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WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT - INTERNATIONAL AND NATIONAL CONTEXT

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ABBREVIATIONS

A/R	Autonomous Republic
BATTRR	Best Available Technology for Treatment, Recovery and Recycling
CFC	Chlorofluorocarbons
CPU	Central Processing Unit
EEE	Electrical and Electronic Equipment
EPR	Extended Producer Responsibility
EU	European Union
GeoStat	National Statistics Office of Georgia
LEPL	Legal Entity of Public Law
MoEPA	Ministry of Environment Protection and Agriculture
MENRP	Ministry of Environmental and Natural Resources Protection of Georgia
MoF	Ministry of Finance
MoESD	Ministry of Economy and Sustainable Development
NGO	Non-Governmental Organization
PBB	Polybrominated Biphenyls
PBDE	Polybrominated Diphenyl Ethers
PCB	Printed Circuit Board
PC	Personal Computers
PRO	Producer Responsibility Organization
SWMCG	Solid Waste Management Company of Georgia
TPP	Triphenyl Phosphate
HARL	Home Appliance Recycling Law
HBr	Hydrogen Bromide
WEEE	Waste from EEE

1 WEEE AND ITS MANAGEMENT PRACTICES

1.1 What is WEEE?

Electrical and Electronic Equipment (EEE) is "any household or business item with circuitry or electrical components with power or battery supply". "E-waste is a term used to cover items of all types of EEE and its parts that have been discarded by the owner as waste without intention of re-use"* (*One Global Definition of E-waste (Step) 2014).

Waste from Electrical and Electronic Equipment (WEEE) is growing very fast worldwide. According to the estimations, its generation was forecasted to increase from 41.8 million tons in 2014 up to 65.4 million tons in 2017 (Breivik et al., 2014). Heterogeneous composition of EEE across different categories contains more than 1,000 different hazardous and non-hazardous substances. It consists of ferrous and non-ferrous metals, plastics and glass, wood, plywood and printed circuit boards (PCB), concrete, ceramics, rubber and other items. Iron and steel constitute is about 50% of the WEEE, plastics and non-ferrous metals such as copper (Cu) and aluminum (Al) account for 21% and 13%, respectively. Precious metals like silver (Ag), gold (Au), platinum, palladium, etc. are represented comparatively in small amounts. Presence of elements such as lead, mercury, arsenic, cadmium, selenium, hexavalent chromium and flame retardants are classified as hazardous, which makes this specific stream of waste harmful for human health and environment if not treated properly (Needhidasan et al., 2014). It should be pointed out that rising interest of WEEE recycling and re-use practices refers to economic benefit in the recovery of valuable metals (Casaro et al., 2017). Substitution of raw resources in EEE production with secondary materials is an important energy saving and environment friendly approach which relates directly to human health protection.

The European Union (EU) has introduced 10 categories of the different types of WEEE (EU directive 2002/96/EC). A number of substantial changes were made to Directive 2002/96/EC and the recast version 2012/19/EU directive was adopted. Annex I and Annex II represent detailed information about distribution of EEE items under the 10 categories given below with corresponding sub-categories. The products within sub-categories are continuously updated because of new technologies and new types of EEE provided by the producers.

10 categories of WEEE(see figure #1)*

1. *Large household appliances*
2. *Small household appliances*
3. *IT and telecommunications equipment*
4. *Consumer equipment*
5. *Lighting equipment*
6. *Electrical and electronic tools (with the exception of large-scale stationary industrial tools)*
7. *Toys, leisure and sports equipment*

8. *Medical devices (with the exception of all implanted and infected products)*
9. *Monitoring and control instruments*
10. *Automatic dispensers*

From 15 August 2018 all EEE will be classified within the 6 categories set out in Annex III of directive 2012/19/EU. (1. Temperature exchange equipment; 2. Screens, monitors, and equipment containing screens having a surface greater than 100 m^2; 3. Lamps; 4. Large equipment (any external dimension more than 50 cm); 5. Small equipment (no external dimension more than 50 cm); 6. Small IT and telecommunication equipment (no external dimension more than 50 cm).

Increasing technological achievements clubbed with rising consumer demands and decreasing life cycle of electr(on)ics has resulted in growing amounts of obsolete EEE which end up as WEEE. For example, the average life span of personal computers (PC) is decreasing rapidly due to shortening life cycle of central processing units (CPU). According to the data, working of CPU had reduced from 4-6 years in 1997 to 2 years in 2005 (Needhidasan et al., 2014). Rapid economic development coupled with strong growth of EEE production and consumption is directly related to the risk of environment and human health due to toxic substances of inadequately disposed WEEE.

1 2 3,4 5 6 7 8 9 10

Figure #1: Distribution of EEE in 10 categories

1.2 **EU Legislation**

WEEE is regulated in EU by WEEE directive (2002/96/EC) and the Restriction of Hazardous Substances (RoHS) directive (2002/95/EC). The recast version of 2002/96/EC directive, 2012/19/EU directive was adopted in 2012.

Introduced by the WEEE directive, the concept of producer responsibility implies that the producers have to finance the handling of products that become waste. This is done as an attempt to ensure that all the waste is properly treated. Those affected by the WEEE directive and obliged to indicate all EEE with a WEEE label also include producers outside the EU who market their products on the European market and the importers. This label is used to inform the consumer to dispose the WEEE correctly. The extra costs for the industry due to the producer responsibility most likely affect the cost of the products. According to the 2005-2008 Waste Strategy of Denmark estimated constituent of the price of the product for treatment is about 0.2-0.3%, although other price additions in different countries come to about 0.1% and even less depending on category of EEE.

RoHS directive determines restriction of the use of certain hazardous substances in electrical and electronic equipment. The EEE substances banned in 2006 are listed in Table #1. The restriction was linked to protecting human health and the environment. Even though these substances are banned, they are still present in equipment produced before the implementation of the RoHS directive.

These directives control design, production and disposal of goods along with the concept of Extended Producer Responsibility (EPR) which obliges producers for collection and proper management of WEEE.

Table #1: *Banned substances according to the restriction of hazardous substances (RoHS) directive (2002/95/EC).*

Compounds	**Symbols**
Lead	Pb
Cadmium	Cd
Mercury	Hg
Hexavalent chromium	Cr
Polybrominated biphenyls	PBB
Polybrominated diphenyl ethers	PBDE

Japanese approach of WEEE management:

Japanese, as one of the leading nations on management and recycling of WEEE, approach is different from the approach in the EU. The home appliance recycling law (HARL) includes the four major types of household WEEE: televisions, refrigerators, washing machines and air conditioners. The HARL includes a take back system where retailers, when selling a new product, are required to take an old one back.

