

The Digital Economy and the Evolution of Waste Electrical and Electronic Equipment in European Union

Nadia Carmen CIOCOIU, Academy of Economic Studies from Bucharest, Romania, nadia.ciocoiu@man.ase.ro

Catalin Razvan DOBREA, Academy of Economic Studies from Bucharest, Romania, rdobrea@yahoo.com

Abstract

The development of the digital economy generates countless effects on society and on the environment. The creation of the new business models via the internet and the large scale employment of the information technology, which guarantees the economic growth in conditions of increased environmental protection, decreasing the consumption of materials in favour of capitalizing information and knowledge. On the other hand, the digital economy generates growth in the number of electric and electronic equipments possessed by the consumers, with a fast rate of moral wear, thus transforming in waste. The management of electrical and electronic equipment waste (WEEE) is a priority for the European countries, due to very recent concerns regarding the implementation of a management system and the alignment to the European Union directives in the field. The paper intends to present the environmental impact of digital economy represented by the increase of the electrical and electronic equipment waste (WEEE) and the evolution of the WEEE situation in the European Union.

1. The relation between the development of the digital economy and the environmental impact

The exponential increase of the mobile communications and of the number of the Internet users, the TIT (telecommunications and information technologies) sector's contribution to the economical growth, the restructuring of the companies and businesses in general in order to benefit from the new technologies and the accelerated development of the e-commerce represent the main elements of the digital economy.

The digital economy, as a result between the interaction of computers, telecommunications, the Internet and the electronics industry, is defined through a series of characteristics totally different from the ones that defined the traditional economy. In the first place, it is about *the creation of a new business model* (e-business, e-commerce, e-banking and so on) through the intra and internet, that change radically its efficiency in the way that the costs are reduced, including those regarding the vending process, on the basis of the relation business/business (B2B), business/costumer (B2C), business/employee (B2E), business/government (B2G) and so on. The development of the digital economy insures the economical growth with a better protection of the environment, accelerating the reduction of the material consume in favour of the valuation of the knowledge and information and shifting the weight between the investments in equipments and the

investments in the human capital.

Alongside these characteristics, the digital economy is responsible for the rapid increase of the number of electrical and electronic equipments (EEE), especially the number of computers and communication equipments used by the individual or company consumers. Thus, between 1975 and 2004, over 1.4 billion computers were sold worldwide and for the period 2006-2010 (a sixth of the other period) the international estimates [2, 3] preview 1.3 billion units to be sold. In 2011 the estimates forsake a sale of 2.9 billion computers for approximate 43% of the total population at that time.

The European Commission on Eco-design of Energy-using Products (EUP) study on computers estimated the sales of computers in the EU25 from 2000 to 2008. These estimates are presented in Table 1, and show that flat panel (LCD) monitors will completely replace cathode ray tube (CRT) displays by 2008, and that the sales of laptop computers increase by 50% between 2005 and 2008.

Table 1: Sales (millions) of computers in the EU25 Member States

Year	Desktops	Laptops	Cathode ray monitors	Fiat panel monitors
2000	24	6	24	0
2001	22	7	20	2
2002	22	8	17	5
2003	24	11	10	15
2004	26	15	6	20
2005	28	20	4	26
2006	28	23	2	32
2007	29	28	0	36
2008	30	31	0	38

Table 2 shows that an estimated total of 266 million items in category 3 - IT and Telecommunications Equipment (excluding fixed telephones and calculators) were placed onto the market in the EU27 Member States in 2005. This represents a weight arising of about 1.1 million tonnes.

The international forecasts show that the digital economy will continue to grow both in dimension and in purpose [8, 10]. The *Time* review called "*the Internet user*" the main figure in 2006, when the number of Internet users in 2007 reached the figure of 1114.3 million (according to the Internet World Statistics) that represents 16.9% of the world population. Regarding the weight of users in the world population, the first place is owned by the Asia with 28.3%, followed by Europe with 28.3% and the USA with

20.9% [1]. But the biggest increase of the user's rate is registered in Africa (638.4% in 2007 against 2000) and the lowest is registered in Europe and USA (115.7% in 2007 against 2000).

