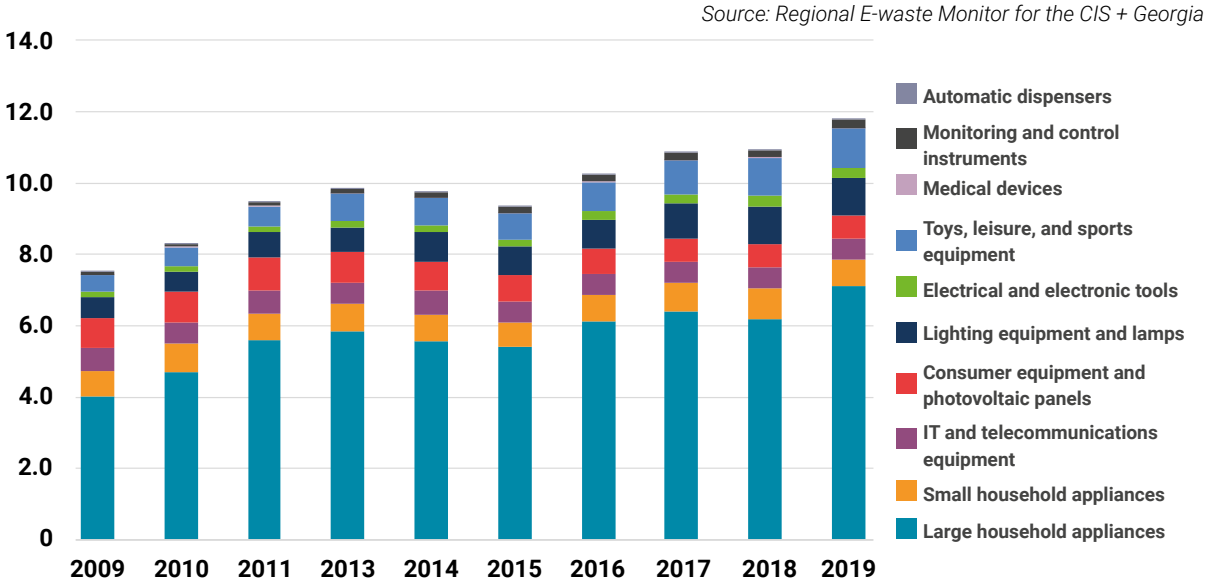
Electronics manufacturing and production in Georgia is still in a nascent stage but is expected to further rise, along with the increasing demand for electronics in Georgia and neighboring countries.[97] Currently, EEE is still mostly imported, and UEEE is imported mainly from Germany, Italy, and other countries. According to a study conducted by the NGO Georgia Environmental Outlook in 2017, the manufacturing and production of EEE in Georgia amounted only to about 1% of the country's total manufacturing industry output, and only 1% of the EEE placed on the market was produced or assembled within the country.[98] Domestic companies are mainly small, and most work based on separated orders rather than mass production. However, some companies adopted modern EU standards and are planning to export their products abroad.[99] Among the few EEE producers based in Georgia are Fresh Georgia, focusing on white-colored household goods (e.g. washing machines, fridges, ovens, etc.), and AG Microelectronics, assembling products such as TVs and Wi-Fi receivers.

Distribution

Over the past decade, the amount of EEE placed on the market in Georgia has increased from 8.3 kg/inh in 2010 to a total of 40.5 kt[100] (10.9 kg/inh) in 2018 (Figure 3-13).

Figure 3-13. EEE PoM per category in Georgia (2010-2018)

Source: Regional E-waste Monitor for the CIS + Georgia (2021)[101]



With regard to weight, the majority of the EEE placed on the market in 2018 was linked to temperature exchange equipment (3.8 kg/inh, 35%), followed by small equipment (3.7 kg/inh, 30%).[102]

3.3.2 Consumption, Use, Reuse, and Repair

Based on the information collected through the interviews, reuse and repair are considered common practices in Georgia. The costs for repair and refurbishment are low. Products imported into the country are generally lower quality, cheap, and unbranded and are usually not under any warranty. This brings short average lifetimes of EEE and faster discharge rates. Imports of EEE are also widespread, but no information on the quantities is currently available.

The UEEE market in Georgia, as in the neighboring countries, is large, and informal UEEE markets are also common. Consumers are used to keep their old (still functioning) EEE in their houses, where they store them for a long time. UEEE is often sold or bought on social media platforms. Some companies (distributors) offer take-back of old appliances, but this cannot be generalised. For larger appliances, repair practices are quite widespread.

[97] Read J. (2021). "EMSNOW Country Review: Considering Georgia for Electronics Manufacturing", June16th. https://emsnow.com/emsnow-country-review-considering-georgia-for-electronics-manufacturing/

[98] PMO (undated). Review of Georgian Electric and Electronic Product's Market, ed. Giorgi Bulia, p.3. https://www.pmo-bc.com/storage/app/uploads/public/5cf/8fd/f52/5cf8fdf528eac328162256.pdf

[99] PMO (undated). Review of Georgian Electric and Electronic Product's Market, cit. p.3.

[100] C.P. Baldé, G. Iattoni, V. Luda, I.C Nnorom, O. Pecheniuk, R. Kuehr (2021), Regional E-waste Monitor for the CIS + Georgia – 2021, United Nations University (UNU) / United Nations Institute for Training and Research (UNITAR) – co-hosting the SCYCLE Program, Bonn, Germany.

[101] https://ewastemonitor.info/wp-content/uploads/2021/11/REM_2021_CISGEORGIA_WEB_final_nov_11_spreads.pdf

[102] C.P. Baldé, G. Iattoni, V. Luda, I.C Nnorom, O. Pecheniuk, R. Kuehr (2021), Regional E-waste Monitor for the CIS + Georgia – 2021, cit.

3.3.3 End-of-Life of EEE

Generation of E-waste

In 2018, Georgia generated 25.5 kt of e-waste (6.9 kg/inh), an amount which had doubled since 2010 (13 kt, 3.4 kg/inh).

Figure 3-14. E-waste generated in Georgia per category in 2018

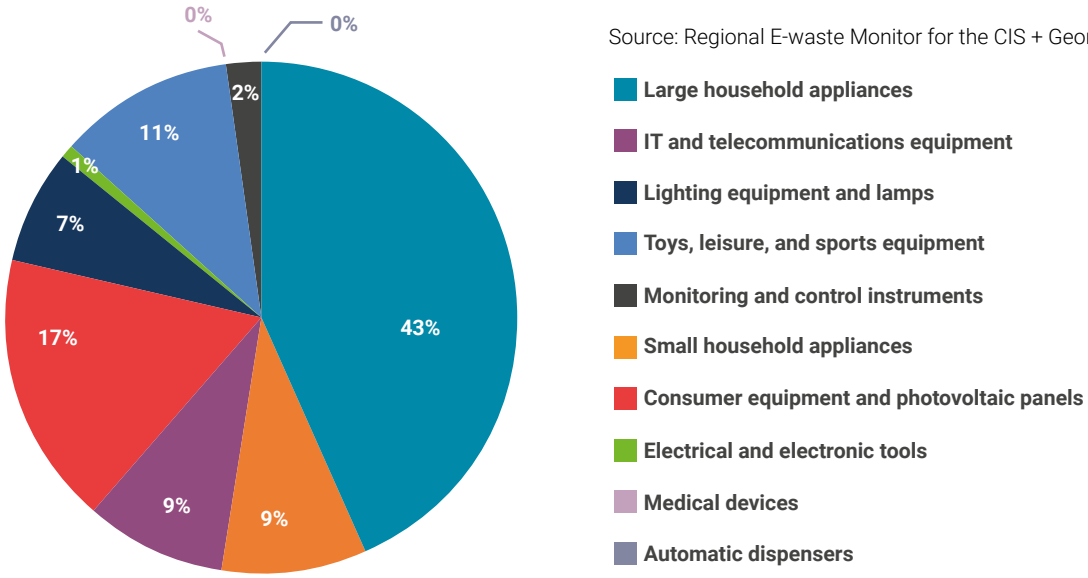


Figure 3-14 shows that the largest fraction was large household appliances, with 2.9 kg/inh (43%), followed by consumer equipment (17%, or 1.2 kg/inh) and toys (11%, or 0.8 kg/inh). The smallest ones were electrical and electronic tools, medical devices, and automatic dispensers (2% of the total).[103]

Collection of E-waste

In Georgia, municipalities are responsible to take care of the waste generated under their jurisdiction. The Ministry of Environment maintains a registry of licensed waste collectors.

Collection of e-waste in the country appears to be a significant challenge, as there is no infrastructure for e-waste, so most of it ends up in landfills. Except for the informal sector, which is involved in the collection and recovery of the most valuable parts, only a few small companies are active in the collection and treatment of e-waste, with a few pilot activities that are not spread across the national territory. Especially in mountain regions, there are no shops with electronics or other shops that could serve for take-back of e-waste. Specific bins for used batteries exist in the country but are not equally distributed across the territory.

Companies are obliged to have a waste management plan. They cooperate with companies that have licenses for treatment of hazardous wastes. For collection of e-waste generated by companies, the situation appears to be better than for e-waste from private households where, because of the very limited awareness of the population, little or no separation of e-waste occurs.

The Technical Regulation on Management of Waste Electrical and Electronic Equipment[104] (WEEE), adopted in May 2020, includes new obligations for producers and importers, as well as responsibilities for the Ministry of Environmental Protection and Agriculture, retailers, and consumers. Furthermore, the by-law gives details about specific requirements for establishing a producer responsibility organisation (PRO) for e-waste management, the authorisation process of PROs, and the establishment of an EPR registry. These are very recent developments, and, for the moment, no official collection is occurring.

Specific statistics on the gender dimension in e-waste collection and treatment are lacking, but respondents assumed that mostly men are involved in collection and treatment of electronics.

Pre-treatment of E-waste

A few small companies are involved mostly in e-waste pre-treatment operations. The Government has established a registry for the companies involved in the treatment of e-waste, but currently, no company is officially registered for e-waste collection and treatment in the country. E-waste is mainly taken care of by the informal sector, which plays an important role in the field by extracting the most valuable

[103] C.P. Baldé, G. Iattoni, V. Luda, I.C Nnorom, O. Pecheniuk, R. Kuehr (2021), Regional E-waste Monitor for the CIS + Georgia – 2021, cit.

[104] See https://leap.unep.org/countries/ge/national-legislation/resolution-no-326-2020-georgian-government-technical-regulation

e-waste components in practices usually marked by pollution.

Final Treatment and Disposal of E-waste and Parts Thereof

Proper infrastructure for final treatment of e-waste in Georgia is lacking. Parts generated by the few companies involved in pre-treatment are shipped to other countries for further final treatment. Otherwise, e-waste and parts thereof, including those containing CoC, can be assumed to end up on landfills.

According to 2018 data, Georgia has 56 official landfills, of which only five have acquired environmental impact permits.[105] A recent report by the World Bank confirms that the landfills in Georgia are not engineered and are without gas management or leachate treatment.[106] Also, law enforcement and communications at the municipal level regarding collection, treatment, and dumping of waste seem to be lacking. Some of the 56 landfills were created between the 1960s and 1980s, with little or no protective measures in place, thereby posing serious threats to both the environment and the population.

As there are no protective underground layers, water from the site soaks into the ground and contaminates groundwater. With no cover over the landfill, gases produced as waste decays also end up in the atmosphere.[107] Furthermore, dangerous chemical substances produced during uncontrolled waste burning on the landfill sites pollute the air. The emissions include persistent organic pollutants (POPs), which degrade slowly in the environment and are transported long distances by atmospheric flows.[108]

The construction of a new sanitary landfill began in June 2018; the landfill will replace several dumpsites in the Imereti, Racha-Lechkumi, and Kvemo Svaneti regions.[109] According to the *Association Implementation Report on Georgia* (2020),[110] the construction of the first EU-standard waste landfill in the Imereti region was postponed in response to local protests.

Treatment of CoC

Currently, the only hazardous waste disposal legally taking place in Georgia is for medical waste, which is incinerated, while there is no infrastructure for e-waste, components, or parts thereof containing CoC. E-waste containing CoC handled by the informal sector can be assumed to be treated and disposed of inadequately.

Role of the Informal Sector

The informal economy remains widespread in Georgia. A survey of informal e-waste collectors in Georgia was published in 2020 for the purpose of assessing their capacities and needs. The survey was conducted in 2019 by the NGO Georgian Environmental Outlook[111] and involved approximately 300 collection points in the country. An estimated 9 kt of e-waste is informally collected each year, which confirms the informal sector's substantial involvement in collection and pre-treatment of e-waste. Door-to-door collection by informal sector actors is common across the country, especially in more remote and mountainous areas. More than half of the informal facilities treat waste manually, as necessary technical equipment and machineries are generally lacking. According to the survey, most of these actors lack personal safety equipment, and only a small percentage of them have received training and awareness of the legal requirements for management and transportation of hazardous wastes.

No other studies, statistics, or estimates for further assessing the informal sector's role could be identified.

Exports of UEEE and E-waste

Georgia exports UEEE primarily to neighboring countries for easiness of logistics and similarities in both consumer demand and technical requirement.[112] As the local EEE production is still in its infancy stage, the great majority of exports are re-exports of UEEE previously imported from undeveloped countries. No information is presently available on the quantities of exported UEEE.

[105] C.f. https://www.matsne.gov.ge/en/document/download/20206/10/en/pdf

[106] World Bank (2021). Georgia Solid Waste Sector Assessment Report. 31 May. p.4. https://documents1.worldbank.org/curated/en/535371622781111161/pdf/Georgia-Solid-Waste-Sector-Assessment-Report.pdf

[107] EU Neighbour East (2018). How Georgia is changing its approach to waste disposal with EU support. 4 June 2018. https://euneighbourseast.eu/news-and-stories/stories/how-georgia-is-changing-its-approach-to-waste-disposal-with-eu-support

[108] UNECE (2015). Georgia Environmental Performance Reviews Third Review – Highlights. P. 9. https://unece.org/DAM/env/epr/epr_studies/Leaflet/Highlights_3rd_EPR_Georgia.pdf

[109] EU Neighbour East (2018). How Georgia is changing its approach to waste disposal with EU support. 4 June 2018. https://euneighbourseast.eu/news-and-stories/stories/how-georgia-is-changing-its-approach-to-waste-disposal-with-eu-support

[110] European Commission, Association Implementation Report on Georgia 2020. https://eeas.europa.eu/sites/default/files/1_en_document_travail_service_conjoint_part1_v4.pdf

[111] GEO, UNEP (2020). Capacity Needs Assessment of Waste Electric and Electronic Equipment (e-waste) Collectors. https://www.undp.org/sites/g/files/zskgke326/files/migration/ge/UNDP_GE_DG_EPR_WEEE_Capacity-Needs-Assessment-of-Informal-Sector_ENG.pdf

[112] PMO (undated). Review of Georgian Electric and Electronic Product's Market, ed. Giorgi Bulia, p 2. https://www.pmo-bc.com/storage/app/uploads/public/5cf/8fd/f52/5cf8fdf528eac328162256.pdf

3.3.4 Extended Producer Responsibility and Certification

EPR

EPR is one of the cornerstone principles introduced by the Technical Regulation on Management of Waste Electrical and Electronic Equipment from May 2020 by Governmental Decree No. 326. The regulation also provides details about specific requirements on establishing a producer responsibility organisation (PRO) for e-waste management, the authorisation process of PROs, and an EPR registry, which is in the process of being established.[113]

The EPR system will be implemented in 2022 – delayed due to the COVID-19 pandemic – but no specific provision has been established regarding its monitoring: the only reference is to individual and collective PROs, which should create a mechanism of self-monitoring.

