REVIEW ARTICLE

Access to Justice in Eastern Europe
ISSN 2663-0575 (Print)
ISSN 2663-0583 (Online)
Journal homepage http://ajee-journal.com

Review Article

E-WASTE MANAGEMENT SYSTEM IN UKRAINE: LEGAL FRAMEWORK AND SWOT-ANALYSIS

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ABSTRACT

Background: *Waste management has been the subject of interest for both Ukrainian and foreign scientists. While Ukrainian researchers have studied waste management and focused on the viability of waste incineration for economic and environmental protection, foreign scientists have directed their attention towards examining the environmental impact of electronic devices. By analysing complex issues related to social-ecological systems, these foreign scientists have studied e-waste management (EWM) approaches to guarantee environmental sustainability and raise public knowledge of EWM. This comparative scrutiny has revealed a research gap, prompting the need to investigate the current state of the e-waste management system (EWMS) in Ukraine to determine the directions for improving EWM.*

Methods: *To meet the objectives outlined in this paper, various scientific and specialised methods were employed. The structural-functional method was used to consider stakeholders' interests and level of influence in the EWMS by dividing them into four groups. A SWOT analysis was performed to determine the EWMS's opportunities, threats, weaknesses, and strengths. The comparison method was used when Ukraine's regulatory framework in the EWMS was approximated and compared with EU legal actions.*

Results and Conclusions: *The study examined stakeholders' interests and level of influence over EWMS, categorising them into four categories: KEEP INFORMED (mass media), MANAGE CLOSELY (the Ukrainian Cabinet of Ministers, various ministries, and state organisations in Ukraine), KEEP SATISFIED (the President of Ukraine and Verkhovna Rada of Ukraine), and KEEP INFORMED + TWO-WAY COMMUNICATION (international organisations, non-governmental and public organisations, activists, and environmental organisations). A SWOT analysis revealed the EWM system's advantages, disadvantages, opportunities, and threats. Taking these factors into account will advance the deployment of EWMS in Ukraine and provide insight into the issues impeding its advancement.*

Access to Justice in Eastern Europe
ISSN 2663-0575 (Print) ISSN 2663-0583 (Online)
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Our analysis of Ukraine's EWM regulatory framework and its adherence to EU law enabled us to conclude that, to effectively manage all waste streams, including e-waste flows, national sectoral laws and regulations that consider international standards and progressive foreign experience should be adopted as the next step in reforming the waste management sector.

1 INTRODUCTION

In modern society, electrical and electronic equipment (EEE) permeates every aspect of daily life. Society's increasing informatisation accelerates equipment obsolescence, prompting enterprises to increase production volumes of constantly updated products. However, the quality of these new products is diminishing, resulting in decreased reliability and shortened service life. Repairing such products often proves impossible or extremely expensive compared to purchasing new equipment. Consequently, this leads to an increase in the consumption of EEE and, consequently, the generation of e-waste. Alarmingly, e-waste accumulates three times faster than other waste.[1]

Global statistics paint a concerning picture: in 2016, 44.7 million tons of e-waste[2] were generated worldwide, in 2019 - 53.6,[3] in 2021 - 57,[4] and in 2023 - 61 million tons.[5] According to forecasts, in 2030, their volume will be 74.7 million tons[6]; that is, it will increase by 22.5% compared to 2023 (over seven years). According to the Global Monitoring of Electronic Waste,[7] 324,000 tons of e-waste were generated in Ukraine in 2019, averaging 7.7 kg per person. However, calculations by the NGO Let's Do It GREEN Ukraine suggest a higher figure of 28.5 kg per person annually in Ukraine.[8]

1 Marija Pazynich, 'E-Waste: Market Analysis and Disposal Issues' (*Ukrainian Society for Nature Conservation*, August 2013) <http://www.ukrpryroda.org/2013/08/blog-post_10.html> accessed 19 September 2023.

2 PACE, *A New Circular Vision for Electronics: Time for a Global Reboot* (World Economic Forum 2019) <https://www.weforum.org/publications/a-new-circular-vision-for-electronics-time-for-a-global-reboot> accessed 19 September 2023.

3 Vanessa Forti and other, *The Global E-Waste Monitor 2020: Quantities, Flows, and the Circular Economy Potential* (UNU/UNITAR, ITU 2020) <https://collections.unu.edu/view/UNU:7737#viewAttachments> accessed 29 October 2023.

4 'We Dispose of Old Equipment Correctly: Where to Donate Power Banks, Smartphones and other Devices' (*We are Ukraine*, 22 September 2023) <https://weukraine.tv/top/utylizovuyemo-staru-tehniku-pravylno-kudy-zdavaty-poverbanky-smartfony-ta-inshi-prylady/> accessed 29 October 2023.

5 Gavin Miller, 'E-Waste Day 2023: Is it time to dial back on how we treat our tech?' (*Sustainable Future News*, 11 October 2023) <https://sustainablefuturenews.com/features/e-waste-is-it-time-to-dial-back-on-how-we-treat-our-tech/#_ftn2> accessed 29 October 2023.

6 Forti and other (n 3).

7 ibid (n 3).

8 'Culture of E-Waste Management in Ukraine: Launch of the first E-Waste Ukraine in Ukraine' (*Ukrinform*, 3 December 2020) <https://www.ukrinform.ua/rubric-culture/3148300-v-ukraini-startuvav-ekoproekt-zi-zboru-elektronnogo-smitta.html> accessed 29 October 2023.