Table 2: Estimated weight for category 3 of EEE

	Number of items (million)	Weight ('000 tonnes)
Computers	78	778
Printers and copying equipment	28	264
Fixed telephones	no data	no data
Mobile telephones	160	40
Calculators	no data	no data
Total EU 27	266	1082

In a worldwide ranking system regarding the degree of preparation in 2007 for the informational society, drawn up by The Economist Intelligence Unit, in the White Book called „*The 2007 e-Readiness Ranking*”, Denmark and Sweden occupy the first and second place respectively, with 8.88 and 8.85 marks received. Sweden is battling for the second place with the USA, both having the same marks. In the same ranking system, Romania occupies the 45-th place (the place before last from the 25+2 relevant countries for the EU) with a 5.32 mark, followed by Bulgaria (the 48-th place with a 5.01 mark). In 2004, Romania occupied the 50-th place and in 2005 the 47-th place, Bulgaria, Hungary, The Check Republic being placed in front.

The e-readiness is determined as a mediate sum of the values of a large number of attributes, grouped in classes as the: the technological connectivity and infrastructure; the business environment; the degree in which the TIT is used by the business environment and the consumers; the legislative environment; the cultural and support service environment. This ranking system is changing permanently due to the rapid progress the countries are making in the digital integration field.

From the historical point of view, the most technological innovations brought not only changes on the economical system but also had a strong impact on the environment, both positive and negative. Since 1955, in the paper “Can We Survive Technology”, John von Neumann stated that: *New technologies affect the earth in it's entirety. The more useful a technology is, the more unstablizing its effects can also be.*

The researchers in the whole world ask themselves about the degree in which the TIT can contribute to the environment protection or to its deterioration, but at this time the international scientific community has no clear opinion on the relation between the environment and the development of the digital economy. What is certain is the fact that EEE are increasing in number, have a shorter life and are transformed more rapidly in waste.

2. The evolution of the European situation on Waste electrical and electronic equipment

Electrical and Electronic Equipment is developing fast and spreading over every part of modern life, especially of economy. This equipment includes diverse substances that may cause serious damage to the environment and have adverse effects on human health so it is essential to manage the waste resulting from EEE in a proper way. Waste Electrical and Electronic Equipment (WEEE) has been identified as a priority area to take specific measures on a European scale. The Directive 2002/96/EC on WEEE along with the complementary Directive 2002/95/EC on the restriction of the use of certain hazardous substances in Electrical and Electronic Equipment (EEE) seeks to reduce the environmental impacts of WEEE. The Commission foresees that out a review of the WEEE Directive will be carried out in 2008. The key aims of the WEEE Directive are thus to: reduce WEEE disposal to landfill, provide for a free producer take-back scheme for consumers of end-of-life equipment from 13 August 2005; improve product design with a view to both preventing WEEE and to increasing its recoverability, reusability and/or recyclability; achieve targets for recovery, reuse and recycling of different classes of WEEE; provide for the establishment of collection facilities and separate collection systems of WEEE from private households; provide for the establishment and financing of systems for the recovery and treatment of WEEE, by producers including provisions for placing financial guarantees on new products placed on the market.

The waste of electronic and electric equipments (WEEE, e-waste) represent at this time the waste category with the most rapid rhythm of increase in quantity and one of the greatest challenge of the XXI century. In the developed countries these are equal to 1% of the total solid waste and it is estimated that the number will reach 2% by 2010. The intensification of the rhythm of market penetration by the EEE in the developing countries, the development of the “replacement markets” in the developed countries and the high rate of moral wear makes the WEEE one of the categories of waste with the most rapid evolution in quantity. Thus, in European Union (EU), the quantity of WEEE increases every 5 years by 16-28%.

Table 3 shows the weight of IT equipment placed on the market in each EU27 Member State (excluding Malta and Cyprus) calculated using data on sales provided by European IT Observatory (EITO, 2006) and the typical weights of equipment.

In time, the quantity of WEEE increases but the researches in the field are still in a beginning stage, especially in the developing countries. The presence of valuable recyclable components determines the development of an unorganized and informal sector with risky and unsafe practices that can generate high risks for the population and the environment. As the progress in the Internet and digital economy domains is very different from one country to another, in the WEEE management the situation is very similar.

