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ASSESSMENT OF WASTE MANAGEMENT IN POLAND

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ABSTRACT: The article presents, which was his purpose, an analysis of waste management in Poland and the changes occurring over the years. According to Statistics Poland, 121 million tonnes of waste were generated in 2021, of which 11.3% was municipal waste. Waste volume increased to 123 million tonnes in 2023. The main sources of waste, as in previous years, were mining and extraction (61.9%), manufacturing (22.0%), and electricity, gas, steam, and hot water generation and supply (12.7%). Of the total waste generated in 2021, approximately 48% was recovered, 44% was disposed of by landfilling, and 7% by other means. In 2021, 13,674,000 tonnes of municipal waste were generated. Effective waste management is essential for ensuring the efficient use of natural resources and sustainable economic growth. In Poland, the amount of municipal and packaging waste produced is increasing. Environmental awareness, however, promotes their rational management. Recovery and recycling are becoming increasingly popular methods of waste management, which is particularly noticeable in the case of packaging waste, amounting to 60%. Therefore, adequate waste management is the future of our planet.

KEYWORDS: waste, recycling, segregation, management

Introduction

Every human activity generates waste (Vambol et al., 2023). Its amount depends on the scale of the activity and the environmental awareness of society. Their appropriate management can reduce negative impacts on the environment and human health (Mazzanti & Zoboli, 2008; Harat et al., 2024). Water, soil, and air pollution are the main indirect effects of inadequate waste management (Khan et al., 2022). Managing them appropriately and using closed cycles are the main challenges facing humanity (Czekała et al., 2023).

According to the Waste Act and the Regulation on the Catalogue of Waste (Act, 2021), waste is divided into groups, subgroups, and types. 950 types of waste are included in 20 groups (Regulation, 2020). Waste should be classified into the appropriate group already at the site of its generation. Accordingly, classified waste is assigned a waste code. The source of generation, properties and composition of the waste should be taken into account. The waste groups included in the catalogue of waste are:

- 01 – Waste resulting from searching, extraction, physical, and chemical processing of ores and other minerals,
- 02 – Waste from agriculture, horticulture, hydroponics, fishing, forestry, hunting, and food processing,
- 03 – Waste from wood processing and the production of panels and furniture, cellulose pulp, paper, and cardboard,
- 04 – Waste from the leather, fur, and textile industries,
- 05 – Waste from oil processing, natural gas purification, and pyrolytic treatment of coal,
- 06 – Waste from the production, preparation, marketing, and use of products from the inorganic chemical industry,
- 07 – Waste from the production, preparation, marketing, and use of products from the organic chemical industry,
- 08 – Waste from the manufacture, formulation, marketing, and use of protective coatings (paints, varnishes, ceramic enamels), putty, adhesives, sealants, and printing inks,
- 09 – Waste from the photographic industry and photographic services,
- 10 – Waste from thermal processes,
- 11 – Waste from chemical surface treatment and coating of metals and other materials and from non-ferrous hydrometallurgical processe,
- 12 – Waste from forming and physical and mechanical surface treatment of metals and plastics,
- 13 – Waste oils and liquid fuel waste (excluding edible oils and groups 05, 12, and 19),
- 14 – Waste organic solvents, coolants, and propellants (excluding 07 and 08),
- 15 – Packaging waste; absorbents, wiping cloths, filter materials, and protective clothing not included in other groups,
- 16 – Waste not included in other groups,
- 17 – Waste from construction, repair, and demolition of buildings and road infrastructure (including soil from contaminated areas) – changes from 1 January 2025,
- 18 – Medical and veterinary waste,
- 19 – Waste from waste management facilities and installations, from wastewater treatment plants, and from the treatment of drinking water and water for industrial purposes,
- 20 – Municipal waste including separately collected fractions.

