KSE | Urban Studies and Postwar Reconstruction

Master's Thesis

"Waste-to-energy plant as an essential component of a circular economy for a sustainable city"

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CONTENT

Abstract. This paper examines the implementation of waste-to-energy technology as a solution to Ukraine's waste management crisis. A sociological survey revealed a low level of public awareness regarding waste sorting and recycling, as well as inadequate infrastructure. Given the numerous overcrowded landfills and the increasing environmental burden, waste-to-energy technology is proposed as a practical solution that can reduce waste volume and provide an additional source of energy. A comparative analysis of Denmark, Poland, and Ukraine's experiences with waste incineration and waste management was conducted. The focus is on adapting European practices to the realities of Ukraine. Therefore, it is suggested that the concept of a zero-waste city be combined with waste-to-energy technology in smaller towns and regional centers to promote a circular economy in Ukraine. This model will effectively support the development of sustainable cities during the war and post-war periods.

Keywords: waste-to-energy, circular economy, zero-waste city, waste management

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1. INTRODUCTION

1.1. Relevance of the research

Modern cities face serious challenges in waste management. Suppose this system is not well-established. In that case, this can lead to catastrophic consequences, including the accumulation of garbage on the streets, its rotting, the spread of infectious diseases, and pollution of air, soil, and water. Such a situation not only worsens the city's ecological condition but also negatively affects residents' quality of life. The lack of an effective waste management system can paralyze the city's work, as happened in Lviv in 2016. In this context, the concept of a zero-waste city becomes critically important. One of the key elements of the circular economy in the city is waste-to-energy (WtE) technology, which enables the conversion of waste into energy (Paul H. Brunner and Leo Morf, 2024). This not only helps reduce the volume of garbage but also provides an alternative energy source, which is especially relevant for Ukraine under martial law.

The circular economy has a profound impact on modern waste management and promotes sustainable urban development. Unlike the linear model that uses and then discards resources, the circular economy seeks to maintain the value of materials and resources throughout the cycle for as long as possible. This approach focuses on minimizing waste production, enhancing reuse, recycling, and adopting innovative strategies for effective resource management.

Despite advancements in adopting circular economy principles, many countries continue to face challenges in waste management. Eurostat's 2022 data indicate a rising trend in waste recycling across EU nations. For instance, Germany, the Netherlands, and Sweden boast

recycling rates exceeding 50%. In contrast, countries like Romania depend significantly on landfilling for most household and industrial waste. This reliance undermines sustainable development goals and poses significant environmental risks, such as soil and water contamination and greenhouse gas emissions, particularly methane.

In this context, waste-to-energy (WtE) plants are increasingly important. They provide a practical way to handle residual waste that can neither be reused or recycled, all while producing electricity or heat (J. Malinauskaite et al., 2017). Nonetheless, the role of WtE plants in the circular economy remains a contentious issue among researchers, given their mixed advantages and disadvantages. On one hand, they help decrease landfill waste and generate renewable energy; on the other hand, concerns arise regarding their potential effects on human health and the environment due to harmful emissions.

This research examines the role of waste-to-energy (WtE) within the circular economy, drawing on examples from Denmark and Poland. Denmark is recognized as a leader in WtE, which forms a crucial component of the national waste management strategy. For instance, the Amager Bakke facility in Copenhagen processes waste efficiently and functions as a tourist destination. Poland's experience in implementing waste incineration plants can serve as a priority for Ukraine in developing a waste management system. After all, these are two neighboring countries with a similar urban structure and level of urbanization, geographical location, climatic conditions, etc. The main reason for the construction and operation of such plants in Poland was the desire to reduce the number of landfills, which is relevant for Ukraine. Additionally, waste management issues in Ukraine are explored, highlighting the obstacles that impede its progress.

This research performs a SWOT analysis of waste-to-energy (WtE), highlighting its strengths, such as waste reduction and energy generation, weaknesses like high initial costs and environmental concerns, opportunities including advancements in technology and job creation, and threats like community opposition and pollution risks (Kohl Ulrik, 2019). To support this analysis, I utilize findings from recent publications from 2012 to 2025, allowing me to compile the latest scientific and practical knowledge in this field.

Therefore, the primary aim of this research is to examine the role of waste-to-energy (WtE) in the city's circular economy, highlight the benefits and challenges of its implementation, and provide recommendations for incorporating such a facility within the broader waste management framework. The findings may inform the development of policies and strategies aimed at establishing sustainable urban systems that align with the principles of the circular economy.

The research is relevant for Ukraine, as it allows us to identify ways to create a zero waste city and build waste-to-energy plants as a key element of the circular economy. This will help solve the waste problem, improve the environmental situation, and ensure the energy sustainability of Ukrainian cities in the future.

1.2. Research question and hypothesis

Main research question: What role does waste-to-energy play in the urban circular economy, and what are the challenges and opportunities of its implementation in Ukraine?

Research hypothesis: Waste-to-energy can serve as an important component of a sustainable city, contributing to the reduction of landfills and their reclamation, which in turn improves the city's ecological condition. As an example, waste-to-energy in Copenhagen is considered one of the safest factories in the world. In modern conditions, the effective use of waste through recycling, reuse, and the production of energy from waste is an important step towards ensuring a sustainable urban ecosystem. Due to military operations in Ukraine, there is a shortage of energy resources; therefore, waste-to-energy can contribute to the development of alternative energy sources and increase the city's energy independence. Additionally, Ukraine has faced the problem of destruction due to the war. Large volumes of construction waste are placing additional pressure on already overcrowded landfills. In such situations, waste-to-energy (WtE) can play a crucial role in disposing of demolition waste that cannot be reused or recycled.

1.3. Research Objective

The research objective is to analyze ways to improve waste management in Ukraine, considering the principles of the circular economy and international experience. To achieve this goal, the research covers study of the successful implementation of waste-to-energy in Poland and Denmark; analysis of current waste management in Kyiv and Kaniv, analysis of legislation, in particular the Law of Ukraine "On Waste Management" (2023), which should comply with European standards; and providing recommendations for implementing a waste-to-energy plant as a means of advancing the circular economy in Ukraine.

1.4. Research methodology

A comprehensive approach was used to achieve the research goal, including quantitative and qualitative methods of analysis.

A questionnaire survey involving 108 respondents from Kyiv and its surrounding areas lasted from October 28, 2024, to April 14, 2025. This survey aimed to assess public awareness of the waste management system in Kyiv, identify reasons for the low level of waste management culture, and evaluate residents' attitudes toward the construction of a waste-to-energy plant in the city.

In-depth interviews were conducted with employees of the "NoWasteUkraine" sorting station and their visitors, allowing for a deeper study of the barriers and difficulties people face when sorting waste and their proposals for improving waste management in Ukraine.

Based on the collected data, the following was realized:

– Comparative analysis of approaches to waste management in Europe and Ukraine, namely Kyiv and Kaniv.

– An analysis of successful models of waste-to-energy plants in Copenhagen (Denmark), Copenhill, a modern plant that combines waste incineration with energy production and urban functions (rooftop ski slope), and waste-to-energy in Krakow (Poland), an example of effective WtE implementation in a country with similar challenges to Ukraine.

– Work with maps. Geoanalysis using QGIS allowed to assess the location and accessibility of waste sorting infrastructure in Kyiv.

Thus, the combination of sociological and analytical methods enabled a comprehensive understanding of the value of WtE as a tool for reducing dependence on landfills, enhancing energy security, and promoting the transition to a circular economy. The collected empirical data, comparative examples, and expert assessments facilitated the formation of substantiated conclusions and recommendations.

1.5. Description of the research structure

The second section is devoted to a review of the scientific and analytical literature related to the circular economy, waste-to-energy, and the concept of a zero-waste city. Particular attention is paid to how these concepts are interconnected and how they shape sustainable urban development. This section also provides a detailed SWOT analysis of waste-to-energy technology, examining its strengths and weaknesses, opportunities, and threats, particularly in the context of the circular economy.

The third section analyzes real examples of the implementation of waste-to-energy solutions and circular approaches in the cities of Copenhagen (Denmark) and Kraków (Poland). It examines how these practices are integrated into local ecosystems and contribute to sustainable waste management.

The fourth section focuses on the problems of the waste management system in Ukraine using the example of the cities of Kyiv and Kaniv. It identifies the key reasons for the current state of the industry, including infrastructural, economic, and social factors. It determines how these factors relate to the potential or constraints for the development of waste-to-energy technologies in the country.

The fifth section analyzes the current legislation in the field of waste management in European countries and Ukraine, allowing for an assessment of legislative barriers and potential.

Finally, the sixth section summarizes the identified problems in waste management in Ukraine, based on the previous sections, and provides an analytical basis for further strategic recommendations on implementing waste-to-energy technology.

2. THEORETICAL BASIS DERIVED FROM THE LITERATURE REVIEW

2.1. Literature Review Methodology

For this study, a literature review methodology was provided, which helps to evaluate the existing academic literature on the principles of the circular economy (CE), with a particular emphasis on waste-to-energy (WtE) and the zero waste city concept as essential elements of sustainable urban development. The primary focus is on assessing the influence of waste-to-energy (WtE) on urban sustainability, while also analyzing the advantages and disadvantages of this technology.

A clear literature search strategy was developed to support a comprehensive analysis. The search queries were crafted using these keywords, which represent the main research topics: "circular economy", "waste-to-energy", "circular economy cities", "urban sustainability", "zero waste city", "waste incinerator", and "municipal waste management."

To find relevant information, keywords were combined using logical operators ("AND" and "OR"). The review utilized scientific databases to ensure a comprehensive literature survey, including ResearchGate, JSTOR, ScienceDirect, and Google Scholar. Additional resources included European Parliament briefings (offering insights into European policy initiatives concerning CE and WtE); institutional reports, particularly from the Stockholm Environment Institute and Ellen MacArthur Foundation, CEWEP (Confederation of European Waste-to-Energy Plants), Zero Waste Europe; Eurostat (supplying data on waste management across European Union countries) and others.

To narrow down the extensive literature available on scientific databases, pre-established inclusion and exclusion criteria were used. Sources must have been published between 2012 and 2025 and include relevant analyses or case studies related to WtE, the circular economy, or the zero waste city, and be available in either English or Ukrainian to facilitate accurate content analysis. Another criterion was the availability of the full text of articles. Also, the titles of the studies and keywords were examined for the presence of relevant search terms. If the article addressed the research question stated above, it was carefully examined, and necessary information was extracted. Furthermore, to search for additional literature, the forward and reverse snowball method was used.

Therefore, according to the conducted literature review methodology, 12 relevant academic papers were selected, which formed the theoretical basis for this study.

2.2. Literature Review

2.2.1. Circular Economy: Meaning and Theoretical Framework

The circular economy (CE) embodies a crucial concept in modern economic thought, aiming to reduce resource consumption and decrease waste. According to the European Parliament's definition website,

The Circular Economy *encompasses a production and consumption model that includes exchanging, renting, reusing, repairing, recycling, and recovering materials and products to prolong their life cycle.*

This approach helps decrease waste generation and lowers the demand for raw materials and harmful emissions, thus preserving the value of products throughout their life cycle (European Parliament, 2023).

CE sharply contrasts with the conventional linear model, which follows the "production – use – disposal path."

Research indicates that CE aims to establish closed loops, where resources are continuously circulated and reused in production, thereby fostering sustainable development (Ellen MacArthur Foundation, 2015).

The circular economy is becoming more embedded in urban sustainable development strategies. Joanna Williams' research, "Circular Cities" (Williams, 2019), examines how the circular economy (CE) is applied in urban settings using the RESOLVE Framework, designed by the Ellen MacArthur Foundation. This framework consists of six essential principles:

1. Regenerate: utilizing renewable resources and rehabilitating ecosystems.
2. Share: enhancing product usage through sharing.
3. Optimize: boosting production efficiency while reducing waste.
4. Loop: facilitating the reuse and recycling of materials.
5. Virtualize: adopting virtual solutions that minimize resource usage.
6. Exchange: substituting resource–intensive products with more sustainable alternatives.

The RESOLVE Framework equips city governments and policymakers with a practical resource for evaluating and executing a circular economy.

The implementation of circular economy principles at the national level relies not only on conceptual frameworks, such as the Circular City or the Resolve Framework, but also on the chosen model of policy implementation. This is clearly illustrated by the examples of Europe and China, which employ their respective bottom-up and top-down approaches to implementing circular policies. The European bottom-up approach encompasses collaboration among local communities, businesses, and authorities, fostering eco-design and promoting recycling and innovation at the regional level. In China, the circular economy is being pursued through a top-down approach (Wang et al., 2018). The government initiative relies on centralized planning and extensive industrial symbiosis. While this strategy enables the swift establishment of large-scale infrastructure, it often struggles to adapt to local circumstances.