1.3 Environmental and Health Impacts of WEEE

As mentioned above hazardous compounds comprising WEEE represent serious threat to both human health and the environment if not treated and disposed of properly. Distribution of 10 WEEE categories into different treatment categories is related to the various technologies used for safe disposal of end-of-life EEE. The restriction on the use of certain hazardous substances in the production of EEE by developed countries does not solve the problem instantly; since the hazardous substances are still presented in equipment produced before the restriction and are used for uncertain period of time. Some production technologies cannot avoid using of banned substances, such as lead in cathode ray tubes and mercury in fluorescent tubes. In these cases the sorting facilities can reduce direct negative impact on human health by observing health and safety norms when handling these items.

Significant issue that causes environmental problems along with difficulties to determine the produced amount of WEEE is the illegal export/import of second hand EEE and WEEE between countries. Such illegally traded wastes are often not treated and end up at the dumpsites in many developing countries. Disposal of WEEE on old existing landfills without protective layers and systems make hazardous compounds from broken devices and heavy metals leak and contaminate soil, water and air. Such contamination is extremely risky not only for local area and people but also for remote territories and its inhabitants.

Heavy metals such as lead, cadmium, and mercury, those are present in WEEE, damage environment and human health even in small doses. WEEE also contains heavy metals like nickel, copper, chromium, and zinc, which cause damage in relatively higher concentrations. These heavy metals are emitted into the environment due to improper collection and treatment of WEEE viz., wrongful incineration or landfilling.

Human health related problems are connected with usage of some complex chemical compounds in EEE production. For example: flame retardants are used for the prevention of fire in electrical compounds by delaying the ignition and spread of fire. Flame retardants like polybrominated diphenyl ethers (PBDEs) and triphenyl phosphate (TPP) are hazardous constituents of WEEE. PBDEs can cause long-term effects on the brain of animals and cause effects on the immune system. TPP is toxic and can be hormone disrupting (Brigden, 2008). When plastics containing brominated flame retardants are burned hydrogenbromide (HBr) is formed. HBr is known to contribute to the formation of polybrominated dibenzodioxins and dibenzofurans, which is very toxic and bio-accumulative in humans, animals, and plants (Thestrup, 2005). The PBDEs and some of the heavy metals have been banned under the EU directives (2006) but they can still be found in WEEE.

Other compounds included in cooling systems of old refrigerators and freezers are chlorofluorocarbon (CFC) gasses and polybrominated biphenyls (PBB) (was banned in 1972) which are highly ozone depleting. One more example is Asbestos. Dust from asbestos is known as a carcinogenic material, which has been banned for 20 years but treatment facilities still may receive asbestos containing products from different heat producing equipment and other sources. It is

important for the recycling industry to be aware of compounds that have been banned and hazardous compounds which are currently in use.

Heterogeneous composition of large and small household appliances, tools, toys, sport equipment, and medicines may also be problem. Particularly printed circuit boards contain fractions of lead, tin, antimony, chromium, beryllium oxide, cadmium, bromine and restricted brominates flame retardants in their plastic parts (yet also precious metals such as gold and platinum which make PCBs one of the most valuable parts of WEEE). During its processing, there is a risk of toxic emissions to the environment and contamination of workplaces with dust and heavy metals. According to the toxicological properties of hazardous substances in PCBs, classification from most hazardous WEEE to less harmful appliances were conducted by Casaro et al., 2017. Results are as follows:

printer > mobile phone > TV > power tools > PC > camera > portable CD/MD player > cassette recorder > game console > DVD player > gas discharge lamps > calculator > monitor > portable audio

Environmental and human health risks are severe if informal collection, dismantling and treatment of WEEE components do not take into account environmental as well as occupational health and safety regulations. Such informal practices are mostly observed in developing countries. Open burning and manual dismantling for recovering valuable materials, without following health-care instructions, pose risk of inhalation of contaminated air by workers and have negative influence on surrounding of the informal working areas.

1.4 Most Common Management Practice for WEEE

Environmentally friendly management of WEEE falls in 6 main treatment categories (presented in the next section), which require appropriate treatment technologies with a mix of manual labour and high-tech reprocessing, balancing the legislative requirements and the economic feasibility. The main objective is to diminish the risks of environmental pollution and human health problems, followed by economic benefits. Consequently, proper management of WEEE refers to reprocessing of high grade metals (gold, silver, palladium and platinum), low grade metals (aluminum, copper and iron) and plastics. It aims to neutralization the negative impact of the compounds comprising of various hazardous parts of EEE.

Aluminum and iron are also valuable metals, where the low market prices are compensated by large amounts. The recovery of aluminum from WEEE has an additional environmental benefit as it is much less energy consuming to extract and recycle from WEEE compared to the virgin production. Copper is a metal with a high value because the known reserve is small. Lack of resources and lower environmental burdens from recycling compared to virgin metal production are also some of the arguments for the recycling of metals from WEEE.

During the last decades developed countries have elaborated effective WEEE management models due to enforcement of obligations like the EPR. WEEE is a waste stream subject to EPR as mentioned in 1.2, which is based on successful cooperation of public and private sectors. EPR is an

approach in which a producer's responsibility for a product is extended to the post-consumer stage of a product's life cycle and manages the waste generated by their products put on the market.

1.4.1 Treatment Categories

In the EU the waste management industry divides the different types of WEEE into six treatment categories that are necessary for further waste management options. The six treatment categories are shown in Table #2 along with the corresponding WEEE categories presented in chapter 1.1. According to the different recycling technologies used in value chain of WEEE management system, treatment categories could be customised and slightly differ within the EU countries. Since the treatment of WEEE requires profound expertise and experience, it must be adapted to the type of processing of WEEE in order to achieve economically and environmentally effective result. Due to the high labour cost in most European countries, the treatment is highly mechanised. Nevertheless, environmentally friendly treatment of such wastes requires a mix of manual labor and high-tech processing.

Table #2*: WEEE treatment categories in relation to the WEEE categories.*

WEEE categories	WEEE treatment categories
1,10	Cooling white goods
1,10	Heating white goods
2,6,7,8,9	Small household appliances (Low grade WEEE)
3,4	Small household appliances (High grade WEEE)
4	TV and monitors
5	Lighting equipment

Cooling white goods contains products such as refrigerators and freezers. The main problem with old refrigerators is that the cooling system might contain chlorofluorocarbon (CFC) gases which are highly ozone depleting. Modern refrigerators contain pentane in the cooling system which is emitted without further treatment. When the white goods are received at the waste facility, the outer cables, compressor, capacitors, printed circuit boards, and mercury containing switches are removed and are further treated at specialised facilities (Petersen, 2008).

Heating white goods contains stoves, ovens, microwave ovens and washing machines. These products consist of iron, plastic and other metals that can be recycled. These appliances are manually checked to see if they contain asbestos. Any asbestos, capacitors, printed circuit boards, components containing ceramic fibers and the outer cables are removed and treated separately. Asbestos and ceramic fibers are not treated and are disposed in landfills.

Small household appliances are divided into 'low grade' and 'high grade' depending on the content of valuable metals. The low grade items are vacuum cleaners, toasters, clocks, and sewing machines. The high grade products are radios, digital cameras, computers, and mobile phones. The basic applied treatment technologies are the same but managed separately because it

is economical for the industry and usage of manual treatment is also essential.

