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Pay-as-you-throw system as an innovative solution in waste management

System „Płać za tyle, ile wyrzucasz” jako innowacyjne rozwiązanie w gospodarce odpadami

Abstract. The study presents the waste management system in force in Poland and the related methods of calculating fees. Based on the analysis, we should assume that the implementation of the fee for waste through the principle of the pay-as-you-throw seems the most appropriate option to ensure reliability in paying for waste management services. Based on the analysis, we should assume that the implementation of the fee for waste through the principle of the pay-as-you-throw seems the most appropriate option to ensure reliability in paying for waste management services. Moreover, the experience of other regions in the world has shown that the system effectively supports the reduction of disposable packaging and creates incentives for at source segregation and composting.

Key words: waste management, PAYT system, indicators, fee, benefits, side effects

Synopsis. W opracowaniu przedstawiono system gospodarki odpadami obowiązujący w Polsce oraz związane z nim sposoby naliczania opłat. W analizach wykorzystano dane Głównego Urzędu Statystycznego. Następnie opierając się na przeglądzie literatury, opisano system „Płać za tyle, ile wyrzucasz” z uwzględnieniem stosowanych wariantów płatności. Na podstawie dokonanych analiz należy sądzić, że wdrożenie opłaty za odpady poprzez zasadę „Płać za tyle, ile wyrzucasz” wydaje się najbardziej odpowiednią opcją zapewnienia rzetelności w płaceniu za usługi gospodarki odpadami. Ponadto, jak wynika z doświadczeń innych regionów, system ten jest bardzo skuteczny we wspieraniu redukcji opakowań jednorazowych oraz stworzenia zachęt do segregacji u źródła i kompostowania.

Słowa kluczowe: gospodarka odpadami, PAYT system, wskaźniki, opłata, korzyści, skutki uboczne

Introduction

The increase in wealth increases the demand for consumer goods, which leads to an increase in the amount of municipal waste, both in the sphere of production and consumption. According to the Central Statistical Office of Poland – GUS, in 2019, there was data

for 332 kg of collected waste per one inhabitant of Poland, i.e. 7 kg more compared to the previous year. 10.8 million t of waste were collected from households, which accounted for 84.5% of municipal waste production.

The rapid pace of urbanization and industrialization, and technological advancement has ended up in the generation of huge volumes and quantities of municipal solid waste worldwide [Sing and Sarkar 2015, Sharma et al. 2018]. Given the increasing amount of waste, one of the most important challenges of the modern world has become proper waste management. Improper waste management endangers the environment and, consequently, the health and life of the inhabitants. Responsible waste management not only contributes to environmental protection but also saves natural resources and reduces economic losses.

Over the past 30 years, significant advances have been made in developing efficient schemes to charge households for their actual waste generation [Reichenbach 2008]. In line with the sustainable development principle, the priority in rational waste management should be recycling, i.e. reusing waste. The implementation of waste recycling is possible due to their selective collection and recovery, in particular, selective collection at source. In municipal waste, selective collection involves primarily secondary materials, including paper, glass, plastics, and metals [Kłos 2012].

Solid waste has become one of the global environmental issues [Song et al. 2015]. In recent years in Poland, municipal waste has been one of the most frequently discussed environmental issues. It is a great challenge for local authorities and the consumers, who play a crucial role in the waste management system. On the one hand, consumers' purchasing decisions and subsequent decisions regarding the post-consumer residues handling are important for the quantity and qualitative composition of the generated waste. On the other hand, consumers are service recipients, and their satisfaction with the level of services and prices offered on the market is important [Lorek 2015].

A new municipal waste management system has been in force in Poland since July 1, 2013. Despite many controversies and reservations, it introduced positive incentives stimulating the residents' responsible behaviour on waste generated in households. The system contributed, among others, to increase the level of recycling and recovery of selectively collected waste and reduce the mass of biodegradable waste sent for landfill. Its important features include the obligatory inclusion of all inhabitants, eliminating the benefit of dumping waste in illegal landfills. However, the implemented system does not sufficiently encourage waste segregation at source, and recycling. Thus, new solutions are sought to contribute to more effective waste management, particularly waste collection and management, which is an expensive process.