In general, waste can be divided into municipal and industrial (Beigl et al., 2008; Srivastava et al., 2022). Municipal waste is very varied and heterogeneous. They can be divided into (Ciuła et al., 2023):

- Biodegradable waste (paper and cardboard, clothing and textiles made of natural materials, green waste, kitchen and garden waste, wood);
- Green waste (grass and leaves);
- Raw waste (plastic, paper, glass or metal packaging that can be recovered and recycled);
- Waste in the form of multi-material packaging (cartons of juice, dairy products, etc.);
- Hazardous waste (used batteries, rechargeable batteries, expired drugs, drug packaging, chemicals, used electronic and electrical equipment, etc.);

DOI: 10.34659/eis.2025.93.2.1030

- Waste electrical and electronic equipment (used consumer electronics and household appliances);
- Bulky waste (furniture, bicycles, strollers and toys, panels, beams, fences, windows and window frames, doors, bathtubs and sinks, radiators, pipes, etc.);
- Renovation waste.

Industrial waste is classified in terms of its generation in production or consumption processes and the extent to which it pollutes the environment. Classification takes into account the threat to nature and toxic potential (hazardous components, harm to living organisms, impact on surface water and soil, carcinogenic properties, dusty properties, flammability, etc.).

Waste can also be divided according to the proportion of organic matter in its mass. There can be organic waste, mineral-organic waste or mineral waste, depending on the degree of organic matter present.

In 2021, approximately 121 million tonnes of waste were generated, of which 11.3% (13.7 million tonnes) was municipal waste. In 2023, the amount of waste increased to 122.8 million tonnes, of which 11% was municipal waste (13.4 million tons) (CSO, 2024). The amount of waste generated each year remains at a similar level. Since 2000, the total amount of waste has decreased from 137.7 million tonnes to 125.5 million tonnes in 2010 and 122.6 million tonnes in 2020 (CSO, 2022).

There are many methods of waste disposal and management (Browning et al., 2021). Recycling, or other methods of recovering waste, can be a source of valuable natural resources, fostering their efficient management and promoting economic growth (Halecki et al., 2021). Thermal waste treatment (incineration, pyrolysis, gasification, plasma) is the future of efficient waste management in Poland and around the world (Binbin et al., 2022; Cai et al., 2023; Andrusikiewicz, 2023). These solutions have long been used in Scandinavian countries to acquire clean energy. In Poland, the main source of energy is hard coal, which is extracted deep from beneath the earth's surface while underestimating the energy properties of the waste that is on the ground (Manczarski et al., 2022; Żak & Wojtasik, 2024).

The Waste Act and Directive introduced a five-stage waste hierarchy: waste prevention, reuse, recycling, other forms of recovery, and, as a last resort, waste disposal (e.g. by landfilling). Therefore, in accordance with the Waste Act (Act, 2021), waste management must be carried out in an appropriate manner to protect the environment and human health and life. Waste management cannot:

- cause a risk to soil, water, air, plants or animals,
- cause a nuisance through noise or odor,
- cause adverse effects on the countryside or places of special interest, including cultural and natural sites.

In the European Union, the amount of waste generated by all countries through economic activities and households was almost 2.15 billion tons in 2020. Germany, France, Poland, Sweden and Romania generated the most waste. Of the total, construction (37.1% of total waste), mining and quarrying (23.4%), manufacturing (10.9%), waste management services (10.7%) and households (9.5%) generated the most waste. The remaining 8.4% was waste generated by other economic activities, mainly services (4.5%) and the energy sector (2.3%). Hazardous waste accounted for 4.4% of all waste generated (95.5 million tons) (Regulation, 2002).

Municipal waste

Municipal waste is waste from households (paper and cardboard, glass, metals, plastics, biowaste, wood, textiles, packaging, waste electrical and electronic equipment, waste batteries, and accumulators and bulky waste) and other waste similar to household waste. The municipal waste liability statute has been regulated with the introduction of a waste management system by municipalities for all property owners as of 1 July 2013 (Act, 1996). In 2021, 13,674,000 tonnes of municipal waste was generated and there was an increase (4.2%) in generation compared to the previous year. In 2023, 13,448,000 tonnes of municipal waste were generated. In 2020, there was an average of 344 kg of municipal waste per inhabitant, while in 2021, the amount of waste increased to 360 kg. In 2020, there was an average of 357 kg of municipal waste per inhabitant. The highest amount was

