

‘DISRUPTIVITY INNOVATIONS’ IN WASTE MANAGEMENT

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The term ‘disruptive innovation’ was coined by Clayton Christensen in 1997 and describes innovations that change the balance of value in the marketplace, making old products uncompetitive. This happens when new technologies or business models create new markets or fundamentally change existing ones, displacing established companies, products or even entire industries. Although the term ‘disruptive innovation’ is not directly related to waste management, the adoption of innovative technologies in this area can lead to significant changes and improvements. For example, the use of smart bins with artificial intelligence-based object recognition allows waste to be automatically sorted, which improves recycling efficiency. In addition, the use of waste level sensors helps to optimise waste disposal schedules, preventing overfilling of bins and reducing transport costs.

Thus, innovations in waste management can significantly transform the industry by making processes more efficient and sustainable, in line with the concept of disruptive innovation.

In Ukraine, innovations in waste management are beginning to play a key role in shaping the environmental agenda, facilitating the transition to more sustainable and environmentally friendly practices.

A new framework of the Law of Ukraine ‘On Waste Management’ has been adopted, aimed at creating an environmentally sound waste management system based on the principles of a closed-loop economy. This law was an important step towards the implementation of European standards in waste management and laid the foundation for further innovative solutions. Ukrainian enterprises are introducing modern technologies to minimise their environmental impact. For example, Zaporizhstal Iron and Steel Works has implemented projects to modernise production, including the installation of dust and gas purification systems and conversion to converter production, which has significantly reduced emissions of harmful substances into the atmosphere.

Ukraine's participation in international climate summits, such as COP29, opens up opportunities for attracting funding from climate funds and implementing green innovations. This promotes the development of sustainable waste management solutions and strengthens the country's environmental agenda in the international arena.

Innovations in waste management also include cultural and educational projects aimed at changing society's attitudes towards waste. Such initiatives help

raise public awareness of the importance of recycling and waste reduction, which is an integral part of the environmental agenda.

In general, the introduction of innovations in waste management in Ukraine contributes to the improvement of the environmental situation, bringing the country closer to the standards of sustainable development and European environmental norms.

In developed countries various innovations in the sphere of public waste management aimed at increasing efficiency, reducing costs and minimising environmental impact are implemented (Table 1.). By implementing these innovations, Ukraine can significantly improve its waste management systems, making them more sustainable and environmentally friendly.

Table 1

Innovations in public waste management

	Innovation	Characteristics	Effect
1	Integration of Internet of Things (IoT) technologies [1]	Smart bins equipped with sensors monitor fill levels, waste type and recycling opportunities	This optimises waste collection routes and schedules, reducing operating costs and carbon emissions
2	Using Artificial Intelligence (AI) and Machine Learning [1]	AI algorithms analyse waste generation data, predicting waste volumes and optimising collection and recycling processes.	This facilitates more efficient allocation of resources and improves the accuracy of material sorting.
3	Advanced recycling techniques [2]	Modern technologies such as optical sorting and robotic systems automate the waste separation process, increasing the proportion of recyclable materials and reducing pollution	For example, in San Francisco, Recology has invested in sorting robots, which has increased the quality and volume of recycling
4	Zero Waste Initiatives [1]	Many cities and companies are striving to completely eliminate sending waste to landfills by promoting zero waste policies	This includes programmes to minimise waste generation, reuse and efficient recycling, supporting the concept of a circular economy
5	Waste-to-energy technologies [1]	Modern techniques can turn waste into electricity or heat, reducing landfill waste and providing an additional source of energy.	These technologies aim to improve recycling efficiency and reduce emissions associated with waste incineration.

6	Underground pneumatic waste collection systems[2]	Some cities, such as Songdo in South Korea, have implemented underground pneumatic pipelines to transport rubbish directly from buildings to recycling facilities.	This eliminates the need for rubbish trucks, reduces emissions, and improves the efficiency of waste collection.
7	Citizen Engagement Platforms [1]	Digital apps and web portals inform residents about waste collection schedules, recycling rules and provide recycling tips.	Such platforms promote public awareness and engagement in waste management processes.

Compiled by the authors based on open sources

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APPLICATION OF ENERGY STORAGE SYSTEMS FOR MUNICIPAL AND HOUSEHOLD FACILITIES AS AN ELEMENT OF ENERGY EFFICIENCY AND ENERGY SAVING POLICY IN UKRAINE

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Introduction. Energy conservation and efficiency improvement are priority areas of Ukraine's energy policy. One of the most promising solutions in this field is the use of energy storage systems (ESS) for municipal and household facilities. These systems help reduce the load on the power grid during peak hours and enhance energy security. Consequently, research on the modern energy storage systems potential implementation and their impact on the country's energy sector is highly relevant.

Advantages and Technological Features of ESS. According to [1, 2], modern energy storage systems offer several key advantages:

- **Reduction of electricity losses** – ESS helps minimize losses associated with long-distance electricity transmission.

- **Improvement in power supply reliability** – battery storage ensures uninterrupted power supply during outages or emergencies.