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EFFECTIVE MUNICIPAL WASTE MANAGEMENT IN THE EU: EXPERIENCE FOR UKRAINE

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The development of society is accompanied by a constant increase in waste volumes, which is one of the main problems of today. A significant problem is municipal waste, the annual amount of which in the world is over 2 billion tons with a tendency for further sustainable growth. The EU has formed an effective comprehensive system of legal regulation and mechanisms for waste management. Their implementation allowed EU countries to minimize their generation, reduce the negative impact on the environment, and create the prerequisites for the transition to a circular economy. Currently, in the EU, the average level of household waste recycling reaches over 48 %, while in Ukraine it is no more than 7 – 9 %. Because of this, a significant amount of waste is stored in landfills, including unauthorized ones. For our country, the issue of effective waste management, including municipal waste, is relevant in the context of European integration processes and harmonization of national legislation with European legislation. In the presented scientific work, the authors analyzed Ukrainian and European legislation on waste management. A comparative review shows that Ukraine has already taken key steps in bringing the waste management system closer to EU standards. In particular, our country has implemented the European waste management hierarchy and has begun the introduction of ecodesign. At the same time, a number of areas are still in the development stage, in particular, draft laws on the management of packaging waste, waste from electronic equipment, batteries and accumulators, etc. Also, Ukrainian legislation currently lacks clearly defined mandatory target indicators, as in the EU. For full harmonization of EU and Ukrainian legislation, further active development, adoption and implementation of legislative acts, implementation of extended producer responsibility systems, creation of infrastructure for waste collection and control are necessary. It is also very important to establish mandatory waste recycling targets. This will reduce landfill volumes, increase resource efficiency and contribute to our country's transition to the principles of a circular economy. *Key words:* municipal waste, waste management, environmental legislation, EU Directives.

Ефективний менеджмент муніципальних відходів в ЄС: досвід для України. Бублієнко Н.О., Салавор О.М., Тогачинська О.В., Ничик О.В.

Розвиток суспільства супроводжується постійним зростанням обсягів відходів, що є однією із головних проблем сьогодення. Значну проблему становлять муніципальні відходи, щорічна кількість яких у світі становить понад 2 млрд тонн із тенденцією до подальшого стійкого зростання. ЄС сформував ефективну комплексну систему правового регулювання та механізмів поводження з відходами. Реалізація їх дозволила країнам ЄС мінімізувати обсяги їх утворення, зменшити негативний вплив на довкілля, створити передумови для переходу до циркулярної економіки. Нині в ЄС середній рівень переробки побутових відходів досягає понад 48 %, водночас в Україні – не більше 7 – 9 %. Через це значну кількість відходів складують на сміттєзвалищах, у тому числі, несанкціонованих. Для нашої країни питання ефективного менеджменту відходів, у тому числі, муніципальних, є актуальним у контексті євроінтеграційних процесів, гармонізації національного законодавства із європейським. У представленій науковій роботі авторами здійснено аналіз українського і європейського законодавства щодо менеджменту відходів. Порівняльний огляд засвідчує те, що Україна вже здійснила ключові кроки у наближенні системи управління відходами до стандартів ЄС. Зокрема наша країна імплементувала європейську ієрархію поводження з відходами та розпочала впровадження екодизайну. Водночас більша низка напрямів ще перебуває на етапі розроблення, зокрема законопроєкти про управління пакувальними відходами, відходами електронного обладнання, батарей й акумуляторів тощо. Також в українському законодавстві наразі відсутні чітко визначені обов'язкові цільові показники, як у ЄС. Для повної гармонізації законодавств ЄС і України необхідне подальше активне розроблення, ухвалення та реалізація законодавчих актів, впровадження систем розширеної відповідальності виробника, створення інфраструктури для збирання відходів та контролю. Також дуже важливим є встановлення обов'язкових цільових показників перероблення відходів. Це дозволить зменшити обсяги захоронення, підвищити ресурсну ефективність та сприятиме переходу нашої держави до принципів циркулярної економіки. *Ключові слова:* муніципальні відходи, менеджмент відходів, природоохоронне законодавство, Директиви ЄС.