Aim and methodology

The research aims to identify the innovative system pay-as-you-throw – PAYT, which, as other countries' experience has shown, motivates residents to reduce waste production and segregate it. The study presents the waste management system in force in Poland and the related methods of calculating fees. Data from the Central Statistical Office were used in the analysis. Then, based on the literature review, the PAYT system was described,

including applied payment variants. The study also presents an example of the PAYT system implementation in the municipality of Parma in Italy and the benefits and possible side effects of this innovative solution.

Municipal waste management in Poland in 2019

Municipal waste is a mixture of waste, including packaging, green waste, biodegradable waste, minerals, and hazardous waste. In 2010–2012, the average amount of waste generated in households was over 12.0 million t (Figure 1). In 2013, it decreased to 11.3 million t. Moreover, the amount of municipal waste collected decreased from 10 to 9.6 million t in the same period. The difference between the amount of municipal waste generated and collected indicates that some of the waste has not been used legally or/and environmentally safe.

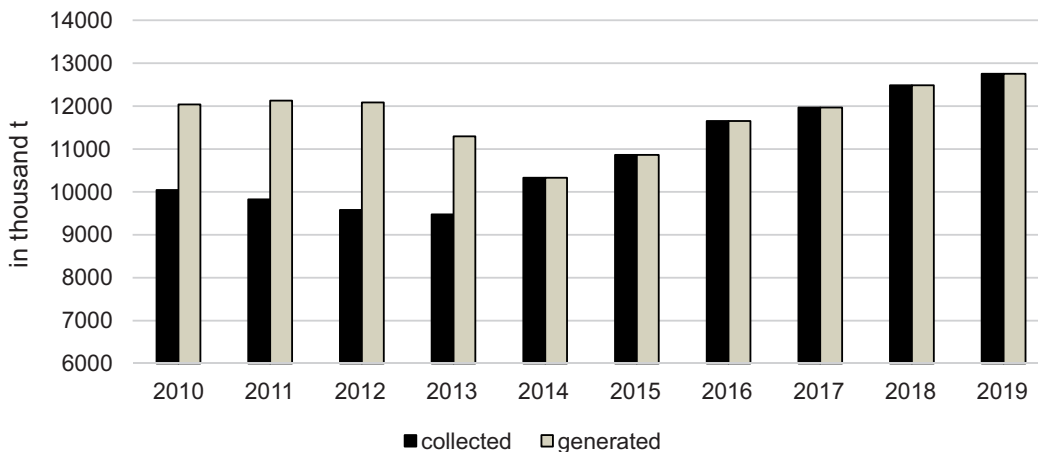


Figure 1. Municipal waste generated and collected in Poland in 2010–2019

Rysunek 1. Odpady komunalne wytworzone i zebrane w Polsce w latach 2010–2019

Source: own elaboration based on GUS data.

In 2014–2019, the amount of municipal waste generated and collected increased by almost a quarter, from 10.3 to 12.75 million t. This was probably due to a gradual increase in both household income and consumer goods purchase. Over 7.7 million t (56%) of collected municipal waste was recycled, and almost 5.6 million t (44%) of waste was neutralized. As part of the recovery, over 3.2 million t (25%) of municipal waste was recycled, while 2.74 million t (21.5%) were thermally transformed to recover energy (Figure 2). In terms of waste disposal, landfilling dominated, accounting for 5.5 million t of waste, which accounted for 43% of collected municipal waste. The 2190 separate municipal waste collection points operated in Poland in X. The 1352 enterprises provided the waste-collecting service from households.

At the end of 2019, there were 278 municipal waste disposal sites, with a total area of 1,670 ha. Over 92.0% of them were equipped with degassing installations, as a result of which about 91 million MJ of thermal energy and about 113 million kWh of electri-

