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## Selective municipal waste collection system in Poland - analysis of the amount and structure of collected waste in Poland

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### ABSTRACT

The following study covers the subject of the system of selective municipal waste collection in Poland. The first part of the study presents the definition of waste and the waste management system. In addition, the concept of selective waste collection was characterized. The empirical part contains an analysis of the amount and structure of waste collected in Poland. The research period covers the years 2012-2018.

**Keywords:** municipal waste, waste management system, selective waste collection, analysis of waste quantity and structure

### 1. INTRODUCTION

The principles of waste management are closely related to the general principles of environmental law in force at international and European Union levels, which are implemented in national legislation. All international law norms and the institutions they set up that directly or indirectly serve environmental protection also apply to the waste management system [1]. The task of international regulations is to create solutions combining the basic principle of all countries, such as sovereignty with the need to use a common environment, and at the same

time with the need for socio-economic development. The growing amount of municipal waste is one of the major problems facing European Union Member States [2].

Rational waste management should ensure the proper condition of the natural environment and reduce the costs incurred by the logistics system, by integrating waste flows in space and time. This can be achieved by proper waste management, recovery of raw materials from waste, substitution of natural resources with waste, increase of profit by recycling, waste disposal in order to reduce the amount of waste intended for storage, compliance with the requirements of national regulations and EU directives in the field of environmental protection [3].

In recent years, there has been an increase in interest in waste management in Poland, rather due to the need to implement new legal regulations relating to the waste management system. In our country's society there is a gradual change in habits and there is a growing interest in education in the field of proper waste management, mainly waste segregation [4].

## **2. SELECTIVE WASTE COLLECTION SYSTEM**

Waste is all solid goods and liquid substances arising as a result of economic activity or human existence, which is considered useless at the place or time in which it arose. The nature and volume of generated waste depend on: standard of living, consumption, production technology, technical progress, ecological awareness. Municipal waste has many unfavorable features that cause many difficulties in its management. These include, among others: variability of quantity and quality of waste in time space, heterogeneity of the morphological and chemical composition, possible sanitary and epidemiological threat, propensity to crease and instability, release of unpleasant odors, occurrence of certain hazardous substances (e.g. heavy metals), and the presence of hazardous waste (e.g. expired drugs, used batteries, lamps or chemicals) [5].

According to the Act on waste (Journal of Laws 2013, item 21), recovery is any process whose main result is that the waste serves a useful application by replacing other materials that would otherwise be used to fulfill a given function, or as a result of whose waste is prepared to fulfill such a function in a given plant or in the economy in general The following elements can be distinguished in the structure of the waste management system [6]:

- collection of waste selectively collected and mixed,
- collection and transport of all fractions,
- recycling of raw materials,
- other forms of recovery, including energy recovery,
- final disposal.

Waste should be collected selectively. Pursuant to Directive 2008/98 / EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain directives, "selective collection means collection whereby a given waste stream only covers waste of one type and of the same nature for facilitating specific processing". In our country, the ordinance of the Minister of the Environment of 29. 12. 2016 on a detailed way of selective collection of selected waste fractions (Journal of Laws of 2017, item 19). The ordinance specifies: a detailed way for the selective collection of selected waste fractions, it also specifies when the selective collection requirement is considered to be met and the types of municipal waste subject to the

obligation of separate collection. According to the regulation, paper, glass, metals, plastics, biodegradable waste are collected separately, with particular emphasis on bio-waste.

Legal regulations related to the implementation of tasks in the field of municipal waste management were included in the Act of September 13, 1996 on maintaining cleanliness in municipalities. In the published text, the legislator specified the tasks which he assigned to the commune [7].

The legislator has made the local government responsible not only for organizing the collection of municipal waste from property owners, but also for most aspects of waste management, including organizational and investment processes. At the same time, the legislator has designed a number of regulations conferring competences on other public authorities, having a significant impact on the planning and implementation of the UCPG, in particular on: [8]

- the amount of the fee borne by property owners for municipal waste management;
- procedures adopted by municipalities related to municipal waste management;
- ways of practical implementation of regulations by entrepreneurs.

