Executive Summary of the Reports on

Mapping of WEEE reuse and preparing for reuse practices and initiatives in Greece

- Collection of reliable data and mapping of WEEE quantities, WEEE generation causes, and WEEE prevention initiatives
- Investigation of the impact of the deep economic crisis in Greece on the WEEE generation)

Action B.3

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«Executive summary of the Reports on Mapping of WEEE reuse and preparing for reuse practices and initiatives in Greece»

(Action B.3)

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Contents

1. Introduction

The present report summarizes the outcomes of the deliverables of the LIFE RE-WEEE project, regarding the mapping of waste electrical and electronic (WEEE) reuse and preparing for reuse practices and initiatives in Greece (Action B.3). More specifically, it includes a short description of the methodology used, the main results and conclusions of the following two Reports:

- ***Collection of reliable data and mapping of WEEE quantities, WEEE generation causes, and WEEE prevention initiatives***
- ***Investigation of the impact of the deep economic crisis in Greece on the WEEE generation***

Within the implementation of the LIFE-REWEEE project, the mapping of WEEE reuse and preparing for reuse practices and initiatives, was conducted for first time in Greece, aiming at the development of a reliable basis for the assessment of:

- the measurements, which are/will be implemented throughout the LIFE- REWEEE project, and
- the design of WEEE reuse initiatives after the end of the LIFE- REWEEE project implementation.

For the mapping of the WEEE reuse and preparation for reuse practices and initiatives in Greece, all available databases regarding EEE reuse and WEEE preparing for reuse in Greece were investigated. A contact database containing contact information about stakeholders of the EEE reuse and WEEE preparing for reuse sector, which could provide data for the elaboration of the reports was developed.

Harokopio University had the overall responsibility for the implementation of Action B3, and therefore for the elaboration, and delivery of the report. Appliances Recycling S.A. facilitated the access and collection of data from the listed stakeholders (which were its members). ECOREC has expanded the database with organisations developing social initiatives. Green Fund participated in the investigation of data, as well as results mapping.

2. Methodology

For the achievement of the aforementioned goals, the following methodology tools were coined: (i) desk study of all available scientific, technical and "grey" literature, as well as analysis of the accessible databases, (ii) design, and distribution of a survey-based questionnaire for data collection, and (iii) implementation of an Input-Output Analysis (a variant of the "Distribution Delay" model), for the estimation of WEEE generation in Greece, and its comparison with WEEE generation in selected countries.

2.1. Desk study

A thorough desk-study on published papers, as derived from searches in bibliographic databases (scientific literature) and publicly available "grey" literature (published reports) was carried out. Relevant papers and reports were read and analyzed by experts, with emphasis on their data sources, methodology, and limitations, in order to evaluate, through expert judgment, the relevance of their data. Of the papers and reports examined, those reporting data based on national statistics or independent evaluations based on specific studies and measurements were used.

A special mention should be made here to the report entitled "The Global E-Waste Monitor, 2014" by Baldé et al. (2015) as it has developed a robust methodology for the estimation of the e-waste

generation and provides numerical estimates for 175 countries. These estimates are widely reproduced and utilized in many reports, as well as articles in the scientific literature, often without clearly indicating that they constitute a calculated estimate.

2.2. Design, and distribution of a survey-based questionnaire for data collection

A questionnaire was developed to facilitate the collection of reliable data from stakeholders (listed in the aforementioned database). More specifically, in June 2017, EC brought the LIFE REWEEE project in primary contact with Deloitte to investigate the potential of a synergy regarding the collection of data in Greece, as Deloitte also conducts a (wider) research on reparability. This contact resulted in the development of an integrated questionnaire, which facilitated both studies. The questionnaire was sent (through e-mail/fax) to over 500 recipients.

The implementation of this Sub-action resulted in the production of a report on mapping of WEEE reuse and preparation for reuse practices and initiatives in Greece. Since the end date of the report (March 2018), just a few (<30 responses than the targeted 100) had been collected, due to the participants' reluctance. However, a draft, but almost completed (over 90%) version of this report was delivered in April 2018 and presented in the 3rd Monitoring Visit (03/05/2018). In order to address the stakeholders' reluctance, HUA decided to make door-to-door contacts with service sector. As a result of these efforts, 105 filled-in questionnaires were collected and analysed. The results of this analysis were embodied in the report, which was delivered in its final version in November 2018.

2.3. Implementation of an Input-Output Analysis

The Weibull distribution is a probalistic distribution which is often used for modelling product lifespans. In this study, a variant of the Distribution Delay method is used. More specifically, the estimation of the amounts of generated waste electrical and electronic (WEEE) is based on empirical data from the method of apparent consumption and the electrical and electronic equipment lifespans. In this model, the lifetime data for each product is subtracted from sales (using the Weibull distribution function) to calculate WEEE.

The method was selected for three main reasons: 1. It is adopted by the EU, 2. The lack of data from the year 2007 onwards for the implementation of other methods, and 3. The need for direct comparison with WEEE estimates among EU-Member States.

According the European Commission Implementing Regulation 2017/699, the Commission has made available the WEEE calculation tool individually for each of the Member States. The calculation of the produced WEEE is relatively simple, after estimating the WEEE available annually in the Greek market after 2014 (the Put On Market in the Greece between 1980 and 2014 are included in the tool).

3. Results

3.1. Amount of WEEE

The amount of WEEE (weight) was calculated according to the aforementioned tool, utilising the data provided by Appliances Recycling S.A. regarding the declared quantities of EEE in Greece by the

contracted producers for the period 2015 -2017. Diagram 1 present the Put on Market (POM) of EEE and estimated quantities of generated WEEE in Greece from 1980 to 2017.