IPR

No known IPR take-back schemes for e-waste exist in the country.

Standards and Certification

The Technical Regulation on E-waste No. 326 of 2020 defines minimum standards and technical requirements for e-waste collection and treatment, which are binding for informal actors, too. Landfill disposal standards are defined by the bylaw on landfill (Governmental Decree No. 421 of 2015), which prohibits landfilling of hazardous wastes.

The Solid Waste Management Company of Georgia (SWMCG) introduced new standards for work safety of its more than 200 employees and environmental protection measures for better managing the 50+ landfills operated by the company.[114]

Regarding labor, health, and safety standards, substantial changes were adopted in the law on occupational safety and health (OSH) in 2019 and in 2020, with revisions of the Law on Labor Inspection as well as a reform of the Labor Code. Some of the central new provisions concerning limits on work hours, mandatory weekly rest time, and breaks between shifts; better protections for interns, part-time employees, and night-shift workers; and strengthening the labor inspectorate by granting it more independence and widening its mandate.

Also, if employers have more than 20 employees, they will be obliged to appoint a certified labor safety specialist and compensate employees for injuries occurring in the workplace, including damages resulting from occupational illness.

3.3.5 Policies on EEE and E-waste

International Agreements

Georgia has been Party to the Basel Convention since 1999. According to the national Law on Import, Export and Transit of Waste No. 4952 of 13 April 2016, export of e-waste as hazardous waste is allowed only through the consent of the authorities of the countries involved in the movement, and exportation must follow the requirements of the Basel Convention.

The country has also been Party to the Rotterdam and Stockholm Conventions since 2007 and is Party to the Montreal Protocol. It signed the Minamata Convention on Mercury in 2013, but the ratification process has not yet been completed.

EU Regulations

In 2014, Georgia signed the Association Agreement between the European Union and the European Atomic Energy Community and their Member States, on the one hand, and Georgia also entered into force on 1 July 2016. In 2017, a revised Association Agenda[115] for 2017-2020 was adopted.

National Regulations, Enforcement and Financing

Georgia has a comprehensive legislative framework regarding e-waste and is developing an e-waste management infrastructure reflecting EU and international practices, though no legal requirement exists to date regarding eco-design and Circular Economy specifically. The challenge is mostly on enforcing and monitoring the regulations.

The Waste Management Code reflects relevant EC requirements according to the Association Agreement between the EU and Georgia. EPR is one of the cornerstone principles introduced by this legislation. E-waste appears only twice (in the section related to the definition of terms and under penalties). Principles are introduced by the Waste Management Code[116]. Specific EPR targets are defined in the National Waste Management Strategy (2016-2030) and the National Waste Management Action Plan (2016-2020). The targets are detailed in the relevant waste stream-specific by law.

[113] Hemkhaus M., Hibler S., and Margus V. (2020). E-waste PRO model for Georgia, p. 4 https://geo.org.ge/wp-content/uploads/2020/11/e-waste-PRO-model-for-Georgia_ENG.pdf

[114] LTD Working safe and clean. http://waste.gov.ge/ka/?p=4652&lang=en

[115] https://www.eeas.europa.eu/sites/default/files/annex_ii_-_eu-georgia_association_agenda_text.pdf

[116] https://matsne.gov.ge/ka/document/download/2676416/1/en/pdf

Regarding e-waste, the Technical Regulation on Management of e-waste was approved by the Government of Georgia with Resolution No. 326 of May 25, 2020. These regulations aim to:

- establish rules for the management of e-waste in accordance with the provisions related to EPR (Art. 9 of the Waste Management Code);
- introduce new obligations for producers and importers and new responsibilities for the Ministry of Environmental Protection and Agriculture, retailers, and consumers;
- introduce specific requirements on establishing a producer responsibility organisation (PRO) for e-waste management, the authorisation process of PROs, and an EPR registry that is in the process of being established;
- prevent the generation of e-waste and ensure reuse, recycling, or other forms of recovery and reduction of their disposal.

According to the National Waste Strategy for 2016-2030, companies were required to adopt preventive measures against waste generation by 2020. By 2025, businesses should be created to generate energy from waste that has not been reused or recycled.

In 2020, technical regulations were adopted regarding management of e-waste. Specific targets for recovery and preparation for reuse and recycling of collected e-waste are established by law per categories and year.

With Decree No. 426 of 2015, the Government established that waste producers are required to fill an official form aimed at establishing a waste inventory, under the supervision of the Ministry of Environmental Protection and Agriculture responsible for the verification of the reliability of data and waste reported as treated.

Georgia has the appropriate legislation in place regarding CoC, but it lacks implementation and enforcement. For instance, asbestos in construction and the use of hazardous substances in EEE are regulated, but secondary legislation required to implement and enforce these regulations are still missing. For example, mercury lamps end up in the landfill because infrastructure is lacking, awareness is low, and adequate comprehensive secondary legislation still needs to be adopted and properly enforced.

Since 2020, as part of the EU-funded EU4Environment program, the Georgian Environmental Information and Education Centre and procurement authorities are in the process of elaborating legislation on Sustainable Public Procurement (SPP).[117]

Finally, regarding environmental protection, the Government approved the draft Law on Environmental Liability in July 2021 and submitted it to the Parliament for adoption.

3.3.6 Science and Innovation

According to interviewees, local research and innovation are hindered by the limited availability of financial resources. Georgia has one specific fund, the Rustaveli fund, that supports research related to CE. A couple universities are also cooperating with international organisations and local non- governmental organisations. The International School of Economics (ISET)[118] under the Tbilisi State University, for instance, is conducting studies on this topic.

3.3.7 Recommendations for CE in the EEE Sector in Georgia

- Though there is only a small local production of small-size EEE in Georgia, **implementation and enforcement of the current legal framework addressing CoC should still be enhanced** to prevent the use and better manage CoC in production and in products.
- An incomplete legal basis, including secondary legislation and bylaws – except for the legislation related to pesticides and agrochemicals – and a lack of data are among the major challenges hindering the introduction of EU practices of chemicals and e-waste management in Georgia. In consideration of the growing demand for EEE in the country, the **Government** should consider **introducing and enforcing the legal basis for sound e-waste and CoC management as well as eco-design principles** into the national policy and regulatory frame.

[117] EU4Environment (2020). Sustainable public procurement in Georgia. 16 September. https://www.eu4environment.org/news/sustainable-public-procurement-in-georgia/

[118] https://iset.tsu.ge/

- **Incentives for repair, reuse, and UEEE markets** should be considered to maintain and enhance consumers' behavior to buy and use UEEE, leveraging on the still prevalent 'culture of repair' in Georgia. The extension of product lifetimes is known to lead to environmental benefits because it saves the energy and resources that would otherwise be consumed in manufacturing new products and also reduces the generation of waste. In this perspective, **attention on the 'optimal replacement moment'**[119/120], **should also be paid** in defining such incentives to tackle trade-offs, e.g. with the energy efficiency and energy consumption of older devices versus new ones. Additionally, when introducing further legislation, in particular (e-)waste legislation, the **Government** should, as much as possible, avoid obstacles **hampering repair and reuse** of products. Repair and reuse organisations should have continued **access to separately collected e-waste** to be able to serve the market for UEEE and components for repair, provided they can prove that they are not involved in illegal practices of substandard treatment and waste disposal. A national register and certificate for such organisations to prevent abuses may be helpful.
- Different possibilities for promoting the repair culture could be explored, such as **tax subsidies for retailers offering repair or the extension of the minimum warranty period for EEE. Tax incentives or disincentives** (such as an import tax for EEE with no, or limited, warranty period) could also be introduced for **imported EEE**, as products imported into the country are generally lower quality, cheap, and unbranded. **Awareness-raising initiatives for importers and distributors** about the environmental and health hazards related to EEE, as well as local possibilities for recycling, could also be undertaken.
- Collection of e-waste generated by companies appears to be working properly in Georgia, while most e-waste from households ends up in landfills because of the lack of infrastructure for this waste stream. Only few small companies are active in separate collection of e-waste, with a few pilot activities in specific areas. The few companies involved in pre-treatment ship pre-treated e-waste to other countries for final treatment. **Municipalities** should **provide proper infrastructure for collection** (e.g. specific bins for small e-waste equipment and specific collection points for large household equipment), **repair, and recycling of e-waste** across the country, including remote areas. J**oint public-private initiatives**, also involving informal sector actors, could also be put in place to **support the establishment of local pre-treatment companies**. Overall, Georgia would need to **establish a stable financing mechanism** – via the upcoming EPR obligations for producers – **for treatment and disposal activities**. This should be accompanied by stringent enforcement of sound treatment practices and monitoring of end-of-life operators to incentivise the establishment of high-quality treatment operators in the country, which could then also create formalised employment.
- In parallel, there is the need for **repeated awareness-raising campaigns for consumers and the public specifically dedicated to e-waste, relevant environmental issues**, and the **benefits of reuse, repair, and recycling**, as well as **local collection points. The younger generation should be especially targeted** through dedicated consumer awareness initiatives using different media.
- Finally, **academic and research entities** could put in place awareness and educational initiatives for producers, **on CoC substitution in manufacturing and the application of the Eco-design principles for product design**. Such activities could be a starting point for joint pilot initiatives.

[119] The UN Environment's review of lifecycle assessment (LCA) studies investigated the optimal replacement moment of several EEE, such as washing machines, refrigerators, televisions, mobile phones, laptops, and vacuum cleaners. The results suggest that washing machines and refrigerators should be used for at least 10 years before they are replaced with a more energy-efficient models, while vacuum cleaners, mobile phones, and laptops are typically replaced prematurely and should be used for longer, though it is difficult to suggest an exact replacement moment for these products. See UN Environment (2017). The Long View – Exploring Product Lifetime Extension. https://www.oneplanetnetwork.org/sites/default/files/from-crm/the_long_view_2017.pdf

[120] One Planet Network, The Long View – Exploring Product Lifetime Extension, https://www.oneplanetnetwork.org/knowledge-centre/resources/long-view-exploring-product-lifetime-extension

3.4 Moldova

Moldova has a steadily declining population. In 2020, Moldova had 2.63 million inhabitants. The GDP per capita was $4,523 USD,[121] which is approximately the same as in Georgia, less than half of the GDP of Bulgaria, and around 20% of the GDP of the Czech Republic.

There is little production of EEE in Moldova; most EEE is imported. The competent authority for (e-)waste management is the Ministry of Environment (MoE). The MoE provides for the implementation of EU provisions in national legislation and implements the national waste management plan (WMP).

The Law on Waste no 209 /2016 that entered into force in 2017 in Moldova was developed in line with Directive 2008/98/EC on waste and took into consideration the following EU legislation: Regulation No 1907/2006 (REACH), Directive 2006/66/EC on batteries and accumulators and waste batteries and accumulators, Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment, Directive 2012/19/EU on WEEE, and Directive 2011/65/EU on the restriction of the use of certain hazardous substances in EEE.

The Waste Management Strategy of the Republic of Moldova for the period 2013-2027, as approved by Government Decision No. 248/2013, aims to establish the indicative direction of infrastructure development activities and services necessary for the proper management of waste in order to protect the environment and the health of the population. The waste management strategy prioritises actions in line with the EU waste hierarchy (reduce, reuse, recycle, recover, disposal), and life cycle assessment tools are used to complement the general rules and better shape the most efficient waste management solutions. The draft National Waste Management Program for 2022-2027 is currently being developed. The concept of the public policy document was developed into a plan, titled 'National Program for Waste Management for the years 2022-2027,' which was coordinated with the State Chancellery and submitted to public consultations.

The EU and Moldova signed an association agreement including several agreements on environmental legislation. Within that context, the EPR on E-waste was approved in 2018. The EPR system is mandatory in the country, and since 2020, a register of producers is operational.

EEE as well as the related use of CoC are regulated by art.12 and 50 of Law no. 209 of 29.07.2016 on waste and the Regulation on Waste Electrical and Electronic Equipment, Government Decision no. 212 of 07.03.2018. A national strategy on waste has been in force since 2013.

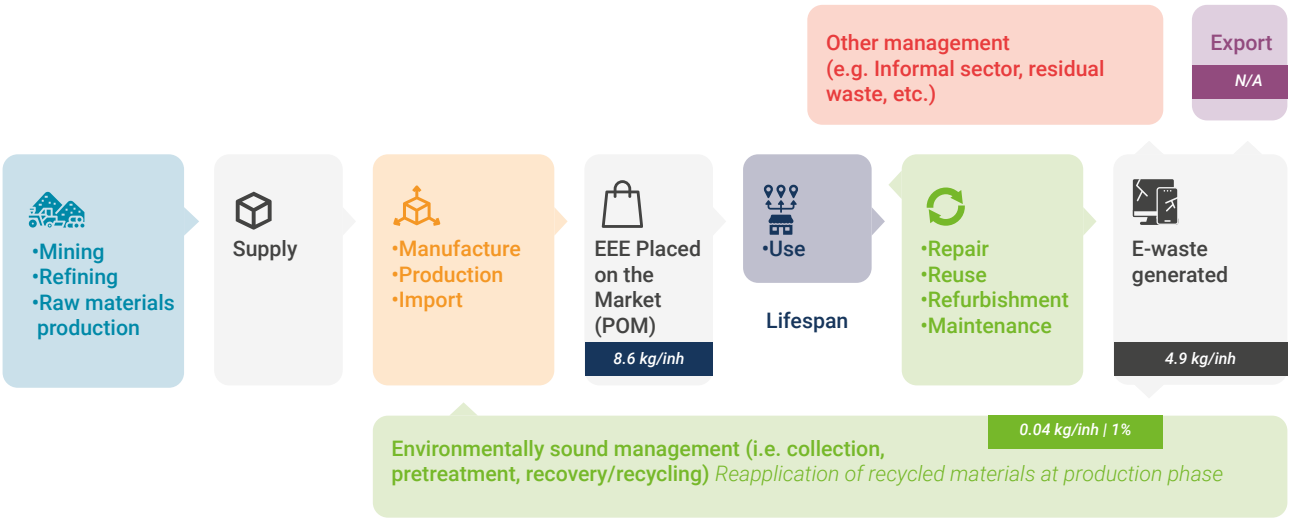
The implementation and enforcement of the provisions are the responsibility of the Environmental Agency under the authority of the MARDE. Supervision and monitoring are done by the Inspectorate for Environmental Protection. Import and export of EEE are controlled by the Customs Service.