DOI: 10.34659/eis.2025.93.2.1030

recorded in the Lower Silesian Voivodeship (435 kg) and the lowest – in the Subcarpathian Voivodeship (250 kg). In Poland, the average amount of municipal waste per capita in 2021 was 360 kg, whereas in European Union countries, this amount was at 517 kg (EU Monitor, 2023). The amount of municipal waste depends on population, affluence, and rural or urban areas. The highest amount of municipal waste per capita is generated in Austria (834 kg), Luxembourg (790 kg), Malta (643) and Cyprus (609). Of the total municipal waste generated in the EU, 30% is recycled, 26% is thermally disposed of, 24% is landfilled, and 18% is composted (CSO, 2022; Tauš et al., 2023). In Poland, landfilling and recycling are still the main waste management methods (Figure 1).

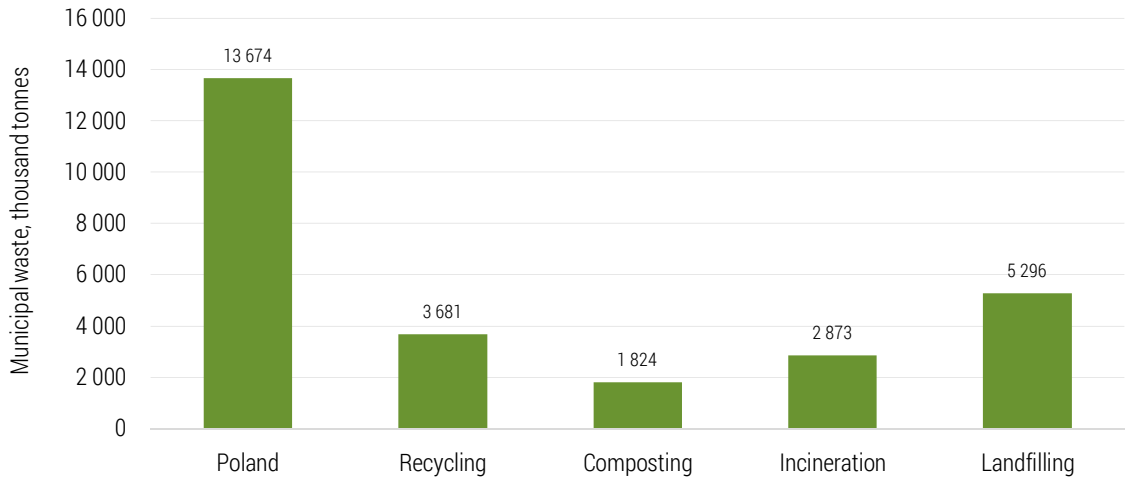

Figure 1. Municipal waste generated according to the treatment operation in 2021

Source: CSO (2022).

It should be noted that there has been an increase in public awareness of separate waste collection over the last few years. The implementation of new legal solutions, separate collection schemes by municipal authorities, and the environmentally friendly attitudes of residents are the main factors favoring waste recycling (Zon et al., 2020). In 2021, there were 2,279 separate waste collection sites, 65% of which were in rural areas and 36% in urban areas. In 2023, the number of selective waste collection points increased to 2,330. In urban areas, approximately 158 kg per capita was separately collected, while in rural areas, this number was 122 kg per capita. The amount of municipal waste collected selectively by year in Poland is shown in Figure 2.