From the point of view of entities operating in the field of municipal waste management, the most important tasks of selected authorities public include, in the case of commune self-government [9]:

- developing and adopting regulations for maintaining cleanliness and order, i.e. defining, e.g. terms and subject of the order for entities operating in the field of municipal waste management;
- determination of rates for municipal waste management
- ensuring the construction, maintenance and operation of municipal installations and equipment for recovery and disposal of municipal waste, or of municipal or economic operators, or providing conditions for the construction, maintenance and operation of installations and equipment for recovery and disposal of municipal waste by economic entities;
- preparing and conducting tender procedures for the collection and management of municipal waste, i.e. regulation of the local municipal waste management market;

Therefore, for the proper functioning of the waste management system, it is necessary to organize: [10]

- segregation and collection of segregated fractions for processing and use,
- selective collection of problem waste, including dangerous,
- electrical, electronic, bulky, construction, etc.,
- collecting and exporting mixed waste.

The first sequence in waste management is its collection. Waste collection is collection from waste sources, i.e. devices and points through which waste is introduced into the system. A very important aspect is the choice of techniques and technologies for waste collection, which is associated with the frequency of waste collection, the type of containers used, and the amount of costs incurred. Municipal waste collection technology can be implemented in a random or

separate collection system, during which the waste is already separated at its source collection points. Waste collection can be carried out by two methods[11]:

- with the use of containers that after emptying remain at the source point,
- using large containers that are transported with waste to a disposal site.

Waste management should be implemented using the following principles [12]:

- the principle of following the hierarchy of waste management methods,
- the principle of protecting human health and life, Ada the principle of closeness and self-sufficiency,
- compliance with environmental protection requirements,
- the principle of the owner's liability for legal waste management,
- the polluter pays principle combined with the extended producer responsibility principle.

The waste hierarchy is of a general nature, it is a kind of guideline applicable to waste management. The waste hierarchy has five stages and includes [13]:

- waste prevention,
- preparation for reuse,
- recycling,
- other recovery processes,
- disposal.

There is a relationship between the waste hierarchy and local law. Local law acts influence this hierarchy. Elements of resolutions constituting acts of local law are constructed in such a way as to be consistent with the hierarchy and serve its implementation. In connection with the above, the main legal instruments affecting the hierarchy of waste management will be legislative measures. The holder of waste that could not be prevented, in the first place is obliged to subject it to recovery, which consists in preparing the waste by its holder for reuse or recycling, and if this is not possible for technological reasons or is not justified for ecological reasons or economically subjected to other recovery processes [14].

Public administration bodies, in their area of competence, take measures to support the reuse and preparation for reuse of waste, in particular by encouraging the creation and support of reuse and repair networks, creating economic incentives. On the other hand, units of the public finance sector apply the criteria of reuse or preparation for reuse of waste when awarding public contracts, insofar as these processes are possible [15].

If the waste is moved for primary processing from the original producer or holder to one of the natural or legal persons, as a rule, there is no exemption from liability for carrying out the final recovery or disposal process. Therefore, for the proper management of waste, Member States are required to establish an integrated and sufficient network of installations for the recovery or disposal of mixed municipal waste collected from households, including cases in which such collection also includes waste from other producers. Instead, waste treatment installations should operate using the best available techniques. The network of such installations should enable recovery or disposal in one of the closest relevant installations that meet the indicated requirements for the methods and technologies used.

Municipal waste collected by companies with permits is transported to the appropriate installations located in the cities in which they arise or neighboring cities [16]. The municipal waste management system should be built on the principles of sustainable development, and the adopted ways of solving problems must be adapted to the specific society, taking into account local, regional and national experiences and conditions [17]. Performing their tasks, municipalities are forced to implement the principles of sustainable development on the one hand, and decide on their shape and degree of fulfillment on the other. In Poland, there has been a discussion for many years on the introduction of such a municipal waste management model that will propose optimal solutions for the collection, segregation, management and disposal of municipal waste while respecting the resources of the natural environment. Undoubtedly, such a model must be built in accordance with the principle of three reduction, rationalization, recycling [18].

### **3. ANALYSIS OF THE QUANTITY AND STRUCTURE OF COLLECTED WASTE IN POLAND**

Waste management belongs to the areas of environmental protection, where many problems still appear. Waste is a potential resource if it is prepared for reuse, recycled or other recovery methods. Utilized waste can be treated as a loss of resources and a sign of inefficiency of the economy.

Proper waste management is an essential element in ensuring the efficient use of natural resources and sustainable economic growth. Therefore, the Waste Act, by implementing the Waste Framework Directive, introduced a five-level waste hierarchy, in which at the top - the best treatment was waste prevention, followed by reuse, recycling, other forms of recovery, and ultimately waste disposal ( e.g. by storage).