The country suffers from lack of official statistics on e-waste generation. The infrastructure of e-waste collection and treatment is insufficient or missing. Most of the generated e-waste is not collected separately and ends up in landfills alongside municipal waste. Informal sector collectors access e-waste from households or, less frequently, from businesses.

[121] https://www.statista.com/statistics/513335/gross-domestic-product-gdp-per-capita-in-moldova/

Figure 3-15 illustrates data as to EEE and e-waste flows in Moldova along the EEE value chain.

Figure 3-15. Quantitative information on EEE and E-waste along the value chain in Moldova[122] in 2019



Sources: The Global E-waste Monitor 2020[123] *inh: inhabitant*

The rate of environmentally soundly managed e-waste in the above figure is calculated as the ratio of e-waste collected to e-waste generated in 2019.

No information indicating that mining/refining and raw materials production for manufacturing of EEE would be of relevance in Moldova was accessible.

3.4.1 Manufacturing and Production of EEE

The number of producers of EEE in Moldova is rather low, and most EEE producers are international companies.

Resources

No data for the country's eco-innovation performance and material reuse rate are available.

Design

Based on interview insights[124] of a local producer, manufacturers and producers of EEE may see their customers as the motivators of requirements related to ecodesign and CE production and products (next to legislative requirements), rather than own initiatives. They follow the applicable legislation in target markets, e.g. the EU RoHS Directive for EEE exported to the EU.

In order to support the extension of the product lifetime, the Moldovan Regulation on Waste Electrical and Electronic Equipment contains sections dedicated to product design requiring producers of EEE to facilitate disassembly and recovery operations and to provide possibilities for reuse and recycling of e-waste, their components, and materials. Other provisions in this Regulation require producers not to prevent the reuse of e-waste by imposing specific design or manufacturing characteristics, unless these specific design characteristics or specific manufacturing processes have significant advantages in terms of environmental protection and public health.[125]

As for further initiatives for sustainable production, some general provisions on product design are also stipulated in the Moldovan Waste law, e.g. adopting solutions and technologies of waste disposal or waste minimisation when designing a product by a producer.

[122] The 2019 data sets are the latest ones that include all quantitative information displayed in the above figure. 2018 data sets used in the equivalent figures for Bulgaria and the Czech Republic did not contain all relevant information and thus could not be used to achieve better consistency of data across the focus countries.

[123] *The Global E-waste Monitor 2020*: https://www.scycle.info/wp-content/uploads/2020/12/GEM_2020_def_dec_2020.pdf

[124] See https://addgrup.com/

[125] Section II (Product design) of the DECISION on approval of the Regulation on waste electrical and electronic equipment no. 212 of 07.03.2018.

Manufacturing and Production

In 2019, the EEE sector in Moldova was represented by 171 companies[126] covering a wide range of activities such as semiconductors, transformers, and navigation systems or electronics for naval ships and submarines. 30.3 kt of EEE were placed on Moldova's market[127] in 2019.

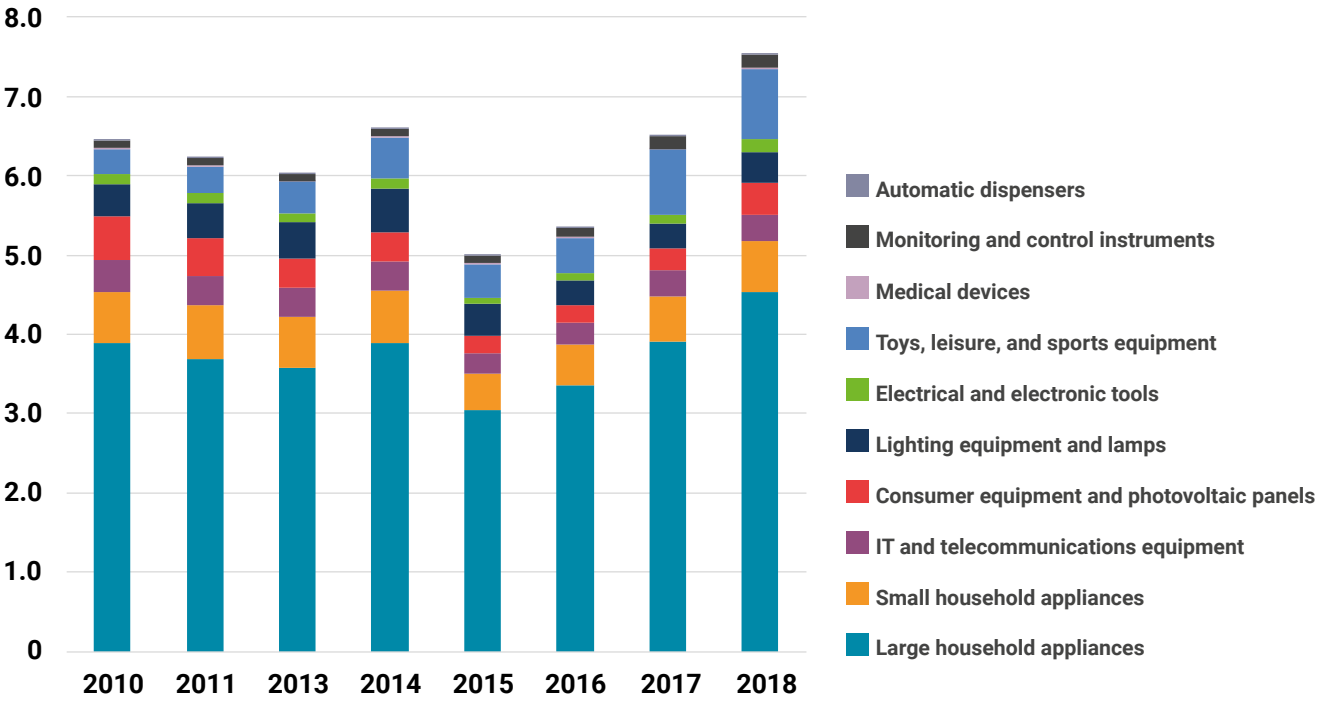
While no manufacturers or producers could be accessed in the other focus countries, an interviewed local Moldavan producer[128] gave some insights to their measures supporting resource efficiency and CE in their production, such as reusing plastic parts in manufacturing from non-repairable products or defected plastic parts from manufacturing. They are put back into the production process or kept as spare parts for potential further use. The company reported to follow ISO 14001 certification for over 10 years. As the requirements are being updated, the country reports continuous efforts to check and adapt to them accordingly. There are yearly plans to improve the environmental policy (e.g. use of paper, production of waste, use of water).

Distribution

In the framework of a *Regional E-waste Monitor*,[129] the State Institution 'Subdivision for the Implementation of Environmental Projects,' part of the Ministry of Environment of Moldova, has applied the methodology developed by UNU/UNITAR to quantify the main EEE and e-waste statistics indicators. As part of this process, the Ministry could also include data on EEE domestic production. Specifically, information on the domestic production of EEE in Moldova, including the name of the product produced and quantity per year, is available on the official website of the National Bureau of Statistics.[130]

The amount of EEE POM in Moldova increased from 6.5 kg/inh (23.0 kt) in 2010 to 7.5 kg/inh (26.7 kt) in 2018 (Figure 3-16).

Figure 3-16. EEE Placed on the market in Moldova per inhabitant and per category (2010-2018)



Source: Regional E-waste Monitor for the CIS + Georgia (2021)

[126] Source: Moldova Business Week 2020, provided by NGO EcoDigital.

[127] C.f. Regional E-waste Monitor: CIS plus Georgia, Turkmenistan and Ukraine, https://ewastemonitor.info/regional-e-waste-monitor-cisgeorgia-2021/

[128] See https://addgrup.com/

[129] UNU/UNITAR SCYCLE: The Regional E-waste Monitor: CIS plus Georgia, Turkmenistan and Ukraine, https://ewastemonitor.info/regional-e-waste-monitor-cisgeorgia-2021/

[130] See https://statistica.gov.md/en/statistical-databank-78.html

3.4.2 Consumption, Use, Reuse, and Repair

In Moldova, the repair of EEE products under warranty is provided by EEE distributors. As well, private companies offer repair services at centers or by authorised individuals (based on a 'patent' for entrepreneurs). One of the interviewed institutions indicated that local companies providing repair and refurbishment services for UEEE may not be authorised for such activities, and their compliance with legislation should also be checked.

As for the lifetime of electronics, there was a consensus among interviewees that due to the standard of living of the population, the life span of electronics is being extended to their possible maximum by proper maintenance and repairs within the household. The exemption of this pattern may be mobile phones, where young people most frequently desire to have a recent model. Older devices are probably handed over to relatives for further use.

Buying UEEE imported from other European countries is widespread, mostly for home appliances. There are numerous shops that already bring and sell UEEE, e.g. from Germany or other European countries. A number of online sites are available where people place ads on the sale of various products (including EEE).[131] One PRO expressed interest in exporting used EEE for repair and refurbishment to Romania.

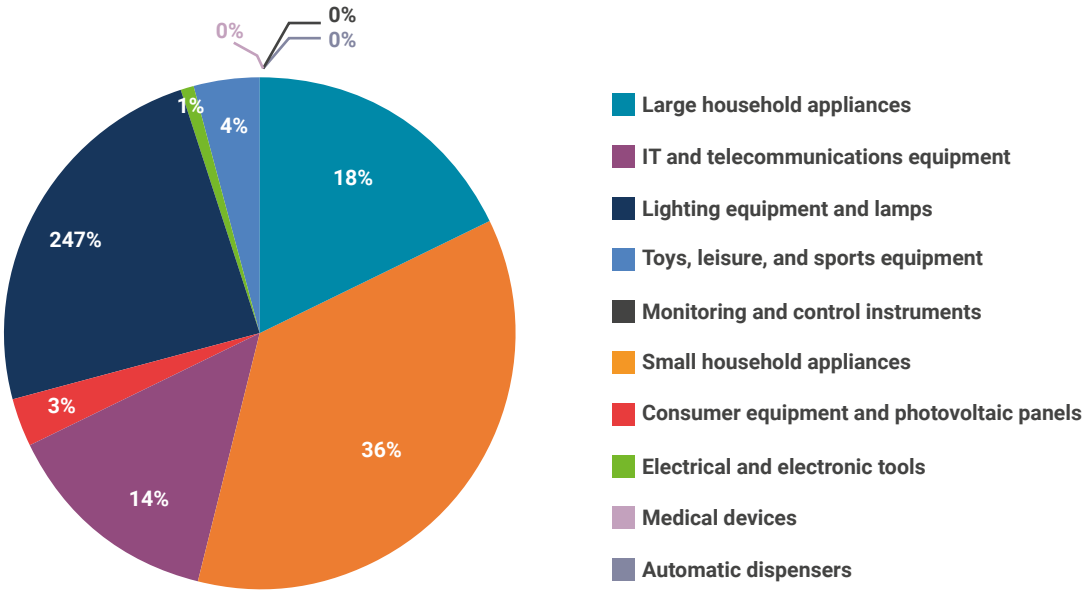
No data are available on the volume of EEE repaired / reused.

3.4.3 End-of-Life of EEE

Generation of E-waste

The Republic of Moldova lacks reliable statistics on e-waste generation. However, an overview of data on generation of wastes including e-waste[132/133] , is available on the Environmental Agency's website for 2019 and 2020. Moreover, a tool developed by UNU within a Regional E-waste Monitor [134] was used in 2020 to evaluate the e-waste generated based on the amounts of imports, exports, and domestic production of EEE in the country.

Figure 3-17. Share of EEE categories in generated e-waste (2018)



Source: Regional E-waste Monitor for the CIS + Georgia (2021)

According to the Regional E-waste Monitor, 16.2 kt of e-waste were generated in 2018 and 17.4 kt were generated in 2019, or 4.6 and 4.9 kg/inh, respectively. This amount is nearly triple the 2010 amount, at 6.9 kt (1.9 kg/inh). The above Figure 3-17 illustrates the shares of categories of EEE in the total e-waste generated in 2018, with the largest being small household appliances at 1.2 kg/inh (36%), followed by lighting equipment (0.8 kg/inh, 24%).

[131] E.g. www.999.md

[132] https://am.gov.md/ro/content/gestionarea-de%C8%99eurilor-%C3%AEn-republica-moldova-%C3%AEn-anul-2019

[133] https://am.gov.md/ro/content/gestionarea-de%C8%99eurilor-%C3%AEn-republica-moldova-%C3%AEn-anul-2020

[134] *Regional E-waste Monitor: CIS plus Georgia, Turkmenistan and Ukraine*, https://ewastemonitor.info/regional-e-waste-monitor-cisgeorgia-2021/

Collection of E-waste

Table 3-1 lists the collection targets for EEE as required by the Decision for the approval of the waste regulation of Electrical and electronic equipment nr. 212 from 07.03.2018, Annex V (e-waste Regulation).

Table 3-1. Legally stipulated annual e-waste collection targets in Moldova

Annual collection target	For 2020	For 2021	For 2022	For 2023	For 2024	For 2025
in %	5	10	15	20	25	30

Source: Decision for the approval of the waste regulation of Electrical and electronic equipment nr. 212 from 07.03.2018, Annex V (e-waste Regulation, Moldova)

The target shall be calculated as a percentage ratio between the total mass of e-waste collected in a particular year and the average mass of the total amount of EEE placed on the market in the three preceding years.

In principle, based on the Moldovan e-waste Regulation, the PROs shall organise, manage, and coordinate separate collection of e-waste from private households on behalf of the producers and then transport the e-waste to collection points. Upon request of a PRO, local governments should provide space for collection points. In case of IPR, the collection of e-waste from private households is carried out through collection points provided by the producers who honor their responsibilities individually.

The infrastructure of e-waste collection is not sufficiently established, but the number of collection points in municipalities has been increasing recently, and various other means of collection are available. Some private companies collect equipment from schools, universities, and other public authorities. Household collection is also feasible by authorised companies on request. E-waste is also collected through various projects implemented by non-governmental organisations. However, most of the generated e-waste is not collected separately and ends up in landfills alongside municipal waste. So, there is currently no environmentally sound management of e-waste at the national level.

The role of distributors for e-waste collection is significant. They are required to provide for the collection of very small e-waste at retail shops with sales areas for EEE of at least 200 m2, or in their immediate proximity free of charge to end-users and with no obligation to buy EEE of an equivalent type. With these requirements, Moldova follows the stipulations of the WEEE Directive. In 2019, Moldova formally collected approximately 0.14 kt (0.04 kg/inh.) of e-waste, out of which 0.014 kt were fluorescent lamps containing mercury. Data on e-waste collected in 2018 was not available.

According to the reports submitted by the economic operators authorised for collection of waste (including e-waste), 293.97 tonnes of waste electrical and electronic equipment were collected in 2020. As well, the official quantity of e-waste collected and reported to the Environmental Agency by PROs in 2020 was 24.43 t. Producers who joined a PRO hand the collected e-waste over to their PRO, and the PRO then exports the collected amounts. Economic operators that are not part of PROs and that have collection and transport of waste (including e-waste) as part of their activities export independently.

