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Packaging waste management in a circular economy in Poland

Gospodarowanie odpadami opakowaniowymi w gospodarce o obiegu zamkniętym w Polsce

Abstract. The article examines the issue of packaging waste management in Poland in the conditions of a circular economy, which requires the implementation of stringent EU requirements for waste recycling. The aim of the article is to demonstrate the need for municipalities to participate in the packaging waste management system as owners of municipal waste. Taking into account the participation of municipalities in the research is a new aspect of the analysis of the waste management system in relation to EU and global research. The research methods used in the research included: analysis of legal acts regulating the functioning of the packaging and packaging waste management system, review of source materials, including expert opinions of waste industry specialists and non-governmental organizations, opinions of councilors and local government advisors, review of articles from the national, regional and local government. In addition to the analysis method, an observational method documented with photos of types of packaging and approaches to implementing the packaging circulation system was used. Subsequent government legislative initiatives undertaken to regulate producer responsibility for packaging recycling were analyzed, initially concerning partial responsibility and then extended responsibility (EPR). The final conclusions demonstrate the need for municipalities to participate in the packaging waste management system that includes extended producer responsibility. The need for fair legislative solutions for all entities operating in packaging waste management was pointed out. It was shown that the implementation of the EPR system will change the entire existing national municipal waste management system and will affect not only the functioning of the packaging industry but also other important areas of the national economy, such as trade and transport.

Key words: Packaging, packaging waste, waste management, circular economy, extended producer responsibility, deposit system, municipalities

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Synopsis. W artykule zbadano zagadnienie gospodarowania odpadami opakowaniowymi w Polsce w warunkach gospodarki o obiegu zamkniętym, co wymaga realizacji rygorystycznych unijnych wymagań dotyczących recyklingu odpadów. Celem artykułu jest wykazanie konieczności udziału gmin w systemie gospodarowania odpadami opakowaniowymi jako właścicieli odpadów komunalnych. Uwzględnienie udziału gmin samorządowych w funkcjonowaniu systemu gospodarowania odpadami opakowaniowymi stanowi nowość w odniesieniu do badań prowadzonych w UE i na świecie. W przeprowadzonych badaniach użyto takie metody badawcze jak: analiza aktów prawnych regulujących funkcjonowanie systemu gospodarki opakowaniami i odpadami opakowaniowymi, przegląd materiałów źródłowych, w tym ekspertyz specjalistów branży odpadowej oraz ekspertyz organizacji pozarządowych, opinii radnych i doradców samorządowych, przegląd artykułów z prasy ogólnopolskiej, regionalnej i samorządowej. Oprócz metody analizy, zastosowano metodę obserwacyjną udokumentowaną zdjęciami rodzajów opakowań i sposobów realizacji systemu obiegu opakowań. Zanalizowano kolejne rządowe inicjatywy legislacyjne podjęte w celu uregulowania odpowiedzialności producentów za recykling opakowań, początkowo dotyczące częściowej odpowiedzialności, a następnie odpowiedzialności rozszerzonej (ROP). We wnioskach końcowych wykazano konieczność udziału gmin w systemie gospodarowania odpadami opakowaniowymi włączającym rozszerzoną odpowiedzialność producenta, a także wskazano na konieczność sprawiedliwych rozwiązań legislacyjnych uwzględniających udział wszystkich podmiotów działających w ramach gospodarki odpadami opakowaniowymi. Wykazano także, że wdrożenie systemu ROP zmieni cały dotychczasowy krajowy system gospodarki odpadami komunalnymi oraz wpłynie nie tylko na funkcjonowanie branży opakowaniowej, także na inne ważne obszary gospodarki krajowej takie, jak handel i transport.

Słowa kluczowe: opakowania, odpady opakowaniowe, gospodarowanie odpadami, gospodarka w obiegu zamkniętym, rozszerzona odpowiedzialność producenta, system kaucyjny, gminy

JET codes: Q53, Q56, Q58

Introduction

Packaging plays an increasingly important role in today's world. Gone are the days when food products were sold by weight in bags or containers that customers brought with them to the store. Nowadays, it is difficult to imagine products sold without packaging. Despite the many advantages, this situation also has drawbacks, because after using the products, the packaging becomes waste, which is often difficult to dispose of, such as plastic bottles and bags.

The aim of the article is to demonstrate the need for municipalities to participate in the packaging waste management system as owners of municipal waste. Taking into the account the participation of municipalities in the research is a new aspect of the analysis of the waste management system in relation to EU and global research.

The implementation of waste management in EU countries in the conditions of a circular economy must take into the account stringent requirements for waste recy-

cling. Attention was drawn to the need for municipalities to participate in the packaging waste management system that includes extended producer responsibility, and subsequent government initiatives to regulate the functioning of the packaging management system were assessed in this respect.

In the current economy in European Union countries, customers cannot be solely responsible for recycling packaging waste. Therefore, the government has undertaken legislative initiatives aimed at introducing the responsibility of packaging producers for their disposal. Initially, the work focused on partial responsibility, but as the EU economy moved toward a closed-loop economy, legislative changes included broader producer responsibility (so-called "extended," in relation to "partial").

