

MANAGING WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT IN ROMANIA: COMPARATIVE ANALYSIS WITH OTHER COUNTRIES IN EUROPE

Sofia-Elena COLESCA¹
Maria-Loredana POPESCU²

ABSTRACT

The paper presents primarily the concept of waste electrical and electronic equipment (WEEE) according to the specialized literature and legislation. The objectives of this article are actually the presentation of WEEE situation in Romania and the comparison with that of other countries in Europe. Waste management is regarded and statistically analyzed in quantities of electrical and electronic equipment put on the market, then collected and recycled. As a result of this study, we can conclude that Romania is occupying the last place in Europe in the field of e-waste management, in what concerns the collected and recycled quantities.

KEYWORDS: *waste electrical and electronic equipment, WEEE directive, Romania, collecting, recycling.*

JEL CLASSIFICATION: *Q53, Q56, Q59.*

1. INTRODUCTION

Urban development and overall growth of the living standard of the population is accompanied by the production of more and more waste quantities. Waste management problem of electrical and electronic equipment is becoming more acute in Romania due to increased quantity and diversity, due to their negative impact on the environment and health, but also because of obligations under the legislation in force. Although there has been made a progress in waste management, Romania has large amounts of waste that remain unmanaged yet. As mentioned in the abstract of the paper, the objectives are to analyze the situation of WEEE management in Romania and to realize a comparative analysis between Romania and the other countries in Europe, Romania being focused on. The WEEE concept and the legislation in force are presented in the theoretical framework and then in the first chapter, is analyzed the WEEE situation starting with researches made by Daedalus Millward Brown company. In the second chapter is made the comparative analysis using the European statistics from European Commission (Eurostat). Based on these data, my contribution is the statistical analysis that shows Romania's position in relation to the European countries.

2. THEORETICAL FRAMEWORK

Waste electrical and electronic equipment (WEEE) are currently considered having the fastest growing in the EU, estimated at 3-5% per year (<http://epp.eurostat.ec.europa.eu>). A wide variety of WEEE is discarded by consumers, often in different ways, small items such as toasters being more manageable than larger ones such as washing machines (Darby & Obara, 2005). WEEE problem has actually become a matter of concern for professionals in the solid waste management (Musson et al., 2000). The challenges facing management of WEEE has consequences not only in the

¹ The Bucharest University of Economic Studies, Romania, e-mail: e_colesca@yahoo.com

² The Bucharest University of Economic Studies, Romania, e-mail: maria.loredana_popescu@yahoo.com

increase of the amount of waste, but also in their complexity, which is one of the most complex waste streams due to the variety of products from mechanical devices to integrated high performance and accelerating technological innovations (Yla-Mella et al., 2004). The concept of "waste electrical and electronic equipment" is often misunderstood as including only the computers and related IT equipment. In the electrical and electronic equipment category there are included not only the IT equipments (information and technology), but also large and small household appliances, equipment including computers, computer games and peripherals, cellular telephones and other telecommunication equipment, portable electronic devices, video and audio equipment, including MP3 players and peripherals, electrical tools (Ciocoiu, Burcea & Târțiu, 2010). Widmer et al. (2005) presented several definitions and use the terms e-waste and WEEE as synonyms. According to the OECD, e-waste is "any device that uses a power source, that has reached end of life", basically refers to the moment when equipment is scrapped. Waste electrical and electronic equipment (WEEE), also known in legal terms as e-waste is a waste type consisting of any electrical or electronic device, broken or abandoned. (Wang, 2008). Sinha-Khetriwal, Kraeuchi, and Schwaninger (2005) defined WEEE as "any device connected to a power source that no longer satisfies the current owner to the purpose for which it was created." According to Sinha - Khetriwal, Kraeuchi and Widmer (2007) electrical and electronic waste include both "white goods" such as refrigerators, washing machines, microwave ovens and "brown goods" goods such as televisions, radios, computers that have reached end of life the for current owner. The European Union has established policies for waste electrical and electronic equipment (Directive 2002/96/EC) and Restriction of Hazardous Substances in electrical and electronic equipment (Directive 2002/95/EC), which aims at improving environmental protection by electronic products (Nnorom & Osibanjo, 2008). On July 4, 2012, was signed in Strasbourg the Directive 2012/19/EU, which defines the electrical and electronic equipment or "EEE" as "electrical and electronic equipment" or "EEE" means equipment which 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 1000 volts for alternating current and 1500 volts for direct current". This directive aims to improve the environmental performance of all operators involved in the cycle of the electrical and electronic equipment life, as producers, distributors and consumers and in particular operators directly involved in the collection and treatment of WEEE.

3. WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT SITUATION IN ROMANIA

Regarding the classification of waste electrical and electronic equipment, given that the new directive has not yet been transposed into the national legislation of each country, the following categories are kept in accordance with Directive 2002/96/EC according to Table 1:

Table 1. Categories of electrical and electronic equipment (EEE)

Category 1	Large household appliances
Category 2	Small household appliances
Category 3	IT and telecommunications equipment
Category 4	Consumer equipment
Category 5	Lighting equipment
Category 6	Electrical and electronic tools
Category 7	Toys, leisure and sports equipment
Category 8	Medical devices (exception of all implanted and affected products)
Category 9	Monitoring and control instruments
Category 10	Automatic dispensers

Source: www.anpm.ro

A study made by the market research company Daedalus Millward Brown, conducted at the request of the associations ECOTIC and Recolamp show that more than a third of Romanians living in urban areas continue to keep in their house electrical and electronic equipment even after they have been damaged. The study was conducted on a sample of 800 people, in cities with over 50,000 inhabitants. It shows that Romanians keep in their houses such equipment with the intent to fix them (25%), because they don't know what they could do with them after scrapping (25%), because don't have time to deal with them (21%) and because there are no facilities for disposal in the area in which they reside (11%). However, over 65% of urban Romanians do not know about the existence of a point of collection of such equipment while the majority of citizens (53%) believe that the local public authorities have the infrastructure responsibilities directly or through sanitation companies. In terms of facilities, according to the recorded results, the majority of urban households are equipped with electrical and electronic equipment like refrigerator (98.8%), washing machine (96.8%), television (98.8%), vacuum cleaner (93%), computer or laptop (77%) and light bulbs (70%). Regarding the duration from the procurement of goods above, most products are in urban households for four years on average. Exceptions are made by the air conditioner (3.2 years), laptop (2.6 years), LED luminaires (2.5 years) and savers (2.2 years) (<http://www.gandul.info>).

In the period 2006-2010, there has been put on the market a quantity of 847,668.2 tonnes of EEE. (www.anpm.ro). In order to achieve the annual collection, reuse, recycling and recovery of WEEE targets, manufacturers can operate individually, either using their own resources or by transferring these responsibilities on a contract to a legally constituted and authorized economic operator in this regard.

The following collective organizations obtained the operating license to take over responsibility for the annual objectives of collection, reuse, recycling and recovery of waste electrical and electronic equipment: ECO TIC Association, Romanian Association for Recycling RoRec, RECOLAMP Association, ENVIRON Association, CCR LOGISTICS SYSTEMS RO SRL, ECOPOINT Association, ECOMOLD Association.

Since 2008, the collection target of WEEE is at least 4 kg waste/capita/year. Despite the efforts made by authorities and responsible operators, so far it hasn't reached this annual collection target.

According to data from the Environmental Protection National Agency, in 2006-2010, was collected an amount of 91,540.87 tonnes of WEEE. Collected WEEE is treated both in Romania and other EU member states.

The situation of treated WEEE in the 2007-2010 period is as follows:

- in 2007 were treated 19.7% of WEEE collected
- in 2008 were treated 36.43% of WEEE collected
- in 2009 were treated 94.39% of WEEE collected
- In 2010, has been treated 100% of WEEE collected, and a part of WEEE in storage at the beginning of the year.

RoRec organization, specialized in the collection of waste electrical and electronic equipment (WEEE) collected from a campaign almost 680 tons of such waste equipment.

In 2011, there were over a million pounds of WEEE collected in 220 actions from 39 counties and the districts 4 and 6 of Bucharest, where attended over 66,000 citizens (<http://www.ziare.com/articole/deseuri+electrice+electronice>).

