Statistics in the national e-scrap arisings and their movement between countries

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Abstract

Used Waste Electrical and Electronic Equipment management is a crucial issue for the goals of Circular Economy strategy, as it is characterized by global interconnections between developed and developing countries. Economic growth; rapid changes in technology; increased development of and access to information and communication technologies (ICT) networks; reduced costs of electrical and electronic appliances; and planned obsolescence, have all resulted in rapidly increasing quantities of e-scrap around the globe.

Numerous studies have been commissioned over the years by academia, NGOs, national and supra-national governmental authorities, as well as others, many attempting to quantify the volume of EEE, UEEE and EoLEEE generated within various geographic borders, as well as the volumes moving across borders. However, due to differing methodologies, assumptions and even definitions of the above-mentioned terms, it has been difficult to compare and, at times, rely on such data.

A thorough desk-study on published technical reports and research papers was carried out on the subjects of: (i) e-scrap arisings; and (ii) transboundary movements of e-scrap. Relevant papers and reports were identified and then analysed, with emphasis on their data sources, methodology, and limitations, in order to evaluate, through expert judgment, the relevance of their data. Published official country statistics were also used, wherever available.

This study also sought to track the movement of e-scrap globally along the following specific paths of: recycling of both UEEE and EoL-EEE; put for repair and refurbishment before reuse; for component salvage; or for material recycling. Trade data on movement of UEEE for Direct Reuse, in other words second hand EEE products, were not distinctly available.

This study provides a solid body of comprehensive data on the quantities of e-scrap worldwide and their expected rise in the next years, along with the best estimates on their registered movements between countries. Data on separate e-scrap collection and recycling are presented, wherever available. Overall, the study highlights the challenges and opportunities related with e-scrap, providing a baseline for the recycling industry and policymakers to plan effective actions to capture the e-scrap potential for contributing to the Circular Economy goals.

Keywords: e-scrap, WEEE, lifespan distribution

Introduction

The environmentally sound and economically viable management of Electrical and Electronic Equipment (EEE) is a critical element of a successful circular economy, with both Used (U) and End-of-Life (EoL) EEE moving within and between countries around the globe. Economic growth; rapid changes in technology; increased development of and access to Information and Communication Technology (ICT) networks; reduced costs of electrical and electronic appliances; the growth of the middle classes in developing countries demanding access to EEE; and planned obsolescence, have all resulted in rapidly increasing quantities of both Used and End-of-Life Electrical and Electronic Equipment generated worldwide.

The study attempts to produce a definitive set of statistics on the national generation of discarded Electrical and Electronic Equipment and their movement between countries, including reuse and recycling data, based on all relevant reported data from published studies and other data sources. It presents the analysis of the most recent available data, along with projections of the generated quantities of discarded EEE in the period 2017-2025, organised across six Geographical regions: (1) African Countries; (2) Asia-Pacific Countries; (3) Eastern European countries; (4) Latin American & Caribbean countries; (5) USA & Canada; and (6) Western European and Others (excluding USA and Canada). The study investigated the quantities of the following WEEE categories:

- large household appliances, i.e. white goods, such as washing machines, dishwashers, dryers, refrigerators, freezers, air-conditioners;
- small household appliances, such as microwaves, vacuum cleaners, irons, toasters, coffee machines;
- ICT equipment, such as PCs, laptops, mobile phones, telephones, fax machines, copiers, printers; and
- consumer electronics, such as television sets, video cameras, VCR/DVD/CD players, Hi-Fi sets, radios.

Methodology

A thorough desk-study on published technical reports and research papers was carried out on the subjects of: (i) e-scrap arisings; and (ii) transboundary movements of e-scrap. Relevant papers and reports were identified and then analysed, with emphasis on their data sources, methodology, and limitations, in order to evaluate, through expert judgment, the relevance of their data. Published official country statistics were also used, wherever available.

While numerous studies were available and reviewed, there was extreme variability in methodologies employed and the scope of data collected. To address the limitations of existing data, an estimation methodology has been applied based on international EEE trade data, to derive e-scrap quantities arising in 2016. In combination with projections about Gross Domestic Product (GDP), e-scrap arisings were estimated until 2025.

A thorough desk-study on published technical reports and research papers was carried out on the subjects of: (i) e-scrap arisings; and (ii) e-scrap and used EEE transboundary movements. Relevant papers and reports were analysed, with emphasis on their data sources, methodology, and limitations, in order to evaluate, through expert judgment, the relevance of their data. Published official country statistics were also used, wherever available (e.g. EUROSTAT, US EPA). The desk study demonstrated that original data reported in the literature are fragmented in time and space, while they cover a very limited number of countries apart from the Member-States of the European Union. Global quantities of discarded EEE seem to be grossly under-reported and underestimated, while data availability is mainly limited to certain regions and countries. Legislative requirements for e-scrap recycling, often through the implementation of Extended Producer Responsibility (EPR) policies, wherever implemented, facilitate monitoring and recording of the quantities and flows of both EEE put-to-the market and e-scrap and therefore allow the development of reliable data series. However, the pace of adopting legislation on e-scrap management worldwide is still slow, while, even in the cases that such legislation exists its enforcement may not be effective. Moreover, there are significant differences in the e-scrap categories covered, among countries that have adopted legislative requirements. There is a critical need for actual, reliable, comparable, and up to date data on discarded EEE, to effectively manage e-scrap, minimising potential risks and consumption of raw materials, and maximising recovered values and jobs creation.