Thus, both approaches demonstrate different ways of integrating circular solutions into strategic sectors, particularly in waste management, where waste-to-energy technology serves as an essential link, combining garbage disposal with energy production.

2.2.2. Waste-to-Energy: Definition and Role in the Circular Economy

A key element of the circular economy is waste-to-energy (WtE). The definition is provided on the CEWEP (European Association of Waste Incineration Plants) website.

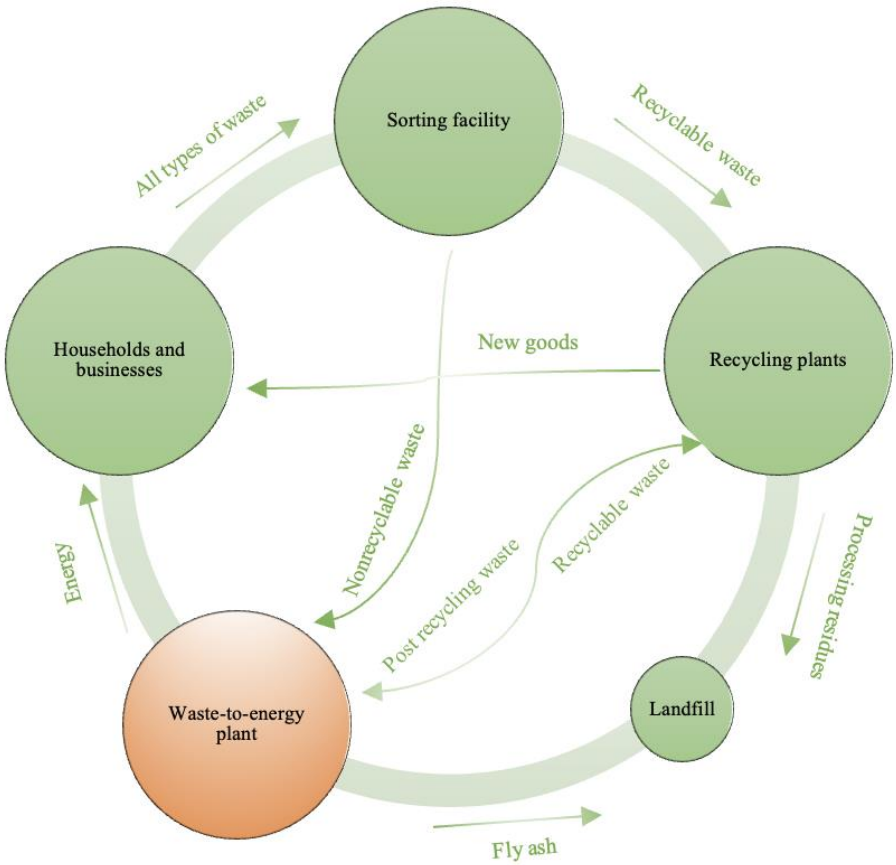
Waste-to-Energy (WtE) plants*, whether stationary or mobile, are technical units specifically created for thermally treating waste to generate energy in the form of heat, electricity, or steam.*

These facilities focus on managing waste that cannot be prevented or recycled, aiming to reduce the quantity that ends up in landfills (CEWEP, 2023).

European experience demonstrates the high efficiency of integrating WtE into circular economy systems. For example, Sweden, Finland, and Norway use WtE to recycle over 50% of their municipal waste (CEWEP, 2021). This significantly reduces dependence on landfills and increases energy security.

Paul H. Brunner and Leo Morf, "Waste to Energy, Indispensable Cornerstone for Circular Economy: A Mini-review," (2024) explain the operation of each component in the circular economy model and highlight the significance of waste-to-energy (WtE) facilities. The scheme below demonstrates how waste generated from consumption progresses through sorting and processing stages within this framework.

Scheme 1. The role of waste-to-energy in the circular economy



Note: The author generated the scheme based on ICLEI (2021) and Paul H. Brunner, Leo Morf (2024).

The scheme illustrates the circular economy model, with a focus on the role of waste-to-energy as a key element. It demonstrates the interconnections between all components of the system. Recyclable materials are directed to dedicated recycling facilities. Meanwhile, non-recyclable waste is transported to Waste-to-Energy (WtE) plants. At these facilities, waste is burned to generate energy, which can be utilized as electricity, heat, or steam to fulfill the community's requirements. Also, WtE combined with carbon capture and storage technology reduces greenhouse gas emissions (Paul H. Brunner and Leo Morf, 2024).

Additionally, metal residues are left behind at WtE plants after incineration, which are subsequently sent for recycling. The ash generated during incineration retains its utility as well. It can be utilized in construction to create materials for roads and other infrastructure projects (Aneeta Mary Joseph, 2018). The waste-to-energy facility also enables the production of clean water, which is recovered during the flue gas condensation stage. Such water is often used to compensate for the losses in the district heating network (Torben Hulgaard and Inger Søndergaard, 2018, 10).

Given the significant role that waste-to-energy technology plays in achieving the goals of the circular economy, it is advisable to analyze its strengths and weaknesses, as well as external opportunities and threats, through a SWOT analysis.

2.2.3. Zero Waste City: connection with the Circular Economy

According to Zero Waste Europe[1],

The zero waste city *concept focuses on minimizing the amount of waste that needs to be incinerated or landfilled. In such cities, preference is given to reuse, repair, composting, and deep sorting.*

Zero waste initiatives encompass circular system thinking, co-creation involving residents, businesses, and local governments, education and knowledge sharing, incentive systems, and the design of spaces that facilitate experiencing the concept (Anna-Sara Fagerholm et al. 2025).

However, it is worth recognizing that even in a zero waste city, a small amount of waste that cannot be recycled still ends up in landfills.

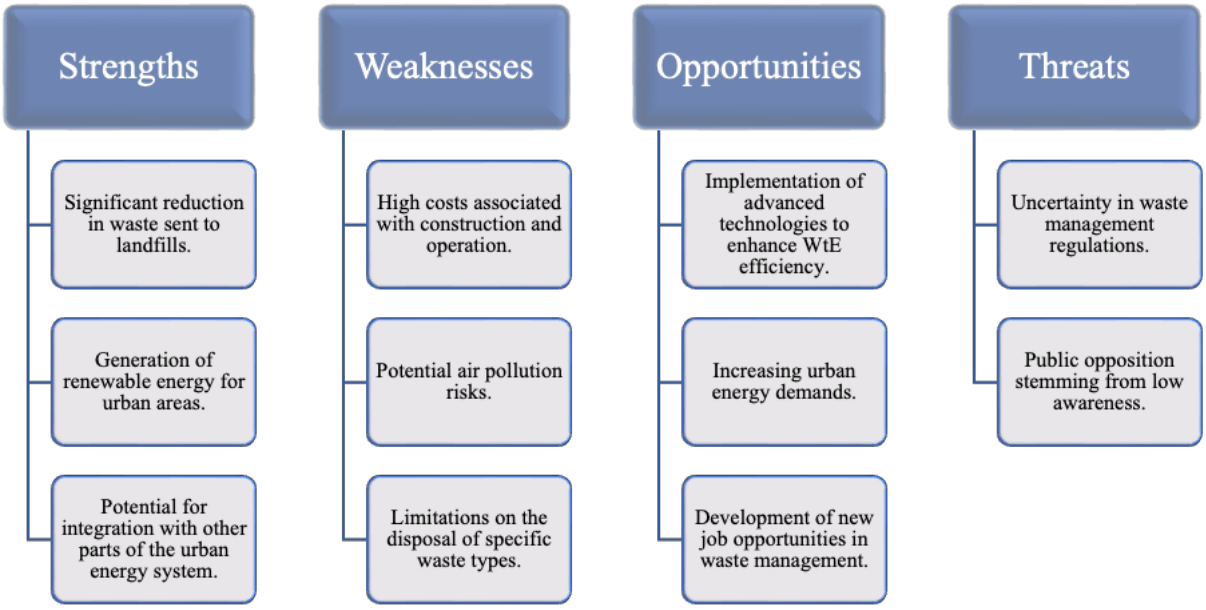
Thus, the zero waste city and the circular economy share a common goal – reducing the environmental burden – but employ different approaches to achieving this goal: the circular economy allows for incineration with energy gain, whereas the zero waste city seeks to avoid it completely.

[1] https://www.missionzeroacademy.eu/municipalities/zero-waste-cities-certification/

2.3. SWOT analysis of Waste-to-Energy utilization

A SWOT analysis evaluates the role of waste-to-energy (WtE) within the circular economy, highlighting key aspects (Kohl Ulrik, 2019), as demonstrated in Figure 1.

Figure 1. SWOT analysis of waste-to-energy



Note: adapted from the basis of Kohl Ulrik (2019)

Based on the SWOT analysis, it follows that the strengths and opportunities of waste-to-energy (WtE) outweigh the weaknesses and threats. The most important thing is that this technology recycles waste that cannot be recycled and converts it into heat or electricity. This not only improves the environmental situation, reducing the burden on landfills, but also provides cities with an additional source of energy.

From an economic perspective, WtE technology is attractive to investors because it generates multiple sources of revenue. Firstly, enterprises receive a fee for accepting and recycling waste (the so-called gate fees), and secondly, profit from the sale of the energy produced (electricity or heat) (Mário Silva et al. 2023).

Among the weaknesses, it is worth noting the high cost of building and operating such plants. Filtration systems that capture hazardous particles, such as fly ash, are expensive. This is confirmed by the words of Ella Stengler, director of CEWEP (Confederation of European Waste-to-Energy Plants): “If waste-to-energy plants are built, they must be equipped with the most modern and expensive technologies. You need to train the staff to operate the equipment properly, and the authorities to exercise proper control.”[2] The construction of such a plant can exceed a billion US dollars, posing challenges in securing financing for the projects. In the absence of these filters and effective monitoring, disposal can have negative environmental consequences.

[2] Спалювання сміття як джерело енергії: за і проти | DW Ukrainian

Another threat that has not been previously considered is force majeure, such as natural disasters (e.g., earthquakes) or military actions that can damage or destroy the plant's infrastructure. At the same time, in the context of the war in Ukraine, such infrastructure, on the contrary, demonstrates its importance. The WtE plant provides part of the city with heat even when Russian shelling disables other sources of energy supply.

3. EXPERIENCE IN USING WASTE-TO-ENERGY IN EUROPE

3.1. Copenhagen (Denmark) – successful integration of Waste-to-Energy into the urban ecosystem

Denmark is a country with one of the most efficient waste management systems in Europe. Its circular economy is characterized by a well-developed infrastructure for sorting, recycling, and waste-to-energy management. As of 2022, only up to 2% of household waste is landfilled, according to Eurostat.

Sorting stations operate in every municipality. Containers for separate waste collection are installed in every household (Circular Copenhagen, 2025). A successful system is in place to encourage the population to sort. Firstly, the principle of "less waste – less fee" is used, which means that the less unsorted waste a person produces, the lower the fee for garbage removal. This motivates residents to sort more carefully. Secondly, the use of a deposit system (Pant system). It refers to the use of specialized machines for accepting containers (such as plastic or metal) in exchange for a specified amount of money. As a result, the collection rate reaches over 90%.

According to the law, starting in 2022, all households are required to sort their waste. Fines are provided for violations of the rules, and the responsibility lies with the housing association or the building manager. Municipalities are required to monitor compliance with the regulations. Additionally, a successful public education campaign on waste sorting is being implemented, beginning with kindergartens.

Waste-to-energy plants play a crucial role in Denmark's circular economy, supplying residents with electricity and heat. Most of the waste incineration plants in the country are owned by municipalities. As of 2025, there are about 30 waste incineration plants operating in its territory, 24 of which specialize in incinerating household waste.

Copenhill

The waste-to-energy facility in Copenhagen, known as Amager Bakke in Danish and Copenhill in English, exemplifies an innovative approach to waste management and sustainable energy production within the framework of the circular economy.

The plant is considered one of the safest and most modern in the world. Copenhill, which officially opened in March 2017, is a unique facility that combines waste disposal technologies with recreational amenities. On its roof, there is an artificial ski slope for skiing, snowboarding, hiking, and walking. There is also one of the highest climbing walls in Europe.

Copenhill demonstrates to residents that a waste incineration plant can be not only environmentally safe but also beneficial to the community, economically and socially.

This section draws on the report "Waste-to-Energy and Social Acceptance: Copenhagen Waste-to-Energy Plant" (March 2021) to examine the plant's key performance indicators, business model, and social advantages and challenges in relation to Denmark's circular economy strategy.

Copenhill Plant Outcomes

Copenhill's operations showcase exceptional efficiency and resource recovery. For each 1,000 kg of municipal waste, the facility generates:

– 2–71 MWh of heat for the district heating system, satisfying the city's energy requirements.