In general, data on the volume of e-waste generation in Ukraine can be obtained based on EEE sales. Despite challenges such as the reduction in electronics sales due to wartime conditions in 2022 (3.3 million smartphones and 657,000 mobile push-button phones were sold, 32% and 42% less than in 2021, respectively),[9] there has been a demand for EEE, such as batteries, chargers and starting chargers, etc.[10] These data give grounds to assert that, despite the hostilities in Ukraine, the volume of e-waste formation shows growing trends.

Household and office EEE contain a large number of hazardous compounds and substances, the release of which into water and soil, causing colossal damage to the environment and, as a consequence, to human health. Although e-waste represents a relatively small portion of municipal solid waste (estimated at 6.8%, according to the RPE "Ecological Laboratory"[11] and 2%, according to the PACE report),[12] its level of danger to nature and human health is colossal. Thus, the RPE "Ecological Laboratory" determines that e-waste in landfills provides 40% of the heavy metals entering water and soil. Meanwhile, the PACE report[13] suggests that it could account for up to 70% of hazardous waste in landfills.

At the same time, e-waste also contains useful, expensive elements (gold, silver, platinum, copper, iron, aluminium) that can be reused. After all, their primary extraction is a costly process. Thus, modern human management requires both measures to reduce the rate of generation of this type of waste and proper handling (reuse, recycling, recovery and disposal). This will not only be a significant contribution to the preservation of the ecosystem and human health but also to the development of the economy.

Specialised enterprises have the capacity to reuse up to 80% of e-waste components, significantly contributing to resource conservation and recycling efforts. The annual cost of e-waste in the world in 2019 amounted to $62,5 billion, surpassing most countries' GDP. However, despite the economic potential, the PACE report[14] indicates that only 20% of all e-waste is collected and recycled globally, and in Ukraine, according to the Global Monitoring of Electronic Waste,[15] the recycling rate was 12,3% of the total amount of generated e-waste in 2019.

9 Oleksandr Sharipov, 'During the Great War, the Smartphone Market Fell by a Third, and Push-Button Mobile Phones – by more than 42%' (*Forbes*, 8 February 2023) <https://forbes.ua/news/rinok-smartfoniv-pid-chas-velikoi-viyni-vpav-na-tretinu-knopkovikh-mobilnikh-na-ponad-42-08022023-11592> accessed 29 October 2023.

10 '"Epicenter" has Sold almost 30 thousand Generators Since the Start of the Shelling of Energy Infrastructure' (*Interfax-Ukraine*, 22 March 2023) <https://interfax.com.ua/news/economic/899194.html> accessed 15 November 2023.

11 Culture of E-Waste Management in Ukraine (n 8).

12 PACE (n 2).

13 ibid (n 2)

14 ibid.

15 Forti and other (n 3).

Access to Justice in Eastern Europe
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Taking into account the indicated threats to environmental safety and, as a consequence, to economic security, the purpose of this article is to study the practical aspects of e-waste handling in the context of EWM and provide recommendations for its improvement, which is a prerequisite for improving the environment, social standard of living and ensuring environmental safety.

Recent examination of current research and publications underscores the pressing need to address Russia's armed aggression and safeguard Ukraine alongside ongoing environmental concerns. Despite the turmoil, environmental issues and environmental protection remain important. Every day, experts record environmental damage, which, as of January 2024, is estimated at more than $56 billion (excluding mined and occupied territories of Ukraine)[16] and is growing daily.

Ukrainian scientists such as O. Skoryk,[17] A. Voitsikhovskaya, O. Kravchenko, O. Melen-Zabramna, and M. Pankevich[18] have made notable contributions to the discourse on waste management. They have considered the best European practices for preventing waste generation, reuse and recycling, focusing on the feasibility of both economic and environmental protection of waste incineration.

Additionally, scientists like I. Krajnov, V. Krylyuk, E. Shago, and V. Bakharev have focused on environmental safety management in the field of e-waste.[19] Meanwhile, foreign scientists, such as Samuel Abalansa, Badr El Mahrad, John Icely, and Alice Newton,[20] used the DPSIR framework in their research to analyse complex problems associated with social-ecological systems and LCA life cycle assessment for analysis of the environmental impact of electronic devices from their production to recycling.[21] A group of scientists, such as Rahul S Mor, Kuldip Singh Sangwan, Sarbjit Singh, Atul Singhc, and Manjeet Kharub,[22] researched EWM techniques to ensure environmental sustainability and people's awareness of EWM.

16 'Andriy Yermak and Margot Wallström held the fifth meeting of the International Working Group on the Environmental Consequences of War' (*President of Ukraine*, 8 January 2024) <https://www.president.gov.ua/en/news/andrij-yermak-i-margot-valstrem-proveli-pyate-zasidannya-miz-88149> accessed 18 January 2024.

17 O Skoryk, 'Forming the Economic Mechanism of Electronic Waste Management in Ukraine' (2017) 2 Efficient economy <http://www.economy.nayka.com.ua/?op=1&z=5433> accessed 18 January 2024.

18 Alla Voitsikhovskaya and other, *Best European Waste Management Practices: Manual* (Olena Kravchenko ed, Manuscript Company 2019).

19 IP Krajnov and other, 'Ecological Safety Management in the Field of Waste Electrical and Electronic Equipment' (2012) 1 Ecological Safety 13.

20 Samuel Abalansa and other, 'Electronic Waste, an Environmental Problem Exported to Developing Countries: The GOOD, the BAD and the UGLY' (2021) 13(9) Sustainability 5302, doi:10.3390/su13095302.