During February-July 2012, the WEEE collection actions across the country have offered over six million Romanians the possibility to discard their old electrical and electronic equipment. Thus, within the 222 actions held by the end of July more than 1,600 volunteers have contributed and the collected quantities amounted to nearly 680 tonnes from 536 villages that had easy access to RoRec WEEE collection actions. According to official statistics of the organization, in 2012, among the actions undertaken were collected over 400,000 pounds of waste electrical and electronic equipment.

4. COMPARATIVE ANALYSIS AT EUROPEAN LEVEL

The issue arises of how much electrical and electronic equipment is put on the market, how much is collected, recycled and reused per capita in Romania. Realizing a graphic that contains a comparative analysis of the situation in Romania toward other countries in Europe, we can say that Romania has put on the market 151,316.7 tones of electrical and electronic equipment and 7.1 kg per capita in 2010, ranging in the last 4 states at the amount of equipment placed on the market and level of collection, but with recycling Romania ranks last place, as shown in the figure 1.

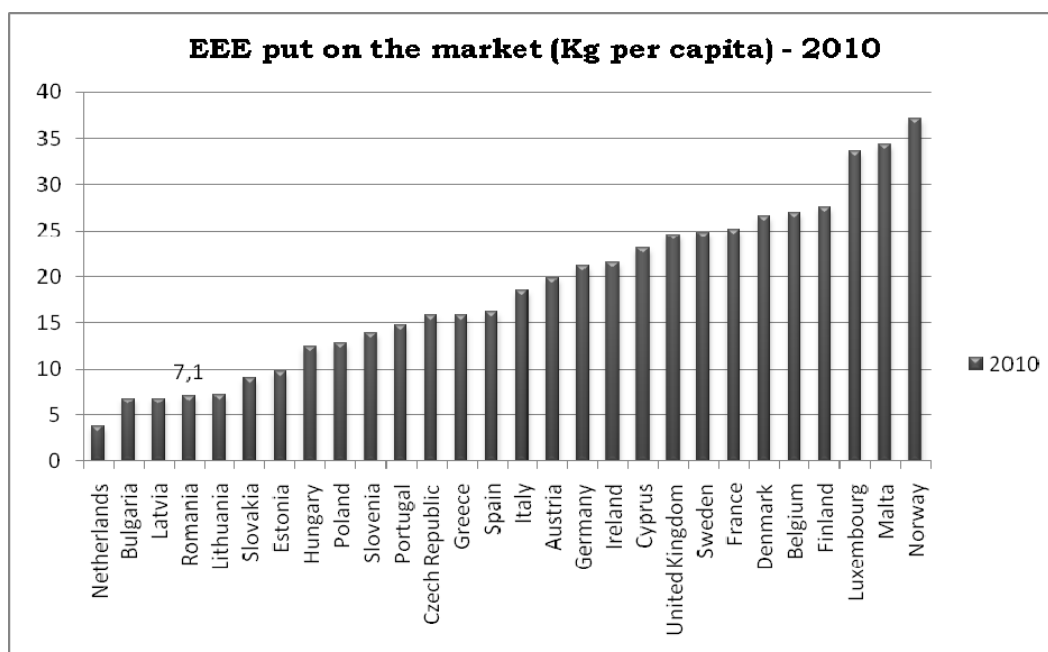


Figure 1. EEE put on the market (kg per capita)
 Source: adapted from Eurostat, accessed on 30.05.2013

Table 2. EEE put on the market (kg per capita – quantities with statistical analysis)

Netherlands	3,7
Bulgaria	6,8
Latvia	6,8
Romania	7,1
Lithuania	7,3
Slovakia	9,1
Estonia	9,8
Hungary	12,4
Poland	12,8
Slovenia	13,9
Portugal	14,8
Czech Republic	15,8
Greece	15,8
Spain	16,2
Italy	18,5
Austria	19,8

Statistical analysis

Mean	18,475
Standard Error	1,723266133
Median	17,35
Mode	6,8
Standard Deviation	9,11866726
Sample Variance	83,15009259
Kurtosis	-0,735369499
Skewness	0,287051477
Range	33,4
Minimum	3,7

Germany	21,2	Maximum	37,1
Ireland	21,5	Sum	517,3
Cyprus	23,1	Count	28
United Kingdom	24,6		
Sweden	24,8		
France	25,2		
Denmark	26,6		
Belgium	27		
Finland	27,6		
Luxembourg	33,6		
Malta	34,4		
Norway	37,1		

Source: adapted from Eurostat, accessed on 30.05.2013

On average in 2010, a European state put on the market a quantity of 18.475 kg per capita of electrical and electronic equipment (EEE) with a standard error of 1.72326 kg per capita. At European state level, the smallest amount of EEE put on the market was 3.7 kg per capita and the highest was 37.1 kg per capita.