– 150 kg of ash utilized in construction projects, including road infrastructure.

– 400 kg of water that is treated for reuse.

These figures demonstrate the plant's multifunctionality, fulfilling energy requirements while also reducing reliance on raw materials.

According to Mar Edo (2021), in 2020, Copenhill provided:

– 1,363 GWh of heat, which was used to heat 90,000 apartments.

– 244 GWh of electricity, which met the needs of 80,000 households.

The plant connects to the Copenhagen district heating network, enabling year-round heat sales at nearly full capacity. This integration minimizes energy losses and maximizes resource efficiency.

Copenhill's economic model

The plant's economic model relies on two primary revenue sources:

1. Gate Fee: Approximately 60 euros are charged for processing one ton of waste, with about 60% of this amount directed to the state budget as taxes.

2. Energy Revenue: The heat and electricity generated at the plant are sold on the market, creating supplementary income. This system enables the plant not only to process waste effectively but also to yield financial benefits, thereby bolstering the local economy.

Compliance with the objectives of the circular economy

The Circular Economy Action Plan 2020, part of the European Green Deal, discusses waste-to-energy in a cautious context, acknowledging that it is a form of recycling rather than a means of resource conservation. This indicates a loss of materials that could be reused or recycled. Thus, waste-to-energy is only the penultimate step when all other options have been exhausted. The EU will, therefore, review the role of incineration with energy recovery in the future circular system, to limit its use. However, for countries lacking a developed infrastructure, waste-to-energy can serve as a temporary transitional stage, as long as it does not hinder the progress of recycling and reuse. Therefore, determining the optimal number of such facilities to ensure systemic balance in waste management is a relevant issue.

Copenhill, on the other hand, fully aligns with the goals of the Circular Economy Action Plan (2020) and the European Green Deal (2021), which aim to achieve climate neutrality by 2050. After all, the plant utilizes state-of-the-art systems for capturing hazardous particles during waste incineration, and Denmark has a highly developed waste management system that is well-established.

According to that, key aspects that highlight the plant's role in the transition to a circular economy are demonstrated below:

– Waste minimization. The plant reduces the amount of waste going to landfills and decreases greenhouse gas emissions.

– Resource recovery. By recovering energy, materials, and water, the plant helps conserve scarce resources.

– Environmental sustainability. Copenhill replaces fossil fuels with energy derived from waste, supporting decarbonization goals.

Social and environmental benefits

Beyond its technological advancements, Copenhill has gained widespread public acceptance due to its multifunctional features. The roof of the plant includes a ski slope, hiking trails, and a climbing wall, turning an industrial area into a hub for community engagement. This creative design enhances the social incorporation of waste-to-energy technologies within urban settings.

The plant plays a crucial role in Denmark's climate objectives by cutting CO_2 emissions and enhancing renewable energy production. Its functioning exemplifies how waste-to-energy technologies can aid sustainable urban development.

Challenges

Copenhill, despite its achievements, encounters several challenges that mirror the broader issues facing the waste-to-energy system in Denmark. Firstly, there is growing competition with recycling. As waste recycling rates rise, the volume of materials available for incineration diminishes, risking under-utilization of the facility. Secondly, reliance on waste imports. Danish waste-to-energy plants, including Copenhill, must import waste from other nations to maintain full capacity, prompting concerns about the environmental ethics and practicality of waste transportation. Thirdly, political and societal debates. Some critics argue that expanding waste-to-energy facilities may contradict the principles of a circular economy, which emphasizes waste reduction and recycling.

So, Copenhill is a crucial example of cities adopting a sustainable waste management model. This case study demonstrates how integrating technology, policy, and innovative design can contribute to achieving global sustainable development goals.

3.2. Kraków (Poland) – experience of the European approach to Waste-to-Energy

The waste management case of Poland is an excellent example for Ukraine to follow. After all, these two neighboring countries share the same geographical and climatic conditions, as well as a similar urban structure. As of 2025, 8 waste-to-energy plants are operating in Poland. As part of its decarbonization strategy, the country plans to construct

additional plants (Jakub Bator, 2024)[3]. Poland intends to provide each region with at least one waste-to-energy plant to optimize the waste management system.

It is worth noting that the presence of 8 WtE plants is insufficient to fully process the amount of waste Poland generates annually. As of 2024, 37.8% of household waste is landfilled. The country faces difficulties in waste recycling, which remains at a low level. Therefore, the focus is now on developing waste sorting.

For example, in Kraków, a mandatory separate waste collection system has been in effect since 2019, utilizing a door-to-door approach.

Additionally, repair and reuse practices are emerging in Poland. For example, Repair Cafés are places where residents repair broken items for free and receive advice on reducing waste. Such activities contribute to raising the environmental awareness of the population.

In Poland, there are incentives for sorting waste similar to those in Denmark, including a "pay-per-quantity" system and a deposit system for plastic bottle collection machines. Municipal services, as well as housing managers (homeowners' associations), monitor compliance with sorting rules.

Ekospalarnia Kraków is one of the most modern waste-to-energy (WtE) plants in Poland, contributing to the decarbonization of the city and serving as an important element in the circular economy. The Eco-incinerator in Krakow was launched in 2016 as part of the "Waste Management Program in Krakow," supported by the Operational Program "Infrastructure and Environment" for 2007–2013. The plant is 100% owned by the city of Kraków. Main characteristics of the plant:

- Capacity. The facility is equipped to handle up to 220,000 tons of municipal waste annually and covers approximately 10% of the Kraków district heating system's needs.

- Waste Type. It processes mixed municipal waste collected from residents, along with residues from mechanical processing, such as construction and other debris. All the waste originates exclusively from the Municipality of Kraków.

- Project costs are considerably lower than those of the Copenhill plant. The net expense was approximately PLN 666 million (gross: PLN 819 million), with PLN 372 million (55.8% of the total) funded through an EU subsidy. The remaining expenses were financed through internal resources and a loan obtained from the National Fund for Environmental Protection and Waste Management.

The plant meets modern standards defined within the Best Available Technologies (BAT) framework, ensuring a high level of environmental protection.

As of October 1, 2016, an educational pathway has been established at the plant site. It provides residents with insights into waste thermal conversion methods, flue gas purification technologies, heat and electricity generation, and the use of byproducts following incineration.

This helps increase environmental awareness in the community and promotes contemporary waste management methods.

[3] https://www.cewep.eu/wp-content/uploads/2024/05/6.-Jakub-Bator_Ekospalarnia-Krakow.pdf

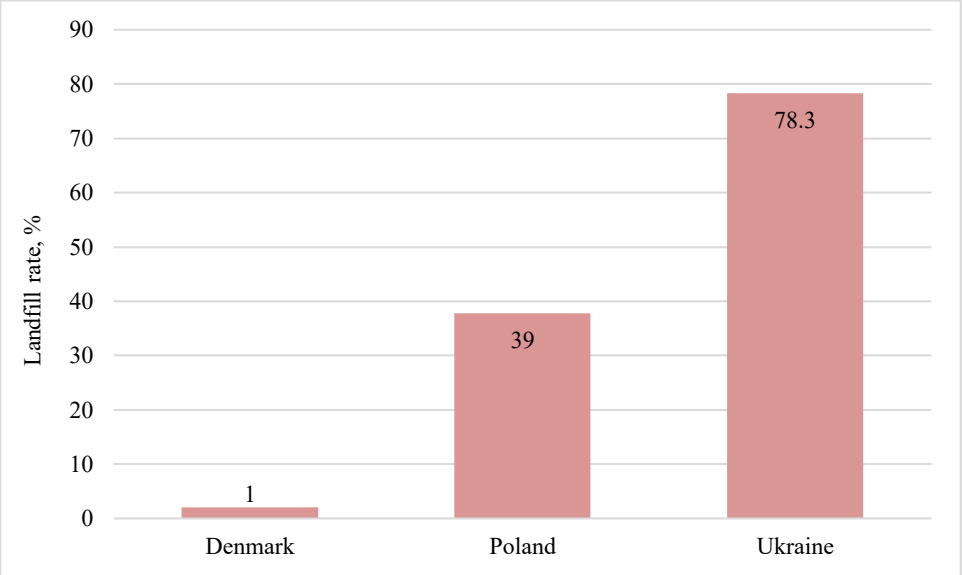
The experiences of European countries, particularly Denmark and Poland, are valuable sources for analyzing the effective development of waste management systems and the implementation of WtE technology within the framework of a circular economy. This knowledge serves as the basis for conducting a comparative analysis, enabling a deeper understanding of what should be considered when developing strategies to improve waste management systems in Ukrainian cities.

4. ANALYSIS OF WASTE MANAGEMENT PROBLEMS IN UKRAINE

4.1. Analysis of the condition of waste management in Ukraine and identification of its problems

Ukraine faces challenges in this sphere, which hinder the transition to a circular economy. To demonstrate the scale of the problem, it is worth comparing the level of municipal waste disposal with that of countries where their waste management systems are more efficient. The following Figure shows the landfill rate of municipal waste in Denmark, Poland, and Ukraine.

Figure 2. Landfill rate of municipal waste in Denmark, Poland, and Ukraine (%), 2020



Note: The author provided own calculations using data from Eurostat and the State Statistics Service of Ukraine, and created the bar chart.

Source 1: The website of Eurostat.[4]

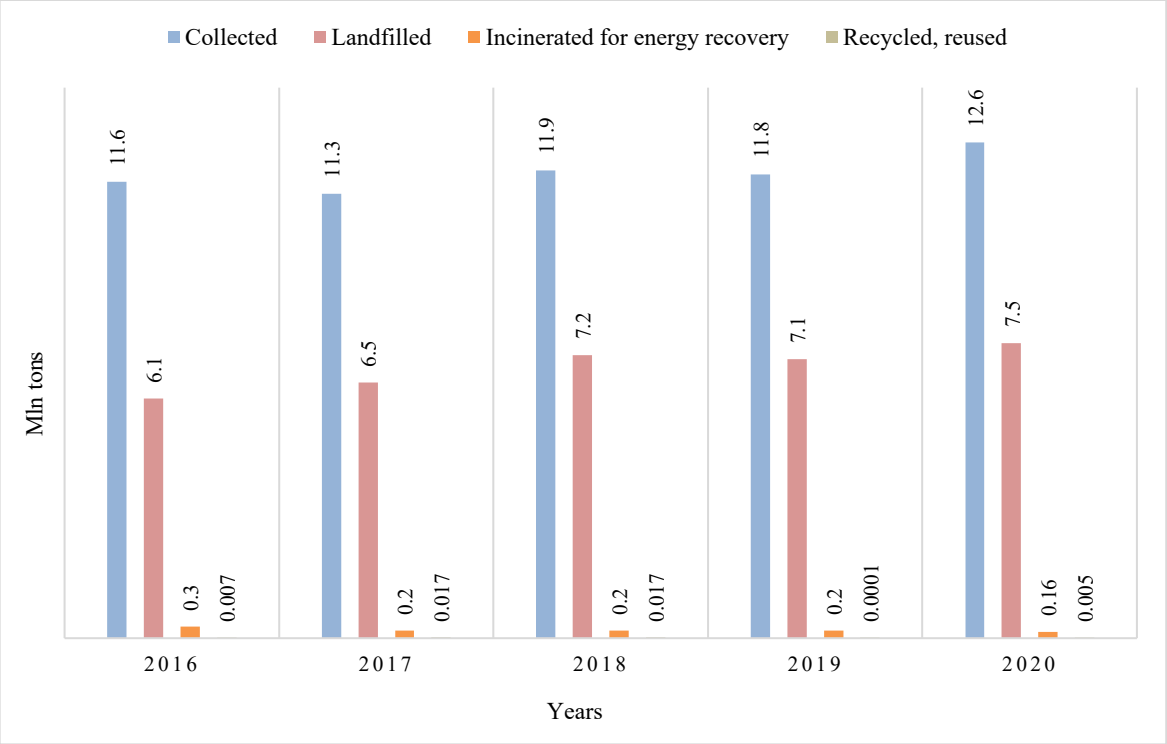
Source 2: State Statistics Service of Ukraine. Environment of Ukraine: Statistical Yearbook 2021, 108.[5]

The chart indicates that Denmark excels in waste management, landfilling the least amount of waste while recycling and burning the rest to generate energy. In contrast, Poland faces challenges with recycling. As for Ukraine, the chart reveals that almost 80% of municipal waste ends up in landfills, highlighting the low level of the country's waste management system. This is confirmed by the data shown in the following figure.