21 M Khurrum S Bhutta, Adnan Omar and Xiaozhe Yang, 'Electronic Waste: A Growing Concern in Today's Environment' [2011] Economics Research International 474230, doi:10.1155/2011/474230.

22 Rahul S Mor and other, 'E-Waste Management for Environmental Sustainability: An Exploratory Study' (The 28th CIRP Conference on Life Cycle Engineering, Jaipur, India, 10-12 March 2021) vol 98, 193, doi:10.1016/j.procir.2021.01.029.

In terms of methodology, the article uses the Ukrainian regulatory framework and EU directives to analyse Environmental Waste Management Systems (EWMS). This analysis incorporates legal, professional and regulatory documents, serving as valuable resources for stakeholder analysis and constructing a SWOT analysis of the EWMS in Ukraine. Furthermore, the analysis of EWM practices is based on information gathered from mass media and information available on the websites of Ukrainian and international organisations.

2 RESEARCH RESULTS

2.1. Regulatory Support for E-Waste Management in Ukraine and its Compliance with EU Legislation in this Area

Ukraine's acquisition of candidate status for EU membership in June 2022 motivates and obliges it to gradually bring national legislation into line with EU directives in this area. It should be noted that the European Parliament and the Council of the European Union are constantly modernising environmental regulations, which are becoming more stringent every year. Thus, Directive 2015/863 (known as RoHS3)[23] expands the list of hazardous substances (four more are added) and imposes restrictions on their use in EEE; from 2018, Directive 2012/19/EU[24] applies to all EEE, even though e-waste previously only covered certain equipment of this kind.

Furthermore, starting from December 2020, revisions to directives concerning the handling of batteries and accumulators, including waste batteries, led to the adoption on 12 July 2023 by the Council of the European Union of a new Regulation (EU) 2023/1542[25] on batteries and waste batteries. This provision will regulate the entire life cycle of batteries - from production to reuse and recycling, in connection with the ban on smartphones without a removable battery; at the end of 2022, the EU approved the introduction of a single standard for chargers (USB Type-C),[26] the transition period for which for small electronic gadgets is 24 months from the date of approval (i.e. from the fall of 2024), for laptops - 40 months.

23 Commission Delegated Directive (EU) 2015/863 of 31 March 2015 amending Annex II to Directive 2011/65/EU of the European Parliament and of the Council as regards the list of restricted substances (Text with EEA relevance) [2015] OJ L 137/10.

24 Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE) (recast) (Text with EEA relevance) [2012] OJ L 197/38.

25 Regulation (EU) 2023/1542 of the European Parliament and of the Council of 12 July 2023 concerning batteries and waste batteries, amending Directive 2008/98/EC and Regulation (EU) 2019/1020 and repealing Directive 2006/66/EC (Text with EEA relevance) [2023] OJ L 191/1.

26 Directive (EU) 2022/2380 of the European Parliament and of the Council of 23 November 2022 amending Directive 2014/53/EU on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment (Text with EEA relevance) [2022] OJ L 315/30; Commission Delegated Regulation (EU) 2023/1717 of 27 June 2023 amending Directive 2014/53/EU of the European Parliament and of the Council as regards the technical specifications for the charging receptacle and charging communication protocol for all the categories or classes of radio equipment capable of being recharged by means of wired charging (Text with EEA relevance) [2023] OJ L 223/1.

Access to Justice in Eastern Europe
ISSN 2663-0575 (Print) ISSN 2663-0583 (Online)
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Currently, the domestic legal framework for waste management consists of fundamental legislative acts, including the Laws of Ukraine "On Environmental Protection"[27] and "On Waste Management"[28] (known as "On Waste" until 9 July 2023),[29] alongside legislative acts relating to individual flows waste. However, significant legislative developments in this direction do not yet allow us to discuss the functioning of a modern and effective waste management model in Ukraine.

A pivotal step towards reforming the waste management system commenced on 9 July 2023, with the official initiation of reforms entry into force of the framework Law of Ukraine "On Waste Management". This legislation marks a significant milestone as it integrates fundamental European principles and provisions into Ukraine's waste management framework. Key elements introduced by this law include:

- a system of long-term waste management planning at all levels of management (national, regional, and local);
- hierarchy of waste management, which is the determination of the priority order for the protection of the natural environment for the management of waste of all types;
- extended producer responsibility (EPR), which is based on the "polluter pays" principle;
- gradual creation of modern infrastructure and waste collection and treatment facilities;
- improvement of waste management processes, incl. licensing and permitting systems and information support in waste management.

The law is the basis for the development of sectoral legislation.[30] The sectoral bills are intended to give rise to the system of EPR, which is especially significant for the management of e-waste. Implementing EPR will allow the use of new methods and tools for e-waste collection and make this process as efficient as possible (for example, by organising the collection of EEE at their points of sale or by manufacturers). Currently, collection points in Ukraine are voluntarily funded by the environmentally responsible corporate sector. Since waste is accepted by the population free of charge, the activities of such centres are unprofitable.

Table 1 shows the steps taken by the central authorities to modernise Ukraine's regulatory framework regarding e-waste in accordance with EU law. Among the priority areas of government activity in waste management regulation is the development of completely new regulatory initiatives for managing batteries, accumulators, and e-waste.

27 Law of Ukraine no 1264-XII 25 June 1991 "On Environmental Protection" [1991] Sheets of the Verkhovna Rada of Ukraine 41/546.