Materials and methods

The research was carried out using the methods of qualitative and comparative analysis as well as the observational method. The authors of the article studied applicable legal acts, such as parliamentary acts and other documents regarding the functioning of the packaging and packaging waste management system in Poland. Source materials were reviewed, including opinions of waste industry specialists and experts from non-governmental organizations, councilors and local government advisors, as well as articles in the national, regional and local government press for information on packaging waste management. In addition to the qualitative analysis method, an observational method was also used, resulting in photo documentation of the types of packaging and the organization of circulation and recycling of packaging.

It should be emphasized that the authors of the article, in addition to their knowledge in the field of return logistics and management, used in their research their experience gained in activities in regional government authorities and in work in local government administration [Bril and Rydygier 2020].

Characteristics of packaging

Packaging, within the meaning of the Act on Packaging and Packaging Waste Management [Dz.U. 2013 poz. 888], is a product, including a non-returnable product, made of any material, intended for storing, protecting, transporting, delivering or presenting products, from raw materials to processed goods. The following products are considered packaging:

– produced and intended to be completed at the point of sale,
– single-use, sold, filled, manufactured or intended to be filled at the point of sale,
– a component part of the packaging and an auxiliary element attached to the packaging, fulfilling the functions of packaging, but an auxiliary element attached directly or as an element constituting an integral part of the product which is intended for joint use or removal.

Packaging material is any type of material that is used to protect a product that is manufactured, sold, and shipped to a customer.

Types of packaging in logistics

The type of packaging is an issue that goes far beyond product protection. The size, material and design of packaging, in addition to purely aesthetic values appreciated by the customer, have a direct impact on the storage and transport costs. Therefore, decisions regarding the selection of the type of packaging are often of strategic importance for the company. Each individual product can be stored in different types of packaging at the same time. Packaging, according to EU Directive 94/62/EC, is divided into commercial, collective and transport [Regattieri et al. 2018].

Commercial packaging

Commercial packaging is used to store and protect the product. It has direct contact with the article and allows it to be kept in optimal condition. It is also the smallest portion of the product intended for individual sale. It can be a can, carton, bag, bottle, or sachet (Figs 1–2). Commercial packaging should have the following features:

– enable product identification in accordance with applicable regulations, indicate information on use and other important data, such as expiration date,
– some packaging can also help identify the brand and attract the consumers' attention,
– ensure stability in the display area in the store (staying on the shelf),
– isolate the contents,
– protect the product using as little material as possible.

Figure 1. Food product packaging
Rysunek 1. Opakowanie produktu spożywczego

Source: private material, photo by E. Rydygier.
Źródło: materiał prywatny, fot. E. Rydygier.

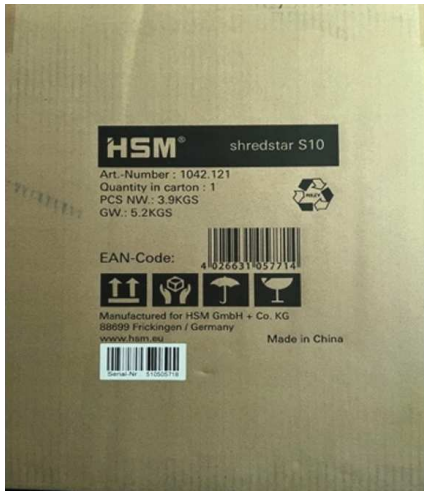

Figure 2. Consumer product packaging (cardboard)
Rysunek 2. Opakowanie produktu użytkowego (karton)

Source: private material, photo by E. Rydygier.
Źródło: materiał prywatny, fot. E. Rydygier.

Collective packaging

A specific number of unit packages are placed in the collective packaging. It provides additional protection and facilitates the sale of the product on a larger scale. For this purpose, mainly cardboard boxes are used, while they are less often made of plastic. Bottles of mineral water or beer cans are often connected together as a form of collective packaging (Figs 3–4). Collective packaging should have the following features [Farmer 2022]:

– can be stacked (in a warehouse or point of sale) and protect the products against damage during transport,
– contain a certain number of products,
– attract the customers' attention.

Figure 3. Fruit (raspberries) in one package
Rysunek 3. Owoce (maliny) w jednym opakowaniu

Source: private material, photo by E. Rydygier.
Źródło: materiał prywatny, fot. E. Rydygier.

Figure 4. Connected 6 mineral water bottles
Rysunek 4. Połączone butelki z wodą mineralną

Source: private material, photo by E. Rydygier.
Źródło: materiał prywatny, fot. E. Rydygier.

Transport packaging

Transport packaging contains a specific number of commercial or collective packaging forming a loading unit; the most common of these include pallets and containers and cardboard boxes with a size adapted to the dimensions of the pallets (Figs 5–6).

Transport packaging should have the following features [Hassak 2019, Janowski 2023]:
– stability and enabling the accumulation of the large number of loads,
– ensuring optimal use of space in warehouses and means of transport,
– having appropriate certificates and being made of durable materials,
– impact on brand perception (this applies especially to e-commerce logistics, where transport packaging can build the company's image, e.g. recognizable Amazon boxes).

Figure 5. Wooden pallet
Rysunek. 5. Paleta drewniana
Source: advertising materials, "Magazyny Kontenery" Selling Co.
Źródło: materiał reklamowy, „Mobilbox" Selling Co.

Figure 6. Container for transporting goods
Rysunek 6. Kontener do transportu towarów
Source: advertising material, "Mobilbox" Selling Co.
Źródło: materiał reklamowy, „Mobilbox" Selling Co.

