

E-waste Handling in the context of Environmental Project Management in Ukraine¹

Zhykhor O.¹ [0000-0003-1917-4265], Iafinovych O.²[0000-0002-6804-0848],
Nosova E.²[0000-0002-7975-0984], Miedvedkova N.²[0000-0001-6359-561X],

¹V.N. Karazin Kharkiv National University, Kharkiv, Ukraine

²Taras Shevchenko National University of Kyiv, Kyiv, Ukraine

olena.zhykhor@karazin.ua, olenayafinovych@knu.ua,
nosovaeuvgenia@knu.ua, nsmedvedkova@knu.ua

Abstract. The article is devoted to the study of the current state of the electronic waste management system in Ukraine which is intended to give an idea of existing environmental projects in terms of handling electrical and electronic waste (e-waste) and problems in their implementation, to determine the directions for improving project management. The discussion calls for revising and improving strategies and practices for managing environmental projects, taking into account international experience. The article is structured as follows: firstly, the current state of e-waste management in Ukraine is disclosed. Secondly, the regulatory framework for e-waste management in Ukraine and its compliance with EU legislation are studied. Thirdly, the level of influence and interest of stakeholders in environmental projects management are investigated. The results of the study made it possible to build a SWOT analysis, namely, to identify the strengths and weaknesses, as well as threats and opportunities in environmental projects management, taking into account which will bring the implementation of environmental projects in Ukraine to a higher level and give an idea of the factors that hinder the development of this process. It is important to note that the article is an important source for the analysis of ecological projects management in order to solve the problems of environmental protection.

Keywords: E-waste, Environmental Projects, Environmental Protection, Stakeholders, SWOT analysis, EU directives

1. Introduction

In modern society, electrical and electronic devices have been used in all spheres. The informatization of society at a frantic pace leads to a reduction in the life cycle of technology through its obsolescence, thereby encouraging enterprises to increase the amount of goods production that are constantly being updated. But new products are becoming lower in quality and less reliable (the service life is shortened, repairs become impossible or extremely expensive in comparison with the purchase of new equipment). All this leads to an increase in consumption of electrical and electronic goods, and therefore e-waste generation which accumulates three times faster than other waste [1]. According to forecasts until 2030, their amount will be increased by 1,5 times [2]. If 44,7 mln tons of e-waste were generated in the world in 2016 [3],

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then in 2019 – approximately 53,6 mln tons [2]. According to the Global Monitoring of Electronic Waste in Ukraine [2], 324 thousand tons of e-waste (7,7 kg per person) were generated in 2019, and according to the calculations of the NGO "Let's Do It GREEN Ukraine" in Ukraine, 28,5 kg of e-waste are generated per person per year [4].

Electronic equipment, household and office equipment contain a large amount of hazardous compounds and substances, the release of which into water and soil causes colossal damage to the environment and, as a consequence, to human health. And although the share of e-waste in the total amount of municipal solid waste is relatively small (according to the RPE "Ecological Laboratory"[4], it is 6-8% of the total amount of waste that ends up in landfills in Ukraine; according to the PACE [3] report – it is only 2% of all streams of municipal solid waste), but the level of their danger to nature and human health is colossal. Thus, the RPE "Ecological Laboratory" determines that e-waste in landfills provides 40% of heavy metals that enter water and soil [4], and according to the PACE report [3], they can generate 70% of hazardous waste in landfills.

At the same time, e-waste also contains useful and expensive elements (gold, silver, platinum, copper, iron, aluminum) that can be reused. After all, their primary extraction is an expensive 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. Indeed, the disposal of such waste by specialized enterprises allows you to reuse up to 80% of their components, while the annual cost of e-waste in the world is \$ 62,5 billion, which is much more than the GDP of most countries. But in the world, according to the PACE [3] report, only 20% of all e-waste is collected and recycled, and in Ukraine, according to the Global Monitoring of Electronic Waste in 2017 [2], it is 12,3% from the total amount of generated e-waste in 2019.

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 environmental projects management and provide recommendations for its improvement, which is a prerequisite for improving the environment, social standard of living and ensuring environmental safety.