TV and monitors contain primarily television and computer monitors. Two types of recovery technologies 'Glass to glass' recycling and 'glass to lead' recycling are commonly used. Glass to glass recycling may result in 100% recycling of the front glass and 96% of the cone glass (Hansen, 2008). The main advantage of glass to glass recycling is the avoidance of landfilling of the glass. Nevertheless treatment requires manual labour, which means that the cost of the treatment is high.

Glass to lead recycling can be done by shredding the entire television and monitor, followed by a mechanical removal of the fluorescent coatings and recovery of the glass cullet. The main disadvantage of this method is that due to high level of contamination of recycled glass it can be difficult to find uses (Herat, 2008).

Lighting equipment contains primarily fluorescent tubes. The tubes are manually sorted according to different lengths and are fed into a machine specially designed for the treatment. The collected constituents are sent for further treatment by means of further recycling.

1.4.2 Treatment Technologies

The treatment technology of WEEE depends not only on the treatment category, but also on the individual company and the metal prices. According to the WEEE directive, treatment of those wastes must be performed by using the Best Available Technology for Treatment, Recovery and Recycling (BATTRR). This can be done by the individual producers or collectively. BATTRR is used when WEEE is managed by third parties as well (DEFRA, 2006).

Treatment of WEEE in general can be described as a two-step process:

1. Manual and mechanical pretreatment and
2. Refining

The purpose of manual and mechanical pretreatment of WEEE is to remove large valuable and/or hazardous parts, and to upgrade the fractions which are sent to recycling facilities. The pretreatment can be a mix of manual and mechanical dismantling. Manual dismantling can be performed both before and after mechanical treatment. Manual sorting is labour intensive and expensive, yet its effectiveness is not high. Often the sorted fractions have to be resorted several times (Sons, 2008).

Mechanical processing has the advantage of having lower investment and operating costs as compared to manual sorting. But it has some limitations that affect the sorting efficiency (Hageluken, 2006). Mechanical treatment technologies include shredders, magnetic separators, eddy current separators, optical sorters, and air classifiers.

Pretreatment steps for small household appliances with potential outcome are shown on figure #2 (Thomas H. Christensen, 2011):

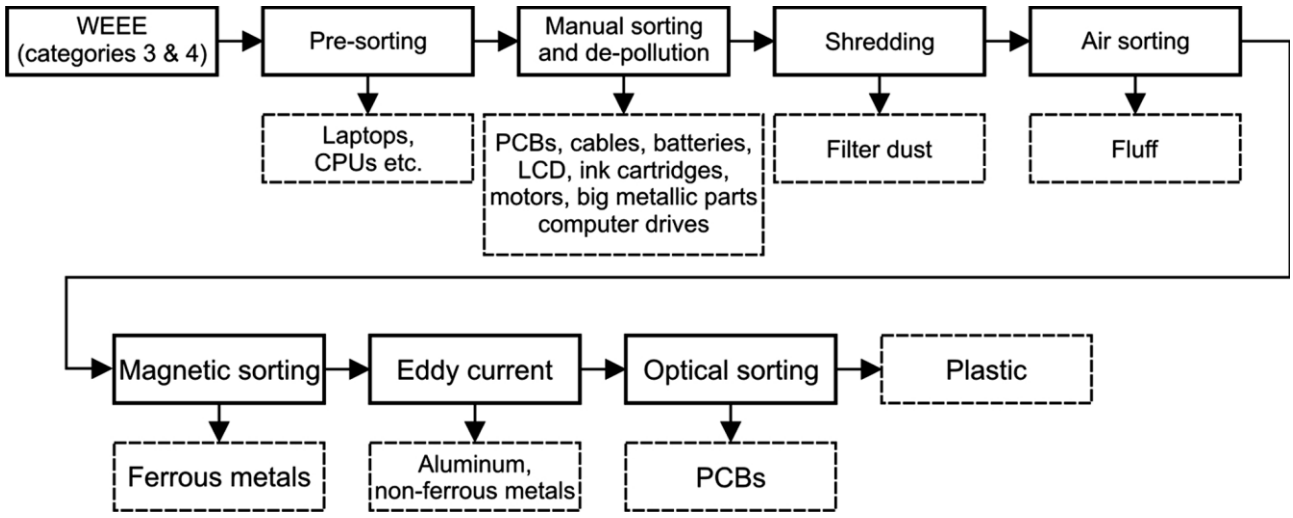


***Figure #2**: Pretreatment steps of 'high grade' small household appliances.*

Refining of output fractions from the pretreatment is the process where the secondary raw materials are recovered. Refining processes are different depending on output fractions (metals, glass or plastic). For example, the traditional way to recover non-ferrous metals and precious metals from WEEE is by pyrometallurgical processing which includes extraction of metals via incineration, smelting, and other techniques at high temperature (Cui and Zhang, 2008).

2 National Context

2.1 Regulatory and Policy Framework

Currently Georgia has no specific WEEE regulation, although first step forward was introduction of Waste Management Code in 2015, which defined WEEE as specific waste stream. According to the new system, WEEE was classified as a hazardous components comprising waste, and became subject to different regulations given below:

The Waste Management Code (2015) creates the legal basis for waste prevention, waste re-use and environmentally safe treatment of waste (which includes recycling and separation of secondary raw materials, energy recovery from waste and safe disposal of waste). According to the Code, WEEE is one of the specific waste streams (Article 3) and is the subject to EPR system. Producers and importers of products, under the concept of EPR, take over the responsibility of proper recovery and disposal of WEEE (Article 9). This obligation should be enacted from 1 December 2019, while the necessary Governmental Decrees concerning detailed determination of above obligation are to be elaborated by the Ministries of Environment Protection and Agriculture (MoEPA) and Economy and Sustainable Development of Georgia (MoESD) and submitted to the Government of Georgia for approval before 31 December 2018. The Annex III of the Waste Management Code provides the properties of waste which render it hazardous.

Waste Management Code (Article 9):
1. A producer of a product that becomes specific waste and a person placing this product on the market shall design the product in a way that ensures:

a) the reduction of the negative impact on the environment and the reduction of waste in the course of production and subsequent use of the product;
b) the recovery and disposal of waste from the product.

2. The obligation under paragraph 1 of this article shall be fulfilled by creating, producing and placing on the market such product that is intended for multiple uses and is technically durable, and the waste from such product is suitable for recovery and safe for disposal in the environment.

3. The producer of a product that becomes specific waste and a person placing this product on the market shall ensure the separate collection, transport, recovery (including recycling) and environmentally safe disposal of waste generated from such product.

4. The obligation under paragraph 3 of this article shall be carried out individually or collectively through an association of producers.

5. The Ministry shall, together with the Ministry of Economy and Sustainable Development of Georgia and other agencies, develop and propose to the Government of Georgia for adoption draft ordinances defining the detailed obligations in relation to the extended obligation of manufacturers under this article.