Table 3: Tonnage arisings in the EU27 for IT equipment [11]

Country	2003	2004	2005	2006	2007
Austria	15,447	16,924	18,384	19,039	19,738
Belgium, Luxembourg	19,487	21,928	24,235	25,693	27,490
Denmark	17,930	19,165	20,978	20,878	19,852
Finland	12,373	13,872	15,661	16,015	16,291
France	119,831	137,949	153,179	161,780	168,048
Germany	193,721	208,072	218,644	223,612	228,264
Greece	8,811	10,024	10,843	11,700	12,591
Ireland	8,729	10,110	11,574	12,424	13,094
Italy	90,074	100,283	108,363	114,503	119,992
Netherlands	36,186	39,593	44,665	47,990	49,681
Portugal	11,931	13,795	15,746	16,832	17,773
Spain	44,762	51,847	55,930	59,447	61,898
Sweden	24,066	24,808	29,644	29,644	29,138
UK	163,741	184,095	197,497	210,389	220,653
EU 15	767,087	852,464	925,342	969,946	1,004,503
Bulgaria	2,946	3,712	5,400	5,202	5,930
Czech Republic	13,321	15,515	17,891	19,423	20,813
Estonia	1,917	2,557	2,944	3,070	3,286
Hungary	10,410	11,990	13,260	14,578	15,894
Latvia	1,937	2,252	2,645	2,893	3,166
Lithuania	2,768	3,428	4,118	4,655	5,017
Poland	34,898	39,693	49,009	55,887	59,276
Romania	8,627	12,198	16,818	18,612	21,470
Slovakia	4,662	6,028	6,478	7,291	8,057
Slovenia	3,502	4,325	4,646	4,949	5,183
EU27 less Malta & Cyprus	852,075	954,163	1,048,551	1,106,504	1,152,594

In Europe, although it is the place in which the Directives on WEEE were implemented (*Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment*), at this time there are no sufficient researches on the impact of the e-waste on the environment and on the development stage of the directive in member states. The WEEE recycling is realized to an insufficient level comparative to the very rapid increase rhythm of the consume (this being a downside of the digital economy development).

The data on amounts of EEE items put onto the market shows that the average across all EU27 Member States is around 21 kg/inhabitant per year. The amounts of WEEE arising are currently estimated to be equivalent to an average across all EU27 Member States of 15

kg/inhabitant per year (see Table 4 for household WEEE). The collection performance of Member States is very different: from 12.20 kg/inhabitant per year in Sweden at 0,33 kg/inhabitant per year in Czech Republic, with an average of 5 kg/inhabitant per year at the European level [9, 11,12].

The studies on waste management points to the poor quality information of statistical data collected at the European Union level on electrical and electronic waste management because of few countries submitting regular, up-to-date information. Although very little information on WEEE treatment capacity in the EU27 Member States can be obtained, it is likely that the EU15 Member States should have installed sufficient capacity to treat WEEE arisings by 2008. The situation in Central and Eastern Europe is likely to be different, and it currently appears

that a regional approach will be adopted. Lithuania is planning to serve the Baltic States needs, and Hungary is expected to provide capacity for its neighbouring countries, which will include Bulgaria and Romania.

Tabel 4: Forecast household WEEE arisings EU27 (tonnes)