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Problem statement. Municipal waste (often used as a synonym for the term «household waste») is waste generated in households and similar waste generated in institutions, schools, service facilities, etc. Such waste includes: paper, cardboard, glass, plastics, metals, biological waste, packaging, waste electrical equipment, used accumulators and batteries, etc. [1].

Every year, more than 2 billion tons of household waste are generated in the world. According to World Bank forecasts, by 2030 the amount of waste may grow to 2.58 billion tons, and by 2050 – even to 3.77 billion tons.

In Ukraine, about 10 – 12 million tons of household waste are produced annually. In EU countries, their amount is also considerable and reaches 517 kg per person [2].

Currently, the average level of household waste recycling in the EU reaches over 48 %, while Ukraine recycles only about 7 – 9 % of waste. Because of this, a significant amount of waste is stored in landfills, including unauthorized ones. Thus, in Ukraine there are 6000 landfills with a total area of 9000 hectares [3].

Relevance of the study. In 2022, Ukraine received the official status of a candidate for EU membership and is gradually implementing EU directives on environmental protection, including waste management. Given the powerful and successful achievements of the EU in municipal waste, European experience, including in the legislative sphere, is important for Ukraine. EU environmental legislation is aimed at maximum waste recycling and reduction. Waste management should become completely safe for the environment and humans. Therefore, the analysis of EU legislative initiatives and achievements, the popularization of their experience within the framework of the European Green Deal strategy will bring Ukraine closer to the model of a circular economy and sustainable development [4].

The connection of the author's work with important scientific and practical tasks. The research is carried out within the framework of the Erasmus+ Jean Monnet Chair project «Effective waste management in the EU as the best option for Ukraine» (101127175-JMREW-ERASMUS-JMO-2023-HEI-TCH-RSCH), 2023 – 2026, and consists in promoting the adaptation of Ukrainian environmental legislation on waste to European standards. The practical value is the possibility of applying the proposed analysis of EU legislation in improving regulatory, technical, and methodological support in the field of waste management in Ukraine.

Analysis of recent research and publications. The EU policy in the field of waste management is based on a comprehensive system of agreed legislative acts. The main one is the Directive 2008/98/EC «On waste and repealing certain directives», which the European Environmental Bureau (EEB) refers to the *1st level of the waste management system* in the EU [5]. The basis for this Directive was the waste management strategy, defined in the European Commission communiqué back in 1996.

The EU Waste Directive defined the term «municipal waste» and introduced the now well-known 5-step waste management hierarchy in order of priority: prevention, preparing for re-use, recycling, other recovery, including energy recovery, and only then – disposal. The main principles of this Directive include the following: «polluter pays», the principle of extended producer responsibility, self-sufficiency and territorial proximity.

Directive 2018/851/EU [6] was adopted to update and supplement Directive 2008/98/EC, the purpose of which was to promote the transition to a circular economy. The document establishes an obligation for EU countries to ensure an increase in the level of preparation for reuse and recycling of household waste by at least the following amount by mass: by 2025 – 55 %, by 2030 – 60 %, by 2035 – 65 %.

The 2nd level of legal regulation is carried out by Directives that determine the procedure for the functioning of waste management systems. These include Directive 1999/31/EC «On the Landfill of Waste» [7].

The 3rd level of legal regulation in the field of waste management in the EU is based on legislative acts that determine the procedure for handling certain types of waste. Such acts include:

– EU Regulation 2025/40 «On packaging and packaging waste», which stipulates that packaging must be designed with recyclability in mind. Indicative targets have been set by the end of 2030: a minimum recycling rate of 70 % by weight of all packaging waste generated (30 % wood, 60 % aluminum, 80 % ferrous metals, 75 % glass, 85 % paper and cardboard and 55 % plastic). Manufacturers are also required to minimize the weight and volume of packaging and introduce clear and uniform harmonized labeling [8];

– Directive 2012/19/EU on waste electrical and electronic equipment (WEEE) has been extended to household appliances, information technology equipment, photovoltaic panels, electronic and electrical equipment, leisure and sports equipment, toys, etc. The requirement is to remove from WEEE capacitors containing polychlorinated biphenyls (PCBs), components containing mercury, asbestos, hydrochlorofluorocarbons, etc. [9];

– EU Regulation 2023/1542 on batteries and waste batteries stipulates that from 2028 certain types of batteries must contain a minimum percentage of recycled materials. Specific targets for battery collection are provided: for portable batteries, it is 63 % by 31.12.27 and 73 % by 31.12.30. Moreover, used batteries must be accepted on a «0:1» basis, that is, the consumer can return the battery without having to buy a new one [10].