Analysis of recent research and publications. Nowadays, environmental issues and environmental protection are extremely important and popular topics. This problem is raised in the studies of such Ukrainian scientists, as A. Skorik [5], A. Voitsikhovska, O. Kravchenko, O. Melen-Zabramna, M. Pankevych [6]. They considered the best European practices for prevention of waste generation, reuse and recycling, and focused on the feasibility of both economic and environmental protection of waste incineration. I. Kraynov, V. Krylyuk, E. Shago, V. Bakharev [7] researched environmental safety management in the field of e-waste.

Foreign scientists, such as Samuel Abalansa, Badr El Mahrad, John Icely and Alice Newton [8] used the DPSIR framework in their research for analyzing complex problems associated with social ecological systems and LCA life cycle assessment for analyzing the environmental impact of electronic devices from their production to recycling. M. Khurram and S. Bhutta [9] researched the problem of e-waste and

methodology for estimating calculations for their growth. A group of scientists, such as Rahul S Mor, Kuldip Singh Sangwan, Sarbjit Singh, Atul Singhc, Manjeet Kharub [10] researched e-waste management techniques to ensure environmental sustainability and people's awareness of e-waste management.

Methodology. To fulfill the goal and analyze e-waste handling and environmental projects management, the article uses the Ukrainian regulatory framework and EU directives. The analysis of legal, professional and regulatory texts has been carried out. These documents have become an important source for the analysis of stakeholders and the construction of a SWOT analysis of the e-waste management system in Ukraine. The analysis of environmental project management practices was carried out on the basis of the mass media and information available on the websites of Ukrainian and international organizations.

2. Research results

2.1 Regulatory support for e-waste management in Ukraine and its compliance with EU legislation in this area

The domestic legal framework for waste management consists of a number of legislative acts (including the Laws of Ukraine "On Environmental Protection", "On Waste", "On Radioactive Waste Management", "On Ensuring Sanitary and Epidemic Safety of the Population ", " On housing and communal services ", " On scrap metal", "On veterinary medicine", "On withdrawal from circulation, processing, disposal, destruction or further use of low - quality and dangerous products", Subsoil Code of Ukraine, etc.), however, it only fragmentarily touches on the regulation of the sphere of e-waste handling and does not allow building a system of measures to minimize the amount of their generation and implementing recycling as a technology of secondary use of e-waste

The European integration course taken by Ukraine, motivates and obliges to gradually bring national legislation in line with EU directives in this area, which are constantly being revised and becoming more stringent every year. By this time, the Ukrainian regulatory framework for waste management still remains devoid of basic European principles and provisions in this area, such as: firstly, a system of long-term planning of waste management at all levels of management (national, regional and local); secondly, the hierarchy of waste management, that is the definition of the priority order of all types of waste handling for environment protection; thirdly, extended producer responsibility, based on the "polluter pays" principle, provides for shifting the financing of collection, transportation, processing and disposal to them[11].

With the adoption of the strategy [12] and the long-term plan [13] in this area at the national level, modern principles and a systematic approach to waste management are being initiated, separating two subsystems - managing (legislative and executive authorities) and managed (business entity). In the context of decentralization, regional and local authorities play an important role in building a waste management system. Their focus is exclusively on improving the management of household waste containing 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.

In 2020, the domestic practice of developing strategic regional plans for waste management was implemented, which is an important element of the entire system, where special attention is paid to e-waste management. However, the lack of a proper legislative regulation of this area, a clear definition of the participants in the relations of the waste management system and the mechanisms of their interaction, responsible persons and responsibility for violation of the law can lead to the improper development of such plans and, as a result, their non-fulfillment.

The implementation of extended responsibility will allow the use of new methods and tools for e-waste collection and make this process as efficient as possible (for example, by organizing the collection of electrical and electronic equipment at their points of sale or by manufacturers).

An analysis of existing domestic legislative initiatives on waste management in general and e-waste in particular demonstrates attempts by central authorities to modernize the legal framework of Ukraine in this area in accordance with European standards (Table 1). Thus, a number of draft laws have been registered in the Verkhovna Rada of Ukraine, which are proposed both to replace the current Law of Ukraine "On Waste" dated 05.03.1998 No. 187/98-VR, and implement completely new ones, the provisions of which determine and regulate the relationship with e-waste management.