Governmental Decree No. 426 on Identification of Waste List and Classification of Waste According to Types and Characteristics of the Waste (2015) defines rules for the classification of waste and identifying its hazardous properties. The Decree contains the list of Waste Groups (Annex I) and the List of Wastes (Annex II) with the six digit codes. The codes with asterisk are referred as hazardous. Annex III of the Decree introduces form of the document of first inventory of waste by the waste producer (Article 7).

The frame **law on Environmental Protection of Georgia** (1996) also stipulates responsibility of producer for waste prevention, collection, recovery and disposal according to environmental, sanitary and epidemiological norms, as well as disposal on permitted locations under strictly defined norms (article 34).

Georgia is party to **Basel Convention**, which regulates trans-boundary movements of hazardous wastes. The draft law on export, import and transit of waste, which was developed in line with the Basel Convention requirements, is planned to be submitted to the Parliament of Georgia for adoption in 2018.

Association Agreement between Georgia and European Union (EU), ratified by the Parliament of Georgia in 2014, requires the harmonization of Georgian Legislation with selected EU Directives. Consequently the waste management national legislation should be aligned with EU directives: #2008/98/EC on waste and #1999/31/EC on the landfill of waste.

National Waste Management Strategy (2016-2030) and Action Plan (2016-2020) approved by the Georgian Government in 2016, define the general framework and specific measures for the implementation of the Waste Management Code. The set objectives, targets and concrete measures address the WEEE related aspects also. Specifically, the Target 7.2 under the Objective 7 sets minimum requirements for the management of specific waste streams, which fall under the EPR system: Minimum target for WEEE management by 2020 is 20% of total amount, whereas 50% and 80% of targets should be achieved by 2025 and 2030 years respectively.

Obligation of keeping records of waste and reporting is imposed on individual (natural person) and legal entities during 3 years (Waste Code, chapter IX, article 29) excluding landfill operators, who have obligation of keeping records during the whole life-cycle of landfill operation. Keeping and updating database of waste is the responsibility of MoEPA (Article 30). In line with the Code the **Governmental Decree No. 422** on Form and Content of Records to be Kept and Reports to be Made was adopted in August 2015.

Governmental Decree No.421 on Arrangement, Operation, Closure and Post-care of Landfill (2015) establishes technical requirements, measures and procedures for types of landfills (non-hazardous, hazardous and inert) along with the acceptance criteria for non-hazardous, hazardous and inert waste contents (part II). Waste from asbestos as a stable hazardous waste with non-reactive features could be accepted on non-hazardous landfills under special requirements (2.3.3 asbestos waste).

Decree No.159 of the Georgian Government (April, 2016) on Rules for Collection and Treatment of Municipal Waste states that for the optimization of waste collection and treatment, municipalities have the responsibility to obtain information on the quantities of municipal waste streams including hazardous waste streams (batteries, WEEE , etc.).

Governmental Decree No.143 (March, 2016) on Approval of Technical Regulation on Waste Transportation Rules aims at safe transportation of waste and sets the requirements for vehicles, containers, experience of drivers transporting hazardous waste and determines roles and responsibilities of involved parties.

Governmental Decree No.144 of Government of Georgia (March, 2016) on Conditions for Waste Collection, Transportation, Preliminary Processing and Rules for Registration of Temporary Storage of Waste corresponds article 26 of the Waste Code and determines procedures and requirements for registration of waste management activities.

Under the special set of rules (article 13) and in line with the article 20 of Waste Management Code, **Governmental Decree No.145** on Special Requirements for Collection and Treatment of Hazardous Waste (March, 2016) introduced information sheets and transportation forms for hazardous wastes such as asbestos, for their collection and disposal.

Trans-boundary movement of wastes (WEEE as a constituent), ozone layer depleting substances (ozone containing cooling electronic devices) and classified list of goods are regulated by the Custom Department of MoF through law on Waste Import, Export and Transit and the following secondary legislation: **Governmental Decree No.259** on allowed list of waste for Import, Export

and Transit into the territory of Georgia. **Governmental Decree No.266** on issuance of permit for import, export, re-export and transit of ozone layer depleting substances and annual import quota allocation (2016) and **Ordinance of the Minister of MoF of Georgia No.241** on the Approval of the National Commodity Nomenclature of foreign economic activities of Georgia (2012).

2.2 Institutional Set-Up and Key Stakeholders

State Agencies

Waste Management Code of Georgia distributes the competences and general obligations in the field of Waste Management (Article 6) between authorities as follows:

Former Ministry of Environment and Natural Resources Protection of Georgia (MENRP), being restructured in December of 2017 as a Ministry of Environmental Protection and Agriculture (MoEPA), develops and implements unified state policy on waste management. Waste and Chemical Management Service is responsible for keeping records, maintaining database on wastes, developing national waste management strategy, coordinating and reporting implementation of a national waste management action plan according to the Article 12. The MoEPA issues permits and carries out the registration of waste management activities, facilitates actions aimed at the prevention, separation, pretreatment, re-use and recycling of wastes, controls activities according to the permit conditions, through its Environmental Supervision Department.

MoEPA together with the Ministry of Finance (MoF) of Georgia, regulates trans-boundary shipment of hazardous wastes and their disposal (Article 28). Revenue Service Legal entity of Public Law (LEPL) of the MoF of Georgia regulates taxation and trans-boundary shipment of goods through Customs Department. LEPL Service Agency of the MoF, along with other obligations, supports transparency of dispose of movable property (including outdated EEE) owned by the state through electronic auctions.

MoEPA together with the Ministry of Economy and Sustainable Development of Georgia (MoESD) and other agencies, develops and proposes to the Government of Georgia for adoption draft decrees defining the detailed obligations in relation to the EPR (Article 9). MoESD is also responsible for issuing admission certificates for the means of transport for transportation of hazardous wastes. Under the responsibility of MoESD is submission to the Government of Georgia for approval draft/drafts of secondary legislation determining the requirements related to the transportation of waste, in particular with respect to:

a) The standards of means of transport to be used for the transportation of waste;

b) The containers to be used for the transportation of waste;

c) The experience of drivers of means of transport carrying hazardous waste.

Ministry of Labour, Health and Social Affairs of Georgia together with the MoEPA regulates and supervises occupational healthcare issues related to waste management sector.

Under the Ministry of Regional Development and Infrastructure, the LTD Solid Waste Management Company of Georgia (SWMCG) is responsible for the construction, operation, closure, after care of non-hazardous landfills and transfer stations in the regions (except Adjara A/R and Tbilisi). According to the Waste Management Code, the powers may be transferred to the third party by a decision of the Government of Georgia.