Also important is Directive 2018/2001 on the promotion of the use of energy from renewable sources, according to which EU Member States must ensure that the share of energy from renewable sources is at least 32 % of total final consumption by 2030. The biomass fraction of mixed household waste and bio-waste (food and kitchen waste from households, catering establishments, trade, biodegradable garden and park waste) can be used as raw material for biogas production [11].

The continuation of Directive 2018/2001 is Directive (EU) 2023/2413 on the promotion of energy from renewable sources (known as RED-3), introduced to more actively promote the production and use of renewable energy. The share of green energy in the overall energy mix is expected to increase to 42,5 % by 2030, with an additional indicative increase of 2,5 % to reach the target of 45 % [12].

Regulation (EU) 2024/1781 on ecodesign for sustainable products aims to increase the level of environmental sustainability. Ecodesign is an approach to designing products that minimises the negative impact on the environment throughout their life cycle. Ecodesign involves the use of natural materials, energy efficiency, recyclability, durability and maintainability, etc. [13].

Highlighting previously unresolved parts of the general problem, which is the subject of this article. A comparative analysis of the Directives and Regulations of the European Union on municipal waste management and the legislative framework of Ukraine aims to identify gaps in Ukrainian legislation in this area. Therefore, this gap is the subject of this study in the field of municipal waste management in Ukraine.

Novelty. According to the Association Agreement with the EU, the state of Ukraine is obliged to bring its legislation in the field of waste management, including municipal, into line with the legislation of the European Union. In the presented study, a comparative analysis of the legislative framework of the EU and Ukraine on municipal waste management is carried out for the first time, the steps already implemented by the country are characterized and gaps in Ukrainian legislation in this regard are identified.

Methodological or general scientific significance. The results of the study will contribute to the adaptation of Ukrainian legislation on waste, including municipal waste, to European standards. The analysis of EU legislation on municipal waste presented here will be important for improving regulatory, technical, and methodological support in the field of waste management in Ukraine, and for forming the basis for further research in this area.

Presentation of the main material. The signing of the Association Agreement with the EU obliged Ukraine to bring national legislation in the field of waste management into line with EU legislation. In 2017, the Cabinet of Ministers of Ukraine approved the National Waste Management Strategy until 2030, and in 2024 approved the National Waste Management Plan until 2033 [14]. Their implementation is designed to bring the country's waste management system closer to EU standards and reduce the negative impact on the environment and human health.

The Law of Ukraine «On Waste Management» (2023) outlined the direction in which our state should move to create a modern waste management system and fulfill obligations under the Association Agreement with the European Union by implementing relevant European Regulations and Directives [15].

Currently, work is underway to create sectoral legislation. The priority bills are the bills «On Electrical and Electronic Equipment and Waste Electrical and Electronic Equipment», «On Accumulators and Batteries» and «On Packaging and Packaging Waste», etc.

The principles of designing solid waste landfills are established in accordance with SBC B.2.4-2-2005 «Solid Waste Landfills. Basic Design Provisions» [16]. The Law of Ukraine «On Alternative Energy Sources» provides for the use of certain municipal waste for the production of electricity [17]. Updated technical regulations «On Ecodesign» have also been introduced for certain groups of household goods, which should contribute to resource and energy efficiency [18].

Table 1 provides a comparative analysis of the EU and Ukrainian legislation on municipal waste.

A comparative review of the systems of European and Ukrainian legislative acts shows that Ukraine has already taken key steps in approximating the waste management system to EU standards. In particular, our country has implemented the European waste management hierarchy and has begun the introduction of ecodesign.

At the same time, a number of areas are still in the development stage, in particular draft laws on the management of packaging waste, waste from electronic equipment, batteries and accumulators, etc.