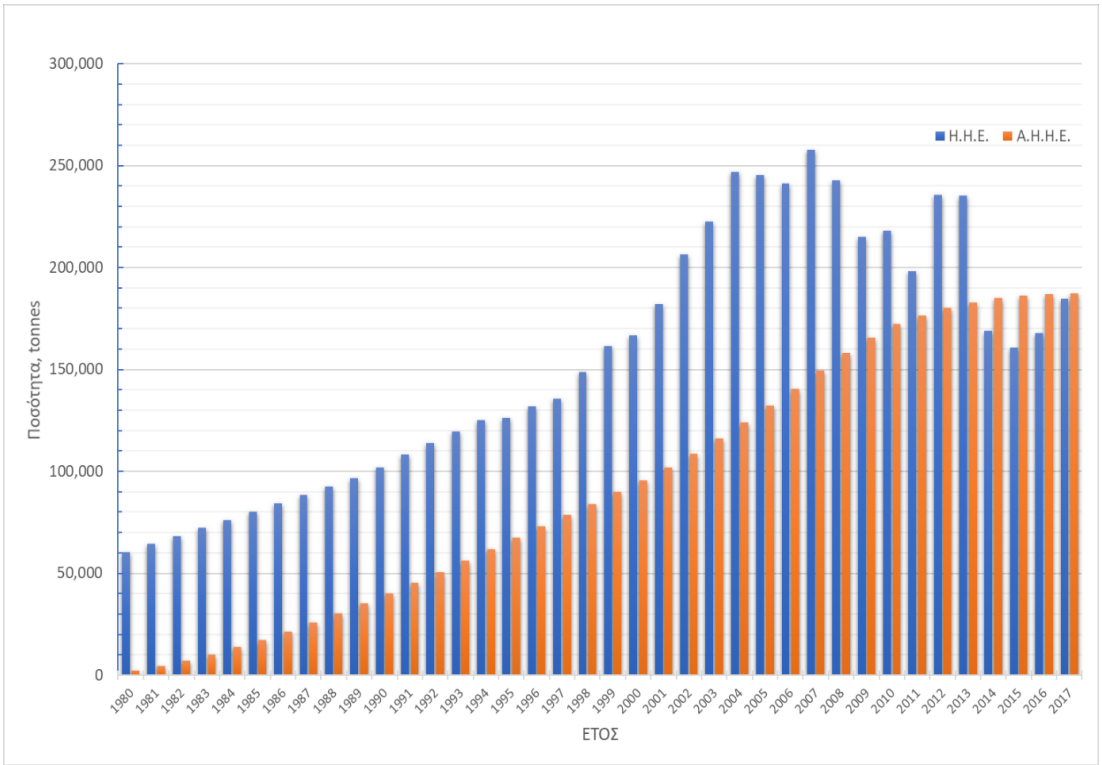


Diagram 1. Available PoM and total estimated quantities of generated WEEE, 1980-2017.

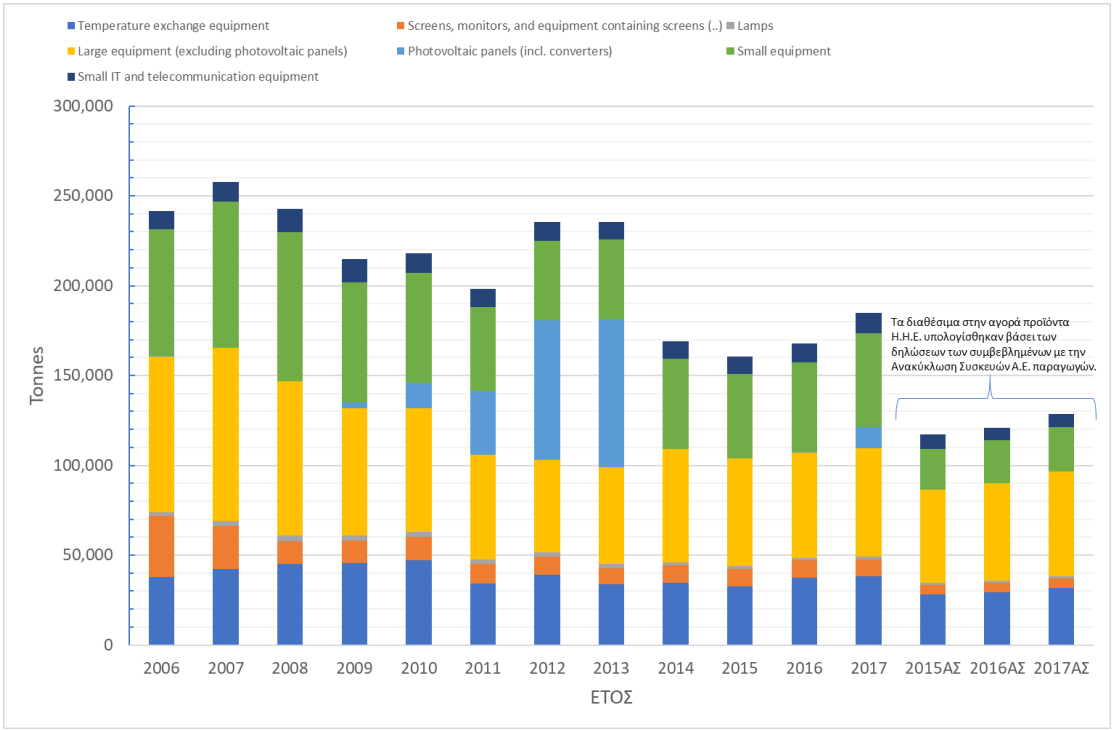


Diagram 2. PoM EEE grouped into the 6 categories of the Directive 2012/19 / EU, 2006-2017.

In the recast WEEE Directive, electrical and electronic devices have been re-categorised. According to Directive 2012/19/EU, the EEE grouped to six (6) categories. Diagrams 2 & 3 show the PoM EEE and the WEEE generated for 2006-2017, divided into the 6 categories of the Directive 20012/96/EC.

