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PLASTIC RECYCLING IN POLAND – A TRANSFORMATION TOWARDS A CIRCULAR ECONOMY?

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Abstract: Plastic is one of the world’s most-used materials. Unfortunately, its widespread use is also connected with a large amount of waste. The main challenge of modern economies, including Poland, is the transition into a circular economy, which aims to minimize the amount of waste generated and the use of unavoidable waste as resources through recycling processes. The aim of the article is to indicate the degree of Poland’s transformation in the area of plastic waste recycling. Poland produces less plastic waste than the EU15, but the level of recycling is lower than the EU average. The recycling of plastic waste is largely based on easy-to-collect waste from commercial networks and transport. A further increase in the recycling rate will be possible when the selective collection and recycling of household waste is intensified. Both campaigns promoting the ecological awareness of inhabitants and systemic actions aimed at increasing the degree of use of recyclable materials are necessary.

Keywords: plastics, recycling, circular economy.

1. Introduction

Waste generation is an inseparable feature of human activity. This applies above all to plastic waste. Technically sophisticated, lightweight and cheap, plastics suit a broad spectrum of uses. However, the problem is not the widespread use of this material but the end-of-life management of plastic products (Gray, Owen, & Sopher 1998).

The aim of the article is to indicate the degree of Poland’s transformation towards an economy in which plastic is not a waste but a reused resource. The main challenge

of modern economies, including Poland, is to reduce the amount of plastic waste generated and to use unavoidable waste as resources in recycling processes. This article focuses on assessing the extent to which this latter objective is being achieved. The following EU targets are the benchmark for this analysis: 65% of municipal waste recycled by 2030; 75% of packaging waste recycled by 2030; reduction of landfill to a maximum of 10% of municipal waste by 2030.

Statistical and deductive methods are used in this work. The statistics are derived from the Eurostat database, PlasticsEurope (an association of plastics producers) and GUS. The statistics are complemented with the interpretation of regulatory solutions in the EU, the Circular Economy Package, and its main part – the European Strategy for Plastic.

The article is structured as follows. The first section presents the scale and the structure of plastic production, while the second defines the recycling process as the way to manage plastic waste in terms of the circular economy. The last two sections show Poland's results in meeting the EU recycling targets (recycling of plastic waste and plastic packaging waste) and discuss the trends and challenges of the Polish recycling sector.

2. Plastics – production and use

The concept of plastics (polymers) is a very broad one. This name refers to materials whose basic components are polymers, i.e. multimolecular chemical compounds obtained in industrial polymerization processes (from so-called mers), and auxiliary components (additives). These additives make it possible to improve the mechanical and thermal properties of plastic products, increase their aesthetic value and at the same time reduce the price and give them special functional properties, e.g. durability, mechanical and chemical resistance (also for corrosion), low electrical and thermal conductivity, low specific gravity and recyclability (Ambrogio, Carfagna, Cerruti, & Marturano, 2017, pp. 87-108). They make the use of plastics versatile (e.g. in the household goods and packaging industry, electrical, electronic, automotive, medical, clothing, construction, aerospace, agriculture and sports sectors) and have led to a dynamic increase in demand for it.

Europe is the second largest plastic producer in the world (2017), with an 18.5% share (29.4% of global production comes from China and 17.7% from NAFTA member countries). The European plastics industry includes plastics raw materials producers, plastics converters, plastics recyclers and plastics machinery manufacturers (European Plastics Converters, n.d). The market sectors with the highest plastic converter demand are: packaging (39.7%), building and construction (19.8%), automotive (10.1%), electrical and electronic (6.2%), household, leisure and sports (4.1%), agriculture (3.4%) and others (PlasticsEurope Market Research Group [PEMRG], 2018; Eurostat, 2018). Poland is the sixth most important player in the European plastics market (which covers 6.5% of European demand, after Germany 25%, Italy 14%, France 10%, Spain

8% and the United Kingdom 7%). The plastics sector in Poland is composed mainly of plastics converters (85% of the entire industry turnover): packaging producers (32.5%), building and construction (25.9%) and the automotive industry (10%). This sector is at the same time one of the most dynamic - its production tripled in the last 15 years. In 2017, it grew by about 9%, compared to 4.4% of GDP growth and 5.6% of the whole converting industry growth (PlasticsEurope, 2017).