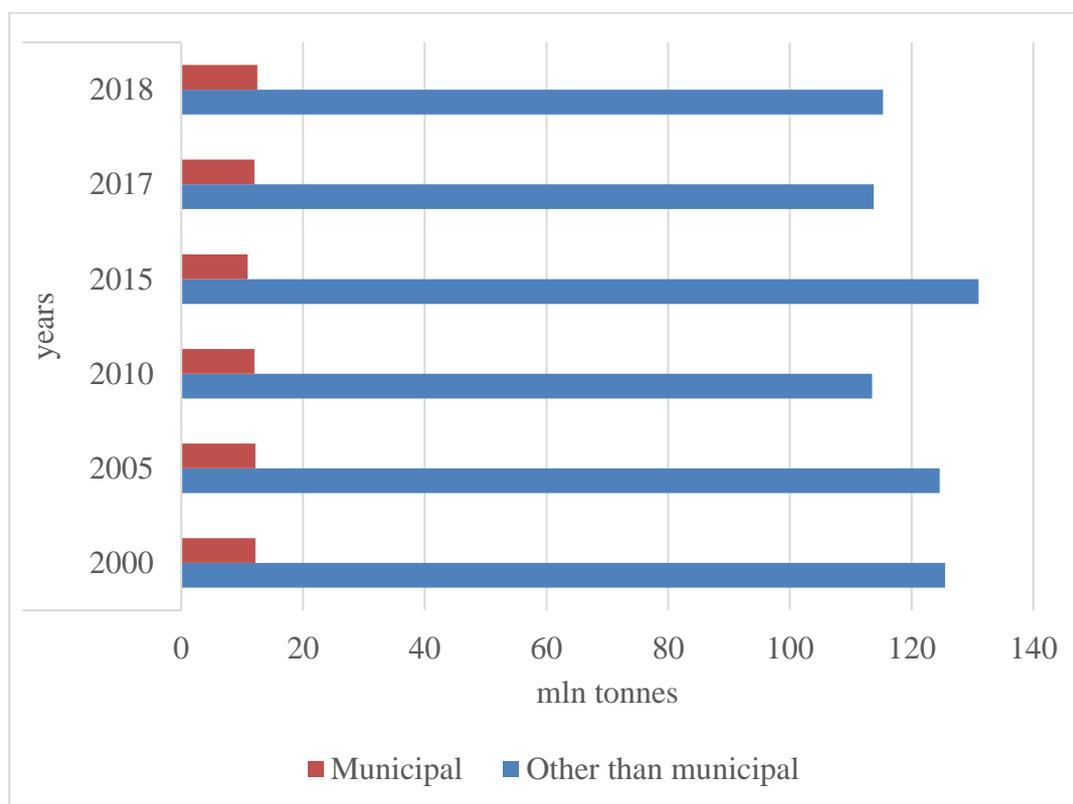
Waste means any substance or object which the holder disposes of, intends to dispose of or is required to dispose of.

Waste generation is an inseparable feature of human activity. An important problem for societies is their proper management. Activities are carried out at national, regional and local level to reduce the impact (nuisance) of waste on the environment and human health, and manage resources as efficiently as possible. The nuisance of waste for the environment manifests itself, above all, in water and soil pollution, air pollution, destruction of aesthetic and landscape values, and exclusion from the use of agricultural and forest areas occupied for waste storage.

The municipal waste management system that has been successfully built in Poland so far has enabled the implementation of the binding objectives set for 2016 (except for a few cases of municipalities). However, achieving recycling levels, definitely increasing in subsequent years and targets in 2030, will require significant system expansion and modification, as we have reached the limit when it comes to municipal waste management based on mixed waste processing. Correct waste statistics are essential for the good functioning of the waste system. The processing capacity, especially of newly built installations, must be balanced with the waste stream to be treated. For any mistakes will pay both investors and residents forced to pay excessive fees for waste management. The main challenge in waste management for the coming years is the transition to a circular economy, which aims to minimize the amount of waste generated and to use unavoidable waste as a resource through

recycling processes. Assuming the place of waste as a division criterion, a distinction is made between a group of municipal waste arising in residential areas and related to human existence (waste code 15 01 from the municipal sector and group 20 of the waste catalog) and industrial waste related to economic activity (the first 19 groups of the waste catalog ).