28 Law of Ukraine no 2320-IX of 20 June 2022 'On Waste Management' [2023] Sheets of the Verkhovna Rada of Ukraine 17/75.

29 Law of Ukraine no 187/98-VR of 5 March 1998 'On Waste' [1998] Sheets of the Verkhovna Rada of Ukraine 36-37/242.

30 Law of Ukraine no 2320-IX (n 28).

***Table* 1. Comparative analysis of the approximation of the regulatory framework of Ukraine in the EWMS with EU legal acts**

Current regulatory legal act of Ukraine	Current EU/EEC legislation
1. Law of Ukraine "On Waste" dated 5 March 1998 No. 187/98-VR (repealed 09.07.2023) Law of Ukraine "On Waste Management" dated 20 June 2022, No. 2320-IX (came into force on 9 July 2023); 2. Procedure for waste classification (20 October 2023); 3. National list of waste (20 October 2023); 4. Resolution of the Cabinet of Ministers of Ukraine dated 30 June 2023, No. 667 "On approval of the Procedure for the development and approval of regional waste management plans"; 5. Guidelines for the development of regional waste management plans (10 September 2021)	Directive (91/689 / EEC) "On hazardous waste"; Directive (2008/98 / EU) "Waste and repealing certain Directives'
1. Law of Ukraine "On Chemical Current Sources" dated 23 February 2006 No. 3503-IV; 2. Regulations on the procedure for collecting and recycling used lead-acid batteries (31 December 1996); 3. Rules for the operation of rechargeable lead starter batteries of wheeled vehicles and special machines made on a wheeled chassis (2 July 2008).	Regulation (EU) 2023/1542 of the European Parliament and of the Council of 12 July 2023 on batteries and waste batteries
1. Guidelines for the collection of waste electrical and electronic equipment contained in household waste (22 January 2013); 2. Technical Regulations for Restricting the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (10 March 2017).	Directive (2011/65/EU) on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS 2) Directive (2012/19/EU) on waste electrical and electronic equipment (WEEE 2)

The draft Law of Ukraine, "On Electrical and Electronic Equipment and Waste Electrical and Electronic Equipment," developed by the Ministry of Environmental Protection and Natural Resources of Ukraine, has been under public discussion since 26 December 2023.[31]

31 'Notice of promulgating the draft Law "On Electrical and Electronic Equipment and Waste Electrical and Electronic Equipment"' (*Ministry of Environmental Protection and Natural Resources of Ukraine*,

Access to Justice in Eastern Europe
ISSN 2663-0575 (Print) ISSN 2663-0583 (Online)
Journal homepage http://ajee-journal.com

It should be noted that Ukraine demonstrates a systematic approach to modernising its waste management system. This happens through the development and approval of national plans in this area. These plans represent a comprehensive vision of the measures that need to be implemented by the state on the path to reforming waste management - from the adoption/improvement of regulations to introducing new technologies and creating the necessary infrastructure.

Thus, in 2017 and 2019, the National Strategy and the National Waste Management Plan until 2030 were adopted, respectively.[32] To bring into compliance with the requirements of the new framework Law of Ukraine "On Waste Management" and European standards on the structure of these documents, in 2023, the Ministry of Environmental Protection and Natural Resources of Ukraine, together with European experts, developed the National Waste Management Plan of Ukraine until 2033 of the year.[33]

A strategic environmental assessment for the new document was launched in December 2023, and its adoption is scheduled for 2024. For the first time, this plan contains separate components - a biowaste reduction program and a waste prevention program, the last of which plays an important role in EWM. In addition, an innovation of the National Plan until 2033 is the development of indicators for monitoring and evaluating the plan's implementation according to EU standards. It is planned that the source of data for this assessment will be data from the waste management information system designed for waste accounting and reporting, transfer of waste from the generator to the processor, and obtaining a license for hazardous waste management[34]. Creating a waste management information system provides the state, the public, and residents of populated areas with information about the volume of waste generated in the territory, waste management operations, etc. Based on foreign practice, the Ministry of Environment launched an

26 December 2023) <https://mepr.gov.ua/povidomlennya-pro-oprylyudnennya-proyektu-zakonu-pro-elektrychne-ta-elektronne-obladnannya-ta-vidhody-elektrychnogo-ta-elektronnogo-obladnannya> accessed 15 January 2024.

32 Resolution of the Cabinet of Ministers of Ukraine no 820-r of 8 November 2017 'On approval of the National Waste Management Strategy in Ukraine until 2030' <https://zakon.rada.gov.ua/laws/show/en/820-2017-%D1%80?lang=uk#Text> accessed 21 November 2023; Resolution of the Cabinet of Ministers of Ukraine no 117-r of 20 February 2019 'On approval of the National Waste Management Plan until 2030' <https://zakon.rada.gov.ua/laws/show/117-2019-%D1%80#Text> accessed 21 November 2023.

33 'Draft National Waste Management Plan for Ukraine until 2033' (*Ministry of Environmental Protection and Natural Resources of Ukraine*, November 2023) <https://mepr.gov.ua/diyalnist/reformy/efektyvne-upravlinnya-vidhodamy/?fbclid=IwAR0UM_1pZGmvlTUxuzbLR0xiHxbl7C7tPk__PUec-t_RYQ1jgzYzwg8tJmc> accessed 10 January 2024.

34 'How to Work in a Waste Management Information System?' (*Ministry of Environmental Protection and Natural Resources of Ukraine*, 29 August 2023) <https://mepr.gov.ua/yak-pratsyuvaty-u-informatsijnij-systemi-upravlinnya-vidhodamy/> accessed 20 December 2023.

information system in December 2023, which considered business proposals for its improvement based on beta testing.