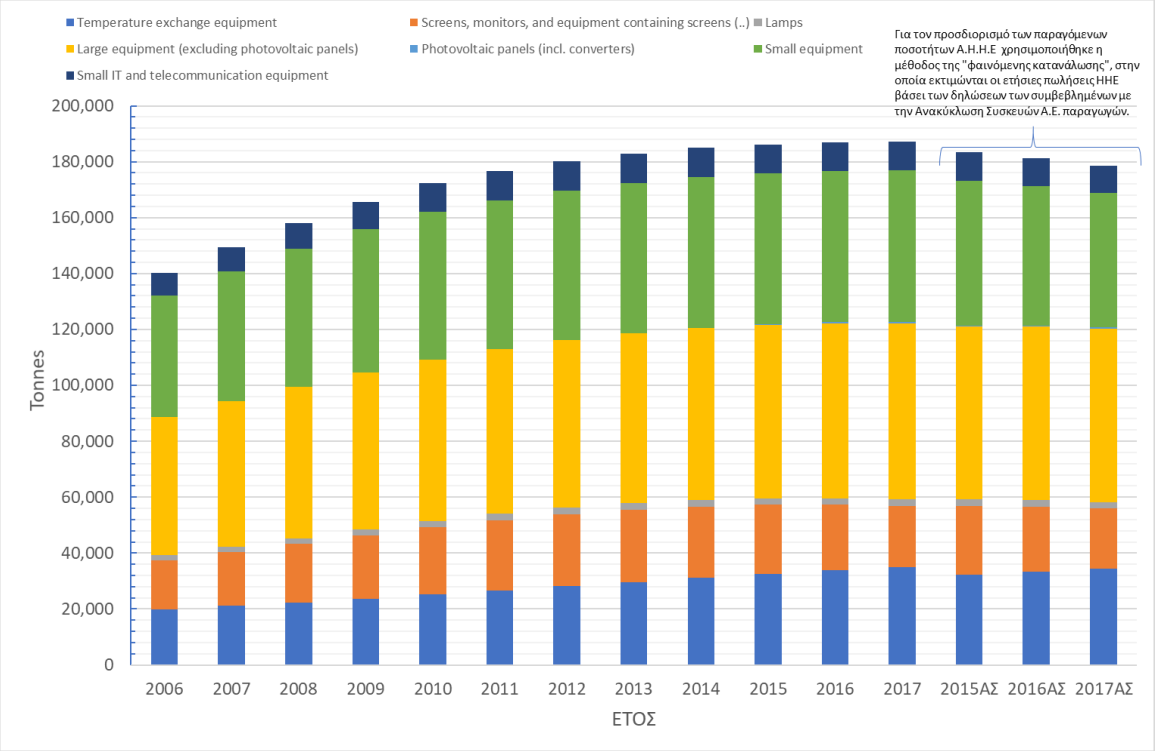


Diagram 3. Generated WEEE grouped into the 6 categories of the Directive 2012/19/EU, 2006-2017.

3.2. Comparison with EU countries

The efficiency and effectiveness of the electrical and electronic equipment waste management system in Greece was compared with that of three other European countries (Portugal, Ireland, and Denmark) through specific indicators.

1. Portugal and Ireland are countries with relatively the same population density and economic situation with Greece. In addition, Portugal has similar climatic conditions to Greece, in contrast to the other countries examined.
2. Denmark is a small country based on population criteria, but it is economically and technologically more advanced in waste management compared to Greece.
3. A comparison with the average European Union performance is also included.

The comparison of the performance of Greece in the management of WEEE in relation to the respective performances of the selected Member States (Denmark, Ireland, Portugal) and the EU is presented in the Diagram 4 and highlights the existence of qualitative differences between them in the way of managing WEEE.

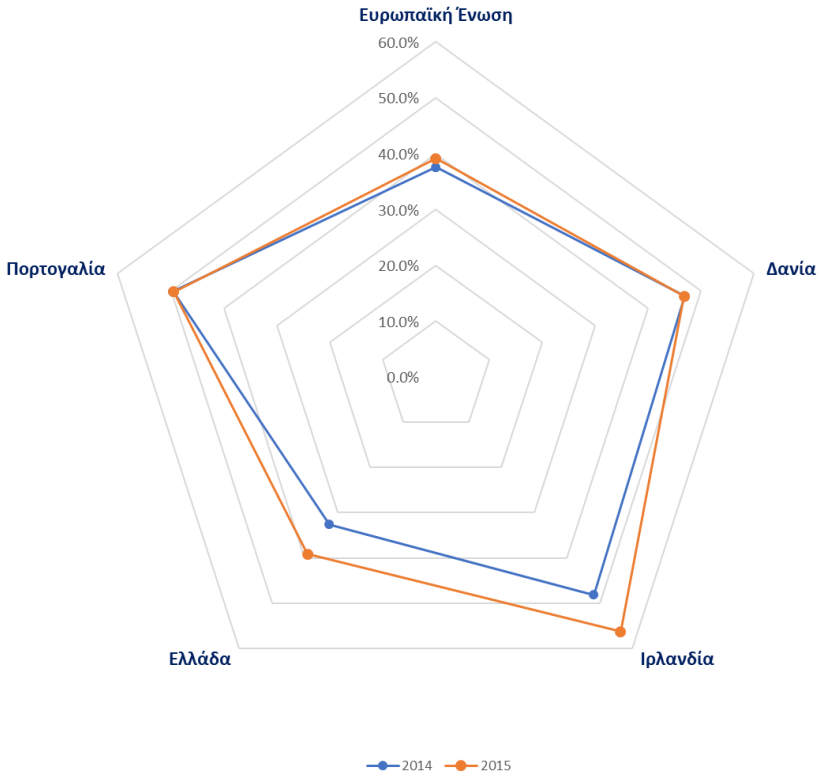


Diagram 4. WEEE collection rate in the European Union, Greece, Portugal, Ireland and Denmark in 2014 and 2015.