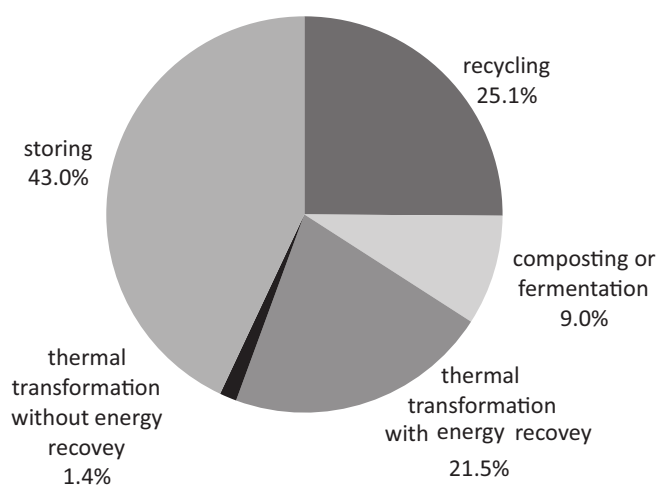


Figure 2. Management ways of collected municipal waste in Poland in 2019

Rysunek 2. Sposoby zagospodarowania zebranych odpadów komunalnych w Polsce w 2019 roku

Source: own elaboration based on GUS data.

cal energy. In 2019, 16 landfills were closed, with a total area of approximately 52.8 ha. Moreover, 11,371 illegal dumps were closed, of which around 26 t of municipal waste were collected in total. At the end of 2019, 1873 illegal dumping sites were recorded.

In 2018, the average amount of municipal waste generated per capita equalled 489 kg in the EU. The largest amounts of municipal waste were generated by the wealthiest countries, i.e. Denmark – 766 kg, Germany – 615 kg, Luxembourg – 610 kg, and small touristic countries, i.e. Cyprus and Malta – 640 kg per person. In turn, Romania generated the least amount of waste in the European Union per capita – 272 kg.

Although among all EU member states, Poland has one of the lowest rates of municipal waste generation per capita, unfavourable waste management is alarming as landfilling is still the most common method of municipal waste disposal. In terms of recycling, Germany is the leader in the EU market as 67.8% of municipal waste was recycled there in 2017. A high recycling rate was also recorded in Slovenia and Austria, 57.8 and 57.7%, respectively. Across the EU, more than 75% of municipal waste generated was processed, including 30% recycled, 17% composted, and 28% incinerated. Less than 25% of municipal waste was landfilled [Zalewska 2019].

The current system of waste payment in Poland (as of 2020)

To increase the efficiency of waste management in Poland, the Act of January 1, 2012 on amendments to the Act of September 13, 1996 on maintaining cleanliness and order in municipalities [Ustawa z dnia 13 września 1996 r.] came into force. From that date, municipalities had 18 months to introduce changes and implement new municipal waste management systems in their areas. The most important municipalities' tasks included:

- taking over responsibility for municipal waste,

- introducing fees for waste management,
- building new waste processing installations,
- selection (by a public tender) of entity/entities responsible for municipal waste collection in the commune area.

For the inhabitants, the most important change was abolishing the obligation to sign municipal waste collection contracts with entities (enterprises responsible for the waste collection that have the appropriate permit from the commune administrator) and pay them for their service. Instead, inhabitants have been required to pay municipal waste management fees to the municipality. Depending on the Commune Council decision, the fee amount depends on one of three elements:

- number of residents living in a given property,
- amount of water used from a given property,
- area of a residential unit.

Thus, charges for individual households in Poland do not depend directly on the amount of waste generated. The adopted system assumes that a household with a larger number of inhabitants, higher water consumption, or a larger area of residential unit generates more waste. In practice, however, this relationship is not clear and obvious. An additional resident who lives in a given property usually does not increase the amount of waste generated proportionally. Moreover, the fixed costs (administration costs, costs per container, part of the waste collecting costs) are independent of the number of residents in a given property (household). However, a solution considering water consumption is also not optimal. Large houses with a garden, using a lot of water for gardening, do not necessarily generate much more waste. Moreover, they have the ability to prevent waste by composting kitchen waste in their own garden. Therefore, the implemented fee system does not reflect the actual amount and type of waste generated. Besides, residents do not have the option of a fee reduction by preventing the generation of municipal waste. Any efforts in waste segregation or limiting their generation are not linked to any financial bonuses. It results, e.g., from the lack of correlation between the amount of collected waste and the number of fees and too small differences in fees for collecting mixed and selectively collected waste.

Depending on the adopted system of fees for communal waste, their rates vary in Poland regionally. On average, in 2019, residents of the Śląskie, Dolnośląskie, Opolskie, and Lubuskie Voivodships paid the most for garbage collection, while the lowest rates for waste disposal were in Podlaskie and Świętokrzyskie Voivodships (Figure 3).