To address the limitations of existing data, an estimation methodology has been applied based on international EEE trade data, to derive e-scrap quantities produced in 2016. In combination with projections about Gross Domestic Product (GDP) growth, e-scrap quantity was estimated till 2025. In 2016, the world production of e-scrap amounted to 41.2 million metric tonnes (Mt), comprising of: 25.4 Mt large household appliances (washing machines, dishwashers, dryers, refrigerators, freezers, air-conditioners etc.); 4.9 Mt small household appliances (microwaves, vacuum cleaners, irons, toasters etc.); 6.7 Mt ICT equipment (PCs, laptops, mobile phones, telephones etc.); and 4.2 Mt consumer electronics (television sets, video cameras, etc.). This corresponds to 5.6 kilogram per inhabitant (kg/inh), although this average value hides a vast geographic variation, from 1.5 kg/inh in Africa to 21.9 kg/inh in USA & Canada.

Results and Discussion

In 2016, e-scrap generated in the world amounted to 41.2 million metric tonnes (Mt), comprising of: 25.4 Mt large household appliances (washing machines, dishwashers, dryers, refrigerators, freezers, air-conditioners etc.); 4.9 Mt small household appliances (microwaves, vacuum cleaners, irons, toasters etc.); 6.7 Mt ICT equipment (PCs, laptops, mobile phones, telephones etc.); and 4.2 Mt consumer electronics (television sets, video cameras, etc.). This corresponds to 5.6 kilogram per inhabitant (kg/inh), although this average value hides a vast geographic variation, from 1.5 kg/inh in Africa to 21.9 kg/inh in USA & Canada.

Table 1. Total and per inhabitant quantity of e-scrap generated in the six geographical regions.

	E-SCRAP GENERATED (kt)		POPULATION (×1000)		E-SCRAP GENERATED (kg/inh)	
	2016	**2025**	**2016**	**2025**	**2016**	**2025**
AFRICA	1,825	2,635	1,196,824	1,480,630	1.5	1.8
ASIA-PACIFIC	15,914	23,709	4,402,260	4,736,314	3.6	5.0
EASTERN EUROPE	2,841	3,400	292,471	284,929	9.7	11.9
LATIN AMERICA & CARIBBEAN	3,741	4,639	622,911	677,375	6.0	6.8
USA & CANADA	7,877	9,246	360,405	384,150	21.9	24.1
WESTERN EUROPE AND OTHERS (EXCEPT USA & CANADA)	8,990	10,249	445,867	452,630	20.2	22.6
WORLD	41,186	53,878	7,320,739	8,016,029	5.6	6.7

The amount of e-scrap is expected to grow to 53.9 Mt in 2025, with an annual growth rate of around 3.0 per cent, resulting in a more than 30% increase in less than a decade. Taking into account the projected population growth, a 20% increase in the e-scrap generation per capita is expected in the same period, resulting to 6.7 kg/inh in 2025.

The United States is the world leader in e-scrap generation, at about 7.3 Mt in 2016. In the same year, China generated about 5.9 Mt, second only to the United States. USA and Canada, together with the Western European countries, have the highest per inhabitant generation of e-scrap, 21.9 and 20.2 kg/inh respectively in 2016. However, the Asia-Pacific region, with low to moderate per inhabitant generation (3.6 kg/inh), is the highest e-scrap generator in terms of absolute quantity, with about 15.9 Mt in 2016 (almost 40% of the World's e-scrap generation).

The scarce available data indicate that trade of discarded EEE has grown not only from the developed to the developing countries, but also within developing countries [1-3]. China has implemented extensive regulations during the period 2001-2008, including a prohibition on the import of e-scrap, resulting in decreased flows of e-scrap into the country. In addition, the rapid growth of electronics use in developing countries is expected to favour the domestic supply of e-scrap over imports from developed countries. However, available statistics and studies cannot provide reliable information on the transboundary movements of e-scrap.

Thε study provides a solid body of comprehensive data on the quantities of e-scrap worldwide and their expected rise in the next years, along with the best available estimates on their registered movements between countries. Data on separate e-scrap collection and recycling are presented, wherever available. Overall, the study highlights the challenges and opportunities related with e-scrap, providing a baseline for the recycling industry and policymakers to plan effective actions to capture the e-scrap potential for contributing to the Circular Economy goals.

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