More specifically, Greece shows the lowest performance in the total collection of WEEE, about 39%, identical to the EU average. In contrast, Denmark, Ireland, and Portugal are approaching 50%. In fact, Portugal with similar EEE consumption per capita with Greece, 11.7 kg and 12.8 kg respectively, demonstrates the highest WEEE collection performance among the three EU Member States with 49.6% and 49.4%, for 2014 and 2015 respectively (Diagram 3). It is important to emphasize, however, the improvement of Greece's WEEE collection performance from 32.6% in 2014, to 39.2 in 2015. Table 1 shows the recycling-reuse and recovery rates for the compared Member States and the EU, for all WEEE for the years 2014 - 2015.

Table 1. Percent of Recycling-Reuse and Recovery

	% recycling-reuse		**% recovery**	
	2014	2015	2014	2015
EU	81,7%	81,8%	89,0%	88,6%
Denmark	83,0%	84,2%	90,5%	92,0%
Ireland	83,7%	83,2%	86,1%	93,7%
Greece	**84,0%**	**89,6%**	**84,0%**	**89,6%**

Portugal	76,9%	78,0%	85,8%	89,8%

Greece, among the other Member States, has the highest rate of recycling and reuse, but lags in the recovery rate. The recovery and recycling rates (%) of WEEE measure the efficiency of the treatment and is defined as the ratio between the quantities of "recovered" and "recycled and reused" for the total quantity of treated WEEE. The weighted average processing rate for all categories of WEEE has now risen to 88.9% and it is approaching the EU average, with slight deviations from the other comparable countries.

3.3. Changes in consumers' attitudes and behaviour as a result of the economic crisis

The economic crisis in Greece contributed to the reduction of the disposal income for citizens and the acquisition of consumer goods. The income available for consumption was significantly affected mainly due to the high levels of unemployment, but also the general decline of income. Consumers try to meet many needs and desires with limited financial resources. At the same time, the economic crisis has created a general climate of anxiety and pessimistic expectations in almost every sector of the Greek society. The psychological factor, which should not be underestimated, has a significant impact even on consumers that have not suffered the purely economic consequences of the crisis.

The quantity of Electrical and Electronic Equipment (EEE) sold in the Greek market (POM) during the years 2006 to 2017 is presented in Diagram 5. In addition, the same chart shows the change in the gross domestic product (GDP) of Greece for the same period.

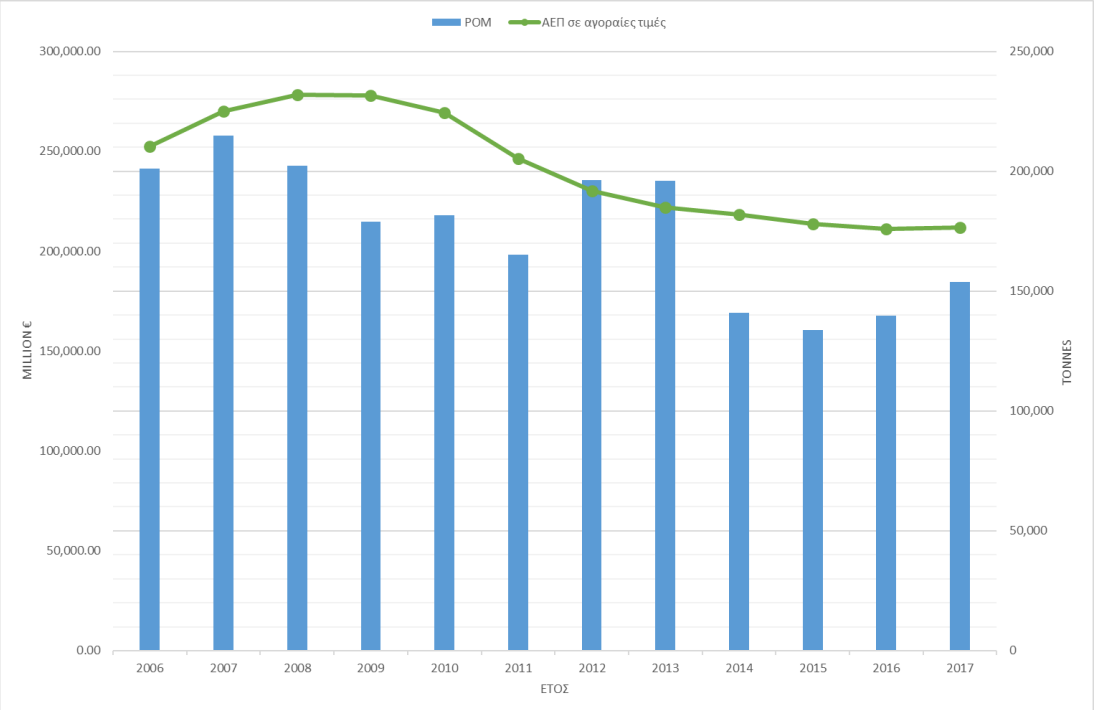


Diagram 5. PoM Electrical and Electronic Equipment (EEE) in Greece during the period 2006 - 2017 (apparent sales) and the trend of the GDP for the corresponding period.

In Diagram 6, the PoM of Electrical and Electronic Equipment (EEE) per inhabitant in Greece for 2006 – 2017 and the course of real expenditure per capita for the corresponding period is represented. The similarities of both trends are noticeable.