Classification of packaging in Polish law

However, the types of packaging according to the Act on Packaging and Packaging Waste Management are classified according to their use:
– unit packaging – used to deliver the product to the user at the point of purchase; they may also be packaging intended for the consumption of products, disposable vessels,
– collective packaging – containing multiple unit packages of products, regardless of whether they are handed over to the user or are used to supply points of sale, and which can be removed from the product without affecting the product's features,
– transport packaging – used to transport products in unit or collective packaging to prevent product damage, excluding containers for road, rail, water or air transport.

Packaging is also classified according to the material from which it is made [Kaźmierczak 2022]:
– plastic (e.g. bags, boxes, bottles, stretch foil, Styrofoam),
– made of aluminum (e.g. cans, lids, caps),
– made of steel, including steel sheets (e.g. barrels, cans, caps),
– made of paper and cardboard (e.g. cartons, labels),
– made of household glass, except ampoules (e.g. bottles, jars),
– made of wood (e.g. pallets, spacers),
– other (e.g. ceramics, cork, jute, textiles).

In addition to the 7 main materials from which packaging is made, there are two more special types of packaging:
– multi-material packaging,
– packaging for hazardous substances.

In Poland, plastic packaging accounts for 24% of the total weight of packaging, glass 24%, paper and cardboard (P/T) 35%, and the others 17% [IOŚ-PIB 2022]. The types of packaging listed above are subject to regulations related to ensuring recovery and recycling. Packaging of hazardous substances requires additional special protection [Żakowska 2021].

In logistics, the "load unit" is of particular importance. It is the basic unit in the transport and storage of products. These include pallets, containers, barrels, reels, IBC containers (also known as IBCs), big bags, etc. Various cargo units can be stored in one warehouse in separate zones or in areas appropriately adapted for this purpose. One of the important criteria for selecting packaging is the desire to reduce direct costs (purchase of materials and waste management) and indirect costs (picking and packaging processes, handling, storage and losses resulting from damage) [Wojewódzka-Król and Roblecki 2018].

Packaging classification criteria

Factors influencing the selection of the type of packaging [Emblem and Emblem 2023]:
– product properties, e.g. state of matter (liquid, solid, gas), mass and volume, sensitivity to external factors, stability (does it deform under pressure), durability, degree of risk, and value,
– production and packaging process – determines what unit and collective packaging can be used. Their form and size also depend on whether the products will be packed manually or automatically,
– method of transport and storage – many different factors should be taken into account in this regard, including permissible height of stacks, storage time, handling methods (some of which may generate undesirable vibrations), number of loading/unloading operations, possible logistics (in accordance with the returns policy in e-commerce, reusable bulk packaging is sometimes used), ambient temperature and humidity during storage and transport,
– impact of the packaging waste on the environment and the possibility of recycling or reusing packaging,
– points of sale – it should be taken into the account where the products will be displayed and how they will be serviced. In e-commerce, it is worth paying attention to the unboxing experience, because it is the customer's first physical contact with the brand and product.
– legal acts and regulations defining packaging requirements, e.g. technical standards (EN or ISO), international transport rules (e.g. International Standard for Phytosanitary Measures ISPM No. 15), environmental regulations and transport regulations and marking of dangerous goods, such as the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR).

Packaging management

According to a report by "The Empty Space Economy" [Forbes Insights 2024], one quarter of the space in transported containers and packages is occupied by air. In addition, as many as 66% of respondents from senior management believe that eliminating empty space would reduce the investment in packaging by at least 25%. This goal can be achieved through actions such as [Stepnowska 2018]:

– standardization of packaging dimension (Fig. 7),
– automation of the transport of packaging materials (Fig. 8).

One of the main benefits of standardizing dimensions is the optimal use of space at all stages of the supply chain, from production through storage to transport. Hence the widespread use of euro pallets in European countries as transport packaging, which allows for the maximum use of the available space. A very good solution is the mutual commitment of suppliers, logistics operators, distributors and sellers to use a common, modular standard: 1200×800 mm (Europallet), 600×800 mm (1/2 Europallet) or 300×400 mm (1/3 Europallet). Entrepreneurs should analyze the assortment and select the appropriate basic dimensions (which are a sub-multiple of the Europallet dimensions) that fit most of the stored products [Bentkowski and Bentkowski 2020]. An important factor from the point of view of transport costs is the so-called dimensional (or volumetric) weight, which determines the space occupied by the goods in relation to their mass. Transport companies use it to set rates for the transport of light but large packages. In this area, the integration of the system with unit load parameter control systems, scales, automatic labelers and cobots supporting the packaging process is a significant convenience, because thanks to the collected data on the assortment, a piece of software is able to indicate to the employee what packaging they should use to prepare a specific order. Properly selected packaging increases the efficiency of packaging management [Meherishi et al. 2019].

Figure 7. Europallets

Rysunek 7. Europalety

Source: advertising materials, "Polskie Opakowania" Distribution Co.
Źródło: materiały reklamowe, spółka dystrybucyjna „Polskie Opakowania".

Figure 8. Automatic unloading system
Rysunek 8. Automatyczny system rozładunku

Source: advertising materials, "Cargomatic" Production Co.
Źródło: materiały reklamowe, spółka produkcyjna „Cargomatic".