E-waste collection financing is provided by the EEE producers through PRO member fees and fees applied to producers on every unit placed on the market. According to point 73 of the Moldovan e-waste Regulation, the financial amounts collected by the PROs from the producers are used exclusively for the financing of the operations of collection, transport, treatment, recovery, and clean disposal of e-waste from private households, as well as for the financing of consumer education and information campaigns on e-waste collection operations.

No data for the gender division of labor in the electronics sector are publicly available, but the prevalent opinion presented in interviews is that most workers involved in e-waste collection are men.

Pre-treatment of E-waste

So far, there are no official operators for pre-treatment of e-waste in the Republic of Moldova. All officially collected e-waste is sent abroad for treatment, mostly to Romania. An interviewed Moldovan PRO indicated that building such a facility is one of the biggest challenges at the current stage.

[135] C.P. Baldé, G. Iattoni, V. Luda, I.C Nnorom, O. Pecheniuk, R. Kuehr (2021), Regional E-waste Monitor for the CIS + Georgia – 2021, cit.

[136] See https://am.gov.md/ro/content/gestionarea-de%C8%99eurilor-%C3%AEn-republica-moldova-%C3%AEn-anul-2020

Final Treatment of E-waste

The applicable e-waste regulation stipulates minimum recovery and recycling rates, which were adopted from the EU WEEE Directive.[137] As with pre-treatment, there are no companies authorised for final treatment of e-waste.

Treatment of CoC

Currently, there are no possibilities for the sound disposal or incineration of non-recyclable hazardous materials from e-waste. The only option to take care of these is to export them for proper treatment, which is possibly also conducted illegally and not in line with the Basel Convention, since these exports would have otherwise had to be reported to the Basel Convention secretariat. A Moldovan EEE producer stated that the company hands waste hazardous substances generated at the manufacturing process to contracted companies, pays for the service, and does not track the substances' subsequent fate.

Role of the Informal Sector

The informal sector in Moldova dismantles EEE for extracting saleable components containing iron, steel, aluminum, copper, and precious metals. Other, non-saleable parts are thrown into t garbage bins. Companies (the same ones collecting metal scrap) illegally collect e-waste, their primary interest being to dismantle it and extract precious and other metals that have market value. Nonetheless, one of the PROs for electronics expressed the opinion that there is no competition between the informal and formal sector, as the methods of EEE collection applied by PROs are more efficient, and consumers are addressed by PROs through various information campaigns promoting the environmentally sound collection and treatment.

Informal sector collectors access e-waste from households or, less commonly, from businesses. No information is available either on the numbers of informal collectors that are active in the country or on the volumes of e-waste collected and dismantled by the informal sector annually.

Most interviewees agreed that the main consequences of informal collection resulting in substandard treatment with respect to CoC in e-waste and parts thereof are risks to the population's health.

Exports of UEEE and E-waste

On the website of the Basel Convention,[138] no annual reports are available with data on import and export quantities of e-waste and the countries of origins/destinations of such transboundary movements of e-waste under the Basel Convention for the years 2018–2020.

3.4.4 Extended Producer Responsibility and Certification

EPR

Thanks to the legal requirement for producers to register to the Moldovan EPR system and the establishment of the collection targets starting in 2020, the country progresses significantly in the path toward the sound financing of e-waste management and treatment by EPR-based PROs, with a view to hazardous substances and CE as well.

According to the provisions stipulated in Law no. 209 of 29.07.2016 on waste and Government Decision no. 212 of 07.03.2018 for the approval of the Regulation on waste electrical and electronic equipment, the obligations of producers subject to the regulations of an extended producer responsibility can be fulfilled individually or by transferring responsibilities, on a contract basis, to a PRO.

The EPR system is mandatory in Moldova. The e-waste Regulation stipulates that starting 1 January 2019, only producers registered in the 'List of Producers' may place EEE on the market. This stipulation applies to all producers, whether fulfilling their obligations individually or being a party to or joining a PRO.

The 'List of producers' is drawn up and maintained by the Environmental Agency through an information subsystem, an integral part of the Automated Information System 'Waste Management' (SIAMD). As of 12 October 2021, 117 economic agents have been registered in the List of EEE producers.[139]

Five PROs are in operation and compete for e-waste and are also complementary for some of the processes.
Obligations for producers/PROs include:

- Collection from households, establishing and running collection points for waste from private households (bring system)
- Collection from retailers/shops
- Collection of e-waste from sources others than private households
- Pickup of e-waste from collection points and transport to collection centers for interim storage and/or directly to treatment operators
- Reporting to the Environmental Agency the amount of EEE placed on the market, e-waste collected, or e-waste received and recovered/recycled
- Awareness raising.

The Government is involved neither in the collection process nor in the administration of EPR fees from producers or payout to operators of the PRO's finances. The collection activities are financed from citizens' disposal fees, PRO

[137] Directive 2012/95/EC, Annex V, Minimum recovery and recycling targets applicable by category from 13 August 2012 until 14 August 2015; https://eur-lex.europa.eu/legal-content/EN/AUTO/?uri=CELEX:02012L0019-20180704

[138] See http://www.basel.int/Countries/NationalReporting/NationalReports/BC2019Reports/tabid/8645/Default.aspx

[139] https://siamd.gov.md/portal/deee.html

member fees, and EPR schemes applied to producers on every unit placed on the market. PROs who joined the collective scheme or the producers themselves (in the case of individual EPR schemes) are responsible, on behalf of producers, for achieving targets given by the legislation.

PROs are legally required to engage in raising consumer awareness to extend electronics' lifetimes by taking advantage of repair services and to use take-back systems or collection points to increase e-waste collection rates. The initiatives of PROs in this regard currently also include use of media and social media campaigns.

EPR for EEE is in the initial phase of implementation in Moldova, and the biggest companies that place EEE on the market just started to take actions to comply. The Environmental Agency supports implementation (e.g. with trainings). An agreement with the Customs Service of the Republic of Moldova was also signed to identify the producers (importers) of EEE to whom the Environmental Agency sent letters, informing them of their obligations.

IPR

Producers can choose to fulfill their EPR obligations individually. Such producers shall carry out the separate collection of e-waste from private households through their own e-waste collection points and provide for sound treatment and disposal of the collected e-waste, i.e. achieving the objectives of the e-waste's recovery, recycling, and disposal in an environmentally safe way.[140]

According to a representative of the Environmental Agency, no IPR schemes were established in Moldova until 2021.

Standards and Certification

The 'Provisions on e-waste', enacted in May 2018, introduced specific e-waste EHS standards. Specifically, Appendix No. 3 stipulates special measures for the collection of e-waste that represents risks to the safety and health of personnel associated with infection at collection points, and Appendix No. 6 introduces requirements regarding the selective treatment/recycling of materials and components of e-waste,[141] especially of those containing hazardous substances.

No treatment operators are known to be audited according to acknowledged e-waste standards, such as EN 50625.

3.4.5 Policies on EEE and E-waste

International Agreements

The conditions of transboundary movements of hazardous wastes are regulated by Government Decision No. 637 in May 2003 – based on the provisions of the Basel Convention, accessed by the Republic of Moldova in 1998. Moldova also accessed the Montreal Protocol in 1996 and then ratified the Stockholm Convention in 2004, the Rotterdam Convention in 2005, and the Minamata Convention in 2017.[142]

EU Regulations

Government Decision No. 99 of 30 January 2018, on 'the Approval of the list of waste', establishes the categories of waste – fully transposed from the European Hazardous Waste List – at the national level.[143] Regarding e-waste categories, 10 categories as per the old EU WEEE Directive have been used so far. The transition to six categories (as in the current EU WEEE Directive) is foreseen, but no plan has been developed yet.[144]

National Regulations, Enforcement, and Financing

The Governmental administration body developing the legislative and normative framework in the field of EEE/e-waste management is the Ministry of Environment. Both electrical and electronic equipment and the related use of CoC are regulated by art. 12 and 50 of Law no. 209 of 29.07.2016 on waste and the Regulation on waste electrical and electronic equipment, approved by Government Decision no. 212 of 07.03.2018. As stated in the e-waste regulation, the costs of collecting, treating, capitalising, and eliminating non-polluting e-waste from users other than private households and those generated by the products placed on the market are to be borne by the producers.[145]

The Environmental Agency monitors the implementation of regulations through the Waste Management Information System, into which the EEE producers under EPR should register, get authorisation, and report data. However, in most cases the approach of the industry is rather reticent. When obligations are not fulfilled, a fine can be applied to the legal person together with a withdrawal of the permission to carry out certain activities for a period of three months up to one year.

[140] Article 12, paragraph 8 of the Law on Waste.

[141] C.P. Baldé, G. Iattoni, V. Luda, I.C Nnorom, O. Pecheniuk, R. Kuehr (2021), Regional E-waste Monitor for the CIS + Georgia – 2021., cit.

[142] See https://treaties.un.org/pages/Treaties.aspx?id=27&subid=A&clang=_en

[143] See https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:02000D0532-20150601

[144] 'C.P. Baldé, G. Iattoni, V. Luda, I.C Nnorom, O. Pecheniuk, R. Kuehr, Regional E-waste Monitor for the CIS + Georgia, Turkmenistan, Ukraine – 2021, cit.'

[145] Article XI, point 78 of the e-waste Regulation.

The implementation of the provisions is the responsibility of the Environmental Agency. Supervision and control of the observance by the economic operators whose activity is the production, import, and sale of EEE is the competence of the Inspectorate for Environmental Protection. Importation and exportation of EEE are controlled by the Customs Service.
According to the Art. 63 of the Law on Waste No. 209 of 2016, the import of waste and residues of any kind into the Republic of Moldova for landfilling (whether raw or processed), recovery, or disposal (by any method) shall be prohibited, except for the categories of waste listed in Annex 7 of this law, intended for use as secondary raw material in local undertakings. Moldovan legislation allows for the export of e-waste in agreement with the Basel Convention and the Ban Amendment.

Sanctions are applied for non-compliance based on the Law on Waste 209/2016 and art. 154 of the Contravention Code of the Republic of Moldova no. 218-XVI of 24 October 2008.

3.4.6 Science and Innovation

Interviewees reported that they do not recognise any contribution of science and research to a more CE within the electronics sector in Moldova, even though there are institutions such as the Science Academy or Technical University.

3.4.7 Recommendations for CE in the EEE Sector in Moldova

- Moldova has a small EEE manufacturing sector. The **Government** should ensure that their **wastes from production are minimised** by high material production efficiency and are **adequately treated and disposed of**, specifically focusing on CoC in production wastes. As for **product design**, Moldova should **adopt regulations such as the EU Ecodesign Directive** to ensure that producers implement them in their products, which they might avoid if Ecodesign rules are different from those in the EU due to the small size of the Moldovan market. General stipulations like those in waste-related Moldovan regulations are too unspecific to incentivise producers to take respective measures.

- Repair of products is still common and practiced for EEE, though partially by non-authorised persons/companies, it seems. Moldova should try to **maintain the repair culture** and **incentivise formalised and authorised repair services**, making sure that prices for repairs and spare parts remain affordable, e.g. by **tax reductions** for such activities or other means. In this perspective, the **Government** should pay attention to the '**optimal replacement moment**',[146/147] in defining such support and incentives to tackle trade-offs, e.g. with the energy efficiency and energy consumption of older devices versus new ones. Additionally, when introducing further legislation, especially (e-)waste legislation, the **Government** should, as much as possible, avoid obstacles **hampering repair and reuse** of products. Repair and reuse organisations should have continued **access to separately collected e-waste** to be able to serve the market for UEEE and components for repair, provided they can prove that they are not involved in illegal practices of substandard treatment and waste disposal. A national register and certificate for such organisations could be helpful in preventing abuses.

- The country has an e-waste legislation with EPR obligations in place approximated to the EU WEEE Directive. The implementation on the ground still seems to be in an early phase with respect to collection and treatment of e-waste. In the face of increasing amounts of EEE placed on the market, Moldova's national **Government and municipalities** should further **develop a sound e-waste management system** with focus on increased collection as a crucial first step to reduce landfilling and the informal treatment of e-waste.

- No end-of-life treatment operators were reported as active in the country. Once the collected e-waste volumes increase, the matter of whether the continued export of collected e-waste for treatment (e.g. to Romania) still makes sense or, alternatively, **whether a national technical infrastructure should be established** should be considered. The **Government** may consider creating **stable financial conditions for pre-treatment operators** so that the economic operators can decide to invest in technical infrastructure and how to cooperate with neighboring countries to achieve economy of scale treatment and disposal of e-waste and parts thereof.

- Moldova seems to have no clear data on imports/exports of UEEE and e-waste. Furthermore, the country still uses the old classification of EEE into ten categories instead of the six categories of the current EU WEEE Directive. Since Moldova signed an association agreement with the EU, a **transition to the six categories of the current EU WEEE Directive** should be undertaken. This would enable the data being comparable with those of EU member states as a first step toward a better data management, complemented by **stringent reporting and tracking requirements for EEE/UEEE and e-waste/parts** thereof leaving and entering the country.

[146] The UN Environment's review of lifecycle assessment (LCA) studies investigated the optimal replacement moment of several EEE, such as washing machines, refrigerators, televisions, mobile phones, laptops, and vacuum cleaners. The results suggest that washing machines and refrigerators should be used for at least 10 years before they are replaced with more energy-efficient models, while vacuum cleaners, mobile phones, and laptops are typically replaced prematurely and should be used for longer, though it is difficult to suggest an exact replacement moment for these products. See UN Environment (2017). The Long View – Exploring Product Lifetime Extension. https://www.oneplanetnetwork.org/sites/default/files/from-crm/the_long_view_2017.pdf.

[147] One Planet Network, The Long View – Exploring Product Lifetime Extension, https://www.oneplanetnetwork.org/knowledge-centre/resources/long-view-exploring-product-lifetime-extension

4. TOWARD A ROADMAP: RECOMMENDATIONS FOR ACTIONS

Transitioning toward a CE electronics value chain (c.f. Figure 2-1 on page 12) in the Central and Eastern European region (CEE)[148] requires a holistic approach, addressing:

1. **Product Design and Manufacturing Phases:**

- How products are designed with respect to the use of CoC, durability and repairability, and recyclability.
- From which materials products are produced, e.g. from secondary or primary materials.

2. **Consumption/Use phase:**

- Whether and how repair services and spare parts are accessible and available at reasonable prices.
- How long products are used, i.e. whether consumers exploit the technical lifetime, incl. repairs.

3. **End-of-life phase:**

- Whether products are collected and treated adequately at the end of their life to maximise their reuse – or the reuse of components – and recycling or sustainably sound disposal of materials.

4. **All value chain phases – data collection and environmentally sound e-waste management:**

- The availability of sound and robust data across the life cycle stages of products is needed to steer the transition process toward CE and to assess progress.