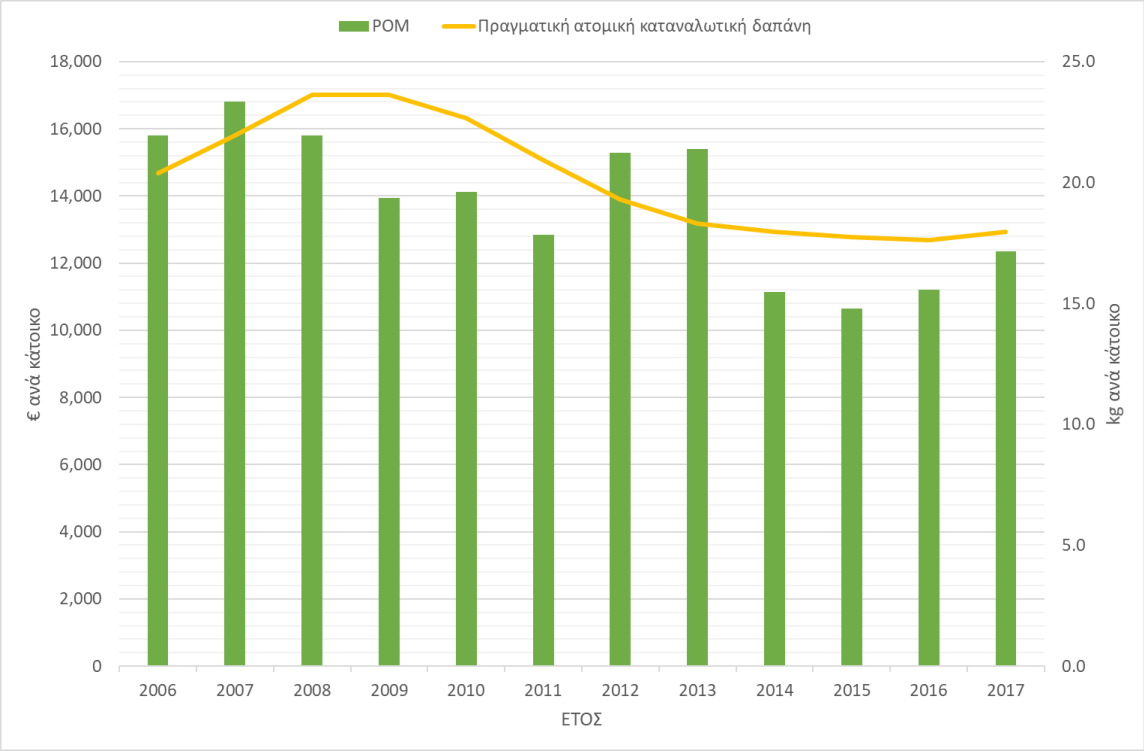


Diagram 6. Electrical and Electronic Equipment PoM per inhabitant during the period 2006 - 2017 (apparent sales) and the rate of change of the real individual spending for the respective period.

During the economic crisis purchasing behaviour in a time of economic crisis is changing radically and of course new consumer values are coming to light. Savingσ, health, value for money (for products considered "value for money"), as well as pleasure, are some of the values that become more important for the consumer in times of crisis. In addition, in societies affected by the economic crisis, conscientious consumption of everyday products is increasingly emerging in contrast to the more relaxed to excessive consumption of the past.

The crisis has caused changes in the lives of citizens and of course in the way they are being entertained. A strong trend that is emerging, due to the financial crisis, is the shift to home entertainment. Groups are concentrated in homes and thus avoid travel expenses or money that would be wasted on entertainment in a store. At the same time, consumers are "investing" in purchases of technology products and electronics (for example, computers) that help them have fun at home and prove to be extremely lucrative long-term markets.

Diagram 7 shows the course of real household expenditure. Also, the estimate for the EEE stock in Greek households for the years 2006 to 2017 is shown. A noticeable correlation is emerging. Moreover, it is evident the fact that the household EEE stock in 2017 is approaching the level of 2010. This drop in the household stock indicates that the life of the EEE has increased either due to repairs and reuse, or due to non-replacement.

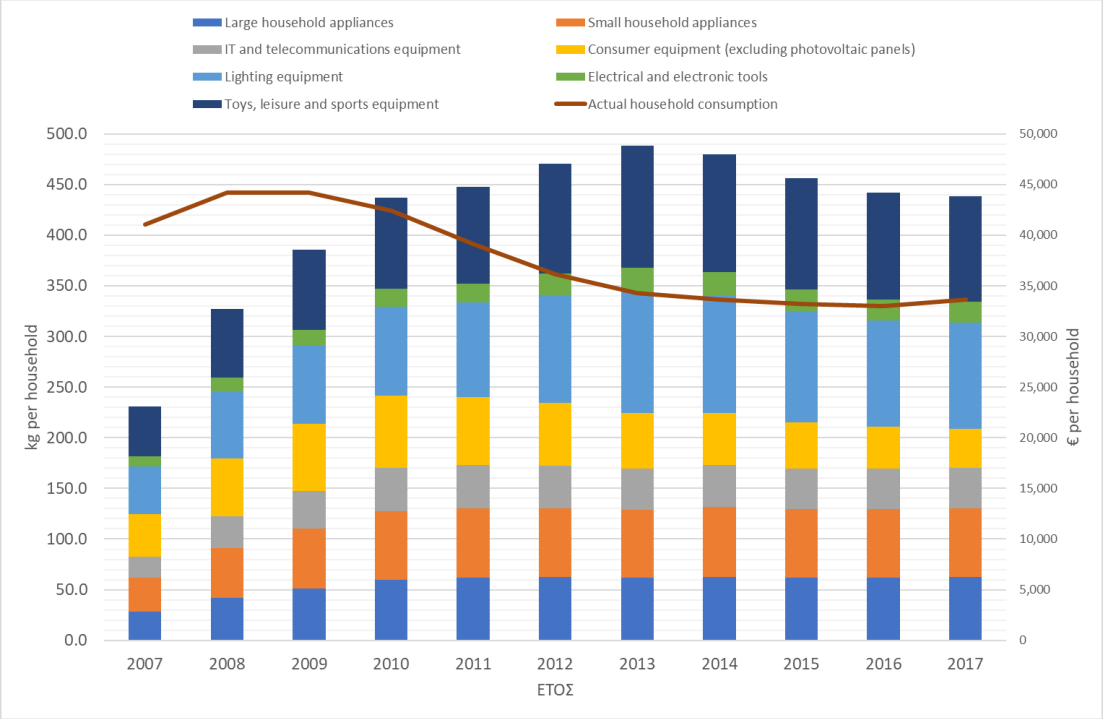


Diagram 7. Stock of electrical and electronic household appliances in Greek households, 2007-2017.