It should be noted that the national plans approved until 2030 in this area involve the identification of two subsystems - the managing (legislative and executive authorities) and the managed (business entity). In conditions of decentralisation, regional and local governments play an important role in building a waste management system. Their focus is exclusively on improving household waste management, including e-waste. They act as an intermediate link, on the one hand, between central government bodies and local communities and economic entities, on the other hand. That is why it is worth noting the domestic practice of developing regional waste management plans, which began in 2020 and improved with the adoption of the Law "On Waste Management," as an important element of the entire system, where special attention is paid to the EWM.

So, in order to properly manage all waste streams, including e-waste flows, the next step in reforming the waste management sector should be adopting appropriate packages of national sectoral laws and regulations, which should consider the progressive experience of foreign countries and international standards.

2.2. Stakeholders in the E-Waste Management System

After studying the regulatory framework in the EWMS, it is advisable to move to its institutional component, consisting of stakeholders. Let us analyse stakeholders' degree of impact and interest by putting them into four sectors (Fig.1).

Veto players are the main stakeholders providing support, and their absence makes it impossible to achieve the target results of political initiatives. At the same time, such stakeholders can veto the program and block its implementation. The President of Ukraine and the Verkhovna Rada of Ukraine are such stakeholders.

The "KEEP SATISFIED" sector includes central authorities vested in improving the environmental situation nationwide.

The relevant ministries and other executive authorities related to the "MANAGE CLOSELY" sector are assigned specific missions to improve the environment and ecological situation. The degree of interest of the Cabinet of Ministers of Ukraine is evidenced by the latest developments in strategic documents on the importance and priority of environmental safety. Local authorities are interested in achieving the target indicators for waste management. At the same time, they require infrastructure and budget optimisation for waste management, which is extremely difficult due to the priority tasks for the front.

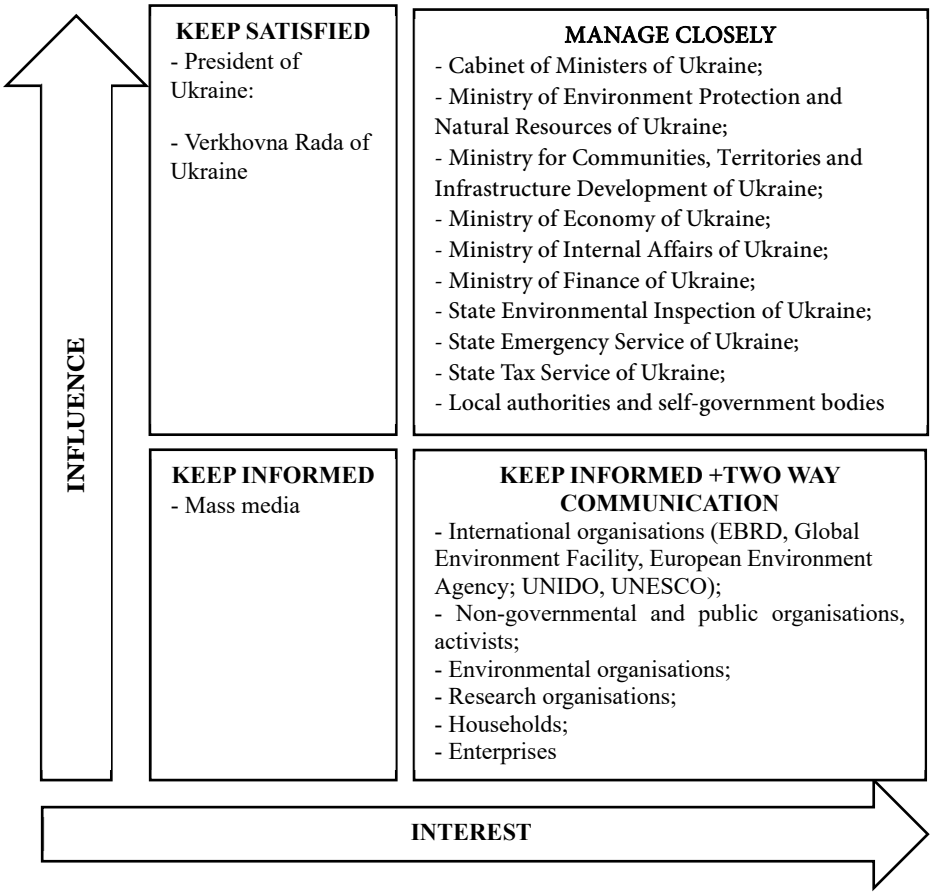

Figure 1. Matrix of stakeholders and veto players *(source: developed by the authors)*

The "KEEP INFORMED" sector includes mass media. The rapid development of telecommunications and information technologies has changed the very nature of the media, and they are becoming an integral part of what is happening. Before the Russian invasion, household waste was the top topic at all levels in all publications. Building an effective EWMS at the state and local levels is possible only if the importance of proper e-waste disposal is widely covered in the media, the existing requirements for EWM and the existing liability for their violation are communicated to the public, and the public is aware of existing environmental projects implemented by NGOs and their importance in terms of environmental safety.

The "KEEP INFORMED + TWO WAY COMMUNICATION" has many stakeholders, each with a different degree of influence.