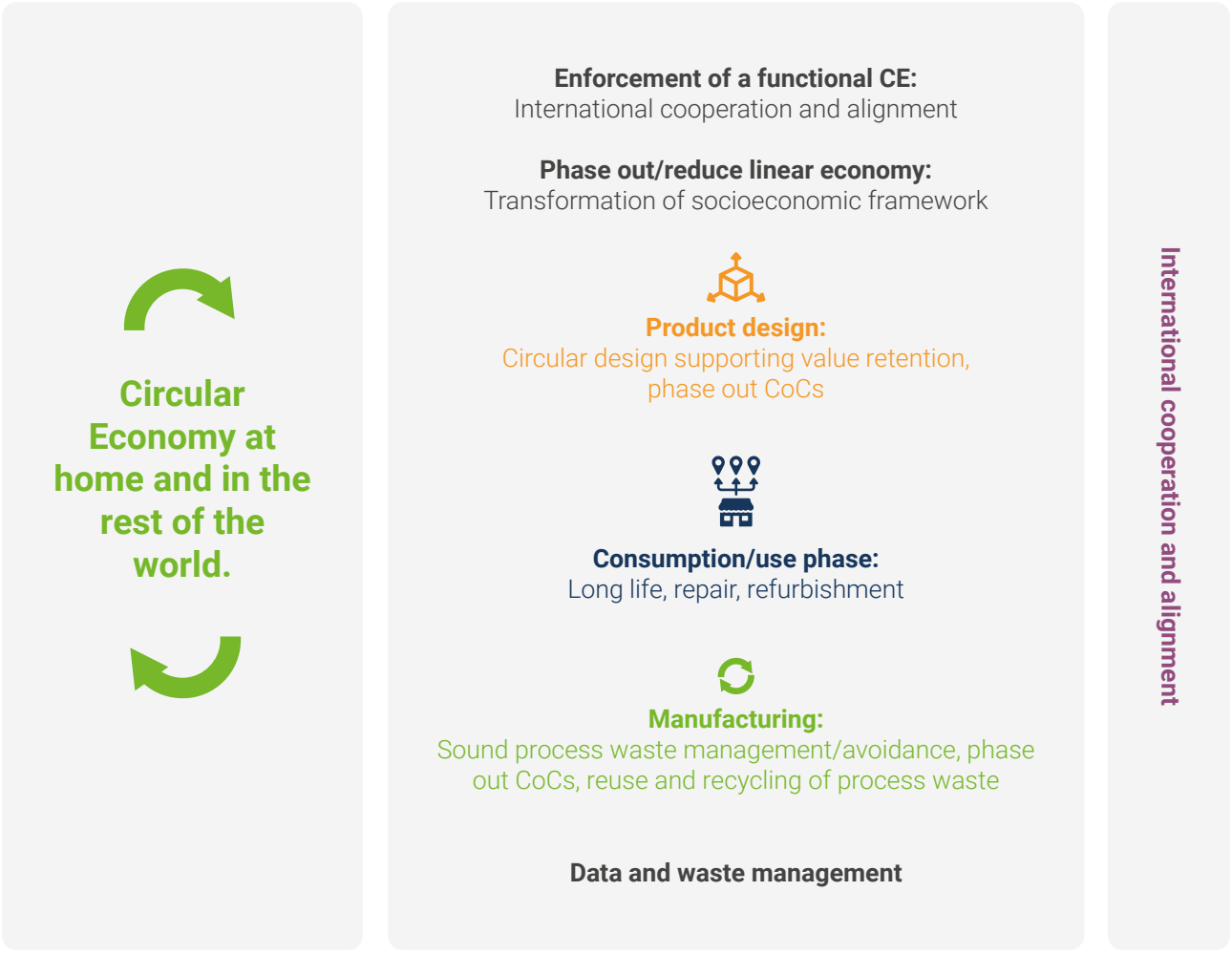
5. **Enforcement of a functional CE in the CEE region: Establishment of a legal socioeconomic framework that systematically favors circular businesses and sustainable consumption and production patterns over linear ones.**

[148] CEE in the context of this study comprises the new EU member states in Central Europe, the West Balkan countries, Caucasus and Eastern Europe, and the Russian Federation

4.1 General Considerations: National Sovereignty and International Cooperation and Alignment for Circular Economy

In the mentioned aspects, the focus countries and the whole CEE region have varying degrees of intervention capabilities for initiating and influencing the transition of their economies. Governments play a key role in setting the appropriate boundary conditions and incentives for transitioning to a CE. In the face of global markets and competition among countries and manufacturers, smaller countries, especially, depend on cooperation and supranational, regionally, and internationally aligned procedures to implement CE measures. The degree of national sovereignty and supranational cooperation is determined by the specific measures. Figure 4-1 illustrates the situation before the aspects are explained in more detail in the next sections.

Figure 4-1. CE in different value chain stages and increasing need for international alignment



Product Design and Manufacturing Phase

National governments may restrict the use of certain substances and materials, e.g. CoC, in manufacturing taking place on their national territories, for materials and substances used in the production process only, meaning that they will not become part of the final product.

Regarding CoC and other materials in the products, the situation is different, as it affects the product design. Most supply chains and EEE manufacturing are organised globally, and the majority of products are produced for regional and often global markets. To enforce circular product design, requirements on supranational producers requires cooperation with other countries so that the market is large enough to represent an attractive market for producers, thereby incentivising acceptance and compliance of such design rules. For example, with its large market power, the EU enforced Directives 2002/59/EC and 2011/65/EU (RoHS Directives). Producers within and outside the EU avoided

the substances restricted under this directive in their EEE to ensure their access to the EU market with their products designed for global markets.

Most CEE countries, including the focus countries, are smaller nations with limited market and/or purchasing power. This implies that recommendations for CE and CoC management in the focus countries and the CEE region cannot target only the focus countries. Such national efforts should be coordinated with other countries, for example the EU, of which several countries in the CEE are already members or have signed association agreements with, among others, the objective to approximate the legislative framework to the one in the EU.

In this context, regulatory efforts on eco-design and CoC in products should be coordinated in the larger international context, and not address only the focus countries and the CEE region. Smaller countries may otherwise risk having certain products no longer placed on their national markets[149] if this would imply specific compliance efforts on the producers' side only for a country with a small market.

Consumption/Use Phase: Product Lifetime Extension, Repair, and Refurbishment

Governments, civil society, and other stakeholders can act on national levels to raise consumer awareness regarding CE, such as by highlighting the importance of repair, refurbishment, purchase, and use of used products, and by limiting consumption. As well, repair and refurbishment require the cooperation of producers regarding the availability and prices of spare parts, as components cannot be retrieved from older appliances for reuse. It may require at least regional cooperation and alignment of measures of CEE countries, or beyond on the EU level, to generate a legislative and market impetus so that all producers contribute their share to repair and refurbishment.

Data and Environmentally Sound E-waste Management

At a national level, governments can influence the end-of-life phase of products by establishing environmentally sound e-waste management and financing systems, such as EPR, at the national level, as well as providing incentives and supporting consumer awareness for the return of waste electronic appliances no longer in use. The same applies to the data management. So, the focus countries are in a good position to implement recommendations relating to collection and treatment of EEE and to data issues, while considering potential harmonisation on a regional and supranational level (i.e. with the EU) for data management.

Enforcement of a Functional CE in the CEE Region

The transition toward a circular electronics value chain in the CEE region also requires coordination at national, regional, and international levels. This is reflected in the recent United Nations Environment Assembly 5.2 resolution on CE ('Enhancing Circular Economy as a contribution to achieving sustainable consumption and production'), which notes the challenges countries face in accessing finance, technology transfer, and capacity-building for circularity.

As smaller countries have actors that do not participate in EEE design decisions, they have limited capacity and incentives to adopt circularity when they must compete with products from other countries that do not adopt circularity. In order to transition to a fully circular electronics sector, global coordination is needed to incentivise circular models while reducing the commercial viability of linear models.

The highly globalised value chain of EEE means that changes in one country may affect the competitiveness and markets of another. This can have positive impacts if applied to CE measures, as shown, e.g., with the EU's work on climate neutrality, which proposes specific import tariffs to compensate for price differences caused by CE measures with the aim of encouraging circular design for EEE.

4.2 Recommendations for the Focus Countries and the Region

Mining/raw material production (virgin materials) in the context of EEE could not be identified in the focus countries and thus was not considered. Recommendations for the other value chain stages are addressed below.

4.2.1 Product Design and Manufacturing

EEE producers and suppliers are located in the focus countries, as well as in other CEE countries.

Collaborating with producers and suppliers, Governments should establish **industrial symbioses** for manufacturing and manufacturing sites with minimal use of energy, CoC and materials, and avoiding wastes to achieve more sustainable production processes. Governments can also generally **establish and enforce proper waste management** for manufacturing wastes, including sound and clear disposal paths.

Suppliers often react on requirements of their customers, i.e. the producers, instead of initiating their own CE initiatives. In interviews, suppliers in the region expressed that they do not see financial benefits in changes, and, above all, that the producers define the design of the final product and specify the requirements and design of supplied parts. Suppliers can propose improvements of supplied parts, but in the

[149] For example, see ChemSafety, https://www.chemsafetypro.com/Topics/Restriction/Norway_PoHS.html

end, producers are actually in the best position to **initiate ecodesign changes** and set up clear **requirements for their products and production processes**. They can hand these requirements down to the supply chain and take them into consideration when selecting suppliers. The requirements should go beyond legislative compliance efforts in manufacturing and in products and focus on minimising the use of CoC, or their elimination where safer alternatives are available. Suppliers should continue to explore material and process innovation and to proactively propose those to the producer to whom they supply.

For further influencing product design and enabling the phasing out of CoC as well as repair, upgrade, durability, recycling – the classical eco-design aspects – **the CEE countries should establish and strengthen regulatory capacity for risk management action on CoC in EEE**, including legal and institutional infrastructure, with sufficient government funding. This entails the development of national strategies and legislation with clear allocation of mandates and responsibility of public bodies and other actors involved. It should also include a mechanism for regular review, revision, and update of regulatory risk management action on CoC in EEE in order to account for rapid development in the electronics sector. Countries should work to strengthen knowledge, close (regulatory) data gaps, increase transparency on chemicals along the value chain, and promote innovation and voluntary initiatives. In this context, countries in the region may consider **supporting, promoting and adopting such regulations of the EU** as the RoHS Directive, the REACH Regulation, and the EcoDesign Directive (Directive 2009/125/EC), and support amendments of these regulations toward phasing out and better management of CoC.

Where feasible, e.g. in the case of regional markets, they could join forces to **establish such requirements at the regional level**, in particular for producers with a focus on the regional market. **It is important that these requirements be specific and verifiable.**

To incentivise producers' efforts, the **CEE countries** could establish – at national or regional levels, or even at the EU level – **competitions for proven best solutions and practices** of producers and their suppliers, repair services and infrastructures, and their end-of-life operators. This could result in a best practice platform to share examples and motivate other producers and suppliers.

Small and medium-sized enterprises, producers, and especially suppliers may require support for a proper sustainable product design in line with CE requirements. **European EcoDesign Initiatives[150] may be helpful** for guiding the designers to new product designs that enable the circularity of products.

Consequent **Sustainable Public Procurement (SPP)** implemented by public institutions could provide strong incentives for producers and their suppliers to apply eco-design for their products, implement cleaner production processes, and result in increased material and energy efficiency. SPP policies should also require that **producers provide spare parts** over a sufficiently long time and **support repair operators**. Triggering such design changes requires a critical mass, i.e. both aligned SPP product criteria as well as sufficient market power to create commercial incentives for international producers. **The CEE countries could implement such SPP programs** following the EU SPP approaches.[151]

4.2.2 Product Consumption (purchasing decision and use phase)

Information campaigns, appropriate product labels, and dedicated information platforms for CE should allow **consumers** to better understand the resulting impacts of the products they purchase and help them make informed decisions. This will support the market success of progressive producers against other producers. Eco-labels can also be used as verification of compliance to SPP technical specifications, and governments could thus consider implementing SPP and eco-labelling in tandem.

Consumers in many CEE countries still seem to be willing to have EEE repaired and to buy UEEE. It was also found that repair services are in place. This **consumer attitude and the infrastructure should be preserved** and improved by raising **consumer awareness** about the positive effects in terms of resource consumption and making value retention processes such as repair fashionable and easy to access. The EU Right for Repair[152] may support such efforts. **Governments in the CEE region should adopt the related requirements and support their national infrastructure**, e.g., with tax cuts for repair services.

[150] See for example the Learning Factory https://www.izm.fraunhofer.de/en/abteilungen/environmental_reliabilityengineering/projekte/learning-factory-for-ecodesign.html

[151] C.f. European Commission, https://ec.europa.eu/environment/gpp/index_en.htm

[152] C.f. the European Parliament, https://www.europarl.europa.eu/news/en/press-room/20201120IPR92118/parliament-wants-to-grant-eu-consumers-a-right-to-repair

In this perspective, **governments** should pay attention to the **'optimal replacement moment'**[153/154], in defining such support and incentives to tackle trade-offs, e.g. with the energy efficiency and energy consumption of older devices versus new ones. Additionally, when introducing further legislation, in particular (e-)waste legislation, **governments should, as much as possible, avoid obstacles hampering repair and reuse** of products. Repair and reuse organisations should have continued **access to separately collected e-waste** to be able to serve the market for UEEE and components for repair, provided they can prove that they are not involved in illegal practices of substandard treatment and waste disposal. A national register and certificate for such organisations may be helpful to prevent abuses.

The private sector could also consider **establishing networks in the region and beyond for spare parts management** to improve their availability **and to enable repair and refurbishment of used EEE and e-waste. Producers or their authorised workshops could use such networks for refurbishment and remanufacturing** of used EEE and WEEE to make both used and new parts available. **Governments should support these activities with initial funding and projects for their incubation**. The preservation and promotion of the repair and reuse culture and a more positive attitude around purchasing used products may also enable consumers to take first steps toward the 'refuse' strategy that aspires avoiding consumption in the first place (i.e. making a product redundant by abandoning its original function or by offering the same function but with a radically different product).

Governments in the CEE region and beyond, in the EU, should **create framework conditions that make repair, refurbishment, remanufacturing, and reuse of used EEE and e-waste profitable** for operators. Governments should, however, pay attention to **the 'optimal replacement moment'**[155] in defining such policies to tackle trade-offs, e.g. with the energy efficiency and energy consumption of older devices versus new ones. Furthermore, once governments have put in place socioeconomic framework conditions allowing these activities to be profitable for operators, financial sector actors such as the EBRD[156] could **financially support small and medium-sized enterprises, specifically, to begin such activities**. These efforts could be further strengthened if **services and infrastructure for value retention of EEE would be explicitly included into the EU Taxonomy**[157] to attract investments of sustainable finance investors.

Repair and reuse of EEE could also **maintain and create additional qualified jobs** with the value-add remaining in the region. This would be an advantage, considering that producers in the region are currently almost exclusively international ones and that most EEE is imported from outside the region.

