

## TOWARDS A CIRCULAR ECONOMY IN POLAND: ARE WE MOVING TO A RECYCLING SOCIETY?

BARAN Jolanta, JANIK Agnieszka, RYSZKO Adam, SZAFRANIEC Marek

*Silesian University of Technology, Poland, EU*

### Abstract

The growing scarcity of natural resources and increase of consumption have resulted in the adoption of an ambitious Circular Economy Package. It has to contribute to "closing the loop" of product life cycles through more recycling and greater re-use of waste generated through entire life cycle. Moving towards a more circular economy is becoming a crucial issue to pursue resource efficiency economy and underpin priorities related to the Europe 2020 strategy. Implementation of circular economy goals fits perfectly to the concept of reverse logistics aiming at ensuring that the products after use and any waste generated in product life cycle are recycled and reused if it is feasible. This means the necessity of modernizing waste policy and treating waste as a resource. In order to improve the benefits gained from better waste management, the European Commission has proposed municipal waste targets for a move to a recycling society. Therefore, this article analyzes the actions and goals that have been accomplished and planned in Poland in the aforementioned subject area. In particular, the reuse and recycling rates of municipal waste and the recycling rate for packaging waste, including specific materials, have been presented and discussed. The barriers that should be overcome for effective implementation of new required solutions have been also described.

**Keywords:** Circular economy, municipal and packaging waste management, reverse logistics

### 1. INTRODUCTION

Moving towards a more circular economy is becoming a crucial issue to underpin the priorities related to the Europe 2020 strategy and, in particular, to the Circular Economy Package. However, the transition from a linear to a circular economy is not easy because it requires changes throughout all value chains (starting from design processes and ending with waste handling). Meeting the circular economy assumptions involves the need to introduce essential changes in all the EU member states, including Poland. The basic targets of the planned package include raising the levels of municipal and packaging waste recycling. In order to determine the prospects of the achievement of the new targets in Poland it is necessary to analyze the actions taken so far and the effects achieved in this area. Considering the above, this paper aims to identify and characterize the circular economy requirements in Poland and identify the barriers to the achievement of higher levels of municipal and packaging waste recycling together with the possibility of overcoming them.

### 2. FRAMEWORK OF CIRCULAR ECONOMY

The concept of the circular economy has become popular in recent years as a potential way to increase prosperity of society, while reducing dependence on natural resources and energy and reducing waste in product life cycle. Its target is "closing the loop" of product life cycle. In the linear model this loop is described as "Take - Make - Dispose". The circular model aims to change "Dispose" into "Re-use" through keeping the value in products for as long as possible and increasing the amount of products undergoing the recycling and re-used when they have reached the end of their life. Owing to that, the consumption of natural resources and the amount of disposed waste are reduced.

The circular economy is one that is restorative and regenerative and aims to keep products, components and materials at their highest utility and value at all times, distinguishing between technical and biological

cycles [1]. The main principle of the circular economy is designing without waste. This means that the product should be designed and optimized for a cycle of disassembly and reuse, which allows to avoid or significantly reduce the amount of waste. Therefore, the model of circular economy can be described as the model of 4R: Reduce, Reuse, Remanufacture and Recycle. The concept of circular economy has been adopted by EU as an essential action to achieve the resource efficiency agenda established under the Europe 2020 Strategy. According to the Communication COM(2014)398 published by EU Commission in July 2014, waste management has been indicated as one of the key areas, in which changes should be made to allow to move toward circular economy. For that reason, following targets for waste were defined [2]: (1) increase the amount of municipal waste undergoing the process of reuse and recycling to a minimum of 70% by 2030 (2) increase the recycling rate for packaging waste to 80% by 2030, with interim targets of 60% by 2020 and 70% by 2025 and (3) ban the landfilling of recyclable plastics, metals, glass, paper and cardboard, and biodegradable waste by 2025, while Member States should endeavor to virtually eliminate landfill by 2030.

To increase motivation for transition to circular economy, on the 2 December 2015 EU Commission implemented an ambitious Circular Economy Package, which consists of an EU Action Plan for the Circular Economy [3] and revised legislative proposals on waste [4,5,6]. The targets for waste set out in this documents are slightly different from those presented in Communication COM(2014)398. The EU proposes: achieving a minimal level for preparing for reuse and recycling of 65% weight of municipal waste by 2030 and 75% for packaging waste, reduction of landfill of waste to a maximum of 10% of total waste by 2030, prohibition of storage of sorted waste and new minimum targets by weight for preparing for reuse and recycling the packing waste depending on the specific materials contained in packaging waste (**Table 1**).