When planning packaging optimization in the industrial sector, it is worth taking into the account packaging materials, methods of internal and external transport and storage, as well as costs related to waste management. Only a comprehensive approach to the problem guarantees the right choice of packaging ideally suited to the needs of the company. When a manufacturer introduces packaging made of any material, paper, wood, steel or plastic, or multi-material packaging or packaging for hazardous substances, they must ensure their statutory level of recycling. This involves additional obligations, such as paying a product fee or submitting an annual report to the Marshal's Office.

Packaging waste

Packaging waste is post-consumer packaging from the entire packaging system. Packaging waste is defined as all types of packaging, including reusable packaging withdrawn from reuse [Gembora 2023].

Types of packaging waste [Zhuo et al. 2023]:

– waste generated on the premises of business entities; some types of waste are used by the plants themselves or sold as raw materials to another company.

This waste should be segregated at the place of generation into groups of homogeneous materials. When waste generated in the production of packaging and packaging materials is not uniform in terms of material (e.g. laminates containing paper, plastics and aluminum) and there are no processing facilities at the place of generation, the producer is obliged to recover or dispose of it.

– household waste, whose collection is related to the initial segregation of waste carried out by residents at the household level and the installation of a network of containers for waste collection. If the waste is homogeneous in terms of material (paper, plastics, cullet) and if it is properly segregated on site and protected against contamination, it is a potential raw material for reuse.

In 2020, the average European generated 178 kg of packaging waste, including 35 kg of plastic packaging and 73 kg of paper and cardboard waste. In the EU, 40% of plastics and 50% of paper are used to produce packaging. In the European market, 36% of the mass of municipal solid waste becomes packaging [Komisja Europejska 2022]. Between 2009 and 2019, the amount of packaging waste generated in the EU increased by 13.6 million tons (20.5%). In Poland, the mass of municipal waste generated in 2021 amounted to 13.7 million tons, which is an increase of over 4% compared to last year. The mass of packaging introduced to the market in Poland in 2020 amounted to 6.5 million tons [GUS 2022].

Impact of the circular economy on waste management

Circular economy rules

The circular economy (also called the closed-loop economy) is an economic model based on the closed cycle of product life. Circular economy means that after the maximum potential of a product has been used in its life cycle, the product is reused and thus returns to the life cycle [Szczech-Pietkiewicz and Czerniak 2024]. This procedure preserves natural raw materials and reduces the amount of waste generated. EU directives on the development of a circular economy favor the reuse and recycling of waste with a strict limitation of disposal through landfilling and incineration [Wiesmeth 2020, Iwaszczuk et al. 2022]. Burning waste is prohibited because it requires energy from the processing of other raw materials and is a source of new pollutants. However, after consultations with experts, the environmentally harmless incineration of high-calorie waste with heat and electricity recovery was allowed, even though in the conditions of a closed-loop economy [Rydygier and Bril 2020], this type of incineration cannot constitute a form of recycling. These activities are part of the search for ways to replace conventional sources with alternative sources, because in terms of energy, 1 ton of coal corresponds to 2–3 tons of municipal waste [Kawęcka and Cholewa-Wójcik 2019].

A circular economy affects not only the way waste is managed but also the entire packaging cycle, because product packaging becomes waste after unpacking or use [Sikorski 2021]. In May 2018, the Council of the European Union adopted new regulations regarding waste packages. These directives require recycling of at least 55% of municipal waste by 2025, 60% in 2030, 65% in 2035. By 2030, only 10% of municipal waste will be allowed to go to landfills [Interreg Europe 2020].

It should be emphasized that the processing of secondary raw materials is a less burdensome process for the environment than the processing of primary raw materials, so recycling contributes to climate protection [OECD 2015].

Packaging waste recycling

Packaging waste, like other waste, must be recycled in accordance with EU directives. Big cities are forced to invest in large recycling installations [Vuk et al. 2023]. In Poland, for example, work is currently progressing on the construction of the Municipal Waste Recycling Center in the post-industrial area of the "Nowa Huta" District in Krakow (Fig. 9). The completion of the first stage of work on the construction of the center is

scheduled for the end of June 2024. The Municipal Waste Recycling Center in Krakow is a multi-task project, implemented in stages, under which it is planned to build [Rąpalski 2024]:

– plastic recycling plant,
– municipal waste recovery plant,
– large waste recovery plant,
– selective municipal waste collection point intended to collect municipal waste delivered by property owners located in the city,
– municipal waste storage hall intended for waste undergoing processing, waste and products obtained in the recycling process, along with the installation of a photovoltaic installation on the roofs of buildings, which is part of an extensive program for producing electricity from renewable sources and will reduce the operating costs of the installation.

The first stage of the plastic recycling center includes the construction of:

– installation for preparing plastic foils for recycling (recovered in municipal waste sorting processes) by sorting PE foils and an installation for producing polyethylene granules by foil shredding, washing and granulation,
– municipal waste storage hall,
– social, administrative and office buildings and reception desk,
– necessary accompanying infrastructure in terms of access road together with internal roads within the center, maneuvering areas and parking lots, external sanitary installations; domestic water, water for fire protection purposes, sanitary and storm sewage, electricity, and heating.

The currently expected total cost of implementing the Plastics Recycling Plant amounts to PLN 245 million. The Municipal Purification Company ("MPO" Kraków) obtained funding for the implementation of the first stage of construction from the National Fund for Environmental Protection and Water of:

– PLN 149,550,000 in the form of a loan,
– PLN 30,000,000 in the form of a grant.