[4] https://ec.europa.eu/eurostat/databrowser/view/env_wasmun__custom_16927289/default/table?lang=en

[5] Environment of Ukraine Довкілля України

Figure 3. Household and similar waste management in Ukraine for 2016-2020



Note: The bar chart was created by the author using data from the State Statistics Service of Ukraine[6]. Due to the full-scale aggression of the Russian Federation against Ukraine, which began in 2022, official statistics on waste management posted on the website of the State Statistics Service of Ukraine were not updated at the time of preparing this master's thesis.

Source 1: State Statistics Service of Ukraine. Household and similar waste management for 2011-2020[7]

The bar chart illustrates that from 2016 to 2020, the household waste management system underwent several changes. In 2020, the State Statistics Service reported a one-million-ton increase in household waste compared to 2016. And the volume of waste taken to landfills increased by 1.4 million tons compared to 2016. One of the reasons for this negative phenomenon could have been the COVID-19 pandemic, which led to mass quarantines and lockdowns in 2020. This indicates a weak household waste management system that is unable to withstand force majeure circumstances. What led to this?

In 1991, after gaining independence, Ukraine inherited from the Soviet Union a rather primitive, ineffective garbage collection and processing system. The state faced new challenges in trash handling. Most of the Ukrainian garbage dumps have already exhausted their resources and have the status of dangerous. For example, the Lviv solid waste landfill opened back in 1960 near the village of Velyki Hrybovychi. In May 2016, a tragedy occurred at this landfill: a large-scale fire started there, and as a result of a debris slide, three firefighters

[6] Data from the territories of Ukraine occupied by the Russian Federation were not taken into account.

[7] https://www.ukrstat.gov.ua/operativ/menu/menu_u/ns.htm

and a landfill worker died. After that, the work of the landfill was stopped, and Lviv found itself in a garbage collapse. There was nowhere to take the trash; other regions refused to accept it at their landfills as they were also full. It was a real garbage blockade of Lviv.

The issue of waste management in Ukraine has remained unsettled at the legislative level for a long time. The problem was that there were no clear rules regarding recycling, the use of renewable resources, and environmental pollution caused by improper waste disposal. More details about this issue will be discussed in the section regarding legislation.

Thanks to the European integration process in Ukraine, following the waste crisis in Lviv in 2016, efforts have been made to improve waste management standards, including increasing recycling and reducing landfill waste. For example, by the end of 2023, a waste processing plant in Lviv was planned to be built, which would process 250,000 tons of waste annually, equivalent to the amount of garbage collected in Lviv in a year. However, unfortunately, the war in Ukraine impacted the construction deadline. The mayor of Lviv, Andriy Sadovy, also mentioned that, alongside the plant's construction, a food and garden waste composting station has already become operational, and efforts to reclaim the Hrybovychi landfill were in progress[8]. Implementing the garbage sorting system in Ukraine is a lengthy process. However, the biggest problem is not financing or setting up this system but informing the country's population about the need for proper waste management.

Unfortunately, due to the full-scale war of Russia against Ukraine, which began on February 24, 2022, and is ongoing at the time of writing this essay, another problem has arisen – waste from the war: unexploded shells and debris from them, burned transport and military equipment, batteries, ruins of buildings and infrastructure (National Waste Management Plan until 2033, 2024, 5)[9]. There is a significant threat of improper processing and harmful disposal of this waste.

Today, Ukraine is also experiencing a severe crisis in the recycling sector. A full-scale war has destroyed some recycling plants, while others have been forced to close due to shelling. Some companies have relocated to relatively safe regions, but this is not enough to ensure a stable recycling system. Due to the low level of waste sorting among the population, enterprises face a shortage of high-quality secondary raw materials. They are forced to import them from abroad, which significantly increases their costs.

Additionally, during the war, the production of goods from recycled plastic became economically unprofitable. In some cases, enterprises have diversified their activities by processing plastic waste into fuel, such as oil and gas, which is often more profitable[10]. Then the next question arises: how environmentally friendly is such an activity?

[8] Сміттєпереробний завод у Львові планують збудувати до кінця 2023 року
[9] https://zakon.rada.gov.ua/laws/show/1353-2024-p#n15
[10] Сміття на вхід, гроші – на вихід. Сотні українських компаній намагаються робити бізнес на відходах. Наскільки це вигідно?

4.2. Determination of the reasons for the low level of waste management based on a sociological study (survey, interview)

4.2.1. Case study of Kyiv

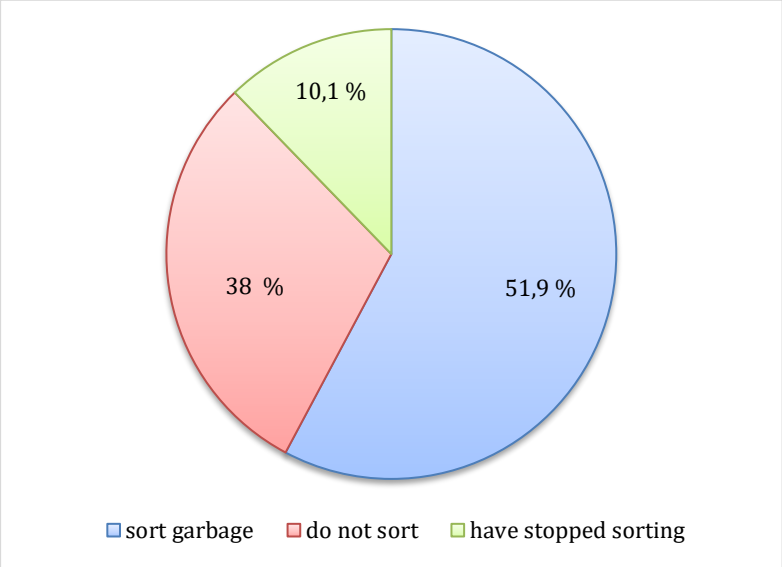
The study selected two contrasting cases — the city of Kyiv and the city of Kaniv — to compare approaches to waste management across different scales and urban contexts. Kyiv was chosen as the capital of the country and the largest urban center, characterized by high population density and a significant volume of solid household waste. In Kyiv, the only waste incineration plant in Ukraine, "Energia," operates on the principle of waste-to-energy. This allowed for a deeper analysis of how this technology is implemented in practice, the challenges it faces, and the role it can play in transitioning a large city to a circular economy. Conversely, Kaniv was chosen as an example of a small city, allowing for the analysis of the waste management situation in a less urbanized area. This provided insight into the specific challenges faced by small settlements, their limited resources, and the potential for applying waste-to-energy technologies. Particular attention was given to the economic feasibility of implementing WtE in small cities and to exploring alternative waste management models that might be more effective for such communities. Therefore, the contrast between a large metropolis and a small city offered a more comprehensive understanding of the problems and opportunities in waste management within Ukraine. The conclusions drawn from this analysis served as the foundation for developing proposals, which are presented in the next sections of the study.

Quantitative survey

A quantitative survey on waste management in Ukraine was conducted between December 28, 2024, and April 14, 2025. The study involved 108 respondents of different genders, aged from under 14 to over 60, living in Kyiv and other settlements, including Bucha, Hostomel, Berdychiv, and the village of Chayky. Participants had different income levels. The full quantitative survey is available in the appendices.

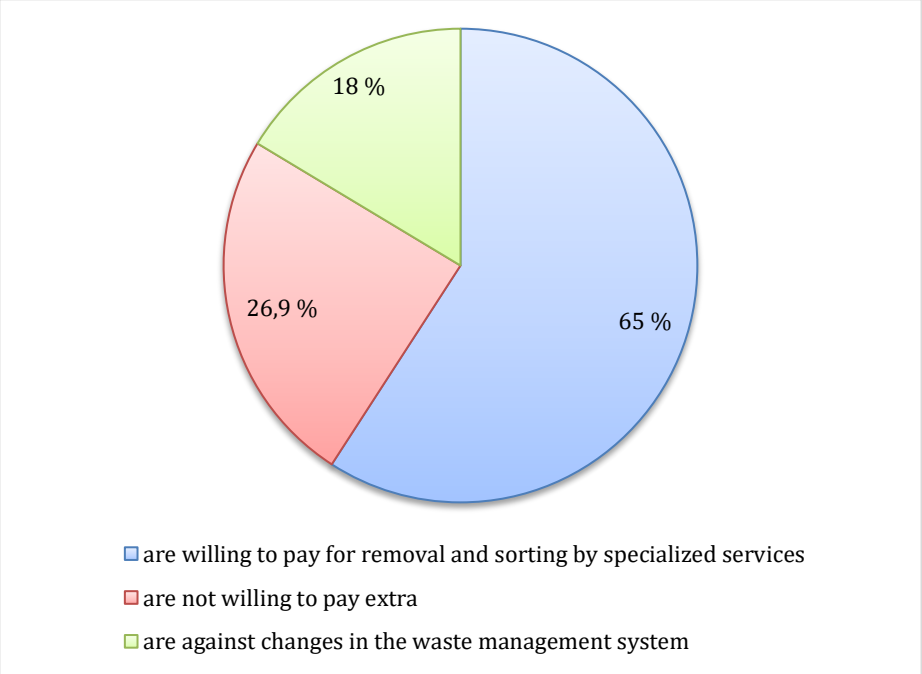
The main findings from the survey

Figure 4. Waste sorting



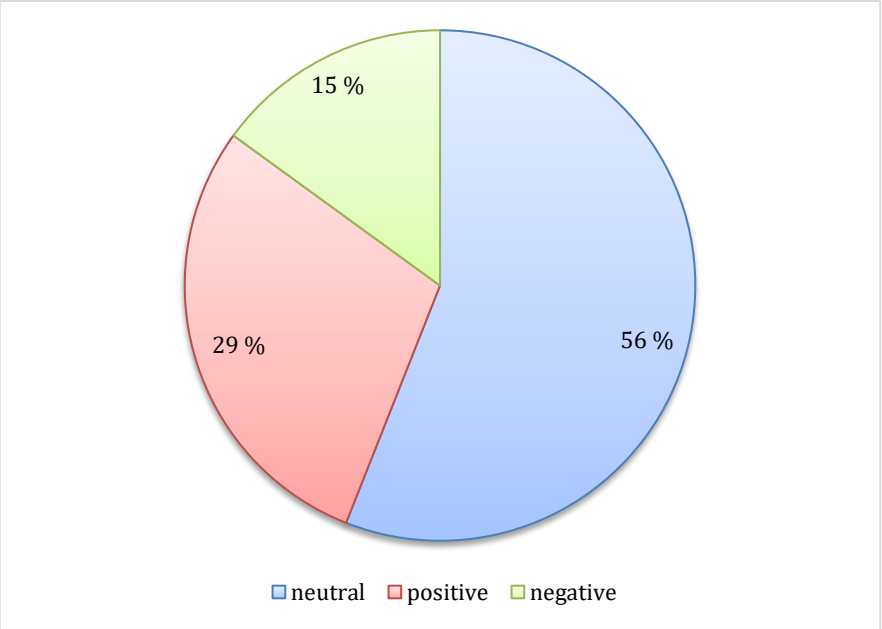
The main reasons for not sorting are a lack of infrastructure, time, war, and laziness. Among those who sort, the majority use containers near the house. It is also worth noting that most respondents indicate that their neighbors have a neutral attitude towards sorting.

Figure 5. Willingness to pay for sorting



Note: In Figure 5, respondents had the opportunity to select multiple answer options for this question.

Figure 6. Respondents' attitude towards the waste-to-energy plant



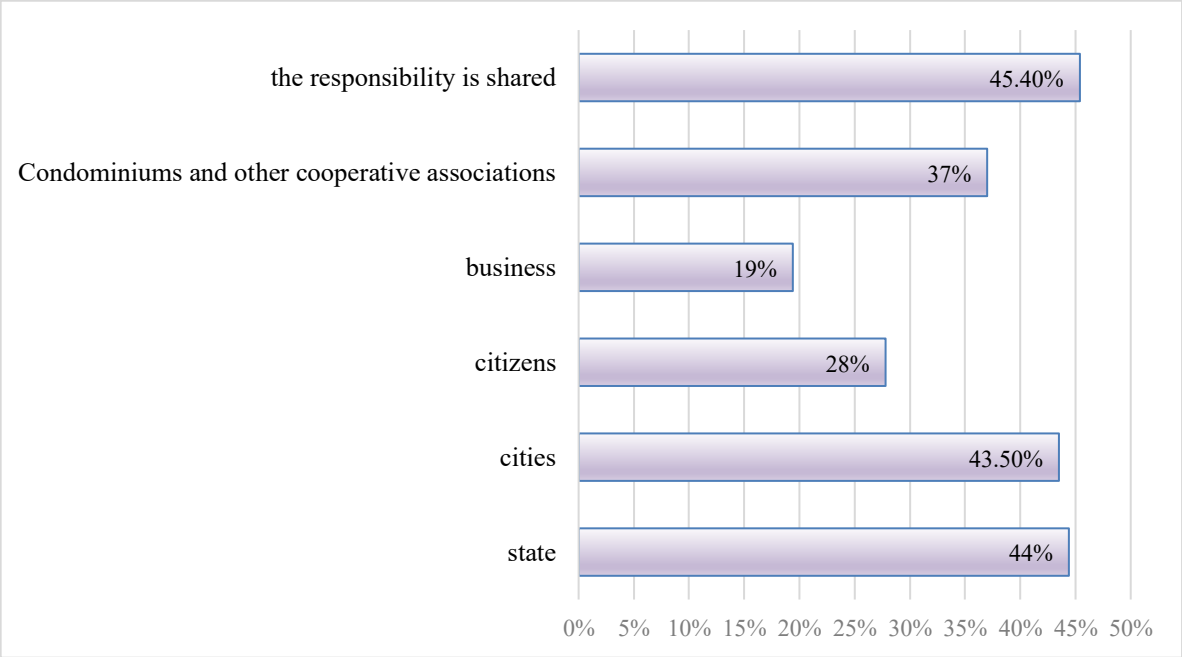
Respondents' explanations for the question in Figure 6

Positive attitude: less garbage in landfills, possibility of energy generation.