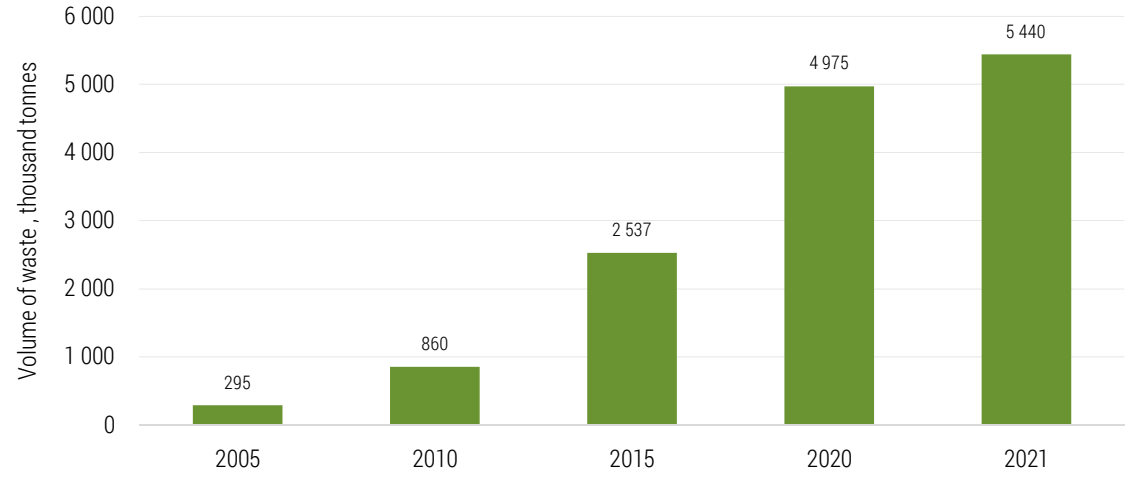

Figure 2. Municipal waste collected separately

Source: CSO (2022).

DOI: 10.34659/eis.2025.93.2.1030

The fraction of waste collected separately has changed significantly in recent years. Currently, biodegradable waste (34%) and other fractions (18%), mainly packaging waste (61%), multi-material packaging, waste electrical and electronic equipment, hazardous waste, and clothing and textiles account for the largest percentage (Figure 3).

Mixed municipal waste dominates the waste generated as it accounts for 60% of all waste generated (8.2 million tonnes). In 2023, the amount of mixed municipal waste will decrease to 8 million tonnes (59%). This type of waste is mainly disposed of by the landfill process, with their number decreasing and standing at 265 landfills (2021). In 2023, 254 landfills accepting municipal waste were in operation. Existing landfills are equipped with biogas recovery and electricity generation facilities. Approximately 98.9 million MJ of heat energy and 109.9 million kWh of electricity were recovered from the extracted gas (Duan et al., 2021).

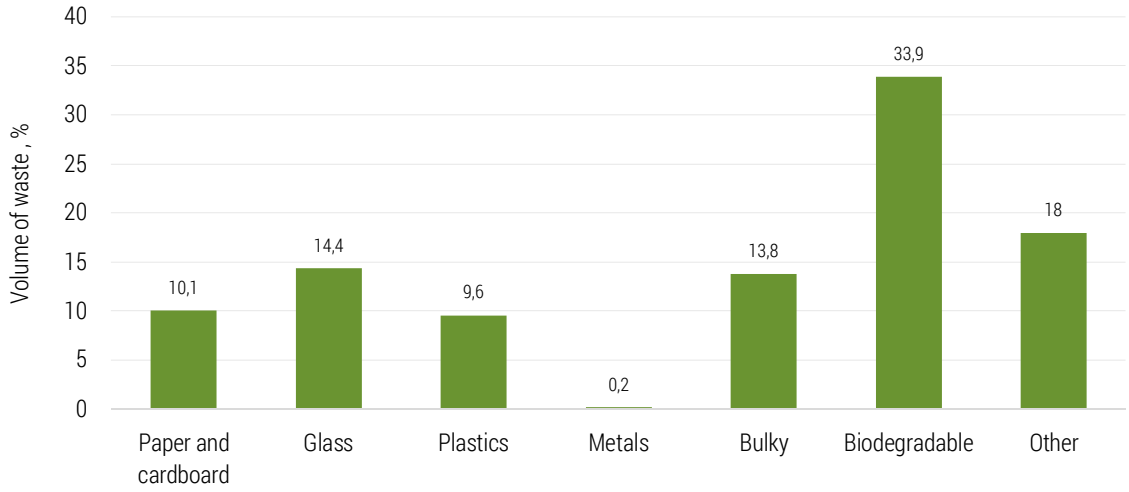

Figure 3. Structure of separately collected municipal waste by waste fraction in 2021

Source: CSO (2022).