3. Recycling of plastic waste in terms of the circular economy

Plastic is one of the world's most-used materials, which unfortunately involves huge amounts of waste. It is estimated that from the 1950s, i.e. from the beginning of the plastics industry's development until 2015, 70% of plastic waste have been accumulated in landfills or in the environment, especially in the oceans (Geyer, Jambeck, & Law, 2017).

Growing awareness of the environmental challenges related to plastic waste management and the economic problems of shrinking resources have led to a discussion on the need to change the way of economic thinking. The strategic goal of many countries and the EU as a whole has become the transformation of the linear economy into a circular one. A circular economy (CE) is explained as an economy "where the value of products, materials and resources is maintained in the economy for as long as possible, and the generation of waste is minimised". The European Commission launched the first Circular Economy Action Plan in 2015 (European Commission, 2015). It identifies five priority sectors to speed up the transition along their value chain. One of them is plastics, beside food waste, critical raw materials, construction and demolition, biomass and bio-based materials.

To deal with the enormous problem of plastic waste, the EU has adopted a separate strategy (European Commission, 2018). It aims at reducing the amount of plastic waste by creating the conditions under which the production of plastic products will be adapted to reuse needs and recycling will be a cost-effective solution for businesses. The strategy specifies that by 2030 all plastic packaging placed on the EU market must be reusable or recyclable. Plastic recycling targets have been set at: 65% of municipal waste recycled by 2030; 75% of packaging waste recycled by 2030; reduction of landfill to a maximum of 10% of municipal waste by 2030. The latest regulations are also aiming at a reduction or even the elimination of the consumption of certain disposable products (a ban on plastic straws, disposable cutlery, plates and mugs is under consideration) and to limit the deliberate use of microbin plastics (which is due to take effect by 2021)¹.

¹ To achieve these goals, numerous legal acts (European Commission, 2019) set ambitious recycling rates, clarified legal status of recycled materials, strengthened waste prevention and waste management measures, set rules on material efficiency requirements (such as availability of spare parts, ease of repair, and facilitating end-of-life treatment measures). Actions have been taken to engage citizens in changing consumption patterns and financial resources have been earmarked.

The EU goals in the CE area are reducing the amount of waste generated, maximising recycling and reuse, limiting incineration to non-recyclable materials and phasing out landfilling to non-recyclable and non-recoverable waste. The hierarchy of the most desirable proceedings in accordance with the principles of CE was defined in one of the directives (Directive 2008/98/EC). Waste prevention is considered best practice, followed by reuse, then recycling, forms of recovery, and ultimately disposal of waste (Figure 1).

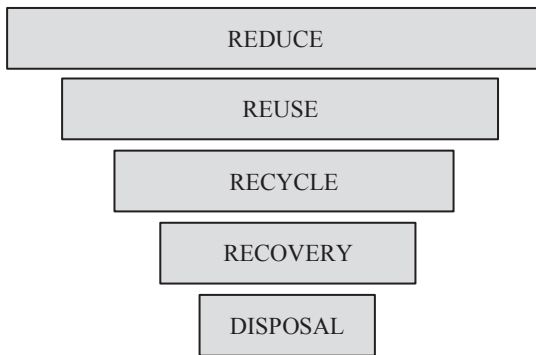


Fig. 1. Waste management hierarchy

Source: own based on (Directive 2008/98/EC).

On the one hand, this hierarchy allows achieving the objectives arising from the general principles of waste management (where the reduction of plastic production is the most desired goal) and on the other hand, it aims to create legal measures to promote the idea of a ‘recycling society’ seeking to eliminate plastic waste generation and to use waste as a raw material (Korzeniowski, 2014). Recycling is promoted as a method of prevention of excessive waste accumulation through their second processing and utilization in the production process of new materials.