Year	2005	2008	2010	2014	2015	2020
Austria	152,504	162,753	169,968	185,373	189,439	211,144
Belgium	186,133	198,966	207,787	226,619	231,588	258,118
Denmark	106,381	113,533	116,567	129,315	132,152	147,295
Finland	91,978	98,162	102,513	111,803	114,254	127,342
France	1,029,451	1,098,682	1,147,396	1,251,389	1,278,826	1,425,299
Germany	1,425,740	1,521,506	1,588,912	1,732,853	1,770,840	1,973,681
Greece	139,966	149,384	156,005	170,133	173,860	193,748
Ireland	95,667	102,099	106,630	116,302	118,854	132,482
Italy	970,612	1,035,929	1,081,881	1,179,962	1,205,835	1,343,936
Luxembourg	14,353	15,320	16,000	17,453	17,836	19,882
Netherlands	282,707	301,711	315,085	343,636	351,172	391,397
Portugal	115,811	123,570	129,033	140,699	143,777	160,213
Spain	624,401	666,546	696,165	759,336	775,99	664,814
Sweden	152,67	162,936	170,159	185,580	189,649	211,37
UK	1,034,090	1,103,586	1,152,500	1,256,937	1,284,494	1,431,625
Cyprus	9,173	10,734	11,920	39,643	15,491	20,131
Czech Republic	111,573	132,851	147,501	161,857	191,635	249,044
Estonia	12,633	15,008	16,661	20,538	23,408	28,120
Hungary	93,916	109,831	121,926	150,293	158,368	205,777
Latvia	17,405	20,347	22,584	27,630	29,323	38,092
Lithuania	26,818	31,355	34,802	42,689	45,191	58,708
Malta	4,566	5,339	5,927	7,308	7,701	10,009
Poland	290,233	339,335	376,652	464,165	489,075	635,319
Slovakia	49,474	57,860	64,233	79,177	83,431	108,403
Slovenia	24,572	28,741	31,910	39,345	41,462	53,890
Bulgaria	40,684	47,540	52,749	64,968	68,446	86,868
Romania	103,928	121,397	134,670	165,403	174,466	226,702
Total WEEE	7,209,939	7,775,019	8,180,137	9,066,264	9,304,995	10,615,411

Source: United Nations University, *2008 Review of Directive 2002/96 on Waste Electrical and Electronic Equipment (WEEE)*, Final report, Contract No: 07010401/2006/442493/ETU/G4, 05 August 2007, p. 67

The environmental benefits and economic costs of recycling WEEE under the European Union legislation depend very much on how the system is implemented. Recycling managed by a monopolist concern, whose main interest is meeting simple recycling targets for a fixed fee, could result in an expensive system with relatively small environmental benefit. A multilateral concern aimed at maximizing profit and reuse across the life cycle presents a more promising picture.

The countries already having WEEE management schemes in place were naturally influential in shaping the Directive and, thus, the adaptation of their national legislation to the Directive is relatively straightforward. The changes needed are generally of a complementary nature and regard issues like individual producer responsibility, labelling of

products, financial guarantees needed in order to place a product on the market and collection and recycling targets.

The situation is very different for other countries, which do not have a WEEE culture. They have faced significantly greater problems in developing the required legal and operational infrastructure. Different systems have been developed, trying to apply more market based approaches with multiple providers of take back services, apart from the collective single compliance scheme models being used in the already existing systems.

Several countries have been late with the transposition of the Directive and many of the countries that did create a timely transposition did so by simply translating the EU Directive, without specifying how the legislation would be applied in

practice. Further secondary regulations and clarifications are thus needed.

The interaction and overlap with other areas of legislation, e.g. hazardous waste regulations, transfrontier shipment regulations, health and safety related marking etc., may have delayed the process of transposition and development of national legislation.

In addition, where countries experience significant cross-border trade and imports, the efforts devoted to coordinate the implementation of the legislation between neighbouring countries and the tendency to resist first-mover disadvantage, have caused further delay.

3. Conclusions

It is obvious the fact that the digital economy has a great potential to positively influence the environment through the 3Ds, respectively *dematerialization* (reducing the material consume through the substitution of atoms with electrons), *decarbonization* (reducing the carbon consume) and *demobilization* (reducing the number of travels due to the communication intensification and to the Internet based businesses). It also can influence the environment negatively by the increase of the EEE number with a very short life term and with a high number of dangerous components for the environment. Any e-waste analysis must take into account the multitude and the interdependency of the action plans and also the impact of the digital economy.

WEEE management become an important subject for the EU member states due to very recent preoccupations for implementing a WEEE administration system and due to the countries alignment to EU terms.

EU states engagement to develop the digital economy generates on one hand, a quantity growth of electronic and electric consumer equipments; on the other hand, they create a series of opportunities for environment protection due to integration of social and environment dimensions to sustain the technology progress, IT applications and communications.

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