The recycling machines planned as part of legislative work on introducing extended producer responsibility for manufactured packaging are intended to improve the selection of packaging waste. For now, municipalities will introduce their own recycling machines for educational purposes. Such an educational recycling machine was placed next to the building of the "Ursynów" District Office in Warsaw (Fig. 10). This device is used to exchange plastic and glass bottles and aluminum cans for ECO-points using a special application (ECO Prtfel – eng. eco wallet). In gratitude for their environmental protection activities, residents will receive discounts on, e.g., coffee, or cinema or theater tickets. From the new season, the offer also includes tickets to the "Jump World" trampoline park, discounts on natural and organic cosmetics in the "BioOrganika" store, and discount codes for subscriptions to *National Geographic* publications. The prize pool will be expanded [Urząd Dzielnicy Ursynów m.st. Warszawy 2020].

The recycling rate in Europe in 2020 was 64% of the weight of packaging waste and 37.6% of the weight of plastic packaging waste [Eurostat 2023]. In Poland, the recycling rate for packaging waste was approximately 60% and 31.5% for plastic packaging waste in 2019 [GUS 2022].

Figure 9. Waste Recycling Center in Kraków
Rysunek 9. Centrum Recyklingu Odpadów w Krakowie

Source: information materials, Portal of the Kraków City
Źródło: materiały informacyjne, portal miasta Krakowa

Figure 10. Recycling machine in Warsaw
Rysunek 10. Recykomat w Warszawie

Source: [Urząd Dzielnicy Ursynów m.st. Warszawy 2020].
Źródło: [Urząd Dzielnicy Ursynów m.st. Warszawy 2020].

System of packing circulation

Role of the producer

In Poland, since 2012, municipalities by law are obliged to manage waste [Dz.U. 2013 poz. 21 z późn. zm.]. Since waste management involves the costs of waste removal and disposal, the Ministry of the Environment has undertaken legislative work on the partial responsibility of producers in the costs of waste recycling. Unfortunately, no major changes have been made to impose financial responsibility on manufacturers, other than requiring customers to purchase plastic shopping bags. In July 2018, a revised package of European Union waste directives was published, setting higher recycling rates for municipal and packaging waste. According to these directives, 50% in 2020 and as much as 65% in 2035 of waste should be recycled. New EU regulations oblige producers of packaged products to comply with the so-called extended producer responsibility (EPR), which is a set of measures taken to ensure that those who introduce products, including products in packaging, bear financial responsibility or financial and organizational responsibility at the stage of the product's life cycle when it becomes waste [Jóźwiak 2024].

The implemented concept of extended producer responsibility leads to a reduction in the amount of packaging waste generated from plastics, which cannot currently be recycled. Another element is the standardization of returnable packaging specified in standards under penalty of penalties for placing non-standard packaging on the market [Brown A. et al. 2023]. During the discussion on the act, municipalities believed that the implementation of extended producer responsibility must involve a product fee paid by producers. Ultimately, these fees would cover the costs related to the operation and development of recovery and recycling organizations and the selective collection of packaging waste.

Developed by the Ministry of Climate (which replaced the former Ministry of Environment), the producer responsibility system was based on two mechanisms: fees and deposits. The fee mechanism was to include two types of manufacturer fees:

– the first fee paid only for packaged products intended for households placed on the market, which will then be paid to marshals' offices,
– a second levy that will apply in practice to all other packaging products that will be sold on the market and that will be paid to the extended producer responsibility organization.

In contrast, the deposit mechanism applies to selected types of packaging.

The new regulations were initially supposed to be implemented in the summer of 2020, meanwhile in October 2020, the Ministry of Climate announced that the new regulations on extended producer responsibility would only enter into force on January 1, 2022. From that date, packaging producers would participate in the costs of waste management. Pursuant to the Act, producers of packaged products are to finance the collection and management of packaging waste at a much higher level than is currently the case. The amount of fees charged to packaging producers was to be determined by the regulator's office. According to the assumptions of the Ministry of Climate, this office was to be established at the Institute of Environmental Protection, which would be responsible, among others, for maintaining the waste database. The fees were to be charged per tone of packaging placed on the market and would depend, among others, on what they consist of (plastic, metal, paper or glass) and whether they are easy to manage (i.e. whether a given product is more environmentally friendly, i.e. more recyclable). The production of PET bottles with shrink film would become unprofitable. Customers would have to pay more for tetra packs, which consist of several materials and are more difficult to recycle. The funds obtained from the application of extended producer responsibility would flow to local governments to co-finance waste collection and processing systems. The act being developed in 2020 was suspended before implementation because it was necessary to introduce extended producer responsibility. Additionally, it was planned to introduce mechanisms aimed at, among others: eliminating cases of certifying untruths in relation to packaging waste recycling and increasing financing for packaging waste recycling.

The proposed changes to the Extended Producer Responsibility Act have an impact on all waste management, which is felt by many entrepreneurs operating in the Polish market.