3.4. Quantity, rate of variation and average annual quantities of WEEE/ EEE over the last decade

The increase of EEE received by service shops varies by equipment category. Table 2 shows the average growth rate in each EEE Category. The increase in the rate of change of the quantities of EEE received for repair, is presented without exception in all categories of equipment with a distinct rate of increase. Category 4 (large equipment) which presents the largest increase (16.3%), while Category 6 (small IT and telecommunications equipment) the smallest (0.2%).

Table 2. Rate of change in quantities of EEE

Category of EEE	Increase/ Decrease	Change (%)
1	**Increase**	14.2
2	**Increase**	1.7
4	**Increase**	16.3
5	**Increase**	6.5
6	**Increase**	0.2

Regarding the percentage of EEE repaired relative to the EEE received by micro-enterprises, most respondents say that the overall picture is also increasing over the last decade. Exceptions are Categories 2 (screens and screen surfaces) and 6 (small computing equipment and telecommunications equipment), for which 50% of respondents answered that they show a decrease. Table 3 shows the average percentage change in the quantities of EEE repaired by very small service enterprises, for each EEE category. Increase in the rate of change of repaired EEE quantities is shown in Categories 1 (heat exchange equipment), 4 (large equipment) and 5 (small equipment), by 15%, 11.3% and 6.2% respectively. A decrease is observed in Categories 2 (Monitors and screen equipment) and 6 (small computer and telecommunications equipment).

Table 3. Variation in the rate of EEE repair compared to EEE received by very-small service businesses in the last decade.

Category of EEE	Increase/ Decrease	Change (%)
1	**Increase**	15.0
2	**Decrease**	2.6
4	**Increase**	11.3
5	**Increase**	6.2
6	**Decrease**	7.1

3.5. The repair section

Although the WEEE recycling sector contributes significantly to the recovery of materials and components, and thus to the saving of raw materials, the reuse and repair of EEE, as a measure to prevent waste generation, have multiple environmental, social and economic benefits. The repair sector (shops and service points, merchants, and social enterprises active in preparing for the reuse of the EEE) shoulder the process of extending the life of the EEE, serving businesses and households, and thus contributing to the implementation and establishment of the principles of the Circular. Economy. The majority (87%) of the respondents came from very small enterprises, i.e., enterprises with less than 10 employees (Chart 4). Only 4% of the questionnaires were completed by large repair companies, i.e. companies with more than 250 employees. For all equipment categories, the largest percentage of companies are engaged in EEE repair or EEE repair, while the percentages of companies dealing with WEEE repair range by category at very low levels, from 1% to 3% (Diagram 8).

Diagram ***9*** shows the start-up year of the service enterprises that took part in the survey. For the best presentation of the results, the chronological years were divided into decades. Based on the results from the answers of 97 respondents, there is a gradual increase in the number of such companies with the largest increase being found in the last decade (2011 - 2018), which is also the decade of the economic crisis in Greece.

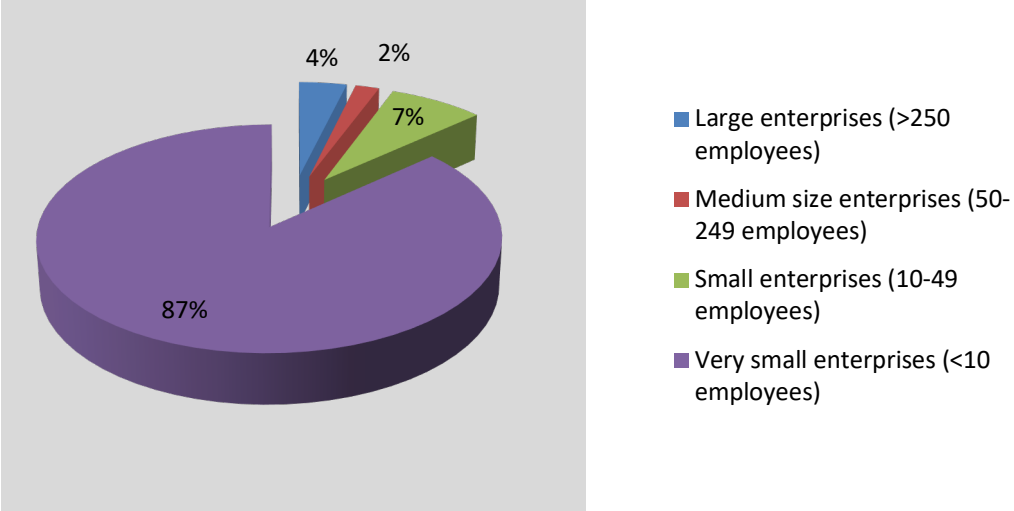
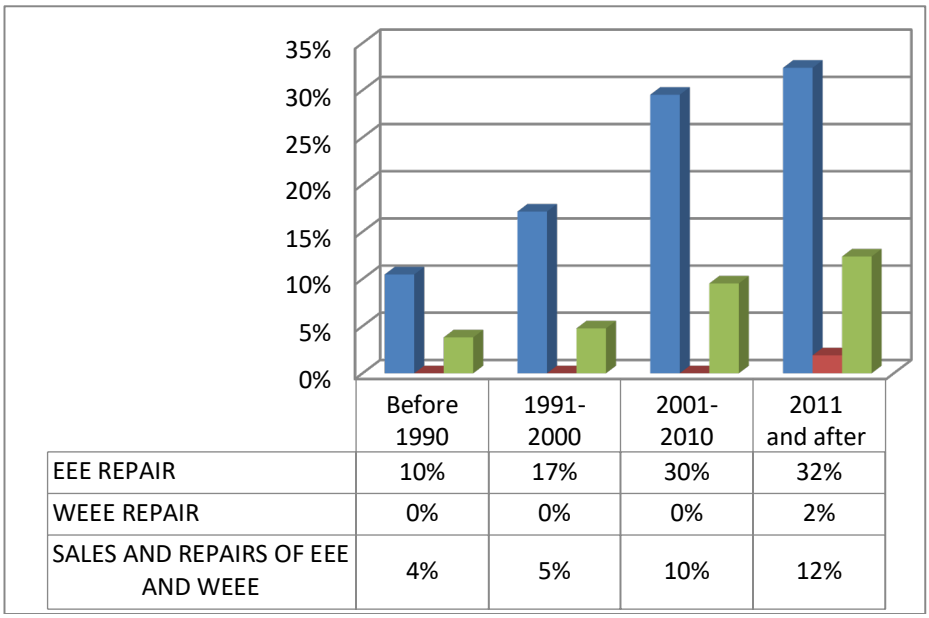


Diagram 8. Categorisation of enterprises according to the number of employees.