Negative attitude: risk of air pollution, especially from burning plastic.

Some respondents indicate conditional support if filters and safe technologies are available; some do not understand the principle of operation of such plants.

Figure 7. Responsibility for waste management



Note: In Figure 7, respondents had the opportunity to select multiple answer options for this question.

Thus, the survey showed that Ukrainian society has a moderately positive attitude towards waste sorting. Still, the lack of infrastructure, inconvenient conditions, and lack of motivation remain the primary barriers. Despite this, more than half of the respondents already practice sorting, mainly due to the availability of special containers near their homes. A significant portion of those surveyed is willing to pay for organized sorting, indicating potential for the introduction of paid services, provided they meet certain quality and convenience standards.

The attitude towards waste incineration plants is generally neutral, with some being cautiously optimistic. Respondents recognize them as a way to reduce waste volumes, but express concern about possible air pollution. Willingness to support such technologies increases if they are accompanied by reliable filtration systems.

Respondents believe that the responsibility for an effective waste management system should be shared among various stakeholders. The key role is assigned to state and local authorities, but they also recognize the participation of citizens and businesses. This indicates an understanding that only through cooperation can changes in environmental behavior be achieved.

In-depth interview

In September 2024, an in-depth interview was conducted with visitors and an employee of the "NoWasteUkraine" sorting station on waste management issues in Ukraine. The study adhered to all ethical principles, protecting the participants' rights, confidentiality, and autonomy. The in-depth interview with some participants can be viewed below in Table 1.

Table 1. Excerpt from in-depth interview

Interviewee code	Status	Questions	Answers
Interviewee 1	the visitor to the sorting station "NoWasteUkraine", the mother with a child	How did you start the practice of sorting waste? Where did it all start?	It was my husband's initiative. We started sorting waste before the war. We only have containers for plastic and glass near our house, and we bring everything else to the station.
		Why do you think some people in Ukraine don't sort waste?	They don't want to waste time, effort, and pay money to burn trash that is not recycled. Indifference. There is no education about waste management. The state has no educational campaign about the importance of sorting waste. Also, there are insufficient containers for sorted waste near houses.

		And what would you suggest to encourage people to properly handle waste?	It would be worth using the experience of European countries. For example, introducing deposit systems for bottles, using deposit machines, as they do in Germany. Also, a need to apply fines for improper waste management. I propose to increase the number of information campaigns about places to receive sorted waste and install comprehensive sorting systems in every yard.
Interviewee 2	the visitor to the sorting station "NoWasteUkraine", former soldier	How did the war affect your sorting habits?	I tried to clean the trenches with my comrades from cigarette butts and burned them in a stove in the Donetsk region. Therefore, my sorting habits and desires did not disappear. There was a misunderstanding with my comrades, who did not want to do it.
		Why are the rest of the people still not ready to sort?	Laziness, laziness, laziness. They do not see garbage dumps near their houses. This satisfies them. And to think about what garbage dumps are and how they are spreading across Ukraine... they do not want to think.
Interviewee 3	an employee of the sorting station "NoWasteUkraine"	How long have you been working at this station?	My work here began before the war. I have been working at the station for more than 5 years.
		Why do you work here?	Sorting garbage is the mission of my life. I want to live in a civilized, clean country. It was nonsense to me when the news said that rescuers died at the landfill (about the tragedy at the Hrybovytsky landfill in 2016). How can this be? People did heroic deeds to put out the fire. And died. In the garbage! It just didn't fit in my head. The garbage landfills are located on Ukrainian black soil, poisoning its groundwater, and rivers. In this way, we are losing the most valuable resources. I wanted to change this, but I didn't know how. Once, I saw a post from NoWasteUkraine on the Internet. I liked their work. That's why I decided to join them and bring their mission to people: to help clean the country of garbage.
		Has the number of users of the sorting station changed after the full-scale war in Ukraine?	Of course, the number has decreased. Many people left the country. But over time, over these two years, some have returned. And we were very happy. And people were also happy that our station survived and did not close. I remember one of the visitors saying that sorting

			saves mental health, and it is easier to survive the war.
		What do you think needs to be done to improve waste management?	Establishing the waste management process at the state level is necessary. Improve the relevant infrastructure and increase the number of containers and waste sorting stations. Ordinary people do not know that many processing plants in Ukraine use raw materials from sorted waste to produce their products. As a public organization working on a voluntary basis, we cannot cover all their needs for raw materials. Therefore, these plants are forced to purchase sorted waste abroad. So, all unsorted waste ends up in landfills. Here is such a paradox.
		Who, in your opinion, bears the greatest responsibility for waste management?	I believe that citizens bear the greatest responsibility. After all, with their actions, they can influence both politics and business.

The results of the in-depth interview clearly show that a significant lack of infrastructure is one of the main obstacles to mass waste sorting in Ukraine. Even in the capital, Kyiv, only a few sorting stations are currently operating – one of which is "NoWasteUkraine". This is critically insufficient for such a large-scale city. Environmentally conscious people take their sorted waste there on their own. However, not everyone has this opportunity. It is limited by both physical accessibility and the time and resources available to the citizens themselves.

Visitors to this station agree that Kyiv is critically short on containers for separate waste collection and similar collection points. Furthermore, as additional confirmation, the Figure below illustrates the irrational placement of bins for sorted waste in Kyiv.

Figure 8. Recycling problem in Kyiv: shortage and wrong placement of containers and sorting points

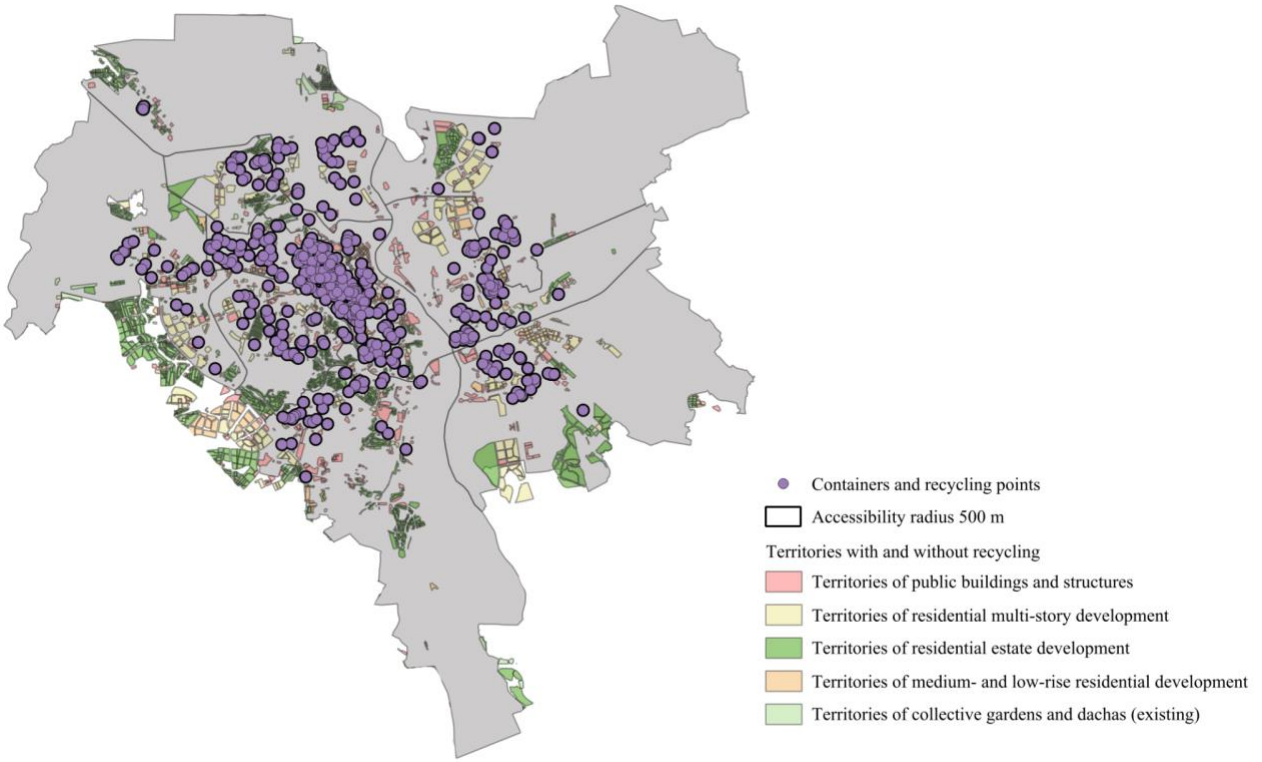
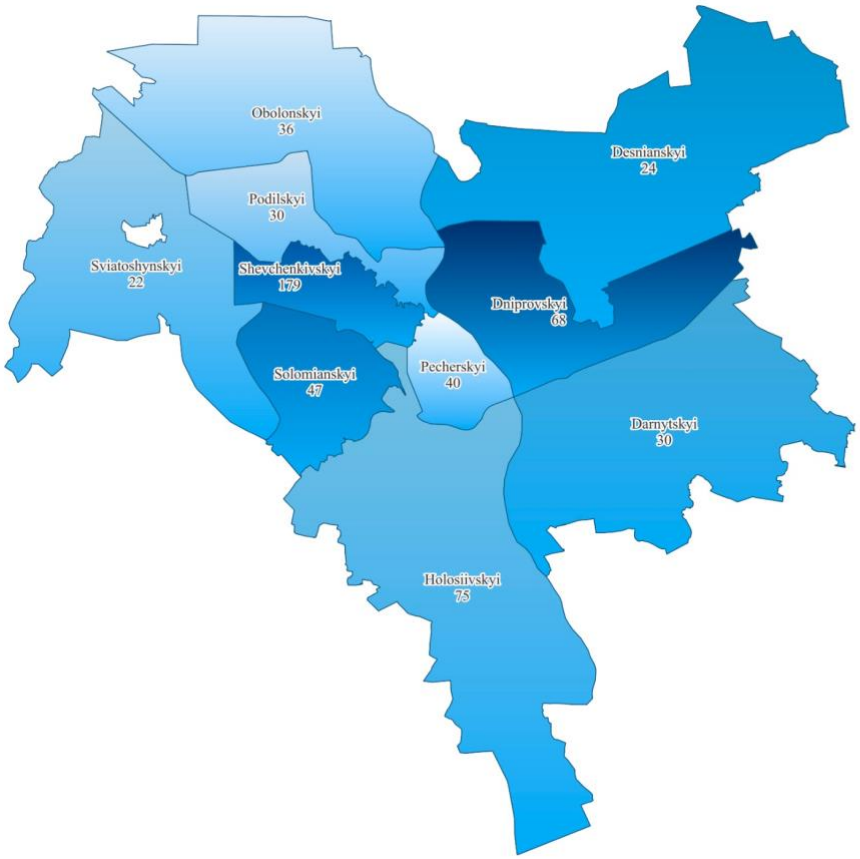


Figure 8 illustrates that the largest container concentration is located in the city's central area. However, in remote areas, especially with predominantly private low-rise buildings (cottage estates, garden societies) and new residential complexes on the periphery, containers for separate waste collection are either completely absent or their number is highly insufficient. In some of these areas, the radius of accessibility to the nearest container exceeds 500 meters, which contradicts the principle of convenient access for residents and significantly complicates waste sorting in everyday life.