International organisations in solving environmental problems are the following:

1) ***International organisations, such as UNESCO and UNIDO, contribute to the improvement of the environmental situation in countries worldwide***. In Ukraine, priority areas of cooperation are environmental protection, conservation of natural resources, and the implementation of resource-saving technologies. Even before the war, Ukraine, like the rest of the world, faced serious environmental challenges: a shortage of fresh water, pollution of rivers and seas, droughts, and forest fires. The war in Ukraine increased the relevance of the study of this issue and showed the depth of the environmental crisis and the importance of preserving natural capital. Therefore, environmental protection, the conservation of natural resources, and the introduction of resource-saving technologies remain important areas of cooperation for Ukraine.
2) ***International organisations promoting information support for the current state of the environment in the country*** (for example, the European Environment Agency (EEA), the main goal of which is to provide independent information on the state of the environment.
3) ***International organisations providing financial assistance to environmental protection and ecological projects*****, such as:**

- *The European Investment Bank (EIB)*[35] finances projects up to 50% of the total cost and often collaborates with other international financial institutions, such as the European Bank for Reconstruction and Development (EBRD).[36]

In Ukraine, the EBRD is the largest institutional investor, and today, its key focus is restoring Ukrainian cities. This recovery challenge aims to apply the principle of green technologies - creating greener and more energy-efficient cities, enhancing energy security, and using green transport.

To date, as part of the coordinated EU and international response to the war, the EIB provides financial support under the EIB Ukraine Solidarity Package. Active work continues to resolve issues of further funding for Ukraine to provide critical government services to the population who remain in the country.

In addition, EIB funds are used to address the impacts of climate change on vulnerable groups, protect biodiversity, and promote sustainable agriculture. Thus, the bank sees one of the goals of its activities as preserving natural resources and ensuring the environment is safe for future generations. All projects supported by the EIB must meet the bank's climate objectives.

35 'Who We Are' (*European Investment Bank*, 2023) <https://www.eib.org/en/about/index.htm > accessed 30 October 2023.

36 'European Investment Bank' (*Ministry of Environmental Protection and Natural Resources of Ukraine*, 2023) <https://mepr.gov.ua/diyalnist/mizhnarodna-diyalnist/spivrobitnytstvo-z-mizhnarodnymy-organizatsiyamy/yevropejskyj-investytsijnyj-bank/> accessed 30 October 2023.

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ISSN 2663-0575 (Print) ISSN 2663-0583 (Online)
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- *The Global Environment Facility (GEF)* provides funds to finance additional costs to make the project environmentally attractive.[37]

In the modern system of public relations, the influence of non-state (non-governmental) and public institutions, as well as activists, is growing. They influence the world political process both globally and regionally, exert direct pressure on governments, and control the implementation of international agreements, including environmental agreements.

From year to year, the number of supporters of environmental organisations is growing, and their contribution to the solution of global environmental problems is increasing. In Ukraine, one can single out influential environmental organisations such as "MAMA-86", "Let's Do It GREEN Ukraine", and the All-Ukrainian Ecological League.[38] Representatives of public organisations take an active part in legislative activities, keeping legislative acts concerning the impact on the environment under control. Environmental organisations are an important driving force in protecting eco-interests, as they can really influence government decisions and society. In 2019, the Professional Organization of Ecologists of Ukraine was created.

The NGO "Let's Make Ukraine Clean Together" has projects such as the "National Green Challenge", "EcoSchool", "Green School", "Eco Hike" eco application, and "E-Waste Ukraine" (a research project to study the impact of solid waste on flora and fauna of Ukraine).

Public Union "Association of Enterprises in the Field of Hazardous Waste Management" unites enterprises that have all the necessary documents, resources and specialised equipment for the collection, storage, processing, and disposal of hazardous waste.

Households are required to dispose of waste, unnecessary bulky items, and electronic equipment and comply with current legislation in the field of waste management.

It is advisable to divide enterprises into those which produce waste and those which recycle it. At the moment, there is practically no waste management infrastructure in Ukraine. There are only a few incomplete recycling enterprises (Waste Management Center[39], SPE "Ecological Laboratory"[40], State Enterprise "Argentum") and sorting stations ("Ukraine without waste"),[41] which are engaged only in waste collection. Collection and recycling projects are implemented exclusively with the support of socially responsible businesses.

37 'Who We Are' (*GEF Global Environment Facility*, 2023) <https://www.thegef.org/who-we-are> accessed 30 October 2023.

38 Kateryna Dudnyk, 'International Environmental Cooperation' *Legal Newspaper* (Kyjiv, 8 November 2016) 24.

39 'Waste Management Center: The First Service Company Organizing the Proper Disposal of a Large List of Waste' (*Waste Management Center*, 2014) <https://recycle.com.ua> accessed 30 October 2023.

40 'About the company "Ecological Laboratory"' (*Scientific and Production Enterprise "Ecological Laboratory"*, 2010) <http://www.eco-lab.com.ua> accessed 30 October 2023.

41 'Waste Sorting Station' (*Ukraine Without Waste*, 2017) <https://nowaste.com.ua/sort-station-2/> accessed 30 October 2023.

The Association of Enterprises in the Field of Hazardous Waste Management inspected about 200 licensees involved in recycling and only 20 of them have at least some equipment for waste disposal; that is, they are unscrupulous players in the market.

In 2020, the NGO "Let's Do It GREEN Ukraine" launched the "E-WasteUkraine" project,[42] implemented with the support of five ministries, socially responsible businesses, which include enterprises operating in various fields and taking an active part in environmental projects as investors, producers' electronic equipment and retail chains that trade in it. The goal is to create a culture of social responsibility among the population. The program consists of educational activities among the population, adolescents, and children, with the involvement of adults; the introduction of separate waste collection in educational institutions; and the installation of containers in individual cities.