	Before 1990	1991-2000	2001-2010	2011 and after
EEE REPAIR	10%	17%	30%	32%
WEEE REPAIR	0%	0%	0%	2%
SALES AND REPAIRS OF EEE AND WEEE	4%	5%	10%	12%

Diagram 9. Time of commencement of activity of service enterprises per decade.

As shown in **Diagram 10**, from the total number of respondents, 52% of them deal with small-sized equipment with external dimensions <50cm, 40% with small-sized IT and telecommunications equipment and 32% with screens and equipment with surface screens>100 cm^2. A smaller part is dealing with the categories of large equipment with external dimensions> 50cm (26%) and heat exchange equipment (22%).

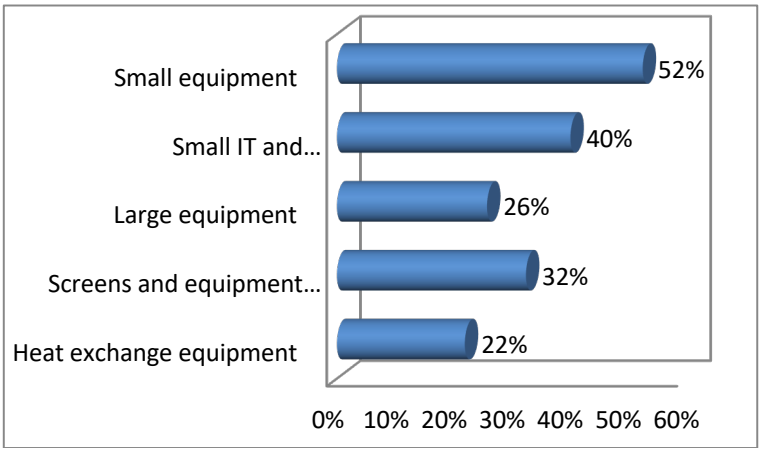


Diagram 10. Activity of repair enterprises in relation to the EEE categories

3.6. Quantity of EEE for repair

In the questionnaire, there was a question regarding the purpose to quantify the status of repairs during the year 2016. More specifically: "what was the proportions of each category of EEE received" (Diagram 11), "how many of these devices were repaired" (Table 4), and "how many of the repairs were performed other than the device warranty" (Table 5). It is noteworthy, however, that only 48 out of 105 respondents (45.7%) provided quantitative data to answer this question.

As shown in Diagram 11, the category of equipment that reaches a larger percentage in stores/ service centers for repair, is the category of small-sized devices and immediately after the category of small-sized IT and telecommunications equipment. Frequent use of such devices in combination with the quality of their construction can often cause unexpected damage to the devices leading consumers to the doorstep of a technician.

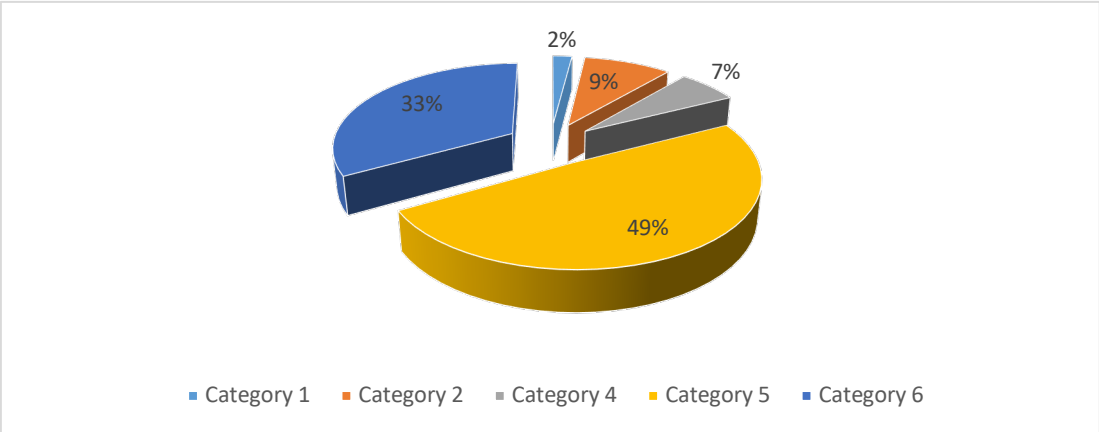


Diagram 11. % EEE for repair for each EEE category

The analysis of the 48 questionnaires that they reported the quantities of EEE received in the shops and repair centers and the quantities of EEE that they were repaired, it appears that the most

successful cases were the equipment categories such as screens and equipment with screens (94%) and small-sized IT and telecommunications equipment (80%), while the smallest percentage of repairs is noted in large-sized equipment (57%).

Table 4. Proportion of quantities of EEE received for repair in relation to the quantities of repaired EEE for each EEE category.

	Category 1	Category 2	Category 4	Category 5	Category 6
Proportion	75%	94%	57%	75%	80%

Products in the large equipment category are expected to be reliable in their use and are usually discarded when they are damaged, as repairing this type of device is difficult or quite expensive in terms of replacement costs and because of this, consumers choose many times replacement versus repair. The EEE that cannot be repaired end up in the special WEEE collection bins at 79% (Diagram 12). However, depending on the policy of each company a percentage of WEEE can be used as a source of spare parts for other devices (56%) or as a source of spare parts sales (19%).