There are three types of recycling. The simplest and most commonly used method is mechanical recycling. That is a process in which waste materials are recycled into ‘new’ (secondary) raw materials without changing its basic structure (a physical process in which plastic waste is formed by cutting, shredding or washing into granulates, flakes or pellets of appropriate quality for manufacturing, and then melted to make the new product by extrusion). More difficult, but at the same time more effective, is chemical recycling. This involves the transformation of plastics, i.e. plastic polymers, by means of heat and/or chemical agents to yield monomers or other hydrocarbon products that may be used to produce new polymers, refined chemicals or fuels (Ragaert, Delva & Van Geem, 2017). Reusing plastics has many advantages, namely: (1) conservation of fossil fuels since plastic production uses 4-8% of global oil production, i.e. 4% as feedstock and 4% during conversion (2) reduction of energy and municipal solid waste, and (3) reduction of carbon-dioxide (CO₂), nitrogen-oxides and sulphur-dioxide emissions (Al-Salem, Lettieri, & Baeyens,

2009). The worst (both from the environmental and economical point of view) way of plastic waste disposal in the EU is energy recovery. This is the combustion of plastic waste to produce energy in the form of heat, steam and electricity (Wasilewski, 2013; Wollny, Dehoust, Fritsche, & Weinem, 2008).

Plastics are a highly heterogeneous secondary material, which determines the method of recycling. The most common polymers groups include:

• PP (polypropylene) • PE (polyethylene) • PET (polyethylene terephthalate) • PS (polystyrene) • PVC (polyvinylchloride). The distribution of European plastics converters demand is as follows: leading polymer (27%) is the PE (used in the production of reusable bags, trays and containers, agricultural film, food packaging film, toys, milk bottles, shampoo bottles, pipes, houseware, etc.). Second in the demand structure is PP (19%, food packaging, sweet and snack wrappers, hinged caps, microwave containers, pipes, automotive parts, bank notes, etc.) and the third one – PCV (window frames, profiles, floor and wall covering, pipes, cable insulation, garden hoses, inflatable pools, etc.). Each type of plastic is suitable for recycling, with packaging being the most common (including PET bottles). The most valuable is homogeneous plastic waste (made of one type of plastic). Mechanical recycling is most suitable for clean (homogeneous) polymers or mixtures thereof, while chemical recycling is used for polyethylene and polypropylene articles (i.e. bottles, canisters, barrels, boxes, containers and bags, foils). Plastic waste made of various types of materials that cannot be separated by simple mechanical methods (and/or is heavily contaminated) should be used in energy production (Hassanpour & Unnisa, 2017).

4. Recycling rates of plastic waste – Poland vs. EU countries

Unfortunately, energy recovery is the most common way of plastic waste disposal in the EU (41.6%). The recycling rate (31,1%) only slightly exceeds the landfill rate (27.3%). In Poland the recycling rate of plastic waste is lower than the EU average (27%). Polish plastic waste is mainly landfilled (44%, Figure 2).

One of the serious problems is that much of the plastic is designed to be thrown away after being used only once. As a result, single-use plastic packaging accounts for about 60% of the plastic waste (EPRO, Eurostat). The EU countries that generate the most plastic packaging waste (chart 2) are Ireland (58 kg per capita), Estonia (50) and Luxembourg (48). By contrast, the countries with the lowest rates are Croatia (15), Bulgaria (17) and Greece (18). Poland produces less plastic packaging waste

(27) than the EU average (33). The recycling rate of packaging plastic waste in the EU is slightly higher than the recycling of plastic waste (42%), but there are significant differences among member states (Figure 3). The three new member states have the highest recycling rate for this type of waste: Lithuania (74%), Bulgaria (65%) and Cyprus (62%). By contrast, the countries with the lowest rates are Malta

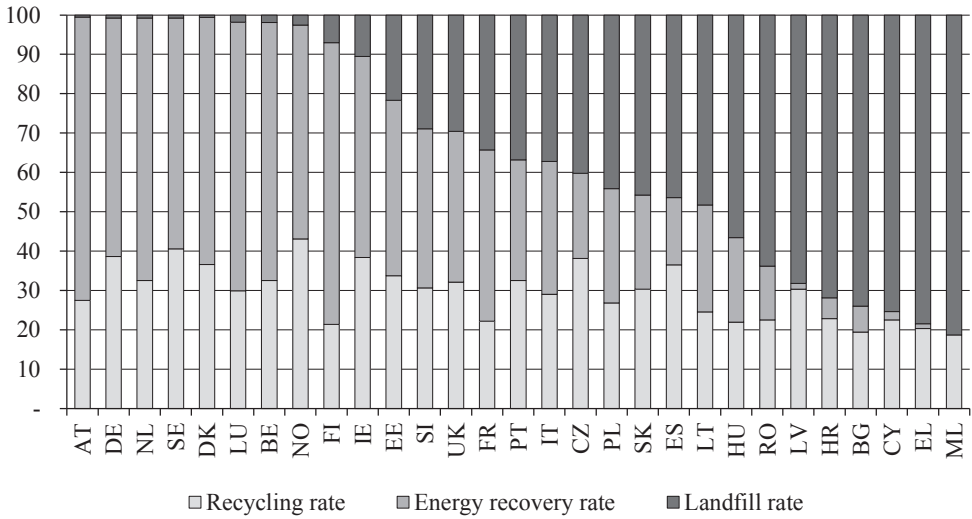


Fig. 2. Plastic waste treatment in EU countries (% , 2016)

