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WEEE (Waste electrical and electronic equipment): a major sustainability challenge

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Abstract

Waste electrical and electronic equipment (WEEE), or e-waste, faces significant sustainability challenges. Characterised by high economic elasticity, i.e. a close correlation between WEEE generation and Gross Domestic Product (GDP), WEEE is one of the fastest growing waste streams worldwide. Hazardous components require attention, while at the same time the potential to implement circular economy schemes with recuperation of valuable components is particularly high for e-waste. An overview on key aspects related to sound management of e-waste is provided in the following.

1. Introduction

Waste electrical and electronic equipment (WEEE), or e-waste, refers to any electrical and electronic equipment (EEE) which the owner intends to discard because it does no longer satisfy for its purpose; WEEE therefore comprises any appliance using an electric power supply and which has reached its end of life [1]. This includes a wide variety of appliances such as equipment of daily use (e.g. phones, computers, refrigerators), but also lighting, medical devices and others. The EU WEEE Directive classifies WEEE into 10 categories [2], but alternative classifications have also been proposed to identify appropriate management schemes for different types of materials [3].

2. Key Sustainability Challenges

WEEE is one of the fastest growing waste streams worldwide and in 2016 amounted to 44.7 million metric tons per year [4]. There is a very close connection between e-waste generation and economic development: WEEE occurrence and GDP (gross domestic product) of a country are closely interlinked, reflecting high economic elasticity of WEEE [5]. Assessing WEEE and GDP data of 50 countries of the pan-European region revealed a linear dependency between WEEE generation and GDP PPP (GDP at purchasing power parity) [5], meaning that a doubling of GDP PPP is associated with a doubling of WEEE generation. This suggests that future economic growth will be accompanied by growing quantities of e-waste. The UN 2030 Agenda for Sustainable Development with the integrated Sustainable Development Goals (SDGs) make a commitment to fostering both economic growth and sustainable management of resources. In this context, the economic elasticity of e-waste and unresolved challenges to sustainably manage WEEE are issues of concern.

E-waste contains hazardous components such as mercury, arsenic, other heavy metals (e.g. lead, cadmium), flame retardants, various chlorinated and other chemical; therefore, responsible collection and treatment of WEEE is vital to reduce environmental harm and adverse health impacts [6-8]. The large quantities of WEEE transboundary movements under complex frameworks, involving both legal and illegal activities, require specific attention [9,10], especially because of significant flows directed from high-income countries to low- or middle-income countries, where often low-standard WEEE processing methods are used [8].

E-waste also contains precious components, such as gold, silver and critical raw materials, i.e. materials that are of vital importance for future prosperity of modern economies; examples of critical raw materials in WEEE are rare earth elements, indium and gallium [11,12]. The potential economic value of recovering secondary raw materials from global e-waste occurrence in 2016 was estimated at approximately 55 thousand million Euros (or 55 billion EUR), which is more than the 2016 GDP of most countries in the world [4]; this figure already considers that the economic value of secondary resources is only a fraction of the value of components in products. However, WEEE recycling is a complex challenge that requires major efforts to implement effective managerial frameworks and advanced technical infrastructures [13-15].

In 2016, only around 20% of global e-waste generated was documented to be collected and properly recycled, while around 4% was thrown into residual waste bins in high-income countries and the fate of the remaining 76% is largely unknown [4]. Especially small WEEE equipment are often thrown into residual waste bins even if appropriate separate collection schemes exist. Encouraging pro-circular economy behaviour of end-consumers is one element to establish sound e-waste management [16], but more effective policies are required at all levels of the e-waste management chain [4].

3. Conclusions

Sustainable management of e-waste requires and merits more efforts. The growing quantities of WEEE, the lack of reliable data about e-waste flows and the potential adverse impacts on environmental and human health are issues of high concern. At the same time, the potential value of circular economy schemes is huge, although high-value recycling schemes remain difficult to implement.

Note: This presentation partially draws from an earlier journal publication exploring economic elasticity of e-waste generation (Kusch, S.; Hills, C.D. The Link between e-Waste and GDP—New Insights from Data from the Pan-European Region. Resources 2017, 6, 15.). The publication can be found here:

https://www.mdpi.com/2079-9276/6/2/15

References

[1] Organization for Economic Co-operation and Development (OECD). Extended producer responsibility: A guidance manual for governments. OECD Publishing, Environment and Sustainable Development 5, Paris, 2001.

[2] Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE).

[3] Baldé, C.P.; Kuehr, R.; Blumenthal, K.; Gill, S.F., Huisman, J.; Kern, M.; Micheli, P.; Magpantay, E. E-waste statistics: Guidelines on classifications, reporting and indicators. Bonn, Germany, United Nations University, IAS – SCYCLE, 2015.

[4] Baldé, C.P.; Forti V.; Gray, V.; Kuehr, R.; Stegmann,P. The Global E-waste Monitor – 2017, United Nations University (UNU), International Telecommunication Union (ITU) & International Solid Waste Association (ISWA), Bonn/Geneva/Vienna, 2017.

[5] Kusch, S.; Hills, C.D. The Link between e-Waste and GDP—New Insights from Data from the Pan-European Region. Resources 2017, 6, 15.

[6] Baxter, J.; Lyng, K.-A.; Askham, C.; Hanssen, O.J. High-quality collection and disposal of WEEE: Environmental impacts and resultant issues. Waste Management 2016, 57, 17–26.

[7] UNEP; UNECE. GEO-6 Assessment for the pan-European Region. United Nations Environment Programme and United Nations Economic Commission for Europe, Nairobi, Kenya, 2016.

[8] Lundgren, K. The Global Impact of e-Waste: Addressing the Challenge. International Labour Organization, Geneva, Switzerland, 2012.

[9] Lepawsky, J. The changing geography of global trade in electronic discards: Time to rethink the e-waste problem. Geogr. J. 2015, 181, 147–159.

[10] Rucevska, I.; Nellemann, C.; Isarin, N.; Yang, W.; Liu, N.; Yu, K.; Sandnæs, S.; Olley, K.; McCann, H.; Devia, L; et al. Waste Crime—Waste Risks: Gaps in Meeting the Global Waste Challenge; GRID-Arendal and UNEP: Arendal, Norway. 2015.

[11] Ylä-Mella, J.; Pongrácz, E. Drivers and constraints of critical materials recycling: The case of indium. Resources 2016, 5, 34.

[12] Bakas, I.; Fischer, C.; Hardi, A.; Haselsteiner, S.; McKinnon, D.; Kosmol, J.; Milios, L.; Plepys, A.; Tojo, N.; Wilts, H.; et al. Present and Potential Future Recycling of Critical Metals in WEEE; Copenhagen Resource Institute, Copenhagen, Denmark, 2014.

[13] Kumar, A.; Holuszko, M. Electronic waste and existing processing routes: A Canadian perspective. Resources 2016, 5, 35.

[14] Alsheyab, M.; Kusch, S. Decoupling resources use from economic growth—Chances and challenges of recycling electronic communication devices. J. Econ. Bus. Financ. 2013, 1, 99–107.

[15] Li, J.; Liu, L.; Zhao, N.; Yu, K.; Zheng, L. Regional or global WEEE recycling. Where to go? Waste Manag. 2013, 33, 923–934.

[16] Shevchenko, T.; Laitala, K.; Danko, Y. Understanding Consumer E-Waste Recycling Behavior: Introducing a New Economic Incentive to Increase the Collection Rates. Sustainability 2019, 11, 2656.