The most important changes underway include:

– introducing a mandatory packaging fee,
– implementing an obligation to ensure recycled plastic content levels in beverage bottles,
– introducing the obligation to achieve levels of selective collection of packaging waste,
– appoitment of an institutional representative for packaking waste,
– changes regarding the functioning of the packaging recovery organization, which will adopt the name of a producer responsibility organization,
– introducing the possibility of using plastic lids and lids attached to containers during the stage of intended use of the product. This obligation is addressed to entities intro-

ducing products in disposable plastic beverage containers with a capacity of up to 3 liters. This obligation is to apply from July 1, 2024,
– introducing the obligation to place labels on packaging indicating the method of selective waste collection. The signage must be usable by visually impaired and blind people,
– regulating the powers of the Institute of Environmental Protection – National Research Institute in the scope of supervision of the Extended Producers Responsibility system,
– improving control over recycling obligations in the system of issuing DPR (packaging waste recovery note) and EDPR (packaging waste export recovery note) documents, which are used by packaging recovery organizations.

The EPR Act entered into force on January 1, 2023, but work on finalizing the act has been delayed. In December 2023, there was a change of government, and the new management of the Ministry of Climate has taken over several delayed but priority tasks for the economy from its predecessors, one of them being building an extended producer responsibility system, which is the basis of the entire circular economy. The act should have entered into force in 2022, but the draft act was criticized by producers. In the European Union countries at that time, the issue of EPR was already well researched and included in the legal regulations of the member states [Joltreau 2022].

The new ministry has started working on the new project and estimates that it will take two years. On the one hand, business admits that this is a necessary act, but on the other hand, it calls for "fair" solutions. Producers anticipate disputes with local governments.

Currently, the Ministry of Climate and Environment (formerly Ministry of Climate) is working on further amendments to this act; two acts on extended producer responsibility are expected as part of this amendment [Jóźwiak 2024]. The first amendment would compensate municipalities for losses due to the exclusion of PET and beverage cans from the municipal stream, while the second would introduce extended producer responsibility. The system is designed to be developed in the future, so it is being implemented in stages. For now, there is no cash flow mechanism, there is the issue of appropriate adjustment periods, i.e. *vacatio legio*, but EU law is changing and there are many challenges in waste management. The Ministry communicates with entrepreneurs well in advance about the direction of legislative changes, so that entrepreneurs have some opportunity to adapt to the changes.

Deposit system

The deposit system that is currently in operation was implemented pursuant to the amendment to the Act on Packaging and Packaging Waste Management of July 13, 2023 [Dz.U. 2023, poz. 1852]. The main provisions of the amendment are:
– introducing the principles of operation of the national deposit system,
– establishing the territorial scope of the system and introducing a refund of the deposit without the need to present proof of purchase,
– obligation for beverage producers to mark packaging with information about the deposit, the value of which cannot exceed PLN 2.00,
– defining the conditions for operating the deposit system, issuing permits for a period of up to 10 years and establishing the rules for calculating fees in the event of failure to meet the requirements for selective waste collection.

The Act defines the concept of a deposit as a specific amount collected when selling products in beverage packaging and returned upon the return of the packaging. The deposit system is the process of collecting a deposit upon sale and returning it when the package is returned. A distinction is made between an entrepreneur dealing in the marketing of products in packaged beverages and an entrepreneur involved in the direct sale of packaged beverages.

Currently, the Ministry of Climate and Environment is working on amending the act passed in July 2023. The changes are intended to clarify the provisions regarding issuing, withdrawing and changing the authorization to operate a deposit system. The project also takes into the account the industry's demands regarding, among others, the deposit following the packaging throughout the sales chain, excluding dairy product packaging, and introducing a harmonized labeling system. The new deposit system is to enter into force on January 1, 2025 [MKiŚ 2024].

Entrepreneurs introducing drinks in packages covered by the system will be obliged to place markings on these packages indicating that the package is covered by the deposit system and specifying the amount of the deposit. The system will cover single-use beverage packaging: PET bottles with a capacity of up to 3 liters, metal cans with a capacity of up to 1 liter, and reusable glass bottles with a capacity of up to 1.5 liters. The deposit amount is specified in the regulation: PLN 0.50 for PET bottles and cans, PLN 1.00 for glass bottles.

The principle of operation of the planned deposit system:

– when purchasing a drink in a package with a logo, the customer will be charged a deposit, which will be added to the price of the drink only at the checkout,
– all commercial units, regardless of their area, if they offer drinks in packages covered by the system, will collect the deposit; it does not matter the business profile of a given store, only the products offered,
– packaging covered by the system will be appropriately marked with the deposit system logo, and it will not be possible to collect the deposit for packaging without the logo,
– the deposit can be collected when you return the packaging, you will not be required to present a receipt,
– packaging can be returned at any collection point. The obligation to collect packaging covered by the system is imposed on stores over 200 m^2, and small stores below 200 m^2 may voluntarily join the system. The packaging should not be crushed before returning to the collection point,
– it will also be possible to create collection points for empty packaging outside commercial units.

Benefits of introducing the system:

– reducing environmental pollution from packaging waste,
– increasing the level of selective collection of packaging waste,
– increasing recycling rates of packaging waste,
– creating positive waste segregation habits.

Entrepreneurs placing packaged drinks on the market will be obliged to achieve certain levels of separate collection of packaging and packaging waste under the system (77% from 2025 and 90% from 2029). Additionally, for single-use plastic bottles, they

will be obliged to ensure that these packaging, including their caps and lids, contain a weight share of at least: from 2025 – 25% of recycled plastics and from 2030 – 30% recycled plastic.