Industrial waste

Industrial waste accounts for the majority of the total waste generated. In 2021, approximately 107,712 thousand tonnes of waste was generated from various sectors of the economy. In 2023, the amount increased to 109,309 thousand tonnes of waste (excluding municipal waste) from various sectors of the economy. The main sources of industrial waste generation are shown in Figure 4. It is noteworthy that half of the waste generated is recycled, while the remainder is mostly landfilled.

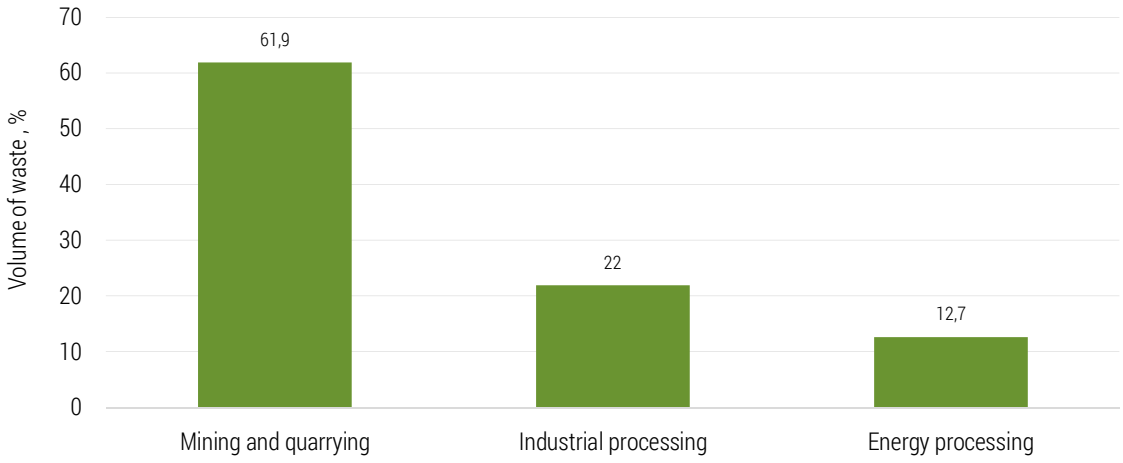

Figure 4. Main sources of industrial waste generation

Source: CSO (2022).

DOI: 10.34659/eis.2025.93.2.1030

Most industrial waste is generated in the Lower Silesian and Silesian Voivodeships. Their amount exceeds 58% of all waste generated. The least amount of waste is generated in the Lubusz and Subcarpathian Voivodeships (approximately 1%). Despite the five-step waste management hierarchy (prevention, reuse, recycling, recovery, disposal), a large proportion of business waste is landfilled (47 million tonnes). The largest areas designated for waste disposal are located in the Lower Silesia, Łódź, Silesian, and Świętokrzyskie Voivodeships.

Packaging waste

In Poland, around 6.5-6.7 million tonnes of packaging are placed on the market annually (Szymańska, 2021). Recovery and recycling rates in recent years have been high, at around 63% and 58% respectively (Figure 5).