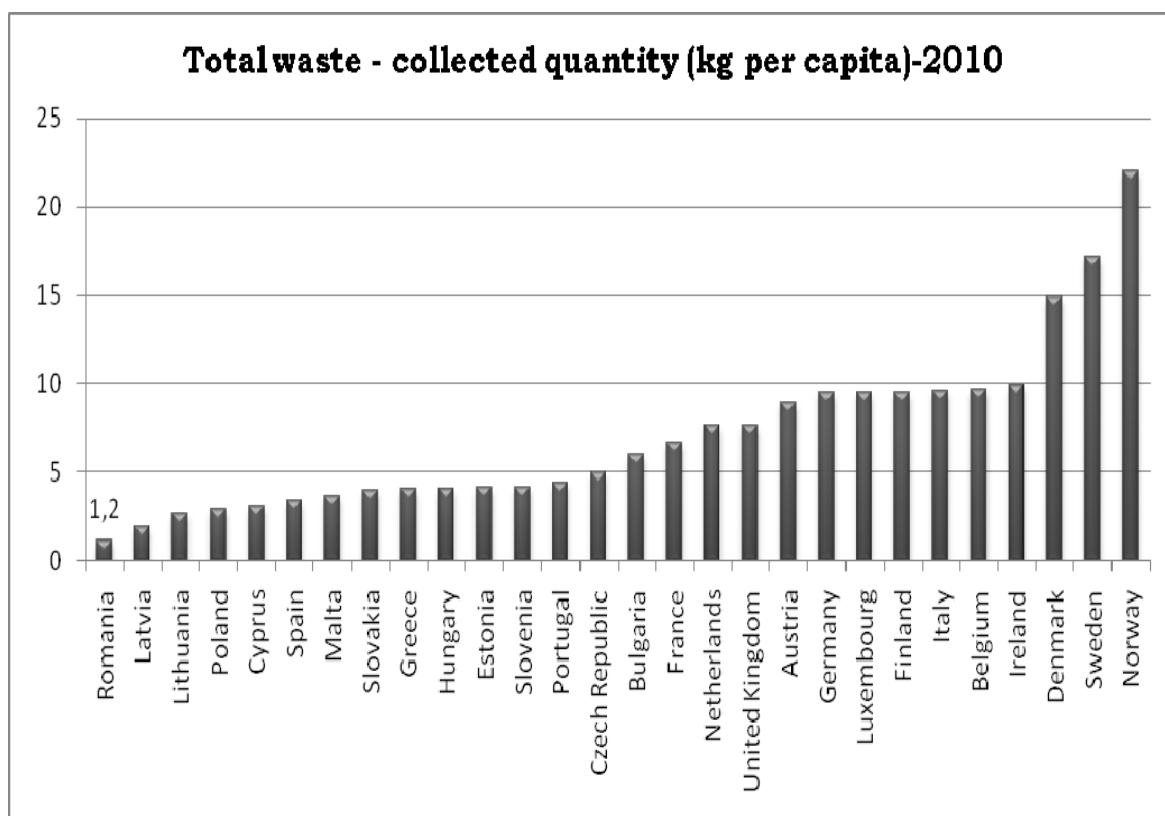


Figure 2. Total waste - collected quantity (kg per capita)

Source: adapted from Eurostat, accessed on 30.05.2013

Table 3. Collected quantity of WEEE (kg per capita - values with statistical analysis)

Romania	1,2
Latvia	1,9
Lithuania	2,7
Poland	2,9
Cyprus	3,1
Spain	3,4
Malta	3,7
Slovakia	4
Greece	4,1
Hungary	4,1
Estonia	4,2
Slovenia	4,2
Portugal	4,4
Czech Republic	5
Bulgaria	6
France	6,7
Netherlands	7,7
United Kingdom	7,7
Austria	8,9
Germany	9,5
Luxembourg	9,5
Finland	9,5
Italy	9,6
Belgium	9,7
Ireland	9,9
Denmark	14,9
Sweden	17,2
Norway	22