Figure 9. Ratio of the number of containers and stations for separate waste collection to the population in different districts of Kyiv



District	Population*	Number of containers and stations for separate waste collection
Dniprovskyi	784723	68
Shevchenkivskyi	728773	179
Solomianskyi	711918	47
Desnianskyi	529931	24
Darnytskyi	509359	30
Holosiivskiy	461885	75
Sviatoshynskyi	446235	22
Podilskyi	425044	30
Obolonskyi	420285	36
Pecherskyi	362215	40

* Modeling data for population estimates in the districts of Kyiv (October 2024)

The analysis of Figure 9 shows that the placement of containers for sorted waste in Kyiv is disproportionate to the population in different districts. In particular, in the Dniprovskyi district, one of the most densely populated areas, only 68 containers have been installed, indicating an insufficient sorting infrastructure.

The situation is even worse in small towns and villages, where the waste management system is at the lowest level, and sorting is almost non-existent.

Among the reasons why the majority of the population does not sort waste:

- Low waste management culture.
- Lack of information – people have not been explained how to do it correctly.
- Apathy and indifference among a portion of the population.
- The impact of the war, as noted by Interviewee 3, an employee of the sorting station “NoWasteUkraine”, is that with the beginning of the full-scale invasion, the number of people bringing sorted waste has noticeably decreased.

Interviewee 3 also noted another important factor – the lack of a system of penalties for violating waste management rules. This provokes irresponsible behavior in a society that fails to consider the environmental consequences. It is also worth paying attention to Interviewee 3’s words, which emphasize that citizens bear the greatest responsibility for waste management. After all, their actions can influence both politics and business.

Despite all the difficulties, visitors to the NoWasteUkraine Station demonstrate a conscious attitude towards recycling. They avoid throwing garbage into landfills, understanding the environmental harm it causes. In addition, the station subsequently sends waste for recycling; what is not recycled is incinerated at the plant "Energy".

This plant is the only waste-to-energy plant operating throughout Ukraine. Established in 1987, Plant "Energy" remains a vital component of the city's waste management system. However, its effectiveness remains considerably restricted. Currently, the plant only serves the Left Bank area, specifically the Pozniaky neighborhood. It accepts 250,000 tons per year, approximately 25% of the city's household garbage[11], and generates heat for 300 high-rise buildings.

However, for the entire country, it is a critically small number of WtE plants to process the quantity of non-recyclable waste.

Thus, Ukraine lacks a developed infrastructure for sorting and recycling waste, which hinders the development of a culture of environmentally friendly waste management. Only the creation of an accessible, convenient, and transparent system, supported by educational campaigns and control and accountability mechanisms, will ensure the transition to effective waste management on a national scale.

4.2.2. Case study of Kaniv

Kaniv is a small city with huge potential to become a sustainable community in Ukraine. It has approximately 23,000 inhabitants and is situated on the banks of the Dnipro River, just 150 km from Kyiv, the capital of Ukraine, and 75 km from the regional center of Cherkasy. Kaniv has a deep historical and cultural significance. The city is home to the burial places of the national hero Taras Shevchenko, hetmans, and numerous monuments from the Cossack era, which form a unique cultural landscape suitable for tourism development.

From an economic perspective, Kaniv has an industrial zone that provides employment opportunities for both the local population and residents of the surrounding villages. The largest enterprises in the city are Kaniv Hydroelectric Power Plant and PrJSC "Myronivskyi Hliboproduct".

However, like many other cities in Ukraine, Kaniv faces challenges, including dilapidated infrastructure, insufficient investment, and the need to develop a waste management system.

Thus, Kaniv can be considered a promising case study for analyzing the possibilities of sustainable urban development in Ukraine's post-war reconstruction.

As part of the spatial planning practice program "Planning Studio" at Kyiv School of Economics, I chose the research direction "Waste management" in Kaniv (project "Zero waste Kaniv", team: Tetiana Kolomiiets, Oleh Deineka, Mykhailo Buhaievskyi, added to the appendices). This issue is particularly relevant for a modern Ukrainian city because effective waste management is not only an environmental but also a social and economic problem that

[11] Чи потрібні Україні сміттєспалювальні заводи?

directly affects the quality of life of residents and the prospects for sustainable development of the territory.

The study found that the landfill, serving the Kaniv hromada[12] and surrounding areas, has a unique status. As noted by Tetyana Nalyvayko, Head of the Economic Development Department of the Executive Committee of the Kaniv City Council, the situation with the landfill is complex and indicative of the Ukrainian practice of land management and communal infrastructure.

The solid waste landfill legally belongs to the Kaniv hromada, as the land is registered for permanent use and Kaniv owns the landfill. However, territorially, the facility is located within the Bobrytska hromada, which creates many administrative and financial barriers. The entrance to the landfill also passes through the territory of the Bobrytska hromada, which makes it impossible to carry out any actions related to its improvement without approval from the neighboring administration. At the same time, all four hromadas that were previously part of the former Kaniv district continue to transport waste to this landfill.

The situation is further complicated by the fact that the Bobrytska hromada, through whose territory access to the landfill passes, is not interested in investing in its maintenance or development, as the facility does not formally belong to it. An administrative conflict arises, in which, on the one hand, the landfill is used as an inter-hromada facility, and on the other hand, it does not have a clear joint management, investment mechanism, or modernization strategy. The lack of cooperation between hromadas creates conditions for the degradation of the facility, and the landfill has long exhausted its resources. During the pre-war period, according to Tetyana Nalyvayko, the city had already established contacts with potential investors who were studying the possibility of creating a waste processing infrastructure in Kaniv. It was found that the volume of waste from four hromadas is insufficient for a full-fledged waste processing plant. However, a promising and realistic option is to install a waste sorting line as a less capital-intensive but effective solution that would reduce the volume of landfilled waste, increase the level of recycling, and partially recoup the costs of transporting waste. Unfortunately, the full-scale war in Ukraine, which began on February 24, 2022, stopped these processes.

Tetyana Nalyvayko emphasized:

"*In the event of the closure of the Kaniv landfill, the entire mass of waste from the city will be forced to be transported to Cherkasy, which, given the current state of the garbage truck fleet and the distance of over 70 km, is an economically unprofitable and technically complex solution.*"

Therefore, introducing a sorting line in Kaniv would not only reduce the volume of waste requiring landfill but also create added value in the form of sorted secondary raw materials that can be sold, reducing the burden on the hromada budget. This would also be the first step

[12] As a result of the decentralization reform implemented in Ukraine from 2014 to 2020, a **territorial hromada** is defined as a collective of residents within a specific area – be it a city, village, or multiple settlements – tasked with its own local government and executive bodies, including a head of the hromada. https://decentralization.ua/newgromada

towards building a regional waste management model based on inter-municipal partnership, considering the interests of all hromadas using the landfill.

Thus, the landfill and waste management situation in Kaniv is not only a local problem but also a reflection of broader challenges in spatial and environmental management in Ukraine. At the same time, the city has real potential to introduce practical solutions within the framework of the circular economy, which is an essential step towards an environmentally responsible and sustainable future.

The study also revealed a serious problem with solid waste management among the local population. A lot of cases were recorded where residents and business representatives threw garbage into ravines, ditches, and open areas, sometimes even near their households. Such examples demonstrate not only the lack of proper infrastructure but also the low level of waste management culture.

This situation is entirely consistent with the results of my sociological survey, which confirms the presence of a systemic problem in Ukraine regarding the population's attitude to waste sorting and disposal. To overcome this, it is necessary not only to introduce modern infrastructure – containers for separate collection, recycling points, and an effective waste removal system – but also to raise citizens' level of awareness simultaneously.

After analyzing the current state of waste management in the city of Kaniv, I reached conclusions and formulated several recommendations to improve the situation.

The first step is determining the body or institution responsible for managing the city's waste management system. In this context, it's better to take the example of the city of Lviv, where a separate municipal enterprise specializing in this area was established. Accordingly, one option is to create a similar municipal enterprise in Kaniv. Another possible approach is implementing a public-private partnership model, where the municipality agrees with a private company for waste management.

Regardless of the form of ownership, the newly created enterprise must ensure the construction of an adequate infrastructure for the separate collection and primary processing of waste. This includes, in particular, the installation of specialized containers for sorting, the organization of secondary raw material reception points, the creation of a sorting station, and the organization of waste delivery. An important component of such a station can be a technological module for processing organic waste, such as composting with the production of mineral fertilizers or biogas, which can be used in the local energy system.

The second step is to raise public awareness of waste management rules. It is necessary to introduce systematic educational work, including conducting lessons in academic institutions, organizing training sessions, public events, and eco-talks, where residents can gain practical skills in sorting waste. It is crucial to involve young people in forming a responsible attitude towards the environment from an early age. In parallel, a clear system of administrative influence should be in place: the introduction of fines for citizens and enterprises that violate waste management rules or engage in unauthorized garbage dumping.

The study also emphasized the expediency of focusing efforts on developing a sorting station in Kaniv, rather than on constructing a full-fledged waste processing or incineration plant. The reason lies in the insufficient waste generated by the city of Kaniv and the

surrounding hromadas. According to experts, for the profitable operation of the incineration plant, a minimum of 200 thousand tons of waste per year is required. Kaniv will not be able to provide such a volume.

At the same time, given the logistics and population density, locating the WtE plant in Cherkasy, the regional center with a population of over 600,000 people, is more expedient. This will enable the optimization of transportation costs and establish a comprehensive regional waste management cluster. According to the National Waste Management Plan until 2033 (2024, p. 43), for economic feasibility, it is necessary to locate a waste incineration plant with a capacity of 300,000 tons per year in an area that will provide a volume of consumer waste of 600,000 tons per year or more. For example, the entire Cherkasy region. In this case, the city of Kaniv should focus on primary sorting and waste preparation for transportation, reducing the load on the local landfill.

Therefore, it was proposed to implement the zero waste city concept in Kaniv, which is based on the widest possible sorting, recycling, and reuse of household waste.

Thus, the implementation of this strategy will allow for the reduction of the load on the landfill; to create infrastructure for the development of the circular economy; to form a system of separate collection and recycling of waste at the local level; and to create the prerequisites for constructing a waste-to-energy plant at the regional level. In the long term, this will contribute to reducing environmental pollution and improving the quality of life of Kaniv's residents.

Cases in Kyiv and Kaniv demonstrate that ineffective waste management is mainly due not only to infrastructural and technical barriers, but also to regulatory shortcomings. Therefore, it is advisable to analyze the legislative framework in the field of waste management and compliance with the European Union's requirements, particularly in the context of implementing European directives into national law.

5. ANALYSIS OF REGULATORY AND LEGAL REGULATION OF WASTE MANAGEMENT IN UKRAINE AND THE EU

5.1. Research on the legislative approaches of the European Union to waste management

Directive 2008/98/EC of the European Parliament and of the Council[13], on 19 November 2008, (Waste Framework Directive), is the primary regulatory act in the field of waste management in the EU. It was updated in 2018 as part of the Circular Economy Package. According to the Directive, countries are required to implement a circular economy and comply with specific provisions. A waste management hierarchy must be established (Article 4): waste prevention, reuse, recycling, other forms of recovery (e.g., waste-to-energy), and, as a last resort, landfill. Member States are also obliged to implement systems where producers bear extended responsibility for the product throughout its life cycle, including the disposal stage. There is a requirement to use separate waste collection (Article 10) for paper, metal, plastic, glass, and organic waste, and from 2025, textiles. The incineration and landfilling of recyclable waste are prohibited. Member States are also required to apply the "polluter pays" principle, meaning that the costs of waste management must be borne by those who generated it or allowed the pollution to occur.

The next important regulatory act is the EU Council Directive 1999/31/EC on the landfilling of waste[14], which aims to mitigate its negative environmental impact, particularly on soil, water, and air. This act provides strict requirements for the design, operation, and closure of landfills.

These Directives provided EU countries with regulatory guidelines on how to manage waste. However, for a deeper understanding of these policies and environmental challenges, it is essential to consult the framework of the European Environment Agency (EEA).

The EEA conceptual framework offers a structured approach for promoting sustainable urban development, encompassing various lenses, contexts, supporting factors, and essential elements of a sustainable city, as outlined by Gorm Dige and Rasmus Dilling (2017). In Ukraine, this framework could serve as a foundation for developing a strategy that considers environmental, social, and economic perspectives. That involves decreasing landfill waste and minimizing greenhouse gas emissions through adopting waste-to-energy (WtE) technologies. Leveraging waste as a resource for energy production enhances energy independence and generates additional revenue streams. And, initiatives that promote educational programs and encourage public engagement in waste sorting and recycling. Therefore, for the effective implementation of the Directives in the field of waste management, it is important to understand the conceptual approaches of the European Environment Agency (EEA). This framework defines the principles that shape modern waste management policies in EU countries. Based on these principles, it is necessary to assess the

[13] 2008/98 - EN - Waste framework directive - EUR-Lex

[14] Directive - 1999/31 - EN - EUR-Lex

extent to which Ukrainian legislation aligns with European standards and identify any existing gaps.