If they align their initiatives and cooperate, **governments of CEE** countries could **create a strong market pull** for the above activities and infrastructures by **extending Sustainable Purchasing Programs from the product scope to entire product systems**. This would include requirements for repairability and the availability of spare parts and repair services, refurbishing and remanufacturing services, and infrastructure for the purchased products.

Civil society organisations could support the above efforts to **maintain or strengthen the awareness for the environmental and financial advantages of EEE repair and use of UEEE** in the region and to further **promote progress at national and EU level toward a repair and reuse culture**.

Besides awareness-raising among consumers, civil society organisations could, with support from governments, create a positive image and link pleasant experiences for consumers of EEE to repair activities. **Establishing and promoting movements like Repair-Cafés**[158] could contribute to this and strengthen the emotional component of having and using products over the consumption aspect, resulting in short-term use and replacement by new products.

Civil society organisations and governments should cooperate to **discourage or restrict business models and advertisements** built on or systematically promoting excessive consumption of EEE, e.g., mobile service providers attracting customers into contracts by promising a new mobile phone every six months or every year.

Civil society organisations generally appear to be in the best position **to promote the refusal of consumption** as an important pillar of CE, reducing resource consumption beyond repair and reuse, i.e. to encourage consumers to purchase consciously after careful consideration of what serves them for a good life.

[153] The UN Environment's review of lifecycle assessment (LCA) studies investigated the optimal replacement moment of several EEE, such as washing machines, refrigerators, televisions, mobile phones, laptops, and vacuum cleaners. The results suggest that washing machines and refrigerators should be used for at least 10 years before they are replaced with a more energy-efficient models, while vacuum cleaners, mobile phones, and laptops are typically replaced prematurely and should be used for longer, though it is difficult to suggest an exact replacement moment for these products. See UN Environment (2017). The Long View – Exploring Product Lifetime Extension. https://www.oneplanetnetwork.org/sites/default/files/from-crm/the_long_view_2017.pdf

[154] One Planet Network, The Long View – Exploring Product Lifetime Extension, https://www.oneplanetnetwork.org/knowledge-centre/resources/long-view-exploring-product-lifetime-extension

[155] The UN Environment's review of lifecycle assessment (LCA) studies investigated the optimal replacement moment of several EEE, such as washing machines, refrigerators, televisions, mobile phones, laptops, and vacuum cleaners. The results suggest that washing machines and refrigerators should be used for at least 10 years before they are replaced with a more energy-efficient models, while vacuum cleaners, mobile phones, and laptops are typically replaced prematurely and should be used for longer, though it is difficult to suggest an exact replacement moment for these products. See UN Environment (2017). The Long View – Exploring Product Lifetime Extension. https://www.oneplanetnetwork.org/sites/default/files/from-crm/the_long_view_2017.pdf

[156] European Bank for Reconstruction and Development, https://www.ebrd.com/home

[157] EU Taxonomy, https://ec.europa.eu/sustainable-finance-taxonomy/

[158] C.f. Repair Café, https://repaircafe.org/en/

4.2.3. EoL Phase

Among the focus countries, the non-EU countries, specifically, still seem to be in the early stages of implementing sound e-waste management systems, including low collection rates and a lack of sound treatment and disposal options. It can be assumed that this mostly applies to other non-EU countries in CEE as well, while EU member states in CEE have had to comply with the WEEE Directive for more than a decade already. If not already in place, **governments in the CEE region should adopt and enforce the EU WEEE Directive and establish a sound e-waste management system and practices** for retaining valuable materials in the economy and avoiding CoC emissions. **Awareness-raising and training of municipal and other e-waste collectors** for high quality collection (no damages, correct sorting of e-waste, etc.) could be a valuable contribution for a subsequent sound treatment/disposal of the separately collected e-waste. To increase collection rates, collection points should be **established close to consumers** (for instance in retail shops). Municipalities should offer **curbside collections** from time to time, placing containers **monitored by trained staff** in certain places/locations so that consumers hand in e-waste.

Producers may incentivise consumers to return e-waste by credits for new products if they give back old ones in shops that (have to) accept e-waste. Also, **municipalities, PROs, and treatment operators** should be allocated a clear obligation **to raise consumers' awareness about the importance of separate collection** of e-waste.

Governments should also make sure that **'e-waste' in good condition remains accessible** for authorised operators at the collection sites to enable its repair, refurbishment or reuse, or 'cannibalization', i.e. the removal of important spare parts for the repair of other devices, which can be offered and distributed over the regional networks discussed above.

Civil society organisations should support and strengthen the efforts to achieve **sound treatment of e-waste with high rates of separate e-waste collection**, ensuring the retention of valuable resources in the economic system and avoiding emissions of CoC into the environment. An important role for them is to **push producers and governments to establish the above-mentioned measures, and to support or initiate own initiatives** for consumer awareness for sound e-waste collection.

During interviews, the crucial influence of PROs on the EoL treatment of e-waste was highlighted. PROs contract logistics and treatment operators, which opens the possibility of **selecting high-quality operators**, e.g. those certified according to credible standards such as the EN 50625 series or similar quality standards, instead of simply contracting the cheapest operators. **Platforms[159] providing information about products' compositions and constructions** may also support the sound treatment of e-waste.

However, PROs in many countries are in a competitive situation with other PROs. Treatment and stringent audits according to high-quality standards can be assumed to cause higher costs than a purely price-oriented operation without high-quality requirements and stringent controls. In the end, the PRO members, i.e. the producers, must cover these higher prices so that they may decide to join the cheapest PROs instead of those seeking good-quality treatment, even though they are or should be responsible for sound treatment of their EoL products. **Producers should assume their responsibility and push PROs for sound treatment or join PROs where this has already been established.**

Obligatory standards combined with an effective EOL operators' certification system could create a level playing field, where competition between EoL operators and PROs would no longer follow only prices, causing a downward trend on quality. The Czech Government introduced an obligatory certification of EoL operators according to the EN 50625 series.[160] **Other governments in the region should consider following this example**, considering the Czech experiences with this approach.

The availability of reliable data related to EEE placed on the market, imported, collected, treated, and data of exported used EEE, etc. is still limited. **Establishing harmonised procedures, methods, and templates among the countries in the CEE region and the EU for data collection and exchange** could be helpful for obtaining transparency on the flows and identifying gaps and loopholes, e.g. for illegal exports or imports. The countries should **enhance the national human and infrastructural capacity to comply with the reporting obligations** to the Basel Convention (annually) and to the Stockholm Convention (every four years). A focus should also be placed on the **expected volumes of CoC from e-waste treatment, and their fate**, e.g. processing, disposal, and their destiny if exported, including certificates for their sound treatment.

[159] As example see the EU I4R platform could be highlighted also as an example. https://i4r-platform.eu/about/

[160] C.f. WEEELABEX Organisation: the Czech Republic Requires Mandatory Certification Against CENELEC 50625; https://www.weeelabex.org/about-us/news-events/the-czech-republic-requires-mandatory-certification-against-cenelec-50625/

4.2.3 Implementation and Enforcement of a Functional CE

Establishing a full-fledged CE for the EEE value chain in the CEE region, besides fundamental national socioeconomic transformations, requires regional and international alignment and cooperation beyond the outreach of individual national governments.

Given the supranational aspects of CE, **the countries in the CEE region could consider cooperating with and support the EU** to reorganise rules for international trade and value chains and promote, **achieve, and align the step-by-step transformation process** from the current status to a full CE.

In this context, CEE countries should set up national CE implementation plans detailing targets, measures, and milestones that can be achieved within the current international and national socioeconomic framework conditions. This would imply measures that can be implemented nationally with no or little alignment and cooperation beyond the national level, e.g. for waste management, and continue with those measures that require increasing regional and international alignment and cooperation. These plans should be adapted regularly in line with regional and international progress. **Continuous regional and international cooperation and alignment with EU policies** is recommended for enabling progress and enforcement of measures at the national level in the CEE region.

Similarly, **producers** should develop such **CE implementation plans** for their supplies, production, products, services, and business models starting with measures that can easily be put into practice and others that require more international cooperation and alignment with EU CE policies. These CE implementation plans could be aligned with the national ones of the CEE countries and the EU in terms of international alignment steps. Each product/service development should pass through a systematic check assessing which steps and degrees of CE are feasible already. Future standards[161] may be helpful in this context.

CE is also a communication task, particularly with consumers, to raise awareness and understanding and to ensure their cooperation and acceptance. This challenge should be taken up by governments, producers, and civil society. **Labels** highlighting CE-compatible EEE manufactured under environmentally and socially acceptable conditions may be an interim solution to orient consumers and provide transparent information for making decisions in purchasing. In a fully functional circular economy, the socioeconomic and legislative framework should sufficiently ensure that products endangering human beings' dignified and fair coexistence and/or the natural bases of life are either less competitive on the market or are restricted by national product regulations.

Civil society organisations have a pivotal role in the promotion and implementation of CE and to organise societal support and acceptance by consumers and, possibly even more, to **create the public impetus to push governments and producers to progress toward a CE**. To increase their **vigor, civil society organisations should network at the EU level** and beyond and join forces in CE campaigns.

Further, **international finance** organisations should **contribute to the implementation of CE**. The International Monetary Fund, for example, already supports countries in combatting climate change,[162] and the World Bank Group addresses[163] aspects of CE. Such programs could be extended to redirect financial flows toward financing and support of the transition to a global circular economy, including a just transition.

Finally, **science/research can work out solutions and generate ideas** to enable **informed decision-making by governments and economic operators** and to shape the future CE that requires innovative solutions to transform the currently highly diversified and globalised market economies.

Close cooperation and exchange will be required in and across the countries between **science/research, citizens, civil society organisations, governments, and economic actors and financial institutions**. Together, they should be better positioned to find and implement the solutions for a CE for the electronics sector in the CEE region and beyond, **respecting the limited resources available on the planet** for an increasing number of people in light of the challenges posed by climate change, loss of nature, and pollution.

[161] AC.f. ISO /TC 323, https://www.iso.org/committee/7203984.html

[162] C.F. International Monetary Fund, https://www.imf.org/en/Topics/climate-change

[163] C.f. World Bank Group, https://www.worldbank.org/en/search?q=circular+economy

4.2.4 Roadmap: Implementation of CE in the CEE Region

Table 4-1 summarises the recommendations for the implementation of a fully functional CE in the CEE region and should be used as inspiration and for further consultations by actors in the region.

Table 4-1. Summary of recommendations and proposed roadmap for the CEE region

Life cycle stage	Recommendations	Key/driving stakeholders	Time frame *[Short term: up to 3 years. Medium term: 3-7 years. Long term: more than 7 years].*
PRODUCT DESIGN	Adopt eco-design requirements for own products and their production for phasing out CoC, etc., including requirements for suppliers	Producers, suppliers	Short-term
	Support and establish eco-design requirements that adopt/align with EU regulations	Governments with EU and/or CEE governments, producers	Medium-term
	Establish national/regional competitions and platforms for best practices on eco-design and production	CEE governments	Short-term
	Support producers and suppliers in implementation of eco-design	CEE governments, EU initiatives	Short-term
	Establish national and regional Sustainable Public Procurement (SPP) programs	CEE governments, EU	Short- to medium-term
MANUFACTURING AND PRODUCTION	Phase out CoC in production, including the supply chain, through national legislation and producer requirements in line with EU CoC legislation and beyond	Governments, producers	Short-term
	Establish and enforce measures for minimisation of waste and energy consumption and for proper management of manufacturing wastes	Governments, producers	Short-term
	Provide sound and clear disposal paths for wastes from manufacturing and production in, or in cooperation with, other countries in the region	Governments	Short- to medium-term
	Establish industrial symbiosis of suppliers and producers to reduce waste and energy consumption	Producers, suppliers, governments	Medium- to long-term

Life cycle stage	Recommendations	Key/driving stakeholders	Time frame *[Short term: up to 3 years. Medium term: 3-7 years. Long term: more than 7 years].*
PRODUCT CONSUMPTION PHASE	Maintain and promote repair culture and infrastructure, long use of products, willingness to buy UEEE, etc., e.g. through financial incentives and by using EU Right to Repair as impetus	Governments, civil society, consumers	Short-term
	In transition to a fully functional CE, use/establish CE labels, informing and motivating consumers to purchase sustainable products	Governments, producers, civil society	Short-term
	Raise awareness of consumers for importance of longevity and repair, e.g. with respect to uses/emissions of CoC into the environment, losses of valuable resources, energy consumption, human health	Governments, civil society, PROs	Short-term
	Promote a modern and positive image and experience around repair and reuse of products, e.g. new ways to repair, such as Repair Cafés	Civil society, governments	Short-term
	Establish and support local networks for spare parts management to improve their availability at reasonable prices and quality	Producers, suppliers, and other private sector operators, civil society, governments	Short- to medium- term
	Ensure access to 'e-waste' by authorised operators to enable reuse, repair, refurbishment, and harvesting of spare parts for repairs	Governments, producers, PROs	Short-term
	Motivate consumers' refusal of consumption through considerate purchasing and use of (reuse) products	Civil society, governments, consumers	Short-term
	Make unattractive or restrict business models and advertisements built on or systematically promoting excessive consumption of EEE	Civil society, governments	Short-term
	Strictly apply regional/EU SPP in the public sectors; the private sector could adopt same approaches	Governments, producers	Short- to medium- term
COLLECTION OF E-WASTE	Adopt/follow EU legislation (WEEE Directive, Waste Framework Directive, etc.)	Governments	Short-term
	Establish collection points close to consumers (containers, shops), organise monitored curbside collection events for e-waste	Governments (municipalities), PROs/ producers	Short-term
	Raise collectors' awareness for proper handling of e-waste for subsequent sound treatment and prevention of CoC leaking into the environment	Governments (municipalities), PROs/ producers	Short-term
	Raise awareness of consumers about importance of separate collection of e-waste, informing about formal e-waste disposal possibilities to increase collection rates	PROs/producers, governments (municipalities), civil society	Short-term
	Incentivise consumers to return e-waste, e.g. by credits for new products if they turn e-waste in at collection points/ shops	Producers	Short-term
	Ensure accessibility to collected e-waste in good condition for authorised repair/refurbishment/reuse operators	Producers/PROs, governments	Short-term

Life cycle stage	Recommendations	Key/driving stakeholders	Time frame *[Short term: up to 3 years. Medium term: 3-7 years. Long term: more than 7 years].*
 **TREATMENT AND DISPOSAL OF E-WASTE**	Join PROs that select high-quality treatment operators, e.g. ones certified according to EN 50625 series standards for handling, transport, treatment, and disposal of e-waste and parts thereof	Producers	Short-term
	Require certification of contracted EoL operators, e.g. EN 50625	PROs/producers	Short- to medium -term
	Enforce obligatory certification of EoL operators, including collectors	Governments	Short- to medium-term
	Work toward procedures, methods, and templates harmonised among countries in the CEE region and the EU for reliable data on (W)EEE flows and to increase data availability	Governments, PROs, producers, treatment operators	Short- to medium-term
	Increase traceability of CoC, focusing on expected volumes of CoC from e-waste treatment and what happens to the e-waste after treatment, e.g. processing, disposal, their destiny if exported including certificates for their sound treatment	Governments, PROs, EoL operators	Short- to medium-term
	Ensure sufficient human resources for compliance with national and international reporting obligations (e-waste reporting, Basel Convention Stockholm Convention, etc)	Governments	Short-term

Life cycle stage	Recommendations	Key/driving stakeholders	Time frame *[Short term: up to 3 years. Medium term: 3-7 years. Long term: more than 7 years].*
ACHIEVEMENT OF FULL CE	Set up and regularly adapt national CE transformation plans in alignment with EU initiatives	Governments	Short- to long-term
	Set up and regularly adapt company-specific transformation plans	Producers	Short- to long-term
	Communication and awareness-raising with and among consumers, governments, and industry	Governments, civil society	Short- to long-term
	Cooperate with/support EU in transformation of national, regional, and international economies and societies toward CE	Governments	Medium- to long-term
	Align and network on the national and EU levels (and beyond) for promoting CE	Civil society	Short-term
	Strengthen exchange between science/research and economy and governments on product design, manufacturing, consumer behavior, new business models, creation of boundary conditions favoring CE products and services, transition paths from the current status to a fully functional CE, etc.	Governments, research institutions, producers	Short-term
	Promote acceptance and awareness of consumers for CE measures	Civil society	Short- to medium-term
	Continuously promote transitioning to CE and CE-compliant products and services to motivate governments and consumers to go and follow the necessary steps	Civil society	Short- to long-term
	Redirect financial resources to investments supporting and enabling the implementation of CE	Regional and international finance organisations, e.g., International Monetary Fund (IMF)	Medium-term
	Foster cooperation and exchange within and among CEE countries and the EU/international level between science/research, citizens, governments, and economic operators to find and agree on solutions for a full CE	All	Medium- to long-term
	Work toward an international regulatory framework (e.g. regional and international trade, standards, customs tariffs) that enables national economies to establish conditions that systematically favor products and services in line with a CE	All	Long-term

5. REFERENCES

Directive 2009/125/EC: Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products (Text with EEA relevance). ErP Directive, Ecodesign Directive.