<i>Statistical analysis</i>	
Mean	7,060714286
Standard Error	0,908882378
Median	5,5
Mode	9,5
Standard Deviation	4,809353486
Sample Variance	23,12988095
Kurtosis	2,514290527
Skewness	1,494177439
Range	20,8
Minimum	1,2
Maximum	22
Sum	197,7
Count	28

Source: adapted from Eurostat, accessed on 30.05.2013

On average, a European state has collected an amount of 7.060714286 kilograms per capita of electrical and electronic equipment (EEE) with a standard error of 0.908882378 kilograms per capita. At European state level, the smallest amount of EEE collected was 1.2 kg per capita and the highest of 22 kg per capita.

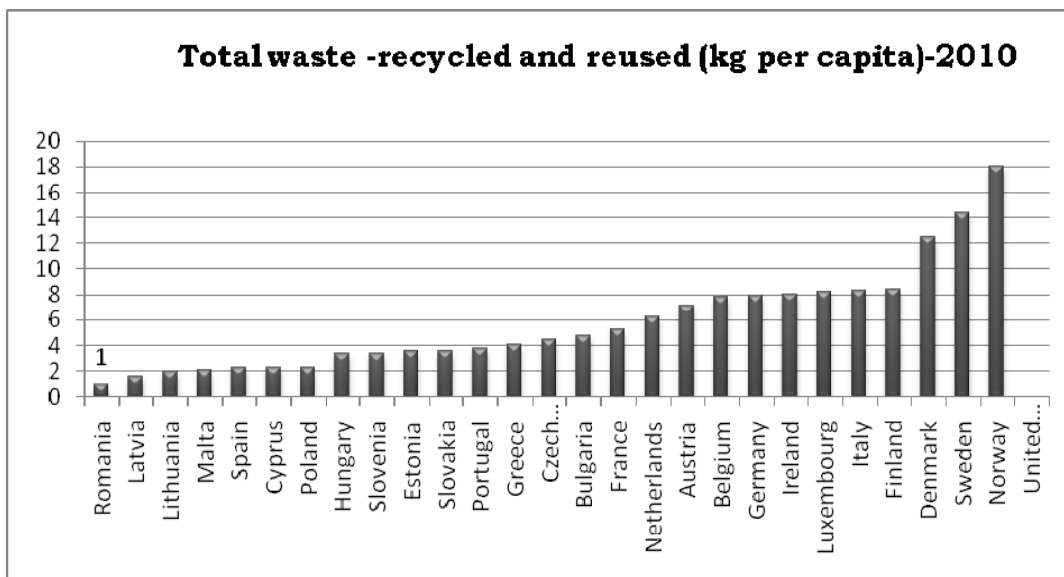


Figure 3. WEEE recycled quantity
 Source: adapted fom Eurostat, accessed on 30.05.2013

Tabel 4. Recycled and reused WEEE (kg per capita - quantities with statistical analysis)

Romania	1
Latvia	1,6
Lithuania	2
Malta	2,1
Spain	2,3
Cyprus	2,3
Poland	2,3
Hungary	3,3
Slovenia	3,3
Estonia	3,5
Slovakia	3,5
Portugal	3,7
Greece	4
Czech Republic	4,4
Bulgaria	4,7
France	5,2
Netherlands	6,2
Austria	7,1
Belgium	7,8
Germany	7,9
Ireland	8
Luxembourg	8,2
Italy	8,3
Finland	8,4
Denmark	12,5
Sweden	14,4
Norway	18
United Kingdom	-

<i>Statistical analysis</i>	
Mean	5,777777778
Standard Error	0,792923354
Median	4,4
Mode	2,3
Standard Deviation	4,120150607
Sample Variance	16,97564103
Kurtosis	1,98202003
Skewness	1,404856672
Range	17
Minimum	1
Maximum	18
Sum	156
Count	27