2.3. SWOT Analysis of the e-Waste Management System in Ukraine

The study of EWM performance, regulatory framework, and the impact of stakeholders allowed us to build a SWOT analysis of the strengths, weaknesses, threats and opportunities in the system of EWM in Ukraine. Let us begin with the identified strengths of the EWMS:

1. Access to modern recycling technologies worldwide
2. The presence of public organisations that popularise an environmental lifestyle and socially responsible businesses that support the development of environmental projects.
3. Availability of EEE manufacturers and large retail chains willing to finance environmental projects and participate in their implementation.
4. Declaration by the leadership of the state, regions, and local governments to create the prerequisites for the existence of a waste management system and to promote its development.
5. Availability of industrial facilities capable of serving as the foundation for e-waste processing and utilisation infrastructure.
6. Convenient geographical location and extensive transport network.
7. Availability of existing regional programs and waste management plans.

At the same time, the EWMS is not devoid of certain shortcomings, as evidenced by several weaknesses:

1. Current lack of a sectoral regulatory framework governing the collection, storage, transportation, recycling, recovery, disposal and extended responsibility of producers and exporters for certain waste streams, particularly EEE.
2. Partial absence and non-compliance with EU standards of the regulatory framework for organising accounting and reporting of EEE. Lack of a well-

42 'E-Waste Ukraine' (*Let's do it, GREEN Ukraine*, 2020) <https://letsdoitgreenukraine.com.ua/project/e-waste-ukraine/> accessed 30 October 2023.

Access to Justice in Eastern Europe
ISSN 2663-0575 (Print) ISSN 2663-0583 (Online)
Journal homepage http://ajee-journal.com

functioning and tested information system for accounting and recording indicators in EEE waste management since it is only at the implementation stage.
3. Absence of extended producer responsibility.
4. Lack of control over waste disposal by the State Environmental Inspection and inexistence of proper mechanisms for holding people accountable for non-compliance with legislation.
5. Low incentives for waste prevention and compliance with the waste management hierarchy due to a lack of tools, stimuli, and incentives, low waste disposal tariffs, and low waste disposal taxes.
6. Lack of targets for recycling and recovery of waste products falling under EPR, including e-waste (currently, the minimum targets for preparation for reuse, recycling, and recovery of e-waste are indicated in the draft sectoral legislative initiative of the Ministry of Environment).
7. Non-transparency of the activities of enterprises involved in recycling, the presence of a "grey" and "black" market.
8. Low investment attractiveness due to the war and the unstable political and economic situation in Ukraine.
9. Limited environmental awareness and knowledge from the population on environmental issues and its impact on the social standard of living and personal health.
10. Low population paying capacity leads to an unwillingness to pay for durable and high-quality products and their disposal.
11. Lack of infrastructure for e-waste collection, accumulation, sorting and disposal.
12. Insufficient statistical data on the volume of waste and the volume of its processing, caused by the lack of systematic collection and analysis of information.
13. Lack of motivation among individuals and legal entities for separate waste collection.
14. Low profitability or even unprofitability of the activities of entities involved in collecting and disposing of e-waste due to low processing volumes and lack of infrastructure.
15. Non-compliance of waste management facilities with safety requirements and their low technological level.
16. Low level of communication and cooperation between local authorities at different levels.
17. Disinterest of real estate associations, such as local building-utilities administrator offices and condominiums, in matters of separate waste collection and environmental safety.
18. Unclear vision for resolving the issue of collecting and recycling e-waste.
19. Insufficient number of qualified personnel.

The future opportunities in the EWMS are as follows:

1. The high profitability of projects for e-waste utilisation, subject to the existence of appropriate infrastructure, creates opportunities for sustainable development of the country's economy, obtaining additional revenues to the state and local budgets.
2. There is a global demand for e-waste recycling capacity, but the current existing recycling capacity is limited (about five countries have recycling capacity at this time).
3. The volume of e-waste is growing consistently every year, presenting ongoing opportunities.
4. Potential to attract funds from International Financial Institutions and foreign investors to implement projects for e-waste utilisation.
5. Raising the environmental population's awareness and pressure on the authorities to implement environmental projects.
6. Prerequisites for the creation of recycling facilities for e-waste (there are a territory, personnel, enterprises that are ready to do this, and raw materials) (will be realistic after the end of the war in Ukraine).
7. Opportunities for domestic consumption will allow the development of other industries experiencing a shortage of raw materials and exports obtained from the processing of secondary raw materials.
8. Creation of new jobs.
9. Overcoming the problem of overflowing landfills and environmental pollution, reducing the negative impact on the health and social standards of living in future.

The imperfection of the legislative and regulatory framework, as well as a clear mechanism for managing environmental projects regarding the management of e-waste, leads to the emergence of threats in the EWMS:

1. High level of corruption and abuse of official duties, in part of issuing licenses and exercising control.
2. Increase in the number of "pseudo-utilizers" of EEE with all the resulting consequences.
3. Low level of social responsibility of individuals and legal entities, including the awareness of the need for separate waste collection and disposal.
4. Lack of funds to finance environmental projects, including those related to waste management.
5. The high cost of implementing projects for their high manufacturability (the need to build factories equipped with the latest science and technology).
6. Gaps in legislation, lack of an effective mechanism for implementing the legislative provisions, the possibility of non-compliance with legislation and the lack of inevitable responsibility for its violation. An increase in illegal operating points for the extraction of components from e-waste, where, as a rule, the extraction of useful components occurs in conditions that do not meet environmental standards and are harmful to both people and the environment.