5.2. Analysis of the new Law of Ukraine "On Waste Management" (2023)[15]

Most landfills for waste disposal in Ukraine were established during Soviet times and have already exhausted their resources. Consequently, they present a significant environmental and man-made threat. Therefore, the traditional waste management model, based on landfills, does not meet the requirements of European legislation.

In connection with European integration, on July 9, 2023, the new Law of Ukraine "On Waste Management" came into force, which must comply with Directive 2008/98/EC of the European Parliament and of the Council on waste and Council Directive 1999/31/EC on the landfill of waste. The primary objective of the new Law was to enhance the environment, establish the necessary infrastructure, and implement a waste management hierarchy. Also, the Ministry of Environmental Protection and Natural Resources of Ukraine, in collaboration with the Ministry of Finance and the State Tax Service, is working on legislation that proposes implementing a garbage tax to stimulate waste sorting[16].

The Law of Ukraine "On Waste Management" (2023) is a framework law that establishes the principles and directions for reforming the waste management system. Unfortunately, the issues regarding promoting a circular economy have yet to be resolved.

After analyzing the law, it appears that Ukraine is likely to continue using landfills. There is no specified timeline for gradually prohibiting the landfilling of organic or other untreated waste, unlike what's outlined in the EU's regulations.

There is a lack of focus on waste incineration plants, and no clear strategy exists for establishing infrastructure that utilizes waste for heat or electricity generation. Furthermore, investment in sorting and processing facilities continues to be minimal.

Amid the war, a new issue arose due to missile attacks and bombings: the need for recycling and processing waste resulting from destruction. The law provides minimal information on addressing these challenges.

5.3. Proposals for the adaptation of the Ukrainian law on waste management to the standards of the European Union

Proposals for improving the Law of Ukraine "On Waste Management":

1. Change the general requirements for waste disposal (Article 40). Sorting and processing of waste should be a priority instead of storage in landfills. Introduce a ban on the disposal of untreated waste and establish a deadline for its implementation. This will reduce the volume of waste in landfills and contribute to the development of infrastructure for sorting, processing, and incineration.

[15] https://zakon.rada.gov.ua/laws/show/2320-20#Text

[16] https://www.epravda.com.ua/news/2023/10/19/705663/

2. Identify incentives for the development of regional centers for sorting, collecting, and transporting waste, as well as incineration and recycling plants. Waste that cannot be recycled can be a source of heat and electricity. This will make cities more energy efficient, especially in wartime conditions. Also, in Section VI, “Incineration, co-incineration and disposal of waste” in Articles 38 and 39, only “waste incineration facilities” are indicated. It is necessary to add a “waste incineration plant for generating heat or electricity”.

3. Introduce a system of extended producer responsibility. Producers must finance the collection and recycling of waste generated by their products.

4. Implement an information campaign on sorting for the population.

5. The law should provide more details on the recycling of construction waste and the creation of appropriate plants for processing it into a resource for construction.

As experts from the NGO “Enough to poison Kryvyi Rih” note in “Analysis of the problem of management of demolition waste”, it is necessary to determine the course of the processes of temporary storage, transportation, sorting, processing, and disposal of demolition waste (Yulia Orekhanova et al, 2023). It is also important to develop a regulatory framework for the use of secondary products from demolition waste for the production of building materials, and to create favorable conditions for the construction of appropriate processing enterprises.

Therefore, Ukraine needs to reform its waste management system, relying on European experience that combines environmental safety with economic benefits. The development of a circular economy will not only solve urgent environmental problems but also create new jobs, attract investments, and bring Ukraine closer to EU standards.

Drawing on the challenges outlined in the third section regarding Ukraine’s waste management system and the regulatory framework discussed in the fourth section, the fifth section presents a practical solution for implementing a waste-to-energy plant as a means of advancing the circular economy in Ukraine.

6. PROPOSALS FOR IMPLEMENTING WASTE-TO-ENERGY IN UKRAINE

6.1. Key steps for implementing waste-to-energy plants in Ukraine

Based on the research conducted, it is evident that effective waste management in modern Ukraine requires a comprehensive approach that considers both the consequences of the war and the European direction of the country's development, as well as the establishment of a circular economy. This approach includes establishing a system of separate waste collection at the national level, expanding secondary raw material processing capacities, and building a network of modern waste-to-energy plants.

Currently, Ukraine has only one incineration plant, which is critically insufficient to process the national volume of solid household waste. Given Poland's experience in developing waste-to-energy plants as part of its decarbonization strategy, it is advisable to introduce the creation of at least one such plant in each region of Ukraine. This will reduce the load on overcrowded landfills, ensure energy diversification through the generation of electricity and heat, and create jobs and attract investment in the regions.

It is also economically justified to introduce a differentiated approach to cities of different scales.

In large cities, regional centers, and agglomerations, it is worthwhile to build waste-to-energy (WtE) plants that can operate at full capacity. It's advisable to provide the zero waste concept in communities with a small population. That concept should combine educational campaigns, conducting programs for the reuse and repair of items, and, of course, opening sorting facilities.

6.2. Financing and attracting investments

WtE plants can operate under municipal ownership (through municipal enterprises) or in the format of a public-private partnership (PPP), which allows for attracting investors, including foreign ones, and sharing financial risks. For instance, in Italy, 55% of incinerators are managed by private companies, either directly or through public-private partnerships (Marinella Favot, 2022, p. 13).

For the implementation of waste-to-energy (WtE) projects in Ukraine, it is advisable to utilize a combined financing model that incorporates both international support and domestic fundraising. For example, grant and loan programs, such as the Green Deal and Horizon Europe, loans from the European Investment Bank (EIB), or the European Bank for Reconstruction and Development (EBRD). Additionally, you can draw on the experience of the WtE plant in Copenhagen (Copenhill), where residents' fees partially cover a 30-year loan for waste disposal.

This approach can be adapted for large cities in Ukraine, with a long-term repayment plan through tariffs for waste removal and processing.

There is also an attractive model of Kraków (Poland), because the financing of the WtE plant was carried out at the expense of EU funds, municipal funds, and a credit line, the

repayment of which is provided by residents' fees and income from the energy produced by the plant.

Thus, during the war and post-war reconstruction time, WtE can become a critically important facility providing cities with energy sustainability.

7. CONCLUSIONS AND OUTLOOK

A modern city must be sustainable and foster a circular economy by developing effective waste management solutions, promoting efficient resource use, and minimizing waste. In this way, it can be beneficial to utilize the EEA conceptual framework for integrating economic, social, and environmental dimensions into urban development strategies. This framework allows cities to adopt a holistic approach to problem-solving. Through its implementation, Ukraine can facilitate the modernization of its infrastructure, promote recycling, enhance public environmental awareness, and achieve energy independence through waste-to-energy technologies within the framework of a circular economy and the zero waste concept.

With the backing of European programs, especially EU directives, and the involvement of public organizations like "NoWasteUkraine," Ukraine has begun to enhance its waste management system. One example is the upgrading of the Energy plant in Kyiv, which illustrates the potential for a more effective waste disposal and recycling system. While the plant supplies heat to a portion of the capital, its capacity is still constrained. To meet European standards, significant infrastructure modernization and the adoption of new technologies are essential.

For Ukraine to integrate into European space, it should take into account the experiences of nations like Poland and Denmark, which have successfully carried out waste-to-energy projects. The Kraków thermal waste incineration facility exemplifies the effective utilization of European grants for substantial environmental initiatives. This case demonstrates that political backing and funding can facilitate the swift adoption of modern solutions.

To support sustainable development in Ukraine's waste management system, the focus should be on the following key areas:

1. Enhancing infrastructure by increasing the number of sorting stations and establishing new waste-to-energy facilities.
2. Implementing educational initiatives and raising public awareness, similar to those executed in Krakow and Copenhagen.
3. Pursuing necessary legislative reforms.
4. Securing financing and international assistance through grants and loans from organizations like the European Bank for Reconstruction and Development (EBRD) for modernizing the system.
5. Promoting integration into the circular economy.

Ukraine has a distinct chance to address its waste challenges by incorporating European standards and insights from other nations into its approach. By utilizing the EEA's conceptual framework for advancing waste-to-energy technologies in the circular economy, Ukraine can establish a more environmentally friendly waste management system, providing economic benefits.

For waste-to-energy plants to be economically viable, it is essential to first adapt the relevant Ukrainian legislation to European standards. Secondly, there is a need to establish a comprehensive waste management infrastructure. This includes the efficient operation of sorting stations, the availability of containers for sorted waste near every household, and the

development of the country's processing industry. However, based on European experience, it is not advisable to construct large numbers of waste incineration plants. For instance, Denmark aims to reduce the volume of incineration to 30% of all household waste by 2030. The number of waste-to-energy plants should be optimal to gather sufficient non-recyclable resources, thereby meeting the capacity of these facilities. Therefore, it is recommended to position waste-to-energy plants in cities and regional centers that provide a volume of consumer waste of 600 thousand tons per year or more, according to the National Waste Management Plan until 2033 (2024, p. 43). In smaller cities and rural communities, implementing a waste management infrastructure based on the zero waste city principle is also beneficial, as it supports the development of recycling and resource reuse.

Therefore, for a practical and economically feasible waste management system in the circular economy of Ukraine, the interaction of three key elements is necessary: sorting, recycling, and waste incineration. Only then will this system be able to work harmoniously and sustainably.

While the study provides a thorough analysis of Ukraine's waste management system, including legislative factors and the potential of waste-to-energy technology, it has notable limitations primarily due to the ongoing military situation. The active war phase has hindered a comprehensive examination of issues surrounding the disposal and processing of specifically debris from destroyed structures, remnants of equipment, and hazardous waste generated by shelling and explosions. This topic is particularly urgent, as there is currently no cohesive strategy or legal framework for managing this type of waste.

Another area needing further exploration is the potential of WtE technology to eliminate war-related residues that cannot be recycled. This technology also holds promise for generating energy from such materials in an environmentally friendly manner. At this time, these matters fall outside the scope of this study due to restricted data access, insufficient official statistics, and challenging security conditions.

Future studies should concentrate on post-war waste management and propose recommendations for integrating military remnants into the circular economy model.

8. BIBLIOGRAPHY

1. Paul H. Brunner and Leo Morf, “Waste to Energy, Indispensable Cornerstone for Circular Economy: A Mini-review,” *Waste Management & Research the Journal for a Sustainable Circular Economy*, January 29, 2024, https://doi.org/10.1177/0734242x241227376.
2. J. Malinauskaite et al., “Municipal Solid Waste Management and Waste-to-energy in the Context of a Circular Economy and Energy Recycling in Europe,” *Energy* 141, November 23, 2017: 2013–44, https://doi.org/10.1016/j.energy.2017.11.128.
3. Kohl, Ulrik. The Copenhill Crisis: The Dark Side of Planning the Greenest Waste-Fired Power Plant Ever Seen. Master’s thesis, Malmö Högskola, 2019. https://rucforsk.ruc.dk/ws/portalfiles/portal/90722255/5_Ulrik_Kohl_Master_thesis_Urban_Studies_2019.pdf.
4. European Commission. "Municipal Waste by Waste Management Operations." *Eurostat*. Last modified 2024. Accessed June 1, 2025. https://ec.europa.eu/eurostat/databrowser/view/env_wasmun__custom_16927289/default/table?lang=en.
5. Official Web Portal of the Parliament of Ukraine. “On Waste Management,” n.d. https://zakon.rada.gov.ua/laws/show/2320-20#Text.
6. Official Web Portal of the Parliament of Ukraine. “National Waste Management Plan until 2033”, 2024. n.d. https://zakon.rada.gov.ua/laws/show/1353-2024-p#n15
7. Ellen MacArthur Foundation. The RESOLVE Framework for a Circular Economy. 2012. https://ellenmacarthurfoundation.org.
8. European Parliament. “Circular Economy: Definition, Importance and Benefits.” *European Parliament*. Last modified May 24, 2023. https://www.europarl.europa.eu/topics/en/article/20151201STO05603/circular-economy-definition-importance-and-benefits.
9. Williams, Joanna. “Circular Cities and Urban Resource Management: Moving Beyond the RESOLVE Framework.” Journal of Urban Sustainability 9, no. 3 (2017): 120–35.
10. Confederation of European Waste-to-Energy Plants (CEWEP). Interactive Presentation 2018: New Slides. July 2018. https://www.cewep.eu/wp-content/uploads/2018/07/Interactive-presentation-2018-New-slides.pdf.
11. Torben Hulgaard, and Inger Søndergaard. “Integrating Waste-to-Energy in Copenhagen.” Proceedings of the Institution of Civil Engineers – Waste and Resource Management (2018). https://doi.org/10.1680/jcien.17.00042.
12. ICLEI. Waste-to-Energy: Renewable Energy Options for Urban Areas. ICLEI Renewable Energy Roadmap Project, November 2021. https://renewablesroadmap.iclei.org/wp-content/uploads/2021/11/Waste-to-Energy_Final-1.pdf.
13. State Statistics Service of Ukraine. Operational Statistical Information: Population and Migration. *State Statistics Service of Ukraine.* Accessed June 1, 2025. https://www.ukrstat.gov.ua/operativ/menu/menu_u/ns.htm.