Table 1

Comparative analysis of the approximation of the regulatory framework and legislative initiatives of Ukraine in the e-waste management system with European Union legal acts

Current normative legal acts of Ukraine	Draft regulatory and legal acts of Ukraine	Current EU /EEC regulations
<ul style="list-style-type: none"> - Law of Ukraine "On Waste" dated 05.03.1998 No. 187/98-VR [14]; - Guidelines for the development of regional waste management plans (12.04.2019) [15] 	Alternative bills: <ul style="list-style-type: none"> - "On Waste Management" (adopted in the first reading by the Verkhovna Rada) [16]; - "On the management of household and other waste"[17]; - "On waste" [18]. 	<ul style="list-style-type: none"> - Directive (91/689 / EEC) "On hazardous waste"; - Directive (2008/98 / EU) "Waste and repealing certain Directives"
Law of Ukraine "On Chemical Current Sources" dated 23.02.2006 No. 3503-IV [19]	Draft Law of Ukraine "On Batteries and Accumulators" (being prepared for the first reading) [20]	Directive (2006/66 / EU) "On batteries and accumulators and used batteries and accumulators"

Guidelines for collection of e-waste included in household waste (22.01.2013) [21]	Draft Law of Ukraine "On waste electrical and electronic equipment" (being prepared for the first reading) [22]	<ul style="list-style-type: none"> - Directive (2011/65 / EU) "Restrictions of the use of certain hazardous substances in electrical and electronic equipment" (RoHS 2); - "Waste Electrical and Electronic Equipment Directive" (2012/19 / EU) (WEEE 2)
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Source: developed by the authors

So, in order to properly manage all waste streams, including e-waste streams, reforming of the waste management sector is necessary to begin with the adoption of an appropriate package of national bills, which should take into account the progressive experience of foreign countries and international standards.

2.2 Stakeholders in environmental projects management in terms of e-waste handling in Ukraine

Having studied the regulatory framework in the e-waste management system, it is advisable to move to the institutional component of environmental projects, consisting of stakeholders. Let's analyze the degree of impact and interest of stakeholders by putting them into four sectors (Fig.1).