Access to Justice in Eastern Europe
ISSN 2663-0575 (Print) ISSN 2663-0583 (Online)
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7. Low level of secondary resource use and loss of a significant part of the scarce raw materials contained in e-waste due to poor management of this waste stream.
8. Lack of an effective unified waste management system at the country level, to which subsystems created in accordance with the territorial administrative structure are subordinated through the initial stage of its implementation.
9. Difficulty in determining places intended for processing and disposal of waste through the so-called effect of "someone else's waste", that is, the reluctance of the population of the region to agree to waste recycling from other settlements on their territory.

By strategically addressing the identified weaknesses and leveraging the strengths outlined above, along with minimising the potential threats and maximising available opportunities, Ukraine can build an effective EWMS and create the prerequisites for successfully implementing projects in the environmental sphere.

3 CONCLUDING REMARKS

Nowadays, the acute issue of building a waste management system extends globally, including in Ukraine. Overcoming the problem of e-waste accumulation and minimising its negative impact as much as possible necessitates collaborative efforts and alignment of interests among various stakeholders. This entails harmonising the interests of the state as a regulator, producers and consumers, organisations involved in utilisation and the public sector through educational activities and coordination of actions. Such cooperation can achieve a synergistic effect and create effective waste system management by coordinating the interests of all interested parties.

The role of the state is to implement such a policy that will help to increase the interest of households and businesses in efficient waste management practices and create the infrastructure for their safe disposal. To do this, it is necessary to set standards by adopting regulations and by-laws or by making changes to existing ones. Additionally, defining control mechanisms for oversight is crucial to regulate the actions of stakeholders, including state and local authorities and private businesses with households. At the same time, the legislation should include, first of all, a regulatory function, and not a repressive one, which will make it possible to build an effective financial and economic model that is beneficial for all parties.

Public authorities need to look for leverage that will motivate local authorities to actively participate in environmental projects for household waste management, including e-waste. This involves not only developing and approving regional waste management plans, as had been initiated in Ukraine but also continuous monitoring of the implementation and control over it. Local authorities should look for ways to cooperate with citizens' associations that generate e-waste and involve them in building the e-waste recycling system at the local level, together with specialised organisations licensed to do this.

It should be noted that without legislative regulation of waste management, regional plans will be improperly developed, resulting in their non-fulfilment.

The regulatory influence of the state should be accompanied by an increase in the social responsibility of legal entities and individuals with the support of public organisations, which play a decisive role in the creation of educational projects to popularise the idea of separate waste collection and inform the households of the need for its disposal for environment protection, increase the interest of the households in the waste collection process and the level of awareness in terms of waste management, which will improve the culture of the citizens on handling e-waste.

Individuals should be responsible for their consumption habits, namely the choice to refuse to purchase equipment or repair existing ones, give preference to high-quality equipment with a long life cycle, reduce consumption, and transfer equipment for disposal while choosing a reliable recycling company and contributing to the creation of a network of e-waste collection points.

In Ukraine, there is a lack of production capacities for e-waste recycling and utilisation. High-tech full-cycle enterprises are generally absent, which requires stimulating investment in this area. A large number of entities work partially or completely in the shadow economy, creating additional threats to the environment. Such steps will allow for the establishment of an effective system for e-waste generation, collection, sorting and disposal, which will eventually help achieve the results already achieved by some environmentally oriented countries.

Waste recycling within Ukraine can impetus the development of the economy because a large number of countries need recycling but do not have the capacity for it.

The start of waste management reform in Ukraine in July 2023 begins a long journey to create an effective waste management system, especially during armed Russian aggression. The problem of implementing EWMS is multifaceted and will be the subject of further scientific research, in particular on:

- finding sources of financing for projects, methods and tools for stimulating the interest of subjects involved in the implementation of these projects;
- identifying the reasons that hinder the adoption and implementation of progressive domestic legislation which aims to prevent e-waste creation and set the rules for its management;
- creating a Ukrainian legal framework for the formation of an effective system of extended liability, taking into account its two elements - producer and consumer liability, the latter of which is currently ignored by the legislator;
- reviewing the extent of liability of legal entities and individuals for improper disposal of e-waste and introducing stricter control over non-compliance with the law in this area.

Access to Justice in Eastern Europe
ISSN 2663-0575 (Print) ISSN 2663-0583 (Online)
Journal homepage http://ajee-journal.com

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Competing interests: No competing interests were disclosed.

Access to Justice in Eastern Europe
ISSN 2663-0575 (Print) ISSN 2663-0583 (Online)
Journal homepage http://ajee-journal.com

Disclaimer: The authors declare that their opinions and views expressed in this manuscript are free of any impact of any organisations.

ABOUT THIS ARTICLE

Cite this article
Nosova E, Iafinovych O, Miedviedkova N, Delas V and Plieshakova N, 'E-Waste Management System in Ukraine: Legal Framework and SWOT-Analysis' (2024) 7(2) Access to Justice in Eastern Europe 355-74 <https://doi.org/10.33327/AJEE-18-7.2-a000221>

Submitted on 18 Feb 2024 / Revised 14 Mar 2024/ Approved 18 Mar 2024
Published: 1 May 2024
DOI https://doi.org/10.33327/AJEE-18-7.2-a000221

Managing editor – Mag. Yuliia Hartman. **English Editor** – Julie Bold.

Keywords: *electronic waste, e-waste, e-waste management system, environmental protection, stakeholders, SWOT analysis, EU directives, legal framework.*

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