In accordance with the principle of extended producer responsibility, those who introduce drinks in packaging covered by the deposit system will finance the deposit system. Those who introduce packaging will bear the costs related to, among others, the collection and transport of packaging and waste, as well as keeping records and settling deposits. The system will be further financed from unreturned deposits and from the sale of recycled materials. The Act allows for the operation of several deposit system operators on the market.

The Ministry does not expect any issues that there will be several deposit machines from different operators in a single store (which is not welcomed by Polish consumers), as the act stipulates that operators are to cooperate with each other and sign contracts (Figs 11–12). There are several operators in other EU countries, including in Germany. The Ministry of Climate and Environment believes that logistically, virtually every country in the EU can be Poland's point of reference when it comes to labeling and collection systems, but from the point of view of the multitude of operators, the best model is the German system [Ernst&Young 2024].

It should be emphasized that the EU is not forcing Poland to introduce a deposit system, but high mandatory recycling levels, such as 77% in the first year of the EU regulation and 90% in 2029, are in practice impossible to achieve without a deposit system. If producers do not achieve these levels, they will be forced to pay product fees per kilogram, as specified in the regulation of the Minister of Climate and Environmental Protection. In the first year of operation of the system, this amount is minimal and amounts to PLN 0.10 per kilogram. The Ministry continues to analyze the functioning of the deposit system to ensure that it is a fair solution, bearing in mind the appeal for a fair EPR from local government officials and entrepreneurs from the waste management industry.

Figure 11. Bottle vending machine design in a store
Rysunek 11. Projekt butelkomatu w sklepie

Source: Portal PAP Self-government.
Źródło: portal PAP Samorząd.

Figure 12. Pilot of the deposit system in Carrefour
Rysunek 12. Pilotaż systemu kaucyjnego w Carrefour

Source: Portal PAP Media Room.
Źródło: portal PAP Media Room.

EU's Packaging and Packaging Waste Regulation

Work in the European Union on the Packaging and Packaging Waste Regulation (PPWR), i.e. the regulation that will have a very large impact on waste management, is currently being completed.

On November 30, 2022, the European Commission published a preliminary proposal for the PPWR. The regulation introduces uniform operating rules in all EU Member States [Komisja Europejska 2022].

The PPWR introduces stricter regulations aimed at ensuring that the principles of sustainable use of packaging are respected in each European Union Member State. The PPWR Regulation will replace the existing PPWD Directive (Packaging and Packaging Waste Directive) on packaging and packaging waste, which has been in force in Europe since 2018 (which replaced Directive 94/62/EC, in force since 1994). Although the PPWD contains guidelines that all EU Member States must follow, these guidelines may be implemented differently from country to country, and there are significant differences in practice.

The primary objective of the PPWR is to reduce the impact of packaging on the environment in Europe. For this purpose, uniform rules for conducting business by producers and importers of packaged goods in the European Union have been developed. Therefore, the same packaging labels and the same definitions will apply in all EU countries. The introduction of the PPWR will result in:

– limiting the amount of packaging (weight and volume),
– eliminating packaging waste that is not suitable for recycling,
– expanding packaging recycling and the use of reusable packaging,
– extending the management of packaging processes.

The PPWR will affect business processes because:

– the use of certain types of packaging will be prohibited (from 2030), such as, among others: disposable packaging in the catering industry (food and beverages), retail (fresh fruit and vegetables) and hotel industries (toiletries and hygiene products),
– all packaging will be recyclable (from 2030),
– unnecessary space in packaging will be prohibited, the packaging must not contain more than 40% of free space or air and must be as light as possible,
– increasing the use of recycled materials in packaging will be required,
– the presence of certain substances in packaging will be limited, packaging materials will be allowed to contain a total of no more than 100 mg/kg of lead, cadmium, mercury and hexavalent chromium,
– the weight of packaging placed on the market per capita will be limited.

The PPWR was recently adopted by the European Parliament but has not yet been implemented. The final text is to enter into force in the last quarter of 2024. Poland must respect the PPWR Regulation, as it is a binding legal act and must be applied throughout the entire EU.

An appeal for a fair EPR

On March 26, 2024, nationwide local government organizations, waste management entrepreneurs and the social side appealed to the government to urgently implement a fair system of extended producer responsibility [Unia Metropolii Polskich 2024]. According to the authors of the appeal, the system should be based on municipal systems, and municipalities should be provided with appropriate financing. The signatories of the appeal criticized the planned implementation of the deposit system from January 1, 2025, because they believe that EPR should be implemented first and only then the deposit system.

It was recalled that despite many years of debates and consultations on the EPR system, it has still not been implemented in the form required by EU law for Poland. An effective and fair EPR currently does not exist in national law and immediate action must be taken to change this fact.

First of all, the EPR system should be based on municipal systems and support their functioning by ensuring adequate financing. Only if producers participate in the costs of waste collection and management will municipalities be able to prevent an increase in fee rates for residents or reduce them.

The EPR system should also take into the account complementary solutions of the deposit system and hazardous waste collection, as well as the provisions of the amended waste directive and the currently pending PPWR of the Council and the European Parliament.

The aim of all the above elements is to ensure that as much raw material waste as possible is recycled, which translates into achieving the legally required levels of recycling by Poland and all system participants, not only municipalities.