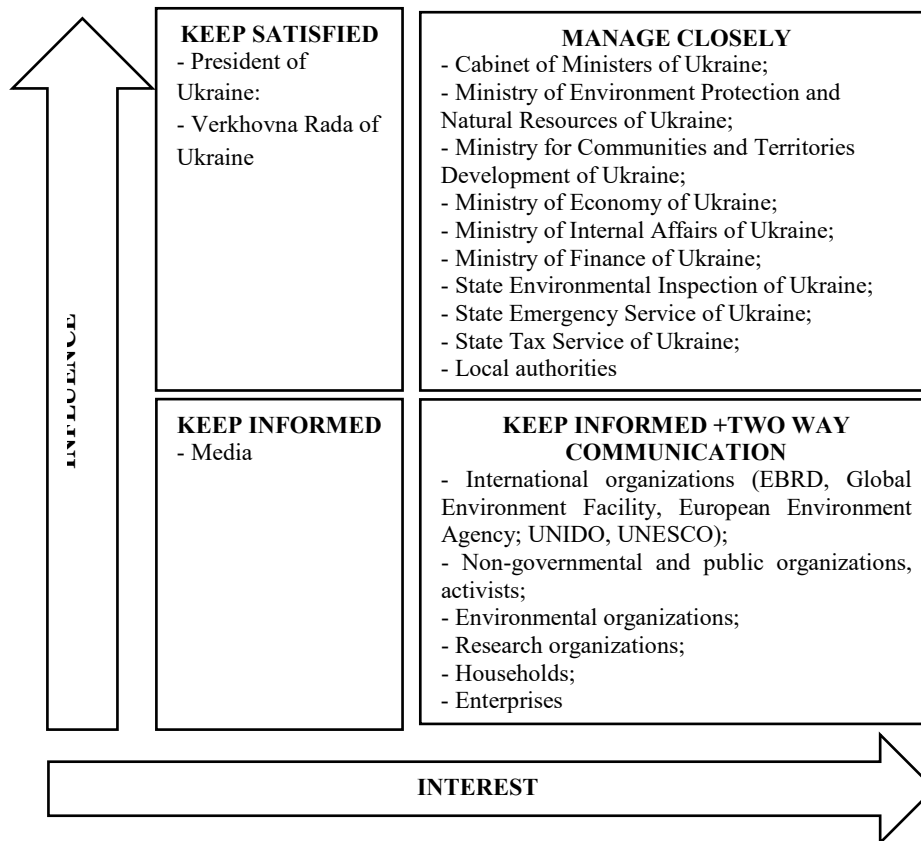


Fig. 1. Matrix of stakeholders and veto players

Source: developed by the authors

Veto players are the main stakeholders providing support, and whose absence makes it impossible to achieve the target results of political initiatives. At the same time, such stakeholders have the opportunity to veto the program and block its implementation (they are the President of Ukraine and the Verkhovna Rada of Ukraine).

The sector "KEEP SATISFIED" includes the central authorities. They are interested in improving the environmental situation in the country as a whole. Specific missions to improve the environment and the ecological situation are assigned to the line of ministries and other executive authorities relating to the sector "MANAGE CLOSELY". 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 optimization for waste management.

The sector "KEEP INFORMED" 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. The top topic at all levels in all publications is the topic of household waste.

The sector "KEEP INFORMED + TWO WAY COMMUNICATION" has a large number of stakeholders, which differ in the degree of influence.

International organizations in solving environmental problems are the following:

- International organizations contributing to the improvement of the environmental situation in the countries of the world (they are UNESCO and UNIDO, where the priority areas of cooperation for Ukraine are environmental protection and conservation of natural resources, as well as the implementation of resource-saving technologies);

- International organizations promoting information support of the current state of the environment in the country (for example, European Environment Agency (EEA), the main goal of which is to provide independent information on the state of the environment;

- International organizations providing financial assistance to environmental protection and ecological projects. Firstly, European Investment Bank (EIB), which finances projects up to 50% of the total cost, can be carried out by the Bank in cooperation and co-financing with other international financial institutions, in particular with the European Bank for Reconstruction and Development (EBRD) [23]. Secondly, The Global Environment Facility (GEF) provides funds to finance additional costs to make the project environmentally attractive [24].

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 in the global and regional dimensions, 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 organizations is growing, their contribution to the solution of global environmental problems is increasing. In Ukraine, one can single out such influential environmental organizations as "MAMA-86", "Let's Do It GREEN Ukraine", the All-Ukrainian Ecological League and the like [25]. Representatives of public organizations take an active part in legislative activities, keeping under control the legislative acts concerning the impact on the environment. Environmental organizations 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.

Among the projects of NGO "Let's Make Ukraine Clean Together" are "National Green Challenge", "EcoSchool", "Green School", "Eco Hike" eco application, "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 their own specialized equipment for the collection, storage, processing, disposal of hazardous waste.

Households require to dispose of waste and unnecessary bulky items and electronic equipment, as well as to comply with the 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 [26], the RPE "Ecological Laboratory" [27], SE "Argentum") and sorting stations ("Ukraine without waste"), which are engaged only in waste collection). Collection points in Ukraine are now funded from the environmentally responsible corporate sector on a voluntary basis. Since waste is accepted from the people free of charge, the activities of such centres are unprofitable.

The Association of Enterprises in the Field of Hazardous Waste Management checked about 200 licensees which are engaged in recycling, among them there are only 20 ones which have at least some equipment for waste disposal, that means, they are unscrupulous players in the market.

In 2020, NGO "Let's Do It GREEN Ukraine" launched the "E-WasteUkraine" project, which is implemented with the support of 5 ministries, socially responsible business, which includes enterprises working in various fields and taking an active part in environmental projects as investors, manufacturers of electronic equipment and retail chains that trade in it. The goal is to form 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; introduction of separate waste collection in educational institutions; installation of containers in selected cities.

