Perspectives of the circular economy in the production and consumption of electrical and electronic equipment

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The transition to a more circular economy is making progress in most areas, although the pace of change differs significantly from sector to sector. In this context, electrical and electronic equipment for household and personal use (classified and listed in Annexes III and IV to Directive (EU) 2012/19) makes a discordant note.

The circularity of technical products implies the extension of the duration of use, the shared use, the facilitation of repair and upgrading, redistribution, refurbishment, specialized collection, and recycling. If at present the emphasis is on proper waste management, for the future, there will be a focus on incorporating circularity into the conception and design of products.

In relation to the stated desiderata, contradictory evolutions are observed. Factors in favor of maintaining the traditional linear model may continue to prevail. The replacement of electrical and electronic equipment is done at shorter and shorter intervals, with few exceptions, the upgrade of products is not possible, and repair is discouraged, the delivery of obsolete appliances to specialized operators is hit by a number of barriers.

Among the possible causes of the delay in adopting the circular model, analysts highlight the legitimate interest of manufacturers to gain competitive advantage by accelerating innovation, promoting newer generation products, and stimulating the demand for renewal, as well as the legitimate desire of consumers to equip themselves with equipment featuring state-of-the-art technology, which provide enhanced functionality and improved comfort. At the same time, equipment maintenance, redistribution, and recycling are, in many cases, inefficient due to high costs. On the other hand, more unjustifiable practices are also mentioned, such as product planned obsolescence, aggressive promotion of novel products with insignificant improvements, and loosely applied hesitant public policies.

Against this background, the perspectives for the circular economy in the production and consumption of electrical and electronic equipment are still unclear. Economic and business research needs to contribute to a deeper understanding of current mechanisms and drivers of future trends, identification of new opportunities, more systematic documentation of successes and failures, increased exchange of knowledge, and strengthening stakeholder participation in the development and implementation of sustainable practical solutions.

In view of all this, *Amfiteatru Economic* journal invites researchers and specialists with preoccupations in the field to propose for publication in issue 62 of the journal original empirical research papers on the state and prospects of the circular economy in the production and consumption of electrical and electronic equipment.

An important issue from a circular economy perspective in the production and consumption of electrical and electronic equipment is consumer behaviour. In this regard, two articles are highlighted (i) ***"The electrical and electronic products consumers' sustainable behaviour in the context of consolidating their fundamental rights"***, whose purpose is to identify and establish the impact of some factors that may influence the behaviour of Romanian consumers in the process of purchasing electrical and electronic products, their environmental behaviour and their intention to recycle old products. In view of these aspects, the paper brings to the fore two determining factors in the field of consumer protection, which may influence their inclination towards the purchase of sustainable and environmentally friendly electrical and electronic goods, namely: the degree of awareness of consumers of their rights and the measures taken by the authorities in this field to strengthen their fundamental rights through the legislative system, and not only. (ii) ***"Integration of circular economy principles in consumer behaviour for electrical and electronic equipment"*** aims to identify consumer behaviour regarding the purchase, use, and disposal of this type of equipment in the context of the transition to a circular economy. The research results show the existence of a rather rational consumer profile in relation to this type of products and whose involvement in repair, recycling, or reuse actions is different depending on the category of equipment, while also observing a relatively low willingness of Romanian consumers to purchase second-hand electrical and electronic products. The article proves its usefulness by proposing a set of measures to improve the circularity of electrical and electronic products, in which both producers and consumers actively participate.

"Bibliometric analysis of electrical and electronic equipment production and consumption in the context of the circular economy" aims to highlight the most relevant elements arising at the intersection of the concepts of circular economy and electrical and electronic equipment, as reflected in the main stream of scientific publications to date. This approach was made possible through the use of a bibliometric study, based on the use of specialised software (VOSViewer and Citespace), which allowed the identification of both current trends and possible new perspectives and research directions that could contribute to the promotion of circularity in the production and consumption of electrical and electronic equipment. The main results obtained relate to the existence of four clusters covering waste management of electrical and electronic products, circular economy, material recycling, and environmental management, respectively.

The article ***"Circular economy practices in the electrical and electronic equipment sector in the European Union"*** discusses specific circular economy practices implemented by manufacturers in the household appliances sector. The study provides an overview of the solutions adopted by appliance companies to respond to market challenges and opportunities. Among the factors influencing resource efficiency according to the Extended Product Value (EPV) business model, the most frequently considered by the companies analysed are: energy consumption during use, transport, repair, and refurbishment. Using the VEP conceptual model, the present research highlights the intentions and progress made by appliance companies to move toward the circular business model.

The wide use of electrical and electronic equipment in companies and households, as well as its frequent replacement due to physical or moral depreciation, have caused an extremely rapid rise in electrical and electronic waste, compared to other types of waste.