**Table 1** The minimum targets by weight for preparing for reuse and recycling the packing waste resulting from the introduction of the EU Action Plan for the Circular Economy [6]

Targets to achieve	The material contained in packaging waste					
	Plastic	Wood	Ferrous metal	Aluminium	Glass	Paper and cardboard
By 31 December 2025	55%	60%	75%	75%	75%	75%
By 31 December 2030	55%	75%	85%	85%	85%	85%

The introduction of changes proposed in directives will cause an increase in the amount of waste collected selectively and undergoing a process of re-use and recycling. This means, undoubtedly, the increase in feedback flows of products for reuse or repair and flows of waste for recycling. It could be therefore said, that implementation of circular economy increases the importance of the reverse logistics. However, it requires an analysis of the current levels of recycling of municipal waste and packaging waste and an identification of actions, which should be taken to fulfill the requirements included in Circular Economy Package.

### 3. RECYCLING OF MUNICIPAL WASTE IN POLAND - THE ACHIEVED AND PLANNED TARGETS

The system of municipal waste management in Poland comprises primarily households (in 2014 the share of generated total municipal waste in this segment reached 79.8%) and other entities generating a similar waste mix: commercial entities, small enterprises, offices, institutions and companies rendering municipal services. The system also constitutes a part of packaging management. Packaging waste is one of the types distinguished within selective collection of municipal waste. In Poland, municipal waste management is regulated by the Act on waste of 14 December 2012 and by the Act of 13 September 1996 on keeping cleanliness and order in communes and municipalities. One of the system tasks is to satisfy the European Commission targets reflected in waste management plans on the national and voivodeships level. In 2001 a requirement was laid down to segregate waste according to the following key fractions: paper and cardboard waste; glass packaging waste (colourless and coloured glass separately); plastic and metal waste; green waste [7]. However, the system of segregation of individual waste fractions is not available to all communes

and municipalities. In 2014, for the total number of 2478, the segregation system was available in 2290 municipalities for paper and cardboard, in 2451 for glass, in 2409 for plastic, in 1322 for metals, in 430 for textiles, in 676 for hazardous waste, in 2287 for bulky waste and in 1880 for biodegradable waste [8]. The main aim of waste segregation is to facilitate waste recovery, recycling and reprocessing. According to binding legal regulations, each real estate owner must conclude an agreement under which municipal waste is collected from its premises. The fee for waste collection is mass-independent, which is to make the system tighter. In order to promote waste segregation among citizens, the fees vary depending on whether waste is mixed or segregated. **Table 2** shows the data concerning the amounts of generated and collected municipal waste in the years 2005-2014, with a division into principal fractions and with achieved levels of municipal waste segregation and recycling.

**Table 2** Selected indicators related to municipal waste management system in Poland in 2005-2014 [8,9]

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Total amount of generated* and collected municipal waste [Gg]	12169	12235	12264	12194	12053	12038	12129	12085	11295	10330
	9352	9877	10083	10036	10054	10044	9828	9581	9474	10330
Collected selectively by fractions [Gg]	295	403	513	682	789	860	984	1005	1275	2049
including (most important fractions):	41	55	67	83	100	124	157	176	220	314
- plastic	7	7	7	9	14	17	17	14	18	20
- metals	96	100	112	145	151	170	175	187	197	240
- paper and cardboard	99	114	136	175	200	216	269	276	316	411
- glass	318	358	363	386	673	790	1644	1128	1231	1154
- textiles	18	25	27	38	36	36	31	38	37	32
- bulky	34	42	72	97	104	103	103	90	136	213
Treated by biological methods [Gg]										
Level of waste collected selectively [%]	3.2	4.1	5.1	6.8	7.8	8.6	10.0	10.5	13.5	19.8
Level of recycling [%]**	3.9***	5.5***	6.6***	8.9	14.1	17.8	11.4	13.0	15.8	21.1

\* - estimated data for years 2000-2013. From 1.07.2013 all real estate owners are covered by the municipal waste management system; \*\* - reported by Central Statistical Office of Poland without composting and anaerobic digestion; \*\*\* - calculated as a level of collected selectively by fractions and sorted out of mixed waste in total collected municipal waste.