Waste producer is understood to mean anyone whose activity or existence causes waste (the original producer of waste), and anyone who carries out pre-treatment, mixing or other operations that change the nature or composition of this waste. The producer of waste arising from the provision of services in the field of construction, demolition, renovation of facilities, cleaning tanks or equipment as well as cleaning, maintenance and repair is the entity that provides the service, unless the service contract provides otherwise.



**Figure 1. Waste generated**  
 [Source: Environment 2019, Statistics Poland Warsaw 2019]

In 2018, 128 million tonnes of waste was generated, of which 9.8% was municipal waste (12 million tonnes). The amount of generated waste (excluding municipal waste) has been in the range of 110-130 million tonnes since 2000. In 2018, it slightly increased compared to the previous year (1.4%) and amounted to 115 million tonnes. The amount of waste generated annually remains at a similar level, with a constant increase in GDP, which may indicate positive trends in waste management. Municipal waste generated includes waste collected from property owners and separately collected solid municipal waste. Waste collected from residents is considered to be waste generated due to the fact that from 01/07/2013 municipalities were covered by the waste management system of all property owners.

Selective collection is understood as collection in which a given waste stream, in order to facilitate a specific treatment method, covers only types of waste having the same properties and the same nature. In the case of separately collected municipal waste, it is forbidden to mix it with mixed municipal waste collected from property owners

In accordance with art. 3 clause 2 point 5 of the Act on maintaining cleanliness and order in municipalities, selective collection is established by municipalities, which should be understood as organizing such selective collection by the commune or creating the necessary conditions for this. Article 3 2 point 5 of the Act on maintaining cleanliness and order in municipalities states that the selective collection of municipal waste includes at least the following waste fractions:

- 1) Paper,
- 2) Metals
- 3) plastics,
- 4) glass,
- 5) multi-material packaging and
- 6) biodegradable municipal waste, including biodegradable packaging waste.



**Figure 2.** Total municipal waste structure.

[Source: Environment 2019, Statistics Poland Warsaw 2019]

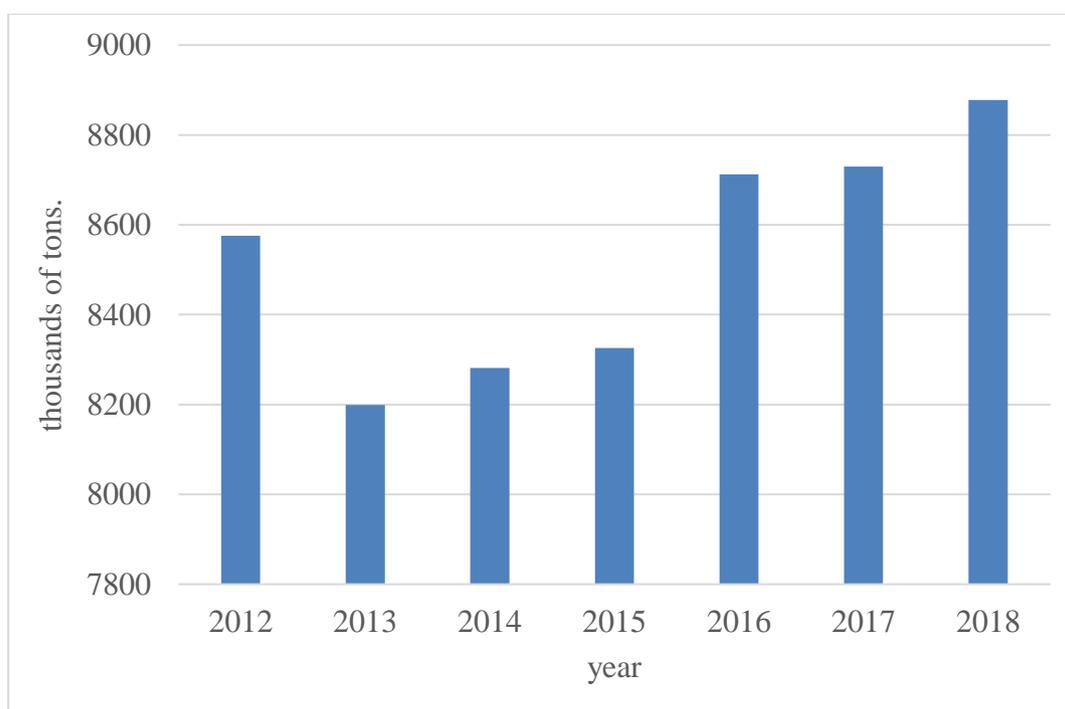
Selective collection of the above-mentioned fractions is, among others associated with the need for municipalities to achieve the required levels of recycling and preparation for re-use of paper, metals, plastics and glass, and to reduce the mass of biodegradable municipal waste. Creating separate collection points will also be an element of the commune's own