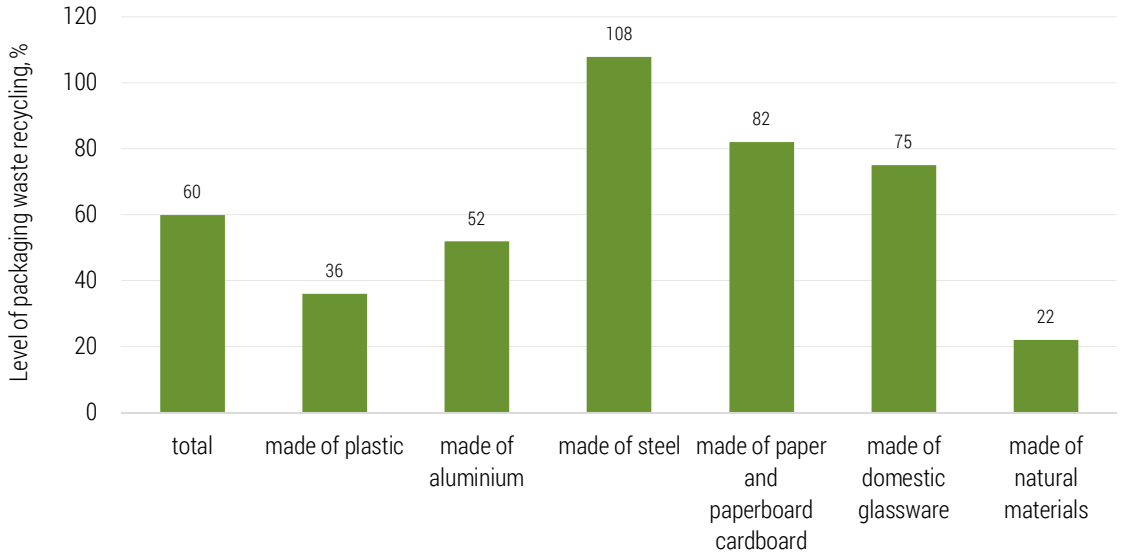

Figure 5. Achieved level of packaging waste recycling in 2020

Source: CSO (2022).

In EU countries, an average of 178 kg of packaging waste is generated per inhabitant. Most packaging waste was produced as paper and cardboard (41%), plastics (19%), glass (19%), wood (16%), and metal (5%). The highest levels of waste recovery were achieved in Finland, Estonia, and Belgium, and the highest recycling levels were found in Belgium, the Netherlands, and Luxembourg (Vuk et al., 2023).

The amount of packaging waste generated has increased in EU countries, mainly from paper and cardboard (24%), plastic waste (26%), wood waste (20%), glass waste (14%), and metal waste 6.7%. Recycling of packaging waste also increased by 24% (Ragonnaud, 2023).

Directive (EU) 2018/852 of the European Parliament and of the Council of 30 May 2018 amending Directive 94/62/EC on packaging and packaging waste contains the main quantitative requirements, i.e:

- by 31 December 2025: recycle at least 65% by weight of all packaging waste,
- by 31 December 2030: recycle at least 70% by weight of all packaging waste; Specific targets have been set for the recycling of individual types of packaging materials (Figure 6).

DOI: 10.34659/eis.2025.93.2.1030

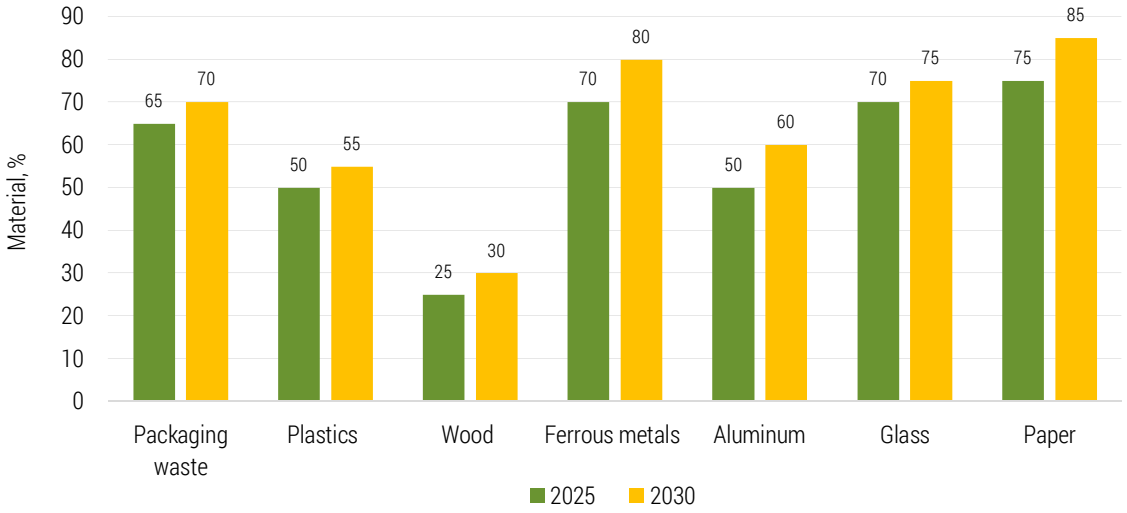

Figure 6. Specific recycling targets for different types of packaging materials

Conclusion

In the last three years, municipalities have become owners of municipal waste. According to the Act on maintaining cleanliness and order in municipalities, the local authority is responsible for waste management in the municipality. Despite this, wild dumps are still a common occurrence. Plastics are mainly found in illegally dumped waste. In the case of their legal disposal, plastic waste management costs include the cost of separate collection of waste, the cost of sorting the collected waste, and the cost of preparation for recycling (IOŚ-PIB, 2021). Post-recycling waste prices are influenced by the following main factors, among others:

- the price of purchase of plastic waste from suppliers,
- energy costs, labor, taxes, etc.,
- the costs of investment and upgrading recycling facilities to comply with legal requirements.

It can be observed that the amount of selectively collected waste has increased in recent years. In the last 10 years, this volume has increased sevenfold to 5,440,000 tonnes. Biodegradable waste accounts for the largest proportion (ca. 34%). The European Union's requirements for the next few years are pushing for an even more ecological approach to waste management, segregation, and recycling. By 2030, the amount of waste recycled should increase by 5% compared to 2025 (Uchwała, 2023). Everything is heading in the right direction, as a result of appropriate government policies and the environmental awareness of the public. However, this requires a lot of financial resources and an increase in waste disposal fees. The rate of the fee and the procedure and frequency of its payment are determined by the municipal council by resolution. The amount of the fee for a property with residents depends on the number of residents, the property area, and water consumption. In the case of a property with no residents, the waste disposal fee depends on the amount of waste collected.

Local government officials and representatives of the waste industry are in no doubt that changes need to be made to the regulations. This view is shared by the Climate Ministry, which has announced another amendment to the Act, proposing, among other things, a change in the way the level of municipal waste recycling is calculated, an increase in the maximum rate for owners of uninhabited properties, the need to place codes on garbage bags from residents of multi-family houses, the possibility of dividing waste into three fractions instead of the current five, provided that the municipality has the technical capacity and the Ministry of the Environment agrees to such a change, and stricter penalties for littering, up to PLN 5,000 for littering in public places. It is important to develop the most coherent and effective waste management system in Poland in collaboration with waste industry experts and the Climate Ministry. It is critical to note that humans are part of nature. By protecting nature, people protect themselves.

DOI: 10.34659/eis.2025.93.2.1030

Acknowledgements

Source of funding of the publication: BS/PB-400/301/24.

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Paweł WOLSKI

OCENA GOSPODARKI ODPADOWEJ W POLSCE

STRESZCZENIE: W artykule, co było jego celem, przedstawiono analizę gospodarki odpadowej w Polsce i zmian następujących w kolejnych latach. Według GUS w 2021 r. wytworzono 121 mln ton odpadów, z czego 11,3% stanowiły odpady komunalne. W 2023 ilość odpadów zwiększyła się do 123 mln ton. Głównym źródłem odpadów, podobnie jak w latach poprzednich, były: górnictwo i wydobywanie (61,9%), przetwórstwo przemysłowe (22,0%) oraz wytwarzanie i zaopatrywanie w energię elektryczną, gaz, parę wodną, gorącą wodę (12,7%). Z ogólnej ilości odpadów wytworzonych w 2021 r., ok. 48% odpadów zostało poddanych odzyskowi, 44% poddano unieszkodliwieniu poprzez składowanie, a 7% unieszkodliwiono w inny sposób. W 2021 r. wytworzono 13674 tys. ton odpadów komunalnych. Właściwe zarządzanie odpadami jest zasadniczym elementem zapewniającym efektywne użytkowanie zasobów naturalnych i zrównoważony wzrost gospodarczy. W Polsce zwiększa się ilość produkowanych odpadów komunalnych oraz opakowaniowych. Świadomość ekologiczna sprzyja jednak racjonalnemu ich gospodarowaniu. Odzysk i recykling stają się coraz popularniejszymi metodami zagospodarowania odpadów, co jest szczególnie zauważalne w przypadku odpadów opakowaniowych, wynoszący na poziomie 60%. Odpowiednie zagospodarowanie odpadów to przyszłość naszej planety.

SŁOWA KLUCZOWE: odpady, recykling, segregacja, zagospodarowanie