The data in **Table 2** show that the municipal waste management system in Poland gives better results with every year. This concerns both general categories and segregated waste fractions. Nevertheless, in the context of the European Commission targets that assume that recycling will have reached the level of at least 65% by the year 2030, this improvement is still not good enough. For this reason, the present system will have to be substantially improved in the nearest future. The indices concerning the possibility of improving the availability and efficiency of both selective waste collection and waste segregation that have been achieved so far are still low. However, this also means that the system can be improved by finding and implementing appropriate solutions in these areas. Another problem is the high number of illegal waste dumps (2371 in the year 2014), which proves how leaky the system is.

#### 4. RECYCLING OF PACKAGING WASTE IN POLAND - THE ACHIEVED AND PLANNED TARGETS

Two legal and organizational systems coexist in Poland in relation to packaging waste management. These solutions comprise separate collection of individual fractions from municipal waste (described in

previous section) and packaging waste management requirements imposed on entrepreneurs. Entrepreneurs launching packaged products into the market are responsible for most aspects of securing the recycling of packaging waste generated as a result of their activity.

The new Act on packaging and packaging waste management of 13 June 2013 modifies the existing law (established in 2001) in Poland and takes over a part of the regulations included in the Act of 11 May 2001 concerning the obligations of entrepreneurs in management of certain wastes and product fees. The Act was introduced to make the functioning of packaging waste management more efficient and to help achieve the targets of recycling levels set by the EU. The Act sets out the recycling target of 56% for all packaging waste, with specific targets of 23.5% for plastic packaging, 51% for aluminium packaging and steel packaging, 61% for paper and cardboard packaging as well as for glass packaging and 16% for wood packaging [10]. In addition, the Regulation of the Minister of the Environment on annual levels of recovery and recycling of packaging waste from households [11] sets out annual levels of household packaging waste recycling which should be taken into account by the packaging recovery organization. The established level of household packaging waste recycling in 2020 is to reach 50%. The Act on packaging and packaging waste management also deals with product fees (introduced in 2001) that apply to packages (unit, transport and collective). The aim of these fees is to shape behaviours related to recycling waste and, after segregation, passing it on to appropriate receivers, as well as to provide financing for waste collection, recycling and disposal. The level of product fees is established based on achieved levels of packaging waste recycling. An exemption from the obligation to satisfy the required recycling levels and to pay product fees is provided to entrepreneurs launching packaging into the market with a total weight not exceeding 1 Mg per year. **Table 3** presents data concerning the packages launched into the market and the achieved packaging waste recycling levels in Poland in the years 2004-2014. The achieved levels of packaging waste recycling are expressed as a percentage and they are the ratio of the weight of packaging waste recycled in a reference year to the weight of packaging placed on the market in the preceding calendar year.

**Table 3** Packaging launched into the market and levels of packaging waste recycling achieved in 2005-2014 [9]

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Total amount of packaging launched into the market [Gg], including:	3174.1	2982.5	3133.7	4181.9	3827.0	4293.0	4611.1	4669.9	4836.4	4846.0
- plastic packaging	580.8	580.1	515.8	669.9	677.0	733.1	784.4	831.9	895.1	896.3
- aluminium packaging	56.7	62.7	22.1	81.4	77.8	78.0	86.1	91.7	86.9	87.7
- steel packaging	139.7	126.9	132.2	167.2	144.8	166.5	160.9	156.9	160.4	156.8
- paper and cardboard packaging	989.3	1037.1	959.1	1237.0	1196.2	1323.0	1419.9	1493.3	1566.3	1568.0
- household glass packaging	959.7	699.7	777.5	1019.0	842.8	955.4	1078.8	1056.5	1068.6	1028.0
- packaging made of natural materials	425.1	475.9	726.9	1007.4	888.5	1037.0	1080.8	1039.6	1059.1	1109.0
Achieved level of recycling in total [%], including:	46.7	62.5	48.2	43.0	36.9	38.9	41.3	41.4	36.0	55.6
- plastic packaging	30.3	36.9	28.0	23.9	21.5	20.2	22.6	22.2	20.0	28.6
- aluminium packaging	86.7	110.4	82.0	60.9	64.2	60.5	54.2	46.7	34.0	48.1
- steel packaging	23.4	34.1	21.2	26.5	33.6	39.5	40.4	47.1	34.8	55.5
- paper and cardboard packaging	65.4	85.6	69.1	67.2	50.9	57.2	58.7	53.2	49.7	72.9
- household glass packaging	38.4	48.0	39.7	43.9	41.9	45.6	45.1	51.3	43.4	60.2
- packaging made of natural materials	47.2	73.4	47.8	26.3	23.1	21.0	27.3	28.5	21.9	48.6

The data presented in **Table 3** show that the total recycling rate achieved in 2014 is slightly lower than the target value of 56% established by the Polish law (this also concerns aluminium and glass packaging), but the other targets have been accomplished. It must be noted that the targets proposed by the European Commission with regard to the circular economy assumptions are much stricter. Their achievement will probably necessitate significant changes in methods of packaging waste collection and packaging waste treatment techniques, as well as modification of economic incentives to improve behaviours related to collection of packaging waste.