According to the Code and the Local Self-government Code (Organic Law of Georgia), the authority of municipalities in the field of waste management includes the management of municipal waste (including the development of a municipal waste management plan) in accordance with Article 16 of this code. Specifically, collection and transportation of municipal wastes to the transfer stations are the responsibilities of municipalities. The municipalities are also responsible for elaboration of tariffs for communal services and collection of fees from households, as well as closure and rehabilitation of the uncontrolled dumpsites number of which is estimated around 3 000 throughout Georgia.

Construction, operation and closure of non-hazardous landfills within the administrative borders of the A/R of Adjara and the city of Tbilisi fall within the authority of the relevant bodies of the Autonomous Republic of Adjara and the Municipality of Tbilisi.

Other Stakeholders

Studies were conducted for identification of key involved parties responsible for EEE inflow, WEEE outflow and existing interconnections between them. Around 10 main importers of household appliances and IT equipment, 8 importers of medical devices and 5 – of toys, supply market of Georgia with the relevant EEE. Total market analysis showed, that it is import driven with less than 1% of local production. There is only one producer of white household goods - Fresh Georgia, Kutaisi based plant assembling ovens, microwaves, fridges, washing machines and TV's. Another producer of telecom appliances is AG Microelectronics; Rustavi based plant assembling TV's and WIFI receivers. Besides household goods, there are numerous small assembly lines producing portable and desktop computers with the average amount of 10,000 devices annually.

As for the WEEE outflow stakeholders, three major groups of consumers - households, governmental organisations and corporate sector have been identified during the study. For the WEEE outflow segment along with consumers there are scrap metal recyclers: collectors, individual entrepreneurs, dealers and scrap metal reprocessing plants. It should be mentioned, that collection and transportation along with other waste management activities became subject to registration (Waste Management Code, Article 26) since 1st of January 2018. Lack of above mentioned obligation in past caused complication in obtaining reliable data regarding the stakeholders, such as individual entrepreneurs, scrap metal collectors and dealers. Currently WEEE is disposed on official landfills by municipalities or on uncontrolled dumpsites mainly by households or other individuals. Stakeholders and their interconnection are given on figure #3.

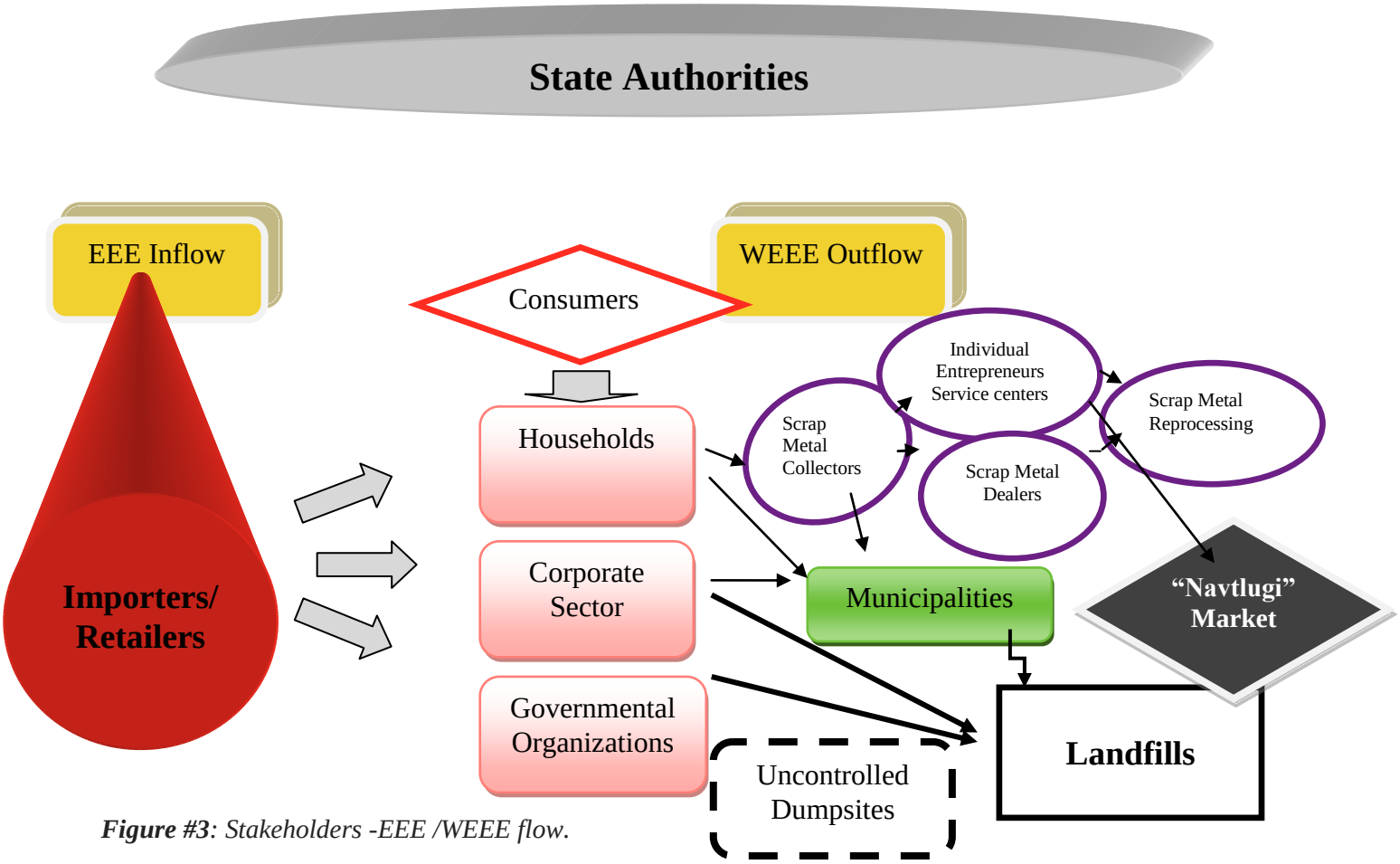


***Figure #3**: Stakeholders -EEE /WEEE flow.*

2.3 Current WEEE Management Practices / WEEE Value Chain in Georgia

2.3.1 Generation of WEEE

Study for determination of consumer groups and current quantities of generated WEEE in Georgia were conducted based on the methodology including interviews, official data collection from GeoStat and online household survey. Researched categories included: washing machine, fridge, air conditioner, CTR monitors and TVs, notebooks and tablets, mobile phones, flat panel televisions and computers.

Three main EEE consumers' households, state organizations and corporate sector were figured out. Questionnaire based online survey was conducted for determination of behavior of households as one of the most complex group of WEEE generators, resulting in calculation of average lifespan of selected EEE, stock volumes, disposal methods and preferences (Current and Future e-waste Flow in Georgia, GEO, December 2017).