Source: own calculations based on (PEMRG, 2018).

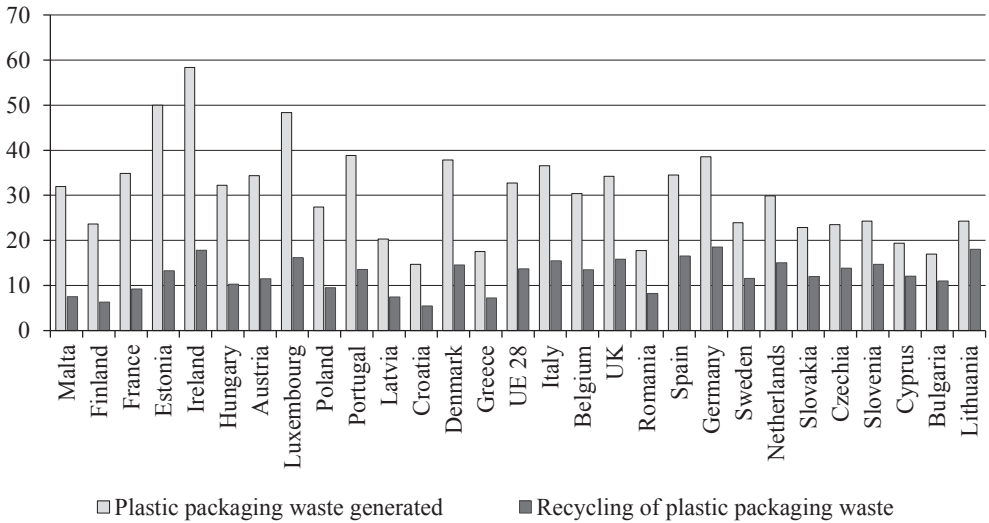


Fig 3. The rate of plastic packaging waste generated and recycled in EU countries (% , 2016)

Source: own calculations based on (PEMRG, 2018).

(24%), Finland (27%) and France (27%). Poland recycles less plastic packaging waste (35%) than the EU average (42%). Poland is therefore far from achieving the EU’s objectives and there is a risk that they will not be met by the end of 2030.

5. Recycling of plastic waste in Poland – trends and challenges

Poland generates a similar amount of waste every year (110-130 million tonnes). In 2018 it was 128 million tonnes of which 10% was municipal waste. Compared to the EU average (486 kg) and other EU countries (e.g. Denmark – 781 kg, Germany – 633 kg or Luxembourg – 607 kg), Poland has one of the lowest rates of municipal waste generation per capita (325 kg) (Eurostat, 2020). The problem, however, is the low level of recycling. In 2018 only 57% of the municipal waste collected was intended for recovery, of which 26% was subjected to mechanical and chemical recycling and 23% to energy recycling. The structure of municipal waste is dominated by: biodegradable waste (26 kg per inhabitant), mixed packaging waste (15 kg), bulky waste (14 kg), glass (13 kg), plastics (9 kg), paper and cardboard (7 kg). Plastics are the third largest stream of mixed municipal waste (14%), immediately after bio-waste (which accounts for nearly 20%) and the segment of paper and cardboard (14.5%). Plastics constitute about 10% by weight and 40% by volume of household waste. Although the amount of municipal waste collected selectively has increased (in 2005 it constituted 5% of municipal waste collected while in 2018 it was 29%), but the recycling of plastic waste is largely based on easily collected waste from commercial networks and transport (Główny Urząd Statystyczny [GUS], 2019).