Consequently, the interest in the efficient management of collecting such waste and in closing the circular flux by reusing it as a new resource has increased. This waste consists of a complex mixture of materials, including dangerous ones, which require specific management in order to avoid major environmental and health damage. Hence, a large number of researchers have focused on the matter of electric and electronic waste. The current issue of the journal includes six papers that approach this type of waste from various angles: (i) ***„Collection of waste electrical and electronic equipment at the European level"*** aims to identify the main factors that influence the electric and electronic waste collection and further to substantiate economic policies able to improve the collection rate; (ii) ***„Performance of EU countries in managing electrical and electronic equipment waste in the context of the circular economy"*** examines the management of electrical and electronic equipment waste in the 27 Member States of the European Union and highlights the changes observed in the countries analysed between 2015 and 2020 (before and after the current energy crisis). Based on a Hierarchical Cluster Analysis, the states are grouped in four clusters for two different periods, with the following determinants: the electronic waste amount generated per capita, the amount of electrical and electronic equipment sold on the market per capita, the recycled electrical and electronic waste that is ready for reuse and the rate of circularity; (iii) ***"Investigating determining factors affecting the waste collection rate from electrical and electronic equipment"*** measures the factors leading to an increase in the collection rate of waste from electrical and electronic equipment in the EU 27 countries, from 2009 to 2020. The results show that a better quality of the road infrastructure, as well as a more intensive online campaign, can bring about an obvious improvement in the amount of used electrical and electronic equipment collected, while variables like the GDP per capita, private consumption, government effectiveness and research and development expenses have asymmetrical effects on the collection rate, but can lead to the improvement of this activity under certain circumstances; (iv) ***"E-Waste and responsible consumption in EU countries - developments and forecasts 2025-2030"*** shows the extent to which the EU countries reached their assumed targets concerning the management of waste from electrical and electronic equipment, as well as the pace of adapting to the increasingly stricter European requirements for the transition to a low carbon economy, based on circularity principles. The analysis is based on five relevant indicators: the amount of electrical and electronic equipment introduced on the market, the collected waste amount, the amount of waste treated in authorized facilities, the reused and recycled waste amount, and the recycle rate of waste from electrical and electronic equipment. The results can be highly relevant for the management of companies in this field, and can further provide a solid base for establishing public policies, or specific initiatives that more efficiently support the promotion of responsible consumption of electrical and electronic equipment, especially in countries where less positive trends are forecasted; (v) ***"Antecedents of consumer intentions towards E-Waste recycling. A perspective on the toy industry from Romania"*** points to the fact that, although Romania has made significant progress in collecting, recycling, and recovering large waste, less attention has been paid to recycling smaller electrical waste, such as electrical toys. Hence, the authors point to the importance of examining the behaviour of parents in respect of recycling electrical toys, in the context of the circular economy. More precisely, the aim of this study is to identify the antecedents that can influence consumer intentions to recycle electrical toys. The research results provide important information for implementing good practices of circular economy, by means of educating the population and raising awareness through social marketing campaigns; (vi) ***"The impact of globalization on the rate of E-Waste recycling: evidence from European Countries"*** emphasizes that recycling and the

better collection of electronic waste are two most important strategies to implement both the circular economy, and the reduce – reuse – recycle paradigm, pursued by the European Union and the United Nations Development Programme. In this line, the factors that affect recycling should be identified, and their influence should be measured. The study examines the effects of globalization and of its three sub-dimensions (economic, political and social) on the recycle rate of electronic devices for the period 2008 – 2018. The results show that globalization has a positive impact on the recycling rate of electronic waste and contributes to the development of a circular economy.

The study on ***"Examining circular economy practices and sustainability performance in knowledge-based companies in Iran"*** is based on a survey of a sample of 384 managers and experts from knowledge-based companies in the field of electronics and electrical equipment manufacturing in Iran. The results show that technology adoption, zero-waste practices, and green economic incentives have a positive and significant effect on circular economy practices. The results also show that circular economy practices have a positive and significant effect on the sustainable performance of electrical and electronics companies.

The article ***"Circular behaviours of Polish consumers in relation to electrical and electronic products"*** presents the concept of circular behaviour in relation to electrical and electronic products as part of the implementation of the circular economy in everyday household life. The aim of this article is to analyse the relationship between the adoption of certain behaviours in relation to these types of products and their effects in the form of perceived household benefits.

The circular economy is an extremely important topic because it is an efficient solution to manage collecting and re-use of all types of waste. In the field of electrical and electronic equipment, the issue of its circularity has become one of the priorities of the European Union economy and of the world. Electronic devices and electrical equipment define modern life: from washing machines and vacuum cleaners to smartphones and computers, it is hard to imagine life without them, but the waste they generate is the fastest growing in the EU and only 40% of it is recycled, and some of it contains potentially harmful materials that pollute the environment and increase health risks. As a result, they have become an obstacle to the EU's efforts to reduce its environmental footprint.

In March 2020, the European Commission presented an action plan for the circular economy that aims to make product design more sustainable, reduce waste, and give citizens new rights, such as the right to repair. The plan pays particular attention to the electrical and electronic equipment sector.

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