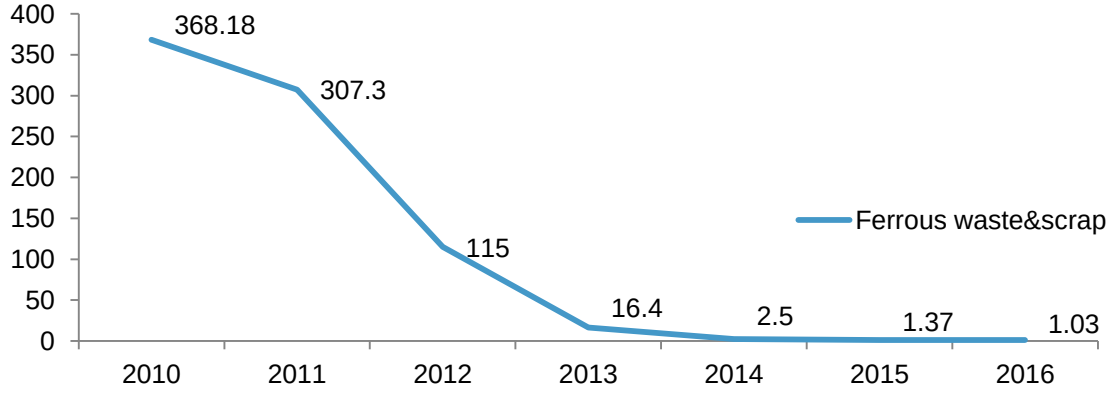
According to Step-initiative database Georgia generated 21 thousand tones of WEEE in 2014 and generation of WEEE per inhabitant comprised 4,6 kg. According to this estimation WEEE

generation in Georgia is 4 times less than it is in EU countries. The recent study1 conducted under the same project in 2017, addressed 9 categories of WEEE (Fridges, household air conditioners, washing machines, dishwashing machines, ovens, television, mobile phones, portable computers (laptop/tablets) and CRT Monitors). The total volume of researched categories amounted to 15.7 thousand tonnes and 4.2 Kg per inhabitant. By the rough estimation the total WEEE in 2017 might account to 29.1 thousand tonnes, which is 7.8 kg per inhabitant[2].

Lack of obligation for separate collection of waste in Georgia, complicates obtaining reliable data on WEEE stream generation. Nevertheless, few studies of mixed Municipal Solid Waste composition were performed and according to them in 2014 on Tbilisi municipal landfill, only 0.1% of WEEE was disposed. Similar studies were undertaken in Adjara and Kakheti where WEEE constituted 0.5% and 0.7% of waste respectively. Based on above information, estimation of amount of exported scrap metal, constituent of which become valuable metals from WEEE was done. It gave valuable information for qualitative characterization of all stakeholders, WEEE generation and general estimation of value chain.

Metal collection and treatment became profitable business in Georgia from early nineties and is quite active up to now. According to the data of National Statistics Office of Georgia (GeoStat) export of three main scrap metal categories such as Ferrous, Copper and Aluminum wastes shows decreasing trend (chart #1 and #2). Export of selected scrap metal categories was analyzed from 2010 to 2016 years.

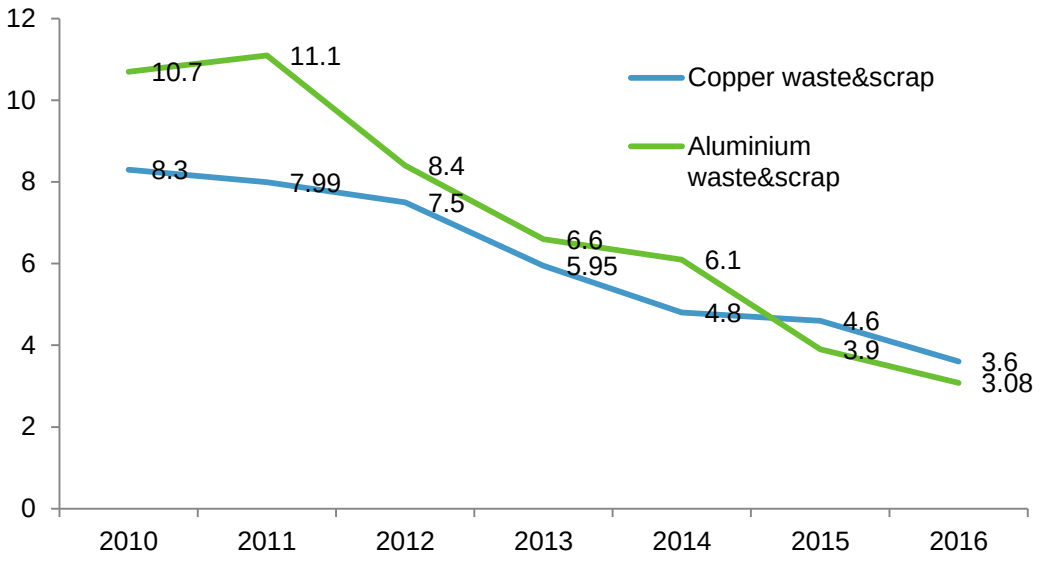
Chart #1: export of ferrous waste & scrap in mln. kg from 2010 to 2016



[1] Current and Future E-waste Flow in Georgia, GEO, December 2017,

[2] This estimation is not backed up by sufficient amount of data and needs further research for clarification. This estimation should not be considered as a reliable as it may contain a high margin of error and should only be used to get a general impression of the market.

Chart #2: export of copper and aluminum waste&scrap in mln. kg from 2010 to 2016



Charts #1 and #2 illustrates, that ferrous waste & scrap export in 2010 stood for 368.18 mln. kg and was sharply decreased in 2013 to the value of 16.4 followed by downward trend to the 1.03 mln. kg in 2016. Whereas export of copper and aluminum was gradually decreased from 8.3 and 10.7 in 2010 to 3.6 and 3.08 mln. kg in 2016. Decreasing tendency of scrap metal export since 2010 can be explained by increasing trend of domestic steel reprocessing industry due to increasing of construction market demand on steel products. Complication of custom procedures due to enforcement of some regulations for trans-boundary shipment of wastes has also stimulating influence on activation of national metal reprocessing in the country.

2.3.2 Collection, Transport, Handling and Dismantling of WEEE

Online household survey revealed, that about 20% of respondents discard obsolete EEE in municipal bins, whereas WEEE disposal data on landfills is very low. It could be concluded, that collection either informal or entrepreneurial base is very active and is performed by individuals or groups of people.

Obsolete large household appliances are collected by scrap metal collectors by “Call System” in Tbilisi and other regional centers. These appliances are picked up free of charge or by receiving a small amount of money for the old equipment. Private collectors and transporters of WEEE are mainly individuals or small group of people mentioned above. For these purposes they use small motor cars supplied with a carrier which can easily move on narrow streets of the city and consumes less fuel.

The second most popular case for large household appliances is giveaway, followed by home storage. Accumulation of WEEE is more common in regions of Georgia because of having enough storing space. Mostly stored items are small household devices such as: mobile phones, laptops and TV's. Other small household appliances are mixed with municipal wastes, which are further collected by municipalities through 100% state owned private limited companies from existing municipal waste collection points.