Source: adapted from Eurostat, accessed on 30.05.2013

On average, it was recycled an amount of 5.777777778 kilograms per capita of waste electrical and electronic equipment (WEEE), with a standard error of 0.792923354 kilograms per capita. The smallest quantity of recycled WEEE and registered in Romania was about 1 kg per capita and the highest amount recycled was recorded in Norway, 18 kg per capita. The mode, namely the value that is repeated in the data series is 2.3 kg WEEE per capita, Spain and Cyprus recycling the same amount (2.3 kg per capita). Once we calculate the dispersion which shows the degree of dissipation of the data as against the average, we can extract the root of the dispersion achieving standard deviation of 4.120150607 kilograms per capita. Deviation and dispersion shows the degree of data dissipation, namely how data are dispersed from the average, respectively as deviating from the mean in absolute value.

5. CONCLUSIONS

The increase of the WEEE amount caused by high levels of consumption in Romania has become a problem in the last few years, as the system of WEEE management is still in its infancy. The fast rate of innovation in the electronics field determine people to buy new types of products or to replace the old ones with other more efficient. Some of Romanians are willing to collect and recycle their old equipment, but most of them do not know how it could be done, where are the collection points and what are the negative effects of WEEE on the environment.

The lack of information makes impossible to achieve the objective of an efficient management of the waste of electrical and electronic equipment. Improving knowledge about WEEE recycling is a course of action that can be applied, and this can be achieved through effective promotion campaigns and a strong commitment to a recycling education system.

I think it is important for the people to be informed about the existence of techniques for collecting and recycling electronic waste and also to carry out an analysis of awareness and then an education in this sense in our country too.

REFERENCES

- Ciocoiu, N., Burcea, Ș., Târțiu, V. (2010). Environmental impact of ICT and implications for e-waste management in Romania. *Economia. Seria Management*, 13(2), 2010, 348-360.
- Darby, L., Obara, L. (2005). Household recycling behaviour and attitudes towards the disposal of small electrical and electronic equipment. *Resources, Conservation and Recycling* 44, 17–35.
- Wang, F. (2008). *Economic conditions for developing large scale WEEE recycling infrastructure based on manual dismantling in China*, Delft University of Technology, Diploma Thesis for Master Programme of Industrial Ecology.
- Nnorom, I.C., Osibanjo, O. (2008). Overview of electronic waste (e-waste) management practices and legislations, and their poor applications in the developing countries. *Resources, Conservation and Recycling*, 52, 843–858.
- Sinha-Khetriwal, D., Kraeuchi, P., Schwaninger, M. (2005). A comparison of electronic waste recycling in Switzerland and in India. *Environmental Impact Assessment Review*, 25, 492–504.
- Sinha - Khetriwal, D., Kraeuchi, P., Widmer, R. (2007). Producer responsibility for e-waste management: Key issues for consideration-Learning from the Swiss experience. *Journal of Environmental Management*, XX, 1-13.
- Widmer, R., Oswald-Krapf, H., Sinha-Khetriwal, D., Schnellmann, M., Boeni, H. (2005). Global perspectives on e-waste. *Environmental Impact Assessment Review*, 25, 436-458.
- Yla-Mella, Y., Pongracz, E., Keiski, RL. (2004). Recovery of waste electrical and electronic Equipment (WEEE) in Finland. In: Pongracz E, editor. *Proceedings of the waste minimization*

and resource use optimization conference, June 10, 2004, Oulu, Finland. p. 83–92.
<http://www.oulu.fi/resopt/wasmin/ylamella.pdf>.

www.anpm.ro.

European Commission Eurostat.

www.mmediu.ro.

Ministry of Economy (reciclare.minind.ro).

Ministry of Environment (www.deseurielectrice.ro/legislatie.htm).

http://www.pce.parliament.nz/assets/Uploads/Reports/pdf/EI_bkgrd_report.pdf.

<http://www.recolamp.ro/downloads/rapoarte/2010RecolampAnnualReport.pdf>.

http://epp.eurostat.ec.europa.eu/portal/page/portal/waste/key_waste_streams/waste_electrical_electronic_equipment_weee.

<http://www.gandul.info/magazin/o-treime-dintre-romanii-din-mediul-urban-pastreaza-echipamentele-electrice-si-electronice-defecte-8886142>).

<http://www.ziare.com/articole/deseuri+electrice+electronice>.