From the collected fees for waste, the commune covers the costs of the municipal waste management system, which include the costs of:

- collection, transport, recovery, and disposal of municipal waste,
- creating and maintaining separate collection points for municipal waste,
- the system administration.

Annual revenues from municipal waste management fees must be in line with annual expenditure on the municipal waste management system. Due to this balancing problem, in subsequent years, the fees for collecting waste from residents will increase. This is mainly due to additional requirements and fees that are imposed on waste processing companies. Moreover, the permission to import (to Poland) waste from other countries where there are subsidies for recycling increases the number of raw materials on the



Figure 3. Average annual family expenses for the collection of selectively collected municipal waste by voivodship in Poland in 2019

Rysunek 3. Średnioroczne wydatki rodzinne na wywóz selektywnie zebranych odpadów komunalnych w województwach w Polsce w 2019 roku

Source: based on [Polski Instytut Ekonomiczny 2020].

Polish market. It replaces more expensive domestic waste with cheaper ones from abroad. As a consequence, the price of waste used in the secondary raw materials' production falls. This means that municipalities have to pay more and more companies for the transferred waste from the selective collection. This, in turn, contributes to an increase in waste management fees offered by the entities in public tenders.

Pay-as-you-throw system – characteristics

Considering the current solutions for collecting waste produced by households in Poland, the pay-as-you-throw (PAYT) system seems fairer. PAYT schemes become widespread solid waste management systems in several countries [Elia et al. 2015]. Even countries with traditional reservations for direct charging have started to consider PAYT in the revision of their national policy programmes [Reichenbach 2008]. This strategy for pricing local solid waste collection and disposal services for how much the residents generate waste, pay for how much waste you throw away) [Folz and Giles 2002]. PAYT is an innovative solution, both in terms of process and organization. Its essential feature is that it links the amount of waste generated with the fee for its management. In practice, different baseline indicators are used to calculate collection fees. The basic values include volume, frequency, and mass, which can be used separately or in combination [Boer et al. 2018]:

1. Volume – In a volume-based system, a household is billed by the volume of the bin used to collect waste. By choosing the size of the container, residents can, therefore, regulate the amount of waste generated and reduce household budget expenses.

2. Frequency – in the frequency-based system, the commune charges the household based on the number of container empties, e.g. once, twice, or four times a month. Depending on the chosen empty out frequency, the containers have lids of different colours. There are also flexible systems. A flexible system, in which the containers placed on the edge of the street or outside the property are emptied, need monitoring the frequency of waste collection.
3. Volume and frequency – In a mixed system based on volume and frequency, residents can choose the size of the container and how often it is emptied. The frequency selection can be fixed or flexible.
4. Mass – in a system based on the mass of generated waste, the household is billed based on the generated waste mass. Garbage trucks are equipped with a scale and can monitor the weight of waste in a given container.
5. Mass and frequency – in a mass and frequency system, the household is billed for both the weight of waste and the number of emptied containers. The frequency selection can be fixed or flexible.
6. “Expensive bag” – a special case of the volume and frequency system, based on the so-called “purchased bag”, also referred to as “expensive bag”. A household that generates more waste also needs more bags, which leads to proportionally higher fees for their waste collection. Labelled bags can be purchased from supermarkets or other retailers.

Launching the PAYT system requires its design and significant financial outlays. To organise this system and facilitate the collection of various types of waste, the following tasks are required [Sprawdzona metoda... 2010]:

- measurement of the amount of generated waste and/or services needed for it,
- identification system implementation for recording the waste generator,
- implementation of unit prices for an individual waste unit or the services used.

Thus, in the PAYT system, all containers need to be coded, and garbage trucks are equipped with a reader and scales. The data are transferred to the headquarters via real-time telemetry, where processing, billing, and invoicing occur. The collected data are also used to measure the economic efficiency of the system and to optimise its logistics.