As mentioned above in chapter 2.2, Service agency of the MoF collects discarded electr(on)ic devices from state-owned organizations. These devices are either upgraded and sold via auction or disposed in the official landfills of Georgia.

Due to market demand for second-hand parts of expensive and large appliances such as refrigerators, cooling devices, heating tanks, trading point of secondary materials emerged in "Navtlugi Market", which is located on the suburb of Tbilisi. Individual entrepreneurs or group of people dismantle collected WEEE, put out valuable parts and sell directly on the market. The scrap metal is sold to scrap metal dealers, who sell it for further recycling to the steel reprocessing companies. The rest from WEEE dismantling: plastic, glass and hazardous parts are placed in waste collection bins and transported by municipalities for final disposal in non-hazardous municipal landfills. It should be underlined, that in repairing service centers, where dismantling of small household appliances, IT, telecommunication and consumer equipment take place, accumulation of obsolete EEE is quite significant.

According to the obtained findings essential accumulation of WEEE is observed not only in households and corporate, but also in public (service agency of MoF) sector. Currently handling and dismantling of WEEE purchased via e-auction is performed mainly by unauthorised recyclers. They are separating the valuable parts for secondary use and the rest - dispose in municipal bins. The main concern for both sectors is the existing legislative drawbacks. It is costly for them to giveaway WEEE to certified recyclers or to charity organizations.

> According to the Tax Code of Georgia, free of charge supply of goods or services by the organization is subject to application of all taxes, which would apply in case the supply was not free of charge.

2.3.3 Reuse and Recycling of WEEE

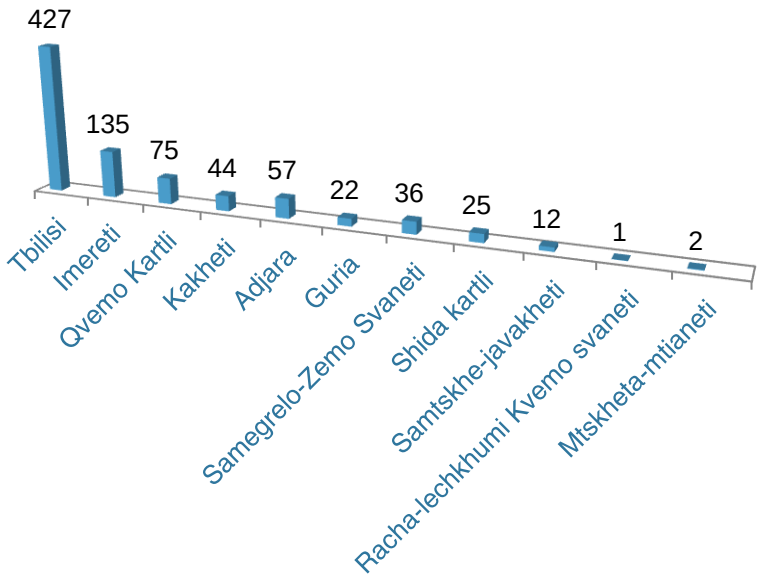
Repairing and reuse of EEE is a common practice in Georgia. Repairing centers are numerous and people actively use their services, since the most of imported EEE are of poor quality and repairing costs are not high.

To find out the WEEE recycling practice, several private and public sector representatives were interviewed. EnviroServe as a private WEEE recycling company working in Georgia underlined some difficulties connected with legislation. Information on national steel reprocessing industry was obtained from GeoStat database, but several attempts to obtain information directly from main steel recyclers were not successful. Undeclared, concealing/hiding import of EEE according to the

Custom Department of MoF is also one of the problems along with the different life cycle and difficult flow of EEE and WEEE within country.

Motivation for recyclers of large household appliances such as scrap metal collectors and scrap metal dealers is economic benefit. Environmental issues are not taken into consideration. Collected scrap metal comprises of metal parts from WEEE and is processed domestically by steel production industry (see chart #3).

Chart #3: Distribution of steel reprocessing companies by regions of Georgia



According to the study more, than 800 steel reprocessing companies are currently registered in the whole country and the most enterprises are located in Tbilisi, followed by Imereti and Qvemo Kartli regions with respectively 135 and 75 companies. The main reasons of such regional distribution of the companies could be the location of two main steel reprocessing plants in Rustavi (27 km from Tbilisi) and higher scrap metal generation rate. It should be mentioned, that the most companies registered as a steel reprocessing are individual entrepreneurs and are assumed as a representatives of the initial stage of metal recycling chain. Finally, scrap metals are domestically reprocessed in different metal products and are mainly sold on local market.

2.3.4 Disposal of WEEE

Landfilling is the only existing disposal practice of WEEE in Georgia. Heterogeneous composition of WEEE consists 80% (by weight) of iron, aluminum, plastic and glass and the rest is accounted to valuable and toxic metals. During WEEE manual dismantling, withdrawal of marketable parts is performed. However the issues of human healthcare and sustainable approach for proper disposal of hazardous compounds are not considered.

Discarded WEEE by households is mixed with municipal wastes and from waste collection points transported by municipalities to landfills for final disposal. On non-hazardous landfills, municipal solid wastes are compacted by bulldozers and covered with layer of soil. WEEE generated from private companies and state organizations is also disposed of at landfills. In this case, depreciated asset or not suitable for sale EEE is destroyed by hard technique on the landfill in presence of tax authority and appropriate documentation is prepared.

It should be pointed out, that after the enforcement of Waste Management Code, WEEE disposal on non-hazardous landfills with permit[3] is banned. Tbilisi and Rustavi landfills have Environmental Impact Permits (EIP) and according to the Code untreated waste disposal on sanitary landfills is restricted. Referring to official data, there are 56 state owned official non-hazardous landfills in Georgia. Tbilisi landfill and landfill of Adjara A/R are operated by Tbilisi and Batumi city halls, respectively. 54 regional landfills are operated by the 100% state owned Ltd Solid Waste Management Company of Georgia (SWMCG).

2.3.5 Voluntary Schemes (Producer Initiatives (If Any))

The level of coerciveness in EPR schemes can vary widely, with mandatory implementation modalities on the one hand and voluntary participation on the other side of the spectrum. Whereas mandatory EPR schemes are established on the grounds of legal stipulations (i.e. provisions in framework legislations or by-laws which include specific collection and recycling targets), voluntary initiatives are run by the private sector itself via industry-led take-back programs or voluntary agreements between industries and national government. In addition, individual components of EPR schemes can be voluntary in nature. This is reflected by voluntary deposit-refund schemes which encourage the consumers to return products at the end of life.

In general terms, mandatory schemes are expected to have a higher degree of reliability due to specific monitoring and enforcement protocols carried out by state's the supervising body (i.e. in the form of financial or administrative penalties). Yet, a high level of coerciveness can also incur additional costs and create administrative burdens for the producers and the EPR system as a whole. Therefore, it is suggested that voluntary schemes can turn out to be less expensive and lead to greater economic efficiency. At the same time, it should be highlighted that voluntary schemes increase the likeliness of free-riding due to the absence of external enforcement which take corrective measures in case of non-compliance.