obligatory tasks in ensuring cleanliness and order in its territory. In accordance with art. 3 clause 2 point 6 of the Act on maintaining cleanliness and order in communes, municipalities form points for selective collection of municipal waste in a way that ensures easy access for all residents of the commune, including places where waste electrical and electronic equipment from households can be collected.

Below is presented data on the amount of municipal waste collected in Poland. Mixed waste is the main waste stream requiring disposal through landfilling. The share of this waste management process is still high. In 2018 it reached 41.6% (in 2017 - 41.8%).

In 2018, 12,485 thousand were generated. tonnes of municipal waste and a 4.3% increase in generation was recorded compared to last year. This means an increase in the amount of municipal waste generated per capita from 311 kg in 2017 to 325 kg in 2018.

A welcome trend is the increase in the amount of waste collected selectively, which would be approximately equal to the decrease in the amount of mixed waste. This situation occurred in 2013. In the following years, however, the amount of mixed waste increased systematically - a particularly high increase took place in 2016. Therefore, the total amount of municipal waste to be managed increased and the dynamics of the increase in the share of separately collected waste was moderate. The largest share of separately collected waste was in 2017 and amounted to 27%.



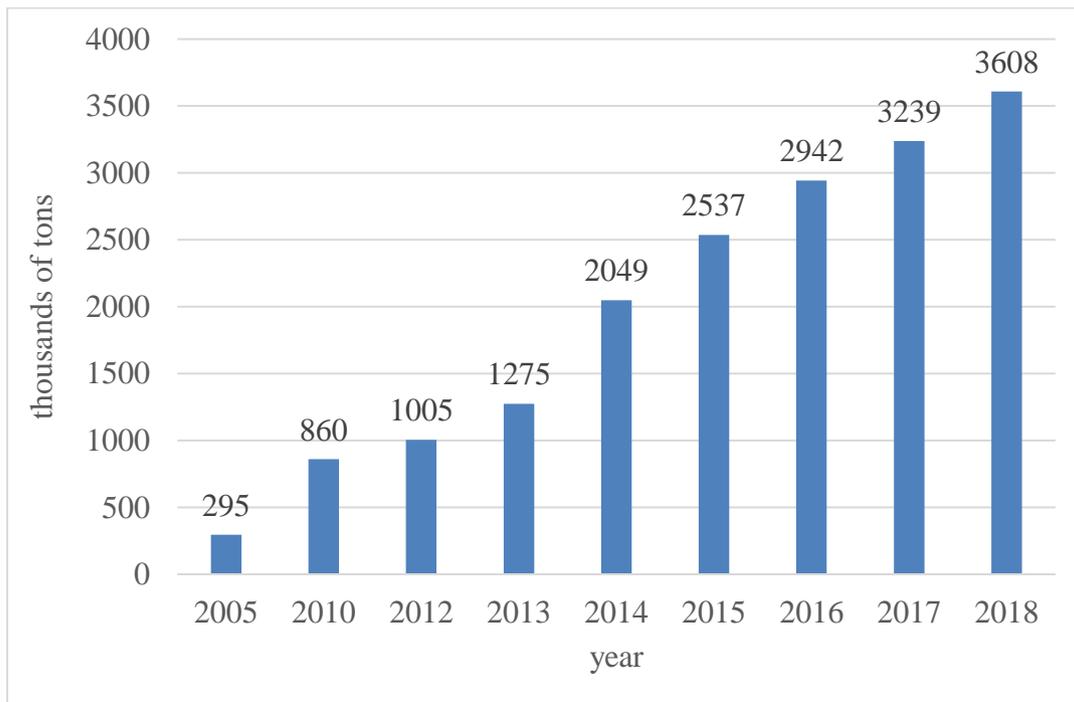
**Figure 3.** Mixed municipal waste collected selectively.