## **5. BARRIERS TO ACHIEVEMENT OF THE INTENDED RECYCLING LEVEL - HOW TO OVERCOME THEM**

The issues of municipal and packaging waste recycling discussed herein indicate that there is a great potential for improvement in the waste management system. On the one hand, the results of many years of observation and analysis of the waste management system performance lead to a critical assessment of numerous solutions and identification of barriers to the achievement of assumed goals. On the other, new, more demanding waste management targets have been laid down within the Circular Economy Package. The barriers that have to be overcome as a prerequisite for the achievement of the required levels of municipal waste and packaging recycling comprise problems related to legal, organizational, technical and economic solutions, together with issues of ecological awareness.

In respect thereof, the impact of loopholes and imperfections of the adopted legal solutions is essential. One example is the imprecise definition of “waste holding” in the municipal waste management logistic chain [12], which makes it difficult to optimize the costs of the system functioning and, as a consequence, limits the potential for recycling. There are also no legal regulations concerning the structuring of municipal waste selective collection by communes and municipalities within which a given waste flow comprises waste of one type and one nature only [7,12].

The barriers mentioned above also include institutional solutions which allow non-observance of the hierarchy of priorities in the municipal waste management system (including the privileged position of municipal waste incineration plants in relation to other types of municipal waste processing, which also decreases the flow of waste directed for recycling) [7,12]. These difficulties are increased by the current practice of using municipal waste processing technologies (the mechanical-biological one mainly) that contribute to the low share of recycling in the waste flow directed to the installation. Moreover, there is no synergy between waste management and other sectors of the economy [12] (this includes for example the lack of precise standards for products that could be made of waste).

Another problem to be mentioned in this context is the insufficient use of economic instruments that could be a substantial incentive to encourage selective waste collection by real estate owners and change the way of handling collected waste, which is too often utilized as a raw material to produce fuels [7,13]. Additionally, the public awareness of appropriate municipal waste management, including the need to limit waste generation at source and implement selective waste collection, is generally poor.

The multi-aspect character of the waste management issue makes it necessary to adopt a holistic approach to making changes in the system. The changes should be based on improving legislation to make it possible to optimize the channelling of individual flows of packaging and municipal waste. The new Circular Economy Package proposals set out in the National Waste Management Plan [7] will have a chance of being put into effect if the issue of “waste holding” in every link of the logistic chain, including reverse logistics, is regulated. Also the structuring of municipal waste selective collection needs improving. The process improved organization will enable creation of efficient pathways for individual waste fractions. One of the options is to introduce minimum objective criteria for their efficiency assessment. Regulations are also needed that will make it possible for institutional and organizational solutions to reflect the hierarchy of dealing with waste.

In the Circular Economy Package context it is important that the new solutions are designed in cooperation with the reverse logistics sectors utilizing waste as a raw material. The effectiveness of the new solutions will also depend on implementing an incentive fee system that will promote selective waste collection (replacement of the lump-sum settlement method). With respect to packaging waste, it is particularly important that a synergy effect is achieved between economic and ecological objectives and that good practices are developed for individual waste fractions [13]. Actions should also be taken ceaselessly in the area of ecological education.

## 6. CONCLUSION

The analysis of the municipal and packaging waste management system in Poland points to a continuing improvement in the indices of the levels of waste collected selectively and of its recycling. This is mainly due to the changes in legislation and the new, systemic, organizational solutions introduced in recent years. Despite the positive effects observed so far, meeting the Circular Economy Package assumptions requires further substantial changes.

The results of the analysis indicate that there is a great potential for improvement in waste management. However, the municipal and packaging waste management effectiveness and efficiency can only be improved if comprehensive modifications are made in legal regulations as well as in the area of organizational, technical, economic and educational solutions. Moreover, initiated changes should affect all links of the logistic chain. This should make it possible for the logistic chain partners to develop good practices and produce the effect of synergy between economic and ecological objectives of waste management.

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