Directive 2011/65/EU: Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (recast). RoHS 2. European Union. Available online at http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32011L0065.

Directive 2012/19/EU: Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE), Text with EEA relevance. WEEE Directive.

Regulation (EC) No 1907/2006: Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH). REACh. Available online at https://eur-lex.europa.eu/eli/reg/2006/1907/oj/eng.

Baldé C.P., Iattoni G., Luda V., Nnorom I.C, Pecheniuk O., Kuehr R. (2021), Regional E-waste Monitor for the CIS + Georgia – 2021, United Nations University (UNU) / United Nations Institute for Training and Research (UNITAR) – co-hosting the SCYCLE Program, Bonn, Germany.

Baldé, C.P., Kuehr, R., Blumenthal, K., Fondeur Gill, S., Kern, M., Micheli, P., Magpantay, E. and Huisman, J. (2015). E-waste Statistics: Guidelines on Classifications, Reporting and Indicators. United Nations Universit, IAS-SCYCLE, Bonn, Germany. https://www.itu.int/en/ITU-D/Statistics/Documents/partnership/E-waste_Guidelines_Partnership_2015.pdf.

Eurostat (2021). European Commission. Eurostat. Circular Economy. Indicators. Monitoring Framework. https://ec.europa.eu/eurostat/web/circular-economy/indicators/monitoring-framework.

European Commission (2020), Association Implementation Report on Georgia 2020. https://eeas.europa.eu/sites/default/files/1_en_document_travail_service_conjoint_part1_v4.pdf.

European Commission (2019). EU Eco-Innovation Index 2019. EOI Brief. https://ec.europa.eu/environment/ecoap/sites/default/files/eio_brief_eu_eco-innovation_index_2019.pdf.

European Commission (2019). Eco-innovation in Bulgaria. EIO Country Profile. 2018-2019. https://ec.europa.eu/environment/ecoap/sites/default/files/field/field-country-files/eio_country_profile_2018-2019_bulgaria.pdf.

EU Neighbour East (2018). How Georgia is changing its approach to waste disposal with EU support. 4 June. https://euneighbourseast.eu/news-and-stories/stories/how-georgia-is-changing-its-approach-to-waste-disposal-with-eu-support.

EU4Environment (2020). Sustainable public procurement in Georgia. 16 September. https://www.eu4environment.org/news/sustainable-public-procurement-in-georgia/.

Forti, V., Baldé, C.P. and Kuehr, R. (2018). E-waste Statistics: Guidelines on Classifications, Reporting and Indicators, second edition. United Nations University ViE – SCYCLE, Bonn, Germany. 2018. Available: http://collections.unu.edu/view/UNU:6477.

Forti V., Baldé C.P., Kuehr R., and Bel G. The Global E-waste Monitor 2020: Quantities, flows and the circular economy potential. United Nations University (UNU)/United Nations Institute for Training and Research (UNITAR) – co-hosted SCYCLE Programme, International Telecommunication Union (ITU) & International Solid Waste Association (ISWA), Bonn/Geneva/Rotterdam. https://www.scycle.info/wp-content/uploads/2020/12/GEM_2020_def_dec_2020.pdf.

Georgia Department of Public Health. Occupational Health Surveillance. Recognizing Lead Hazards: For Workers in Electronic Waste Recycling. https://dph.georgia.gov/document/document/leadbatterymanufacturinggafinalpdf/download.

GEO, UNEP (2020). Capacity Needs Assessment of Waste Electric and Electronic Equipment (e-waste) Collectors. https://www.undp.org/sites/g/files/zskgke326/files/migration/ge/UNDP_GE_DG_EPR_WEEE_Capacity-Needs-Assessment-of-Informal-Sector_ENG.pdf.

Hemkhaus M., Hibler S., and Margus V. (2020). E-waste PRO model for Georgia, p. 4 https://geo.org.ge/wp-content/uploads/2020/11/e-waste-PRO-model-for-Georgia_ENG.pdf.

SAICM 2009, Strategic Approach to International Chemicals Management (SAICM). 2009. Report of the International Conference on Chemicals Management on the work of its second session. https://www.saicm.org/Portals/12/documents/meetings/ICCM2/doc/ICCM2%2015%20FINAL%20REPORT%20E.pdf.

Manhart 2021. Jaromír Manhart, Ministry of Environment of the Czech Republic.

Novotny 2021. Petr Novotny, Managing Director WEEELABEX.

United Nations Economic Commission for Europe (UNECE) (2015). Georgia Environmental Performance Reviews Third Review – Highlights. P. 9. https://unece.org/DAM/env/epr/epr_studies/Leaflet/Highlights_3rd_EPR_Georgia.pdf.

UNEP (2017). The Long View – Exploring Product Lifetime Extension. https://www.oneplanetnetwork.org/sites/default/files/from-crm/the_long_view_2017.pdf.

UNEP (2020). Chemicals of Concern in Electronics: Review of Legislative and Regulatory Approaches. https://wedocs.unep.org/xmlui/bitstream/handle/20.500.11822/35362/CoCE.pdf.

United Nations Environment Programme (UNEP (2021). Global Chemicals and Waste Indicator Review Document. United Nations Environment Programme, Nairobi. https://wedocs.unep.org/xmlui/bitstream/handle/20.500.11822/36753/GCWIR.pdf.

United Nations Department of Economic and Social Affairs (UNDESA), 2019 Revision of World Population Prospects. https://population.un.org/wpp/Download/Standard/Population/.

World Bank (2021). Georgia Solid Waste Sector Assessment Report. 31 May. p. 4. https://documents1.worldbank.org/curated/en/535371622781111161/pdf/Georgia-Solid-Waste-Sector-Assessment-Report.pdf.

6. ANNEX A - STATISTICAL APPROACH

As a first step of the methodology to measure EEE and e-waste statistics, it is necessary to quantify the amount of EEE placed on the market. EEE placed on the market (POM) includes any product supplied to the national market for consumption and use by households, businesses, and public authorities.

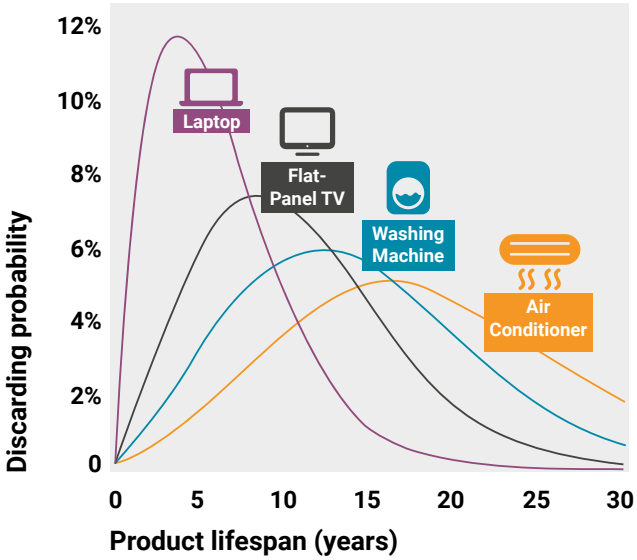
The **EEE placed on the market** has been calculated through the apparent consumption methodology:

POM = Import - Export + Domestic Production

Since trade statistics and domestic production data are usually expressed in units, a unit to weight conversion factor per equipment is calculated and applied to obtain the amount in mass.

After a product has been placed on the market, it stays in use – or at the household, business, or governmental institute – until it is discarded. The lifespan of a product is the period from when the product has been placed on the market until it becomes e-waste. This includes the hibernation phase, as well as the passing on of the equipment from one owner to another (reuse). The lifespan of EEE is expressed as a Weibull function[164] and varies per equipment.

Figure A-1. Examples of EEE product lifespans



E-waste generation is calculated using the EEE placed on the market and equipment lifespans data. E-waste generated in a country refers to the total weight of e-waste resulting from EEE that had been placed on the market in that country, prior to any other activity, such as collection, preparation for reuse, treatment, or recovery, including recycling and exporting.[165]

[164] The Weibull distribution function widely used to describe the lifetime distributions of systems is very versatile and is considered to be the most suitable function for describing discard behavior for EEE; it has been applied in the European Union and in scientific literature (Wang, 2014; Xianlai et al., 2016).

[165] Seyring, N., Kling, M., Weissenbacher, J., Hestin, M., Lecerf, L., Magalini, F., Sinha-Khetriwal, D. and Kuehr, R. (2015). Study on e-waste Recovery Targets, Preparation for Re-use Targets and on the Method for Calculation of the Recovery Targets, Final Report. European Commission. April 2015. [Online]. Available: https://ec.europa.eu/environment/pdf/waste/weee/16.%20Final%20report_approved.pdf

The mathematical description of **'E-waste generated'** is a function of the lifespans and EEE placed on the market of the previous years. In particular:

- *E-waste Generated (n)* is the quantity of e-waste generated in evolution year *n*
- *POM (t)* is the product sales (POM) in any historical 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*

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

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 flat-screen monitors. In such cases, lifespan distributions should ideally be modelled for each historical sales year. The Weibull function is defined by a time-varying shape parameter $\alpha(t)$ and a scale parameter $\beta(t)$ as described in the equation below:

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

For other, more stable products, time-independent lifespans 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:

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

In general, e-waste management involves the collection, transportation, storage, and disposal of waste. Waste management can be undertaken by an economic unit within a legal framework, but waste handling carried out by informal economic units (e.g., informal waste-picking) and illegal e-waste-handling also exist.

It is important 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 performed under the requirements of national e-waste legislation. Therefore, this flow is referred to as **'e-waste formally collected'** in this report and in the e-waste statistics guidelines. 'E-waste formally collected' implicitly means that the e-waste is collected under the specific legislation for e-waste.[166] The ratio between the amount of e-waste formally collected and the amount of e-waste generated yields the **collection rate**.

The activities performed by the informal sector usually do not imply minimum safety requirements, environmental standards, and depollution techniques.

Importation and exportation can occur for used-EEE and e-waste and can happen for components or whole products. It is important that it is made clear whether the exported e-waste is designated according to the national legislation (and thus managed by e-waste-certified recyclers in the receiving countries) or not.

[166] C.P. Baldé, G. Iattoni, V. Luda, I.C Nnorom, O. Pecheniuk, R. Kuehr, Regional E-waste Monitor for the CIS + Georgia - 2021, 2021, cit.

7. ANNEX B - EEE AND E-WASTE FLOWS IN THE FOCUS COUNTRIES

Table A-1 summarises the statistical indicators related to EEE and e-waste flows presented in the individual focus country chapters. Since Belarus was initially included into the study as a focus country, the respective data are included in the table.

Table A-1. Summary of the statistical indicators, by country

COUNTRY	YEAR	EEE PLACED ON THE MARKET (POM)		E-WASTE GENERATED		E-WASTE COLLECTED		COLLECTION RATE
		kg/inh	tonnes	kg/inh	tonnes	kg/inh	tonnes	%
Belarus	2014	8.8	83415.6	6.0	57060.8	0.3	2490.0	4 %
	2019	10.6	99573.9	8.1	75938.6	2.7	25500.0	34 %
Bulgaria	2014	9.1	65595.0	9.8	70825.6	5.9	42310.0	60 %
	2018	11.7	81869.0	11.4	79948.3	7.5	52616	66 %
The Czech Republic	2014	17.1	179328.0	14.1	148148.1	5.6	58585.0	40 %
	2018	18.6	196918.0	15.5	16399.6	8.8	93083	57 %
Georgia	2014	9.8	36259.5	5.3	19569.7	0.0	0.0	0 %
	2019	11.8	43481.8	7.3	26856.4	0.0	0.0	0 %
Moldova	2014	6.6	23492.3	3.3	11854.6	0.0	0.0	0 %
	2019	8.6	30298.6	4.9	17393.0	0.04	137.0	1 %

The years 2014 and 2019 were chosen as reference years. However, for Bulgaria and the Czech Republic, 2018 was used since no data are available for 2019 yet. When looking at the amount of e-waste generated, the Czech Republic is highest, both in absolute terms and per capita. By contrast, Moldova is the country with the lowest amount of e-waste generated within the ones in the scope of the project. The collection rate in 2014 was assumed to be equal to 0% for Georgia and Moldova, since it remained below 1% in 2019 as well, though no clear information is available.

For Moldova, data on EEE placed on the market, e-waste generated, and e-waste collected was provided by the Ministry of Agriculture, Regional Development and Environment in the context of the *Regional E-waste Monitor for the CIS + Georgia*.[167]

For the Czech Republic and Bulgaria, on one hand, the official WEEE Directive data reported to Eurostat in terms of EEE placed on the market and e-waste collected has been used. On the other hand, to quantify the amount of e-waste generated, UNU/UNITAR data in *The Global E-waste Monitor 2020* were used, as no reliable data on that flow have yet been reported to Eurostat by the authorities.