This state of affairs is due to legal and organizational conditions. The most important are (Styś, Foks, & Moskwik, 2016):

- the imprecise definition of organizational roles in the waste management system (stakeholders and their competencies);
- the imprecise definition of the issue of waste ownership, its transfer and disposal (which hinders the possibility of optimizing the costs of functioning of the municipal waste management system; the revenues from trading in secondary raw materials do not constitute municipalities' income);
- institutional solutions that result in the consolidation of the municipal waste collection market and the creation of local monopolies (which results from the scope and manner of conducting public tenders);
- institutional solutions that favour activities contrary to the hierarchy of waste management (the privileged position of municipal waste incineration plants in the municipal waste management system and the functioning of the Regional Municipal Waste Processing Installations as part of regulated rather than free market activities);
- barriers preventing the development of technological, business, social and organizational innovation and achieving synergies between the waste management industry and other sectors of the economy;
- the lack of extensive social campaigns, which maintains low ecological awareness of the inhabitants.

The low level of selective collection certainly also results from technological barriers. Recycling of plastic waste generates higher costs than recycling of glass, cardboard or metal packaging waste. Therefore the prices obtained for secondary plastics are not competitive with the prices of primary raw materials. The recycling sector in Poland is still under-developed. This problem is also visible in other EU countries. As a result, the demand for recycled plastics accounts for only 6% of demand for plastics (EPRO). The recycling sector faces the need for technological change to make it more profitable. It is estimated that the economic losses resulting only from the single-use plastic packaging amount to 95% of their material value, which is between EUR 70 and 105 billion per year (EPRO; Eurostat). The scale of the problem associated with the improper management of plastic waste is therefore enormous, which entails economic costs and, above all, irreversible damage to the environment.

6. Conclusion

Plastics are valuable materials covering a wide range of applications in everyday life and have the potential to be recycled many times while retaining their value and functional properties. The efficiency of plastic waste management in the EU is improving: between 2006 and 2016 the amount of plastic waste recycled increased by 79%, for energy recovery by 61% and the amount of landfilled waste decreased by 43%. However, the problem is that the energy recovery rate (41.6%) is still higher than the recycling rate (31.1%), and the recycling rate only slightly exceeds the landfill rate.

Poland produces less plastic waste than the EU15, but the level of recycling is lower than the EU average. The recycling of plastic waste is largely based on easy-to-collect waste from commercial networks and transport. A further increase in the recycling rate will be possible when the selective collection and recycling of household waste is intensified. However, this requires legal and organizational changes as well as extensive social campaigns increasing the ecological awareness of the inhabitants. The Polish sector of plastics producers and the recycling industry will have to increase their investments in technology and cooperate more closely with R&D centres.

A circular economy has become a strategic goal at EU level both in the context of environmental restrictions and because of its economic potential. Legal regulations will enforce specific behaviour among stakeholders, whose responsibility will no longer be only their good will, but an obligation imposed by law. Add to this the growing consumer awareness, then real changes can be expected. EU regulations will have the greatest impact on the process of changes in the Polish recycling sector. Poland will have to meet the indicators, yet currently it is far from achieving them.

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RECYKLING TWORZYW SZTUCZNYCH W POLSCE – TRANSFORMACJA W KIERUNKU GOSPODARKI CYRKULARNEJ?

Streszczenie: Plastik to jeden z najpowszechniej używanych materiałów na świecie. Niestety jego popularność wiąże się również z generowaniem dużej ilości odpadów. Głównym wyzwaniem współczesnych gospodarek, także Polski, jest zminimalizowanie ilości wytwarzanych odpadów plastikowych oraz odzyskanie podstawowych surowców w procesie recyklingu. Celem artykułu jest ukazanie zmian w tym obszarze w Polsce. Analiza statystyczna wskazuje, co prawda, że Polska generuje mniej odpadów z tworzyw sztucznych niż większość krajów UE 15, ale poziom recyklingu sytuuje się znacznie poniżej średniej UE. Recykling odpadów z tworzyw sztucznych w Polsce opiera się w dużej mierze na łatwobieralnych odpadach z sieci handlowych i transportu. Warunkiem poprawy w tym zakresie jest zintensyfikowanie selektywnej zbiórki i recyklingu odpadów z gospodarstw domowych. Niezbędne są zarówno kampanie podnoszące świadomość ekologiczną mieszkańców, jak i systemowe działania mające na celu zwiększenie stopnia wykorzystania surowców wtórnych.

Słowa kluczowe: plastic, recycling, gospodarka cyrkularna.