14. Silva, Mário, João Lagarto, Jorge Sousa, Feliz Mil-Homens, Carla Viveiros, and Filipe Barata. 2023. "Impact of the New Electricity Remuneration Scheme on the Waste-to-Energy Recovery Activity in Portugal" *Energies* 16, no. 18: 6624. https://doi.org/10.3390/en16186624

15. Jakub Bator. Ekospalarnia Kraków: Presentation at CEWEP. *Krakowski Holding Komunalny S.A.*, May 2024. https://www.cewep.eu/wp-content/uploads/2024/05/6.-Jakub-Bator_Ekospalarnia-Krakow.pdf.

16. State Statistics Service of Ukraine. Environment of Ukraine 2020. Edited by Oleg Prokopenko. *Kyiv: State Statistics Service of Ukraine*, 2021. https://ukrstat.gov.ua/druk/publicat/kat_u/2021/zb/11/Dovk_20.pdf.

17. Cabinet of Ministers of Ukraine. On Approval of the National Waste Management Plan Until 2033. *Official Bulletin of Ukraine*, 2024. https://zakon.rada.gov.ua/laws/show/1353-2024-p.

18. Liya Ilchenko. Economichna Pravda. "The Ministry of Natural Resources is Preparing a Tax on Garbage." *Economichna Pravda*, October 19, 2023. https://www.epravda.com.ua/news/2023/10/19/705663/.

19. Natalia Karnaukh, Ivanka Dusko. Suspilne Lviv. "Waste recycling plant in Lviv planned to be built by the end of 2023." *Suspilne Lviv*, April 3, 2023. https://suspilne.media/433986-smittepererobnij-zavod-u-lvovi-planuut-zbuduvati-do-kinca-2023-roku/

20. "About NoWasteUkraine," *website of NoWasteUkraine, June, 2025*. https://nowaste.com.ua/projects/.

21. Amanda Kulson-Drasner, Maksym Drabok. "Incineration of waste as an energy source: pros and cons". *DW Ukrainian,* December 4, 2021. https://www.youtube.com/watch?v=ybpdvog1rz4

22. Ghisellini, Patrizia, Catia Cialani, and Sergio Ulgiati. "A Review on Circular Economy: The Expected Transition to a Balanced Interplay of Environmental and Economic Systems." Journal of Cleaner Production 114, 2016: 11–32.

23. Krakowski Holding Komunalny Spółka Akcyjna w Krakowie. "About the Plant," n.d. https://khk.krakow.pl/en/eco-incinerator/about-the-plant/.

24. Aneeta Mary Joseph, Ruben Snellings, Philip Van den Heede, Stijn Matthys, and Nele De Belie. 2018. "The Use of Municipal Solid Waste Incineration Ash in Various Building Materials: A Belgian Point of View" *Materials* 11, no. 1: 141. https://doi.org/10.3390/ma11010141

25. "Directive - 2008/98 - EN - Waste Framework Directive - EUR-Lex," n.d., https://eur-lex.europa.eu/eli/dir/2008/98/oj.

26. Gorm Dige, Rasmus Dilling. EEA guidance document – policy evaluation, June 2017. https://www.researchgate.net/publication/317594615_EEA_guidance_document_-_policy_evaluation

27. Marinella Favot, "Moretto Favot Massarutto it journal of public economics oct18 published." *Areasciencepark*, November 24, 2022.

https://www.academia.edu/91503519/Moretto_Favot_Massarutto_it_journal_of_public_economics_oct18_published?utm_source.

28. European Commission. "Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: A New Circular Economy Action Plan for a Cleaner and More Competitive Europe." *COM* (2020) 98 final. Brussels, March 11, 2020. https://eur-lex.europa.eu/legal-content/en/txt/?uri=com:2020:98:fin.

29. European Commission. "The European Green Deal," *European Commission*, July 14, 2021. https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en.

30. Yulia Orekhanova, Anna Ambrosova, Kateryna Taran. State Territorial Development Company. Analysis of the problem of management of demolition waste. Kyiv: *DTKR*, 2023. https://dtkr.com.ua/wp-content/uploads/2023/07/analiz-problemi-vidhodi-rujnuvan.pdf.

31. Circular Copenhagen. *Waste Management in Copenhagen*. Accessed June 1, 2025. https://circular.kk.dk/waste-management-in-copenhagen.

32. European Parliament. Briefing: Closing the Loop - New Circular Economy Package. EPRS | European Parliamentary Research Service, March 2016. https://www.europarl.europa.eu/regdata/etudes/brie/2016/573899/eprs_bri(2016)573899_en.pdf.

33. Anna-Sara Fagerholm, Henrik Haller, Anders Warell, and Per-Olof Hedvall. "Zero Waste for All? Sustainable Practices in a Small-Scale Zero Waste Community From a Universal Design Perspective." *Sustainability* 17, no. 9, May 1, 2025: 4092. https://doi.org/10.3390/su17094092.

34. Monika Chmielewska. "Assessment of the Waste Management System in Krakow as an Element of Circular Economy." *Architecture Civil Engineering Environment* 14, no. 1 (January 1, 2021): 85–93. https://doi.org/10.21307/acee-2021-008.

35. Mar Edo. IEA Bioenergy. *Waste-to-Energy and Social Acceptance: Copenhill WtE Plant in Copenhagen*. March 2021. https://www.ieabioenergy.com/wp-content/uploads/2021/03/T36_WtE-and-Social-Acceptance_Copnehhill-WtE-plant-in-Copenhagen.pdf.

36. Peter Tauš, Zuzana Šimková, Michal Cehlár, Ivana Krajňáková, and Július Drozda. "Fulfillment of EU Goals in the Field of Waste Management Through Energy Recovery From Waste." *Energies* 16, no. 4, February 15, 2023. https://doi.org/10.3390/en16041913.

37. European Environment Agency. "Economic Instruments and Separate Collection Systems — Key Strategies to Increase Recycling," *European Environment Agency*, June 8, 2023.https://www.eea.europa.eu/publications/economic-instruments-and-separate-collection?utm_source.

38. "Impact story: Sri Lanka's First Waste-to-energy Power Plant Turns Mountains of Trash Into Clean Electricity | UN Global Compact," December 19, 2024. https://unglobalcompact.org/take-action/impact/sri-lankas-first-waste-to-energy-power-plant-turns-mountains-of-trash-into-clean-electricity.

39. danskretursystem.dk. “Dansk Retursystem – Find All Information in English Here,” *danskretursystem.dk*, March 12, 2025, https://danskretursystem.dk/en/dansk-retursystem-english/.

40. Publications Office of the European Union, “Poland, 2025 EU Waste Recycling Targets : State of Play.” *Publications Office of the EU*, 2023, https://op.europa.eu/en/publication-detail/-/publication/d5566f79-0351-11ee-87ec-01aa75ed71a1/language-en?utm_source=chatgpt.com.

41. Eco-Miasto. “Napraw Zamiast Wyrzucać, Czyli Repair Cafe W Polsce,” *Eco-Miasto*, 2020. https://www.eco-miasto.pl/pl/aktualnosci/napraw-zamiast-wyrzucac-czyli-repair-cafe-w-polsce?utm_source.

42. Oleksandr Horbatovsky. Komunal Ukraine. “Does Ukraine Need Waste Incinerators?” June 25, 2019. http://capital.jkg-portal.com.ua/ua/publication/one/chi-potrbn-ukrajin-smttespaljuvaln-zavodi-56634?fbclid=IwAR1dc7euLM

9. APPENDIX

КАНІВСЬКА МІСЬКА РАДА
ВИКОНАВЧИЙ КОМІТЕТ
УПРАВЛІННЯ ЕКОНОМІЧНОГО РОЗВИТКУ

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Від 29.05.2025 № 17 на №____ від _____

Студентці
Київської школи економіки
Тетяні Коломієць

Відповідно до Вашого запиту, надаю підтвердження, що не заперечую проти використання моїх висловлювань, зроблених під час захисту студентських проєктів у межах студії планування Київської школи економіки (дата: 14.04.2025), у дипломній роботі Коломієць Тетяни на тему: «Waste-to-energy plant as an essential component of a circular economy for a sustainable city».

Надаю письмову згоду на цитування моїх слів із відповідним посиланням на моє ім'я.

З повагою,
Начальник управління Тетяна НАЛИВАЙКО

ZeroWaste Канів

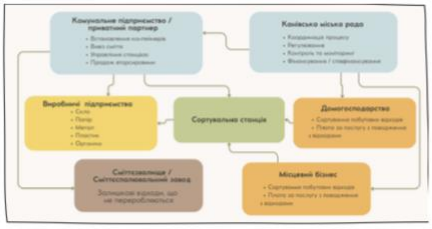
Проєкт спрямований на створення ефективної системи управління відходами в місті Канів із залученням громади, бізнесу та влади.
Основна мета — поступове зменшення утворення відходів, їх переробка та повторне використання, а також запобігання несанкціонованим звалищам.

План дій для ефективного управління відходами в Каневі

I. Інфраструктура для сортування та переробки

- Для обслуговування 23 000 осіб необхідно близько 52 комплектів контейнерів для збору різних фракцій: папір, пластик, скло, метал, змішані та органічні відходи.
- Створення сортувальної станції в промисловій зоні Канева площею 3 га.
- Виробництво компосту з органічних відходів для подальшого продажу.
- Організація продажу вторсировини підприємствам (скло, пластик, метал, макулатура).

Схема організаційної моделі управління відходами



II. Введення штрафів за несанкціонований вивіз сміття та створення стихійних звалищ

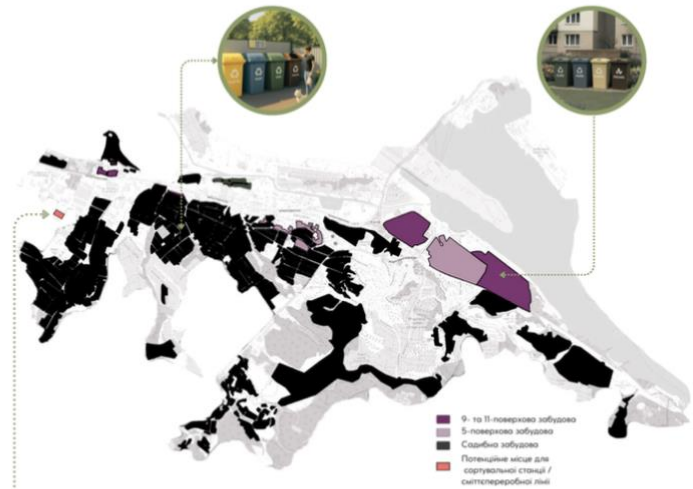
III. Інформування та залучення громади

- Масштабна просвітницька кампанія про сортування сміття через соцмережі, зустрічі, воркшопи, проведення толок.
- Введення освітніх програм у школах та ВНЗ.
- Запуск zero waste-зон (наприклад, кафе без пластику, встановлення фандоматів в магазинах).



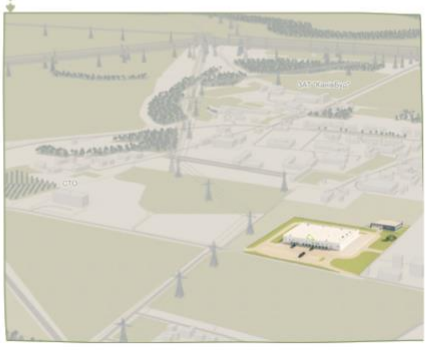
Схематичне зображення інфраструктури управління відходами

Зони для розміщення контейнерів для відсортованого сміття та сортувальної станції



Приміщення сортувальної станції

Приміщення для переробки органіки в добриво



KSE Квітень, 2025

Над проєктом "Zero Waste Канів" працювали студенти освітньої програми "Урбаністика та повоєнна відбудова" Київської школи економіки .


Олег Дейнека


Тетяна Коломієць


Михайло Бугаєвський

Quantitative survey

A quantitative survey on waste management in Ukraine was conducted between December 28, 2024, and April 14, 2025. The study involved 108 respondents of different genders, aged from under 14 to over 60, living in Kyiv and other settlements, including Bucha, Hostomel, Berdychiv, and the village of Chayky. Participants had different income levels.

The full quantitative survey is available here:

https://drive.google.com/drive/folders/19wBd7jyLL4ijFNeVeL-NG5816u8QZI2g?usp=sharing