Regarding renewable energy sources, the EU sets specific goals for increasing the share of renewable energy by 2030. However, Ukrainian legislation currently lacks the same clearly defined mandatory target indicators as in the EU.

For full harmonization of EU and Ukrainian legislation, further active development, adoption and implementation of legislative acts, implementation of extended producer responsibility systems, creation of infrastructure for waste collection and control are necessary. It is also very important to establish mandatory waste recycling targets. This will reduce landfill volumes, increase resource efficiency, and contribute to our country's transition to the principles of a circular economy.

Main conclusions. Ukraine, having the official status of a candidate for membership in the European Union, must implement Directives, Regulations and other environmental legislative acts of the EU. This also applies to the field of waste management, including municipal waste. The EU environmental legislation on municipal waste management is characterized by a deep, scientifically based approach, specifics on achieving certain indicators, the reality of the established goals and is an important reference point for Ukraine.

In recent years, the legislation of Ukraine has introduced a waste management system at the state and regional levels, which is consistent with the European one, strategic directions for the development of waste management for the next decade have been developed, tools for the implementation of these tasks and mechanisms for monitoring their implementation have been identified. These are important, but initial stages.

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Table 1

Comparative analysis of EU and Ukrainian legislation on municipal waste management

EU legislation	Main provisions – European Union	Ukrainian legislation	Main provisions – Ukraine
Directive 2008/98/EC	Establishes a 5-step hierarchy: prevention – reuse – recycling – other recovery – disposal	Law «On Waste Manage-ment»	Implements the European 5-step model with a similar sequence of priorities
Council Directive 1999/31/ EC	Defines landfills as engineered structures for waste disposal and divides them into hazardous, non-hazardous and inert waste	SBC B.2.4-2-2005	Defines landfills as specialized engineering facilities for the disposal of solid household and conditionally inert waste
Regulation (EU) 2025/40	By the end of 2030: achieve a minimum recycling rate of 70 % by weight of all packaging waste (30 % wood, 60 % aluminum, 80 % ferrous metals, 75 % glass, 85 % paper and cardboard, and 55 % plastic)	National Waste Manage-ment Strategy in Ukraine	Develop a draft law «On Packaging and Packaging Waste» with recycling rates by 2030 of 65 % of the total mass (60 % plastic, 65 % wood, 75 % aluminum, ferrous metals)
Directive 2012/19/	Collected WEEE is processed to remove	National Waste	Development of a draft law «On WEEE», which
EU	hazardous components (PCB, mercury, asbestos, hydrocarbons and other similar substances)	Manage-ment Strategy in Ukraine	will determine the system of separate collection, processing and disposal of WEEE
Regulation (EU) 2023/1542	Collection targets for portable batteries: 45 % by 2023; 63 % by 2027; 73 % by 2030, and for light vehicle batteries: 51 % by 2028; 61 % by 2031	National Waste Manage-ment Strategy in Ukraine	Develop a draft law «On Waste Batteries, Batteries and Accumulators», which will establish mandatory indicators
Directive (EU) 2018/2001	The share of biomass fraction and biowaste for biofuels and biogas in the transport sector should be 1 % in 2025, 5,5 % in 2030	Law «On Alternative Energy Sources»	Provisions on the use of alternative energy sources (biodegradable municipal waste) and promotes their expansion in the fuel and energy complex
Directive (EU) 2023/2413 (RED – 3)	Increase the share of rene-wable energy in total con-sumption to 42,5 % by 2030, complementing an additional target of 2,5 %		
Regulation (EU) 2024/1781	Approved ecodesign criteria and digital product passport	Technical regulations «Regarding eco-design requirements»	Aimed at increasing the energy efficiency of household appliances

Despite the difficult period due to the russian-Ukrainian war, further steps should be actively taken to develop and implement laws and legislative acts, specify final indicators, and create a real waste infrastructure.

Prospects for using the research results. The results of the comparative analysis of the legislative framework of the European Union and Ukraine on municipal waste management will be important and useful for the further development and improvement of this system in our country. This will contribute to Ukraine's approach to the model of a cyclical economy and sustainable development.

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