[Source: Environment 2019, Statistics Poland Warsaw 2019]

The majority of municipal waste generated in 2018 (84% - 10 446 thousand tonnes) was collected from households (compared to 2017, the share of this waste increased by 1 pp). In order to be able to process waste in the recycling process, it is necessary to achieve the highest

possible rates of selectively collected waste. This is possible due to the implementation of legal solutions, building a selective collection system by the municipal authorities and the involvement of residents in the segregation of household waste. In 2018, there were 2,144 publicly available points for separate municipal waste collection, of which 37% were located in cities and 63% in rural areas.

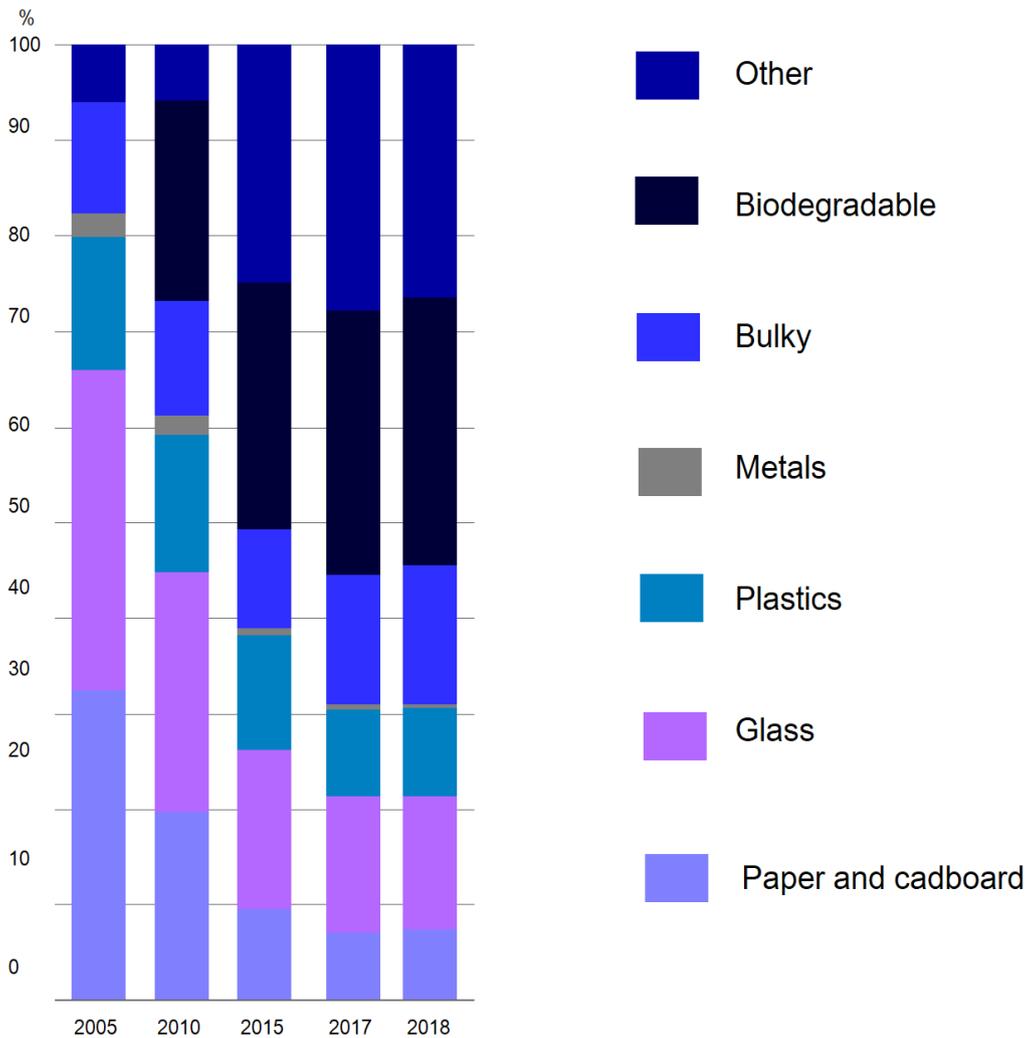
After the entry of new waste collection rules, a decrease in the amount of mixed municipal waste collected was noted in 2013. This was the result of the more common use of waste segregation at source introduced under new local waste management systems. In 2014-2015, the amount of mixed waste collected was at a similar level. In 2016, the amount of waste increased by 4.6% compared to 2015. In 2017, this level was similar to 2016, while in 2018 the amount of waste increased.