Data on the population in the various countries has been obtained from the United Nations Department of Economic and Social Affairs (UNDESA).[168] To determine the amount of e-waste imported and exported per country, data have been extracted, if available, from the national reports submitted by Parties to the Basel Convention. When no data could be retrieved from the Basel Convention reports and no official information was provided by the authorities of the country, the unavailability of data on e-waste imports and exports is mentioned in the relevant country chapters.

[167] C.P. Baldé, G. Iattoni, V. Luda, I.C Nnorom, O. Pecheniuk, R. Kuehr (2021), Regional E-waste Monitor for the CIS + Georgia – 2021, United Nations University (UNU) / United Nations Institute for Training and Research (UNITAR) – co-hosting the SCYCLE Program, Bonn, Germany.

[168] United Nations Department of Economic and Social Affairs (UNDESA), 2019 Revision of World Population Prospects. https://population.un.org/wpp/Download/Standard/Population/

8. ANNEX C - BELARUS COUNTRY PROFILE

As mentioned above, initial information was collected regarding Belarus, before the decision was made to focus on the four target countries outlined herein. Belarus's brief country profile is thus included here.

Country Profile

Belarus has a population of approximately 9.4 million inhabitants. Waste management is a highly relevant topic, especially as per capita waste production is quite high. The country has adopted a strategy on municipal waste management until 2030. The Ministry of Housing and Utilities is responsible for municipal waste, as well as secondary raw materials including e-waste. As well, the Ministry of Housing and Communal Services is currently developing a draft-unified methodology for determining the morphological composition of municipal solid waste, which can also be useful for improving data on e-waste in the country. In Belarus, there is a general law, Law No. 271-Z on waste management, dated 20 July 2007. E-waste is managed within a framework of EPR of manufacturers and suppliers. Within the 'Municipal Waste Management and Use of Recycled Resources' component of the national program 'Comfortable Accommodation and Favourable Environment' for 2016-2020 (Order of the Council of Ministers of Belarus, dated 21 April 2016, No. 326), an objective was set to reach the intermediate target of 20% by 2019. E-waste collection in Belarus currently takes place in various ways. It is collected in shops that sell EEE, but most e-waste is also collected by eco-taxis (call centers), or individuals can bring their E-waste to municipal collection points. On the other hand, people still scavenge e-waste or use devices as spare parts. Valuable components are taken out and Chemicals of Concern are dumped. Ferrous metal law bans the collection of e-waste by metal scrap recyclers. Despite that fact, such collection probably still happens. Coordination mechanisms and implementation seem to be quite limited.

E-waste collection issues have already been reflected in the state program on municipal waste and secondary raw materials for 2016-2020 and will be reflected in a similar state program for 2021-2025 as well. For what concerns the general improvement of waste prevention and management, back in 2011 large-scale and a multi-target EU/UNDP project was launched in Belarus: national and international experts worked on improving environmental legislation in the field of biodiversity conservation, municipal solid waste (MSW) and water management, and ecological certification. Many ecological challenges have been resolved through implementation of practical activities.

In Belarus, the Extended Producer Responsibility principles have been in effect since 2012.

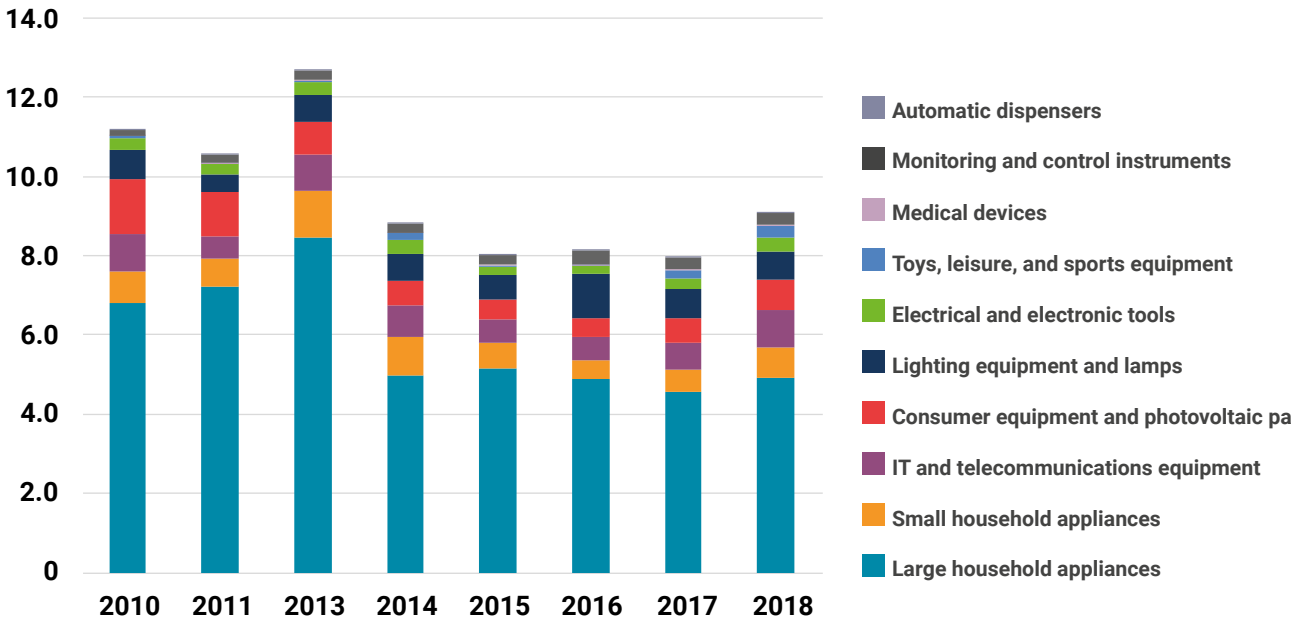
Since 2020, the implementation of the EPR is regulated by the Decree No.16, 2020 'On improving the procedure for handling waste of goods and packaging' and the implementing Resolution No. 388 of 2020, which establishes for manufacturers and importers the amount of fees for organising the collection and recovery of waste goods and packaging.

Through an interview conducted with an NGO[169] in the country, it was possible to conclude that the EPR works well in the country and that the e-waste management system is well-developed, with many collection points widespread over the territory. However, no regulation on Circular Economy, eco-design, and use of recycled materials for EEE production, etc. exists in the country so far. One obstacle identified in this regard is the limited consumer awareness about the EPR, so that most citizens do not know where to properly discard their equipment or that they can bring it for recycling.

[169] IPO Ecopartnership.

Based on the data produced by the National Statistical Committee (Belstat), Belarus EEE POM did not increase substantially in the last decade. Specifically, the amount of EEE POM increased from 11.2 kg/inh (106.2 kt) in 2010 to 12.7 kg/inh (119.9 kt) in 2013, then decreased to 8.0 kg/inh (75.9 kt) in 2015 before beginning a new increasing trend up to 9.1 (85.8 kt) in 2018[170] (Figure A-2).

Figure A-2. EEE PoM per category in Belarus (2010-2018)



Source: Regional E-waste Monitor for the CIS + Georgia 2021.

The largest share of EEE POM in Belarus is large household appliances, with 4.9 kg/inh in 2018, equivalent to 54% of the total EEE POM. The category is then followed by IT and telecommunication equipment, at 10% of the total (0.8 kg/inh).

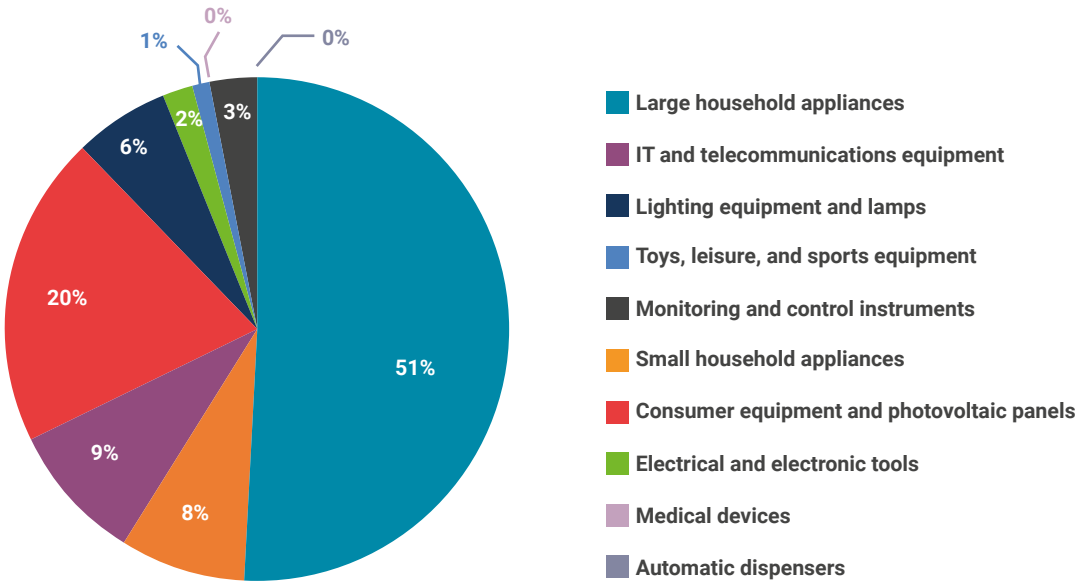
Compared to other countries in the scope of the project (e.g. Georgia, Moldova), the domestic production of EEE in Belarus is a strong sector. Data reported by Belstat[171] shows that in 2019, the country produced 131 kt of EEE, partly placed on the national market and partly exported abroad. Some of the equipment produced domestically relates to refrigerators, TVs, and other home appliances.[172]

The amount of e-waste generated in Belarus more than doubled from 2010 to 2018, from 3.5 kg/inh (33.5 kt) in 2010 to 7.7 kg/inh (73 kt) in 2018.

[170/171] C.P. Baldé, G. Iattoni, V. Luda, I.C Nnorom, O. Pecheniuk, R. Kuehr (2021), Regional E-waste Monitor for the CIS + Georgia – 2021, cit.

[172] Interview with IPO Ecopartnership.

Figure A-3. Categories share in e-waste (2018)



Source: Regional E-waste Monitor for the CIS + Georgia 2021.

The highest shares of e-waste generated for 2018 in Belarus are large household appliances (3.9 kg/inh, 51% of the total) and consumer equipment (0.7 kg/inh, 20% of the total) (Figure A-3).

In 2020, the amount of e-waste managed in an environmentally sound manner in Belarus as reported by the Ministry of Housing and Utilities[173] was equal to 2.7 kg/inh (25.5 kt) in 2019. Being equivalent to 34% of the total e-waste generated, the e-waste collection rate of Belarus is higher than those of Moldova and Georgia, but lower than those of Bulgaria and the Czech Republic. Belarus doesn't have to comply with the European WEEE Directive, but it has established a national target of 30% of e-waste to be collected by 2020, and the data shows that the country already fulfilled its target one year in advance.

Based on a study shared by Belstat, 'Environmental Protection in the Republic of Belarus', the entire amount of e-waste collected in 2019 was also recycled.[174]

Belarus has a well-developed UEEE market, and repair shops are very common in the country. National producers provide many repair shops for consumers across the country, and people can easily buy good-quality replacement components for EEE. This is because Belarus preserves a cultural attitude from the past toward reparation and UEEE markets. In general, people repair as much as possible, and they discard only very damaged goods that would cost too much for repairing. Nevertheless, nowadays this is mainly done for economic purposes, rather than for environmental sensibility.[175]

The reports from the Basel Convention show that, between 2018 and 2019, Belarus exported 14 tonnes of e-waste for materials recovery and recycling (11 tonnes in 2018 and 3 tonnes in 2019). The recipient countries were Germany and Lithuania.

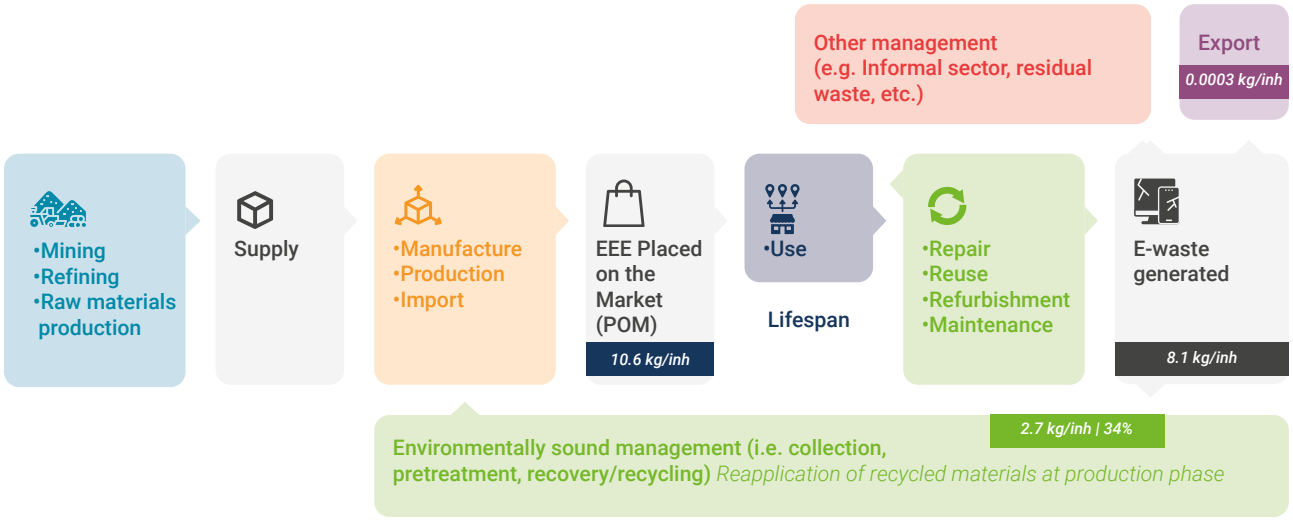
[173] C.P. Baldé, G. Iattoni, V. Luda, I.C Nnorom, O. Pecheniuk, R. Kuehr (2021), Regional E-waste Monitor for the CIS + Georgia – 2021, United Nations University (UNU) / United Nations Institute for Training and Research (UNITAR) – co-hosting the SCYCLE Program, Bonn, Germany.

[174] https://www.belstat.gov.by/upload/iblock/f02/f02bd3e6749df60522dc85491b86fb25.pdf

[175] Interview with IPO Ecopartnership.

The following graph summarises the main data available for Belarus across the EEE value chain.

Figure A-4. Quantitative information on EEE and E-waste along the value chain in Belarus in 2019



The Global E-waste Monitor 2020[176] inh: inhabitant

The year 2019 was chosen as reference year for data in Figure A-4 in order to use the latest available data.

The rate of environmentally soundly managed e-waste in the above figure is calculated as the ratio of e-waste collected to e-waste generated in 2019.

[176] The Global E-waste Monitor 2020: https://www.scycle.info/wp-content/uploads/2020/12/GEM_2020_def_dec_2020.pdf

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Toward a Circular Economy for the Electronics Sector in Central and Eastern Europe

Overview, Actions and Recommendations