2.3 SWOT analysis of the e-waste management system in Ukraine

The study of e-waste management performance, regulatory framework and the impact of stakeholders allowed to build a SWOT analysis of strengths / weaknesses, as well as threats and opportunities in the system of e-waste management in Ukraine. Thus, the strengths of the e-waste management system were identified as follows:

1. There are modern technologies in the world for e-waste recycling that can be used in Ukraine.
2. The presence of public organizations popularizing an ecological lifestyle and socially responsible business that supports the development of environmental projects.
3. Availability of electrical and electronic equipment manufacturers and large retail chains that are ready to finance environmental projects and participate in their implementation.
4. Declaration of a desire to create prerequisites for the existence of the waste management system and promote its development by the leadership of the state and individual regions.
5. Availability of industrial facilities that can be the basis for creating the infrastructure for recycling and utilization of e-waste.
6. Convenient geographical location and extensive transport network.
7. Availability of operating regional programs and plans for waste management.

At the same time, e-waste management system is not devoid of certain shortcomings, as evidenced by a number of weaknesses:

1. Imperfection of the regulatory framework governing the process of collection and disposal of waste.
2. Lack of proper control over waste disposal by the State Environmental Inspection.
3. Lack of transparency in the activities of recycling companies, the presence of a "gray" and "black" market.
4. Unstable political and economic situation in the country, which leads to low investment attractiveness.
5. Low level of population's knowledge on environmental issues and its impact on the social standard of living and personal health.
6. Low population's paying capacity, that leads to unwillingness to pay more durable and high-quality products, as well as for its disposal.
7. Lack of infrastructure for e-waste collection, accumulation, sorting and disposal.
8. Lack, and sometimes the absence of statistical data on the amount of waste, the amount of their recycling caused by the lack of systematic collection and analysis of information.
9. Lack of a developed system of accounting and registration of indicators in the field of waste management.
10. Lack of motivation among individuals and legal entities to separate waste collection.
11. Low profitability or even unprofitable activities of entities involved in the e-waste collection and utilization at this point in time due to low recycling amounts and lack of infrastructure.
12. Non-compliance of waste management facilities with safety requirements, low technological level.
13. Low level of communication and cooperation between regions and municipalities.
14. Disinterest of associations of co-owners of real estate, such as local building-utilities administrator offices and condominiums in matters of separate waste collection and environmental safety.
15. Lack of focus of state and local policies on environmental safety issues.
16. Lack of a clear vision of resolving the issue of e-waste collection and disposal.
17. Insufficient number of qualified personnel.

The future opportunities in the e-waste management system are as follows:

1. The high profitability of projects for e-waste utilization, 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. The need for e-waste recycling capacity around the world and the currently existing recycling capacity is limited (at this time, about 5 countries have recycling capacity).
3. A large number of e-waste, the amount of which is growing every year.
4. The possibility of attracting funds from International Financial Institutions and foreign investors for the implementation of projects for e-waste utilization.

5. Raising the environmental population's awareness and pressure on the authorities to implement environmental projects

6. Prerequisites for creation of recycling facilities for e-waste (there are a territory, personnel, enterprises that are ready to do this, raw materials).

7. Opportunities for domestic consumption, which will allow the development of other industries that are 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, 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 in environmental projects management in terms of e-waste handling, leads to the emergence of threats in the e-waste management system:

1. High level of corruption and abuse of official duties, in part of issuing licenses and exercising control.

2. Low level of social responsibility of individuals and legal entities, including the awareness of the need for separate waste collection and disposal.

3. Lack of funds to finance environmental projects, including ones which are related to waste management.

4. The high cost of implementing projects for their high manufacturability (the need to build factories equipped with the latest science and technology).

5. 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.

6. Lack of a unified waste management system at the country level, which subordinates the subsystems created in accordance with the territorial and administrative structure.

7. The difficulty of determining places intended for processing and disposal of waste through 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.

So, subject to the maximum elimination of threats, the use of opportunities, taking into account the existing strengths and weaknesses listed above, it will be possible to build an effective e-waste management system and create the preconditions for the successful implementation of projects in the environmental sphere of Ukraine.