Table 5. Proportion of EEE (for each category) repaired out of warranty.

Category	1	2	4	5	6	Total EEE
Outside warranty	56%	96%	76%	69%	77%	81%

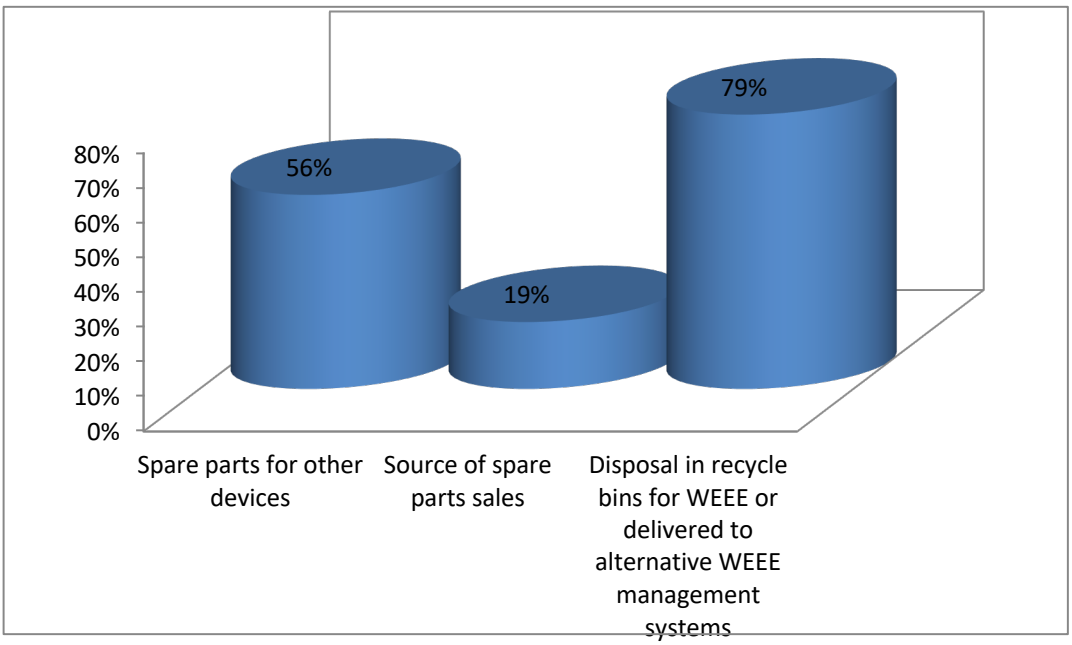


Diagram 12. Management and final disposal of devices that are not repairable, from stores / repair centres.

It is worth noting that several respondents answered that many consumers demand back their electrical and electronic devices even if they are damaged. In this case, there is no information from the participants in the survey about their outcome, i.e., whether the users (consumers) save them or discard them. However, according to independent research, most of the devices end up in some storage space of the owner's house.

4. Conclusions

The recession of the Greek economy in recent years has significantly affected all aspects of life in Greece. One of the impacts is the rapid decline of electrical and electronic devices (EEE) available on the market, with the consequence that it follows the downward trend of Greek economic indicators. As WEEE recycling costs are borne solely by producers based on their actual market share, financing the collection, treatment, recovery, and environmentally sound disposal of WEEE has been a challenge, as many producers struggle to cope with adverse conditions. market, due to the intense competition in this sector.

The recession of recent years and the contraction of household incomes have resulted in the market for electrical and electronic home appliances constantly declining. In 2016/15 it is estimated that this market decreased by 3.1%, while it is expected to fluctuate between stagnation and marginal reduction in 2017.

The availability of "Put on Market" (POM) quantity, as well as the identification of types and routes of disposal are key elements for the calculation of WEEE generation rate and therefore for the rapid implementation of the project. EEE POM data in the European Union (EU) is quite accessible, as EEE producers are required by EU law to declare EEE POM. However, the available databases and/or datasets do not include official routes of WEEE collection and recycling" and they are limited to data from the official WEEE processing infrastructure.

The comparison of Greece's performance in WEEE management with respect to the performance of the selected Member States (Denmark, Ireland, Portugal) and the EU highlights the existence of qualitative differences between them in the way WEEE is managed. More specifically, Greece shows the lowest performance in the total collection of WEEE, about 39%, identical to the EU average. In contrast, Denmark, Ireland, and Portugal approach 50%. However, it is noteworthy that its performance in the WEEE collection has drastically improved from 32.6% in 2014 to 39.2% in 2015.

The analysis of the questionnaires captured in the most embossed way the characteristics of the sample, the activity of the service companies and the opinion of the professionals in the field for the image of the Greek market.

For the preparation for reuse of Category 1 (heat exchange equipment), the lion's share of repairs are held by medium-sized repair shops (ie with up to 250 employees), while for the remaining Categories 2, 4, 5 and 6 (excluding of light bulbs), the very small (micro companies) repair shops (<10 employees) stand out in the field of repairs.

In general, the availability of spare parts in Greece for all categories of electrical and electronic equipment can be characterized as satisfactory. The availability of spare parts is determined by a wide range of different factors, which may be relevant to the manufacturer up to the durability of a product.

The analysis of the results confirms the lack of social economy actors in the field of reuse and preparation for reuse.

In general, no financial facilities have been developed and implemented (for example, in terms of VAT, duties, etc.) to encourage repairs in Greece. Some large companies in the field of retail trade may give a kind of discount to citizens who hand over their old electrical appliance for recycling, however there is no greater mobilization, which provides financial incentives. There are individual initiatives of large EEE chains, which offer social incentives, such as repairing (A) EEE free of charge and donating it to socially vulnerable groups or social organizations.

In terms of consumer attitudes and behaviour, there are indications that the latter are much more receptive than in the past. Typically, in the last decade (2008-2018), when the country is suffering from a deep economic crisis and purchasing power has fallen, the attitude and behaviour of consumers is characterised as more favourable towards repairs of appliances.

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