**Figure 4.** Municipal waste collected selectively.  
[Source: Environment 2019, Statistics Poland Warsaw 2019]

The amount of municipal waste collected selectively is increasing every year. In 2005, selective collection constituted only 3% of municipal waste collected (295,000 tonnes). In the years 2012-2016 in Poland there was an increase in the amount of municipal waste collected selectively. The largest increase in the amount of collected waste was selectively recorded in 2014 compared to 2013 by 60%. 2014 was the first year of application of the new requirements. In 2015, compared to 2014, the increase in waste collected selectively amounted to 23% and in 2016 compared to 2015 by 16%. In 2018, over 3.6 million tonnes (29% of the total municipal waste generated) was collected selectively, which means an increase in the amount of this waste by 11% compared to the previous year. A decreasing dynamics of increase in the amount of waste collected selectively can be observed. In 2018, the amount of waste collected or collected separately for Poland amounted to 94 kg per inhabitant, including:

- biodegradable waste - 26 kg per inhabitant (23 kg in 2017),
- mixed packaging waste - 15 kg per inhabitant (14 kg in 2017),
- Bulky waste - 14 kg per inhabitant (about 11 kg in 2017),
- glass - 13 kg per inhabitant (12 kg in 2017),
- plastics - approx. 9 kg per inhabitant (8 kg in 2017),
- paper and cardboard - 7 kg per inhabitant (6 kg in 2017).



**Figure 5.** Structure of separately collected municipal waste.  
 [Source: Environment 2019, Statistics Poland Warsaw 2019]

The amount of selectively collected waste varies widely in individual poviats and communes and depends largely on how the system of collecting this type of waste was organized by the local authorities. In 2018, three municipalities obtained over 90% the level of selective collection for all collected and collected waste, while in one commune less than 1% of waste was collected selectively.

Mixed municipal waste dominates among the generated waste. In 2018, their amount was 8.9 million tonnes, i.e. 71% of all municipal waste generated.

The structure of separately collected municipal waste has changed over the years. Waste fractions dominating in 2005 such as paper and cardboard, glass and plastics (in total 80% of selectively collected waste) currently account for just over 30% of the total, the share of metals also decreased (from 2.5% in 2005 to 0, 3% in 2018). Selective collection of bulky waste remains at a similar level of 10-15%. In recent years, the largest share has biodegradable waste (28% in 2018) and other fractions (26% in 2018), which mainly include mixed packaging waste (60%), multi-material packaging, waste electrical and electronic equipment, hazardous waste and clothing and textiles.

#### **4. CONCLUSIONS**

For many years, the amount of waste generated on a global scale has shown an upward trend, and their management is becoming a growing problem for most countries of the world. Waste management is an important issue that needs to be addressed as it concerns the three basic pillars of sustainable development: social, economic and environmental. Therefore, it seems necessary to undertake initiatives aimed at reducing the amount of waste generated and improving the waste management system.

Depending on the type, properties and composition, waste can be a great threat to human health and the environment. For this reason, the European Union implements an environmental policy largely focused on the recycling of used products, and emphasizes the strict requirements regarding storage, incineration and waste treatment [19].

An important task of local government units is to organize waste management, which should be consistent with the assumptions of the national environmental policy regarding the collection, collection and disposal of waste. Limiting the negative impact of waste on the environment has been adopted as the priority priority of waste management. The actions taken by municipal authorities should improve the state of waste management as well as ensure that the standards required by Polish and European Union law are achieved.

The municipal waste management system in Poland should focus on the gradual but consistent implementation of the basic principles of the waste hierarchy, including minimization, recycling, energy recovery and disposal. Bearing in mind all the potential possibilities of re-utilization of waste plastics from the municipal stream, each time the most economically and ecologically advantageous method should be selected [20].

In waste management, an important sector of the national economy and one of the priority municipal management, it is necessary to set long-term goals for reducing waste storage and to intensify preparations for reuse and recycling of waste, such as municipal waste and packaging waste. Work has also been underway at EU level for a number of years on waste reduction programs in Europe under which a circular economy action plan is proposed in which waste generation is kept to a minimum.

Actions in this area should be undertaken both at international and national level. State authorities have competences in this area that should contribute to increasing the efficiency of operations. In addition, the significant role of local government units in shaping the country's waste management should be emphasized. A significant part of the tools is transferred from central to local level in order to carry out waste management tasks [21].

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