In 2015 PAYT system was implemented by the 28 EU capital cities: Berlin, Budapest, Dublin, Helsinki, Ljubljana, Tallinn and Vienna. The average separate collection rate on total municipal waste generation in these cities is 35%. The applied PAYT schemes tend to be based on charges on the residual waste used to fund the separate collection of recyclables [European Commission 2015]. In the second half of 2015, the PAYT system was implemented in the municipality of Parma in Italy too. The collection fee for each household has two main components: fixed component, depending on the number of people and household space, and variable, depending on the amount of waste generated. The fee is calculated based on the number of bags, bins, or containers collected and whether the bio-waste is home-composted. The fixed part of the fee covers the minimum number of waste collections. Its purpose is to prevent illegal waste disposal. The additional rate depends on whether the waste is collected in a bag, bin, or container. Since the introduction of the PAYT system in Parma, the amount of waste collected has decreased. The system operator and environmental protection services ensure that selective collection is carried out correctly, and the residents receive feedback.

Benefits and side effects related to the pay-as-you-throw system implementation

The PAYT system is most often used in smaller municipalities, where most households have their own container. In the case of shared containers, e.g. in a block of flats, the waste management costs are billed collectively. The main benefits of using the PAYT system include [Boer et al. 2018]:

- encouraging selective collection,
- encouraging waste prevention,
- changing the behaviour and shopping habits of residents,
- rewarding good behaviour and punishing bad ones considering waste management,
- reducing municipal waste management costs.

As a consequence of implementing the PAYT system, the amount of generated waste is reduced.

Dahlen and Lagerkvist [2010] indicate the following strengths of PAYT systems:

- households' acceptance,
- fair allocation of costs to the system users,
- a substantial reducing waste in bags, bins, and containers (15-90% reduction reported),
- ensuring transparency of waste management costs,
- increasing sorting of recyclables,
- encouraging home composting.

However, apart from the positive features of the system, including waste management cost reduction, increased level of waste segregation, reduction of waste generation, the PAYT system can lead to several unintended side effects. These effects are mainly related to throwing mixed waste in illegal places. Based on experiences from other countries, four different cases were observed [Boer et al. 2018]:

- waste is not in the right container,
- waste is not in the resident's container,
- waste is near instead of in a container,
- waste is not even near the container.

Dahlen and Lagerkvist [2010] indicate the following weaknesses of PAYT systems:

- increased investment and operational costs of the system,
- encouraging waste tourism (is. Waste moved to neighbouring household or communities),
- encouraging illegal waste dumping,
- increased amounts of contaminants in recyclables.

Littering areas with waste is a frequently used argument against the pay-as-you-throw system. Experiences from the municipality of Brixen in Italy have shown that finding the original owners of the waste and imposing appropriate penalties on them is an effective measure in reducing the formation of such illegal landfills. Simultaneously, the combination of system improvement, quick cleaning of litter, prosecution of criminals, and environmental education can reduce the problem to an acceptable level [AOO 2004, Weijers et al. 2013].

Brown and Johnstone [2014], based on a web-survey on environmental behaviours with 4000 households across four countries, i.e. Canada, Netherlands, Sweden, Sweden, showed that experience with PAYT increased residents' support for the system. Only households that generate relatively more waste were less PAYT supportive.

Conclusions

The system of fees for municipal waste in force in Poland is ineffective. Its obligatory nature means that it is not profitable for anyone to throw waste outside the containers intended for this purpose. Still, the lack of appropriate differentiation of fees does not encourage limiting waste generation and segregation. In 2014–2019, the amount of municipal waste generated in Poland increased by 2.4 million t, i.e., almost a quarter. Moreover, in 2019, only 25% of the collected waste was recycled, and as much as 43% of municipal waste was landfilled.

Based on the analysis, we should assume that the implementation of the fee for waste through the principle of the pay-as-you-throw seems the most appropriate option to ensure reliability in paying for waste management services. Moreover, the experience of other regions in the world has shown that the system effectively supports the reduction of disposable packaging and creates incentives for at source segregation and composting. The system respects the polluter pays principle fairly by charging citizens according to the amount of waste they produce and the corresponding services they have gained access to.

Unfortunately, the implementation of the pay-as-you-throw system in Poland is not possible in the current situation (as of 2020), as the legal system does not allow for the implementation of the system of determining the fee for waste management depending on the amount of waste generated. Furthermore, considering the current Polish reality with the existing large grey zone in other areas of waste management (e.g. end-of-life vehicles, waste electrical and electronic equipment), the probability of system abuse on a larger scale is much higher than in the other EU countries.

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