Concluding remarks

Nowadays there is an acute issue of building a waste management system in the world and in Ukraine. It is possible to overcome the problem of e-waste accumulation or to minimize its negative impact as much as possible only by combining efforts and harmonizing the interests of the state as a regulator, producers and consumers, organizations involved in utilization and the public sector (educational activities and coordination of actions), which will allow achieving a synergistic effect and creating an effective-waste system management due to the coordination of 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 business in efficient waste management 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, as well as to define control mechanisms to regulate the actions of stakeholders, which include both state and local authorities and private business 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, not only through the development and approval of regional waste management plans, so far started in Ukraine, but also by continuous monitoring of the implementation and control over it. And local authorities should look for ways to cooperate with citizens' associations that are generators of e-waste and involve them in building the e-waste recycling system at the local level, together with specialized organizations licensed to do this.

It should be noted that without legislative regulation of the waste management sphere, regional plans will be improperly developed, which will result in non-fulfillment of such plans.

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 organizations, which play a decisive role in creation of educational projects to popularize the idea of separate waste collection and inform the households of the need for its disposal in order 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 consumption, namely for the opportunity to refuse to buy, 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 collection points of e-waste.

Now in Ukraine there is a lack of production capacities for e-waste recycling and utilization, and high-tech full-cycle enterprises are generally absent, that 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 during the time will help to achieve the results already achieved by some environmentally oriented countries.

Waste recycling within Ukraine can give an impetus to the development of the economy, because a large number of countries need recycling, but do not have the capacity for this.

The problem of implementing environmental projects for e-waste handling is multifaceted and will be the subject of further scientific research, in particular, to find sources of financing for projects, methods and tools to stimulate and interest the subjects involved in the implementation of these projects.

References

1. Electronic Waste: Market Analysis and Disposal Issues, Ukraine Nature Conservation Society. http://www.ukrpryroda.org/2013/08/blog-post_10.html, last accessed 2021/06/21. [in Ukrainian]
2. Forti, V., Balde, C.P., Kuehr, R., Bel, G.: The Global E-waste Monitor 2020: Quantities, flows and the circular economy potential. In: United Nations University (UNU)/ United Nations Institute for Training and Research (UNITAR) - co-hosted SCYCLE Programme, International Telecommunication (ITU) & International Solid Waste Association (ISWA), Bonn / Geneva / Rotterdam, 119 p. (2020). https://www.itu.int/en/ITU-D/Environment/Documents/Toolbox/GEM_2020_def.pdf
3. A New Circular Vision for Electronics: Time for a Global Reboot. In: World Economic Forum, Platform for Accelerating the Circular Economy (PACE), 23 p. (2019). http://www3.weforum.org/docs/WEF_A_New_Circular_Vision_for_Electronics.pdf
4. Culture of e-waste management in Ukraine: start of the first project “E-Waste Ukraine” in Ukraine, Ukrinform (Multimedia International Broadcasting Platform of Ukraine), <https://www.ukrinform.ua/rubric-culture/3148300-v-ukraini-startuvav-ekoproekt-zi-zboru-elektronnogo-smitta.html>, last accessed 2021/08/02. [in Ukrainian]
5. Skorik, A.: Forming the economic mechanism of electronic waste management in Ukraine. *Efektivna ekonomika* 2, (2017). <http://www.economy.nayka.com.ua/?op=1&z=5433>. [in Ukrainian]
6. Voitsikhovska, A., Kravchenko, O., Melen-Zabramna, O., Pankevych, M.: Best European waste management practices (manual). Publishing House "Company "Manuscript", Kravchenko, O. (eds), Lviv, 62 p. (2019). http://epl.org.ua/wp-content/uploads/2019/07/Krashchi_ES_praktuku_NET.pdf. [in Ukrainian]
7. Kraynov, I., Krylyuk, V., Shago, E., Bakharev, V.: Ecological safety management in the field of waste electrical and electronic equipment. *Ecological safety* 1(13), 13-17 (2012). [http://www.kdu.edu.ua/EKB_jurnal/2012_1\(13\)/13.pdf](http://www.kdu.edu.ua/EKB_jurnal/2012_1(13)/13.pdf). [in Ukrainian]
8. Abalansa, S., El Mahrab, B., Icely, J., Newton, A.: Electronic Waste, an Environmental Problem Exported to Developing Countries: The GOOD, the BAD and the UGLY. *Sustainability* 13 (5302), (2021). <https://doi.org/10.3390/su13095302>, <https://www.mdpi.com/2071-1050/13/9/5302>
9. Khurram, M., Bhutta, S., Omar, A., Yang, X.: Electronic Waste: A Growing Concern in Today's Environment. *Hindawi Publishing Corporation Economics Research International* 2011, (2011). doi:10.1155/2011/474230. <https://www.hindawi.com/journals/ecri/2011/474230/>
10. Mor, R.S., Sangwan, K. S., Singh, S., Singhc, A., Kharub, M.: E-waste Management for Environmental Sustainability: An Exploratory Study. <https://www.sciencedirect.com/science/article/pii/S2212827121000524>
11. Kolodiichuk, I.: Formation of territorially balanced waste management systems: regional dimension: monograph. State Institution “Institute of regional research named after M.I. Dolishniy of NAS of Ukraine”, Lviv, 524 pg. (2020). <http://ird.gov.ua/irdp/p20200003.pdf>. [in Ukrainian]