All entities supporting the appeal declared their will and readiness to cooperate and support the Ministry of Climate and Environmental in legislative work in order to achieve a common goal – creating a fair and complete EPR system combined with the deposit system that is consistent with EU law.

According to the entities signing the appeal, the future EPR system should be based on the following assumptions:

1. Introduction of a new act, not building a system in subsequent amendments.
2. Basing the EPR on existing municipal systems while maintaining full municipal authority over waste.
3. In accordance with the currently applicable waste directive, the entity introducing products in packaging should be obliged to cover the full costs of collection, transport, preparation and recycling of waste arising from its products, cover the costs of ecological education, conduct proper reporting on the amount of waste recycled, and pay a fine (named a product fee) for failure to fulfill the recycling obligations.
4. A well-structured reporting module that takes the into account the interests of all parties, including:
   – records of municipal waste management systems,
   – records prepared by producer responsibility organizations,
   – records prepared by recycling companies,
   – records prepared by economic self-government organizations.

Fees paid by entrepreneurs (including the deposit) should depend on the type of packaging (ecomodulation) and be calculated for all packaging (including those covered by

the deposit system) placed on the market and calculated in such a way as to ensure full financing of the costs of waste collection and management. It is necessary to ensure that the deposit system operates as part of the EPR system and not separately. It is necessary to ensure that both systems enter into force simultaneously. The regulator of the system is to be the National Institute of Environmental Protection – Research Institute, which will perform functions in the field of supervision, control and implementation of analytical tasks in relation to the entire EPR system. The mechanism for sealing the system of issuing DPR and EDPR documents should function by giving the Regulator the authority to verify the data contained in these documents, including directly with recyclers.

The signatories of the appeal believe that taking into the account the above assumptions in the final draft of the act may contribute not only to achieving the legal and economic goal, but above all also the environmental one. This will make it possible to develop a complete and coherent EPR system defining the roles and requirements for individual groups of system stakeholders and to ensure them an appropriate place in the system, without discriminating against any of them.

The signatories of the Appeal point out that work on the regulation, which will have a significant impact on waste management, is nearing completion in the European Union.

Conclusions

Due to the government's decision to legislatively regulate the issue of extended producer responsibility for recycling packaging waste, the Ministry of Climate and Environment is carrying out intensive work on further amendments to the Act on Extended Producer Responsibility, modeled on the solutions implemented in Germany.

Legislative changes regarding packaging waste management are important for the broadly understood waste industry. The situation in the municipal waste industry has been unstable for years, and since 2018, there has been an ongoing legislative offensive, resulting in constant changes in the required standards. This unstable situation translates into costs incurred by residents. It should be emphasized that all the proposed changes will largely affect local governments that own municipal waste. The implementation of the deposit system and extended producer responsibility will have a direct impact on municipalities, and the possible implementation of the PPWR indirectly. The implementation of EPR is part of the implementation of the principles of a circular economy in the field of waste management, as it ensures the implementation of the "polluter pays" principle. All waste management entities agree that the implementation of the EPR system will change the entire functioning of the municipal waste management system.

Municipal governments criticize government proposals to transfer funds from packaging fees to packaging recovery organizations, because municipalities have been constructing and strengthening their municipal waste management systems since 2011as part of the implementation of their own tasks, which are regulated primarily by the provisions of the constitution specifying the role and place of local government. The EPR system should complement these systems with an important factor, which is the financial element, which should be fair, effective, transparent and controllable. Therefore, those who place products on the market should pay fees under extended producer responsibility

to the operator, a public entity, which would then transfer these funds within the public finance sector to local government units as funds intended solely for the implementation of waste tasks, which, in accordance with the waste directive, should be financed from the EPR system. Municipal governments have undertaken an initiative called "Fair EPR," which brings together all local government organizations from large metropolises to small communes, and its main postulate is to introduce extended responsibility first, and the deposit system should only be implemented in the second stage.

Despite appeals from municipal governments arguing that only the EPR system with transparent rules of financial and organizational responsibility will ensure success in achieving environmental and social goals, the Ministry of Climate and Environment distances itself from their demands.

The introduced deposit system is a challenge not only for the waste industry but also for the industry of enterprises that collect packaging. Experts from the Polish Chamber of Packaging emphasize that stores are primarily responsible for organizing the trade system and operating the deposit system is an additional task imposed on them. Residents will have to return undamaged bottles, and then it may turn out that the support for the system expressed in surveys will quickly turn into discouragement, the consequences of which will be borne by the entire industry. Today, residents support the implementation of the system, but they do not take into the account that it may result in higher prices for waste collection, because waste collection companies will have to compensate for the lack of valuable raw materials in the collected waste.

The contractor providing waste collection services to the commune will include in the price of the service the risk of failure to achieve the stipulated levels, which will be transferred to it. As a result, the miniature cosmetics packaging used in hotels and disposable tableware will be withdrawn from the market, and plastic bags with a thickness of less than 15 microns will disappear. It should be noted that many types of packaging will no longer be produced, which will ultimately translate into the raw material composition of future waste. Experts predict that the implementation of changes in packaging waste management due to the implementation of the extended producer responsibility system will make the EU requirements to achieve a 55% waste recycling level by 2025 unrealistic.

Waste processing installations will have to operate differently, but the changes will also be felt by residents as customers who buy packaged goods. The changes will affect not only the packaging industry but also broad areas of the national economy, such as trade and transport.

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