While the majority of EPR schemes to date is indeed based on legislative provisions and can thus be classified as mandatory, voluntary schemes have been successfully implemented in a number of states across the globe. With regards to the implementation of the Packaging Ordinance in Germany in 1991 for instance, the automotive industry proactively avoided legal take-back obligations by initiating a voluntary collection scheme. Despite various legal changes in Germany EPR landscape, this collection scheme still operates today in the form of a private entity (i.e. a Partslife) which coordinates collection and recycling of packaging on behalf of its members.

[3] Landfill with Environmental Impact Permit (EIP)

Analysis revealed no existence of voluntary schemes working on regular base regarding WEEE management in Georgia. Nevertheless several campaigns from producers regarding home appliances such as TV and refrigerator were conducted during recent years. Under such campaigns, the customers received cash vouchers for bringing the old or obsolete equipment to the store and substitute it with buying new equipment on special offers. Launch of such campaigns by producers in Georgia was mainly initiated by 'brand' representatives.

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ANNEX I

Directive 2012/19/EU

Categories of EEE covered by this Directive during the transitional period as provided for in Article 2(1)(a)

1. Large household appliances
2. Small household appliances
3. IT and telecommunications equipment
4. Consumer equipment and photovoltaic panels
5. Lighting equipment
6. Electrical and electronic tools (with the exception of large-scale stationary industrial tools)
7. Toys, leisure and sports equipment
8. Medical devices (with the exception of all implanted and infected products)
9. Monitoring and control instruments
10. Automatic dispensers EN 24.7.2012 Official Journal of the European Union L 197/53

ANNEX II

1. LARGE HOUSEHOLD APPLIANCES Large cooling appliances Refrigerators Freezers Other large appliances used for refrigeration, conservation and storage of food Washing machines Clothes dryers Dish washing machines Cookers Electric stoves Electric hot plates Microwaves Other large appliances used for cooking and other processing of food Electric heating appliances Electric radiators Other large appliances for heating rooms, beds, seating furniture Electric fans Air conditioner appliances Other fanning, exhaust ventilation and conditioning equipment.

2. SMALL HOUSEHOLD APPLIANCES Vacuum cleaners Carpet sweepers Other appliances for cleaning Appliances used for sewing, knitting, weaving and other processing for textiles Irons and other appliances for ironing, mangling and other care of clothing Toasters Fryers Grinders, coffee machines and equipment for opening or sealing containers or packages Electric knives L 197/54 Official Journal of the European Union 24.7.2012 EN Appliances for hair cutting, hair drying, tooth brushing, shaving, massage and other body care appliances Clocks, watches and equipment for the purpose of measuring, indicating or registering time Scales.

3. IT AND TELECOMMUNICATIONS EQUIPMENT

Centralized data processing:

Mainframes Minicomputers Printer units

Personal computing: Personal computers (CPU, mouse, screen and keyboard included) Laptop computers (CPU, mouse, screen and keyboard included) Notebook computers Notepad computers Printers Copying equipment Electrical and electronic typewriters Pocket and desk calculators and other products and equipment for the collection, storage, processing, presentation or communication of information by electronic means User terminals and systems Facsimile machine (fax) Telex Telephones Pay telephones Cordless telephones Cellular telephones Answering systems and other products or equipment of transmitting sound, images or other information by telecommunications.

4. CONSUMER EQUIPMENT AND PHOTOVOLTAIC PANELS

Radio sets Television sets Video cameras 24.7.2012 Official Journal of the European Union L 197/55 EN Video recorders Hi-fi recorders Audio amplifiers Musical instruments and other products or equipment for the purpose of recording or reproducing sound or images, including signals or other technologies for the distribution of sound and image than by telecommunications Photovoltaic panels.

5. LIGHTING EQUIPMENT Luminaires for fluorescent lamps with the exception of luminaires in households Straight fluorescent lamps Compact fluorescent lamps High intensity discharge lamps, including pressure sodium lamps and metal halide lamps Low pressure sodium lamps Other lighting or equipment for the purpose of spreading or controlling light with the exception of filament bulbs

6. ELECTRICAL AND ELECTRONIC TOOLS (WITH THE EXCEPTION OF LARGE-SCALE STATIONARY INDUSTRIAL TOOLS) Drills Saws Sewing machines Equipment for turning, milling, sanding, grinding, sawing, cutting, shearing, drilling, making holes, punching, folding,

bending or similar processing of wood, metal and other materials Tools for riveting, nailing or screwing or removing rivets, nails, screws or similar uses Tools for welding, soldering or similar use Equipment for spraying, spreading, dispersing or other treatment of liquid or gaseous substances by other means Tools for mowing or other gardening activities.

7. TOYS, LEISURE AND SPORTS EQUIPMENT Electric trains or car racing sets Hand-held video game consoles Video games Computers for biking, diving, running, rowing, etc. Sports equipment with electric or electronic components Coin slot machines.

8. MEDICAL DEVICES (WITH THE EXCEPTION OF ALL IMPLANTED AND INFECTED PRODUCTS) Radiotherapy equipment Cardiology equipment L 197/56 Official Journal of the European Union 24.7.2012 EN Dialysis equipment Pulmonary ventilators Nuclear medicine equipment Laboratory equipment for in vitro diagnosis Analysers Freezers Fertilization tests Other appliances for detecting, preventing, monitoring, treating, alleviating illness, injury or disability.

9. MONITORING AND CONTROL INSTRUMENTS Smoke detector Heating regulators Thermostats Measuring, weighing or adjusting appliances for household or as laboratory equipment Other monitoring and control instruments used in industrial installations (e.g. in control panels).

10. AUTOMATIC DISPENSERS Automatic dispensers for hot drinks Automatic dispensers for hot or cold bottles or cans Automatic dispensers for solid products Automatic dispensers for money All appliances which deliver automatically all kinds of products.

ANNEX III

1. Temperature exchange equipment

2. Screens, monitors, and equipment containing screens having a surface greater than 100 cm^2

3. Lamps

4. Large equipment (any external dimension more than 50 cm) including, but not limited to: Household appliances; IT and telecommunication equipment; consumer equipment; luminaires; equipment reproducing sound or images, musical equipment; electrical and electronic tools; toys, leisure and sports equipment; medical devices; monitoring and control instruments; automatic dispensers; equipment for the generation of electric currents. This category does not include equipment included in categories 1 to 3.

5. Small equipment (no external dimension more than 50 cm) including, but not limited to: Household appliances; consumer equipment; luminaires; equipment reproducing sound or images, musical equipment; electrical and electronic tools; toys, leisure and sports equipment; medical devices; monitoring and control instruments; automatic dispensers; equipment for the generation of electric currents. This category does not include equipment included in categories 1 to 3 and 6.

6. Small IT and telecommunication equipment (no external dimension more than 50 cm)