12. National Waste Management Strategy of Ukraine until 2030: Order of the Cabinet of Ministers of Ukraine dated November 8, 2017 No. 820. <https://zakon.rada.gov.ua/laws/show/820-2017-%D1%80#Text>. [in Ukrainian]

13. National Waste Management Plan until 2030: Order of the Cabinet of Ministers of Ukraine dated February 20, 2019 No. 117. <https://zakon.rada.gov.ua/laws/show/117-2019-%D1%80#Text>. [in Ukrainian]

14. On Waste: Law of Ukraine dated 5 March, 1998 No. 187/98-BP. <https://zakon.rada.gov.ua/laws/show/187/98-%D0%B2%D1%80#Text>

15. Guidelines for the development of regional waste management plans: Order of the Ministry of Ecology and Natural Resources of Ukraine dated 12.04.2019 No. 142. <https://zakon.rada.gov.ua/rada/show/v0142737-19#Text>

16. On approval in principle of the Draft of Law of Ukraine "On Waste Management": Resolution of the Verkhovna Rada of Ukraine dated July 21, 2020 No. 813-IX. <https://zakon.rada.gov.ua/laws/show/813-IX#Text>

17. On the management of household and other waste: Draft Law of Ukraine dated 03.10.2019 No. 2207. http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?pf3511=66998

18. On waste: Draft Law of Ukraine dated 17.10.2019 No. 2207-2. http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?pf3511=67116

19. On Chemical Current Sources: Law of Ukraine dated 23.02.2006 No. 3503-IV. <https://zakon.rada.gov.ua/laws/show/3503-15#Text>

20. On batteries and accumulators: Draft Law of Ukraine dated 30.10.2019 No. 2352. http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?pf3511=67236

21. Guidelines for collection of e-waste included in household waste: Order of the Ministry of Regional Development, Construction and Housing and Communal Services of Ukraine dated January 22, 2013 No. 15. <https://zakon.rada.gov.ua/rada/show/v0015858-13#Text>

22. On waste electrical and electronic equipment: Draft Law of Ukraine dated 30.10.2019 No. 2350. http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?pf3511=67234

23. Cooperation with international organizations, <https://mepr.gov.ua/content/spivrobitnictvo-z-mizhnarodnimi-organizacijami.html>, last accessed 2021/05/19. [in Ukrainian]

24. Environmental organizations, <https://knute.edu.ua/blog/read/?pid=5104&uk>, last accessed 2021/04/09. [in Ukrainian]

25. Environmental organizations in the international arena, <https://artius.ua/novini/statti/ekologichni-organizacii.html>, last accessed 2021/04/08. [in Ukrainian]

26. Waste Management Centre, <https://recycle.com.ua/>, last accessed 2021/04/09. [in Ukrainian]

27. RPE" Ecological Laboratory", <http://www.eco-lab.com.ua>, last accessed 2021/03/22. [in Ukrainian]