

# Analysis of Municipal Waste Separation in Slovakia and Possible Alternatives

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**Abstract** - Environmental problems affecting the global community and its climate and thus endangering the natural functioning of the ecosystem are attracting worldwide attention. Waste management is one of the most urgent problems of human existence, as the population is increasingly centralised in cities and produces increasingly more waste that negatively affects the environment and degrades people's quality of life. The aim of the article is to illustrate the state of separation of municipal waste in the Slovak Republic, the importance of separation and the possibility of increasing it through the emphasis on community, the establishment of social enterprises in social entrepreneurship and incorporation of disadvantaged populations in the labour market to solve this problem.

**Keywords** – environment, municipal waste, separation.

## 1. Introduction

An important strategic document in the field of environmental studies is the Environmental Policy Strategy of the Slovak Republic lasting until 2030 (the so-called 'Environmental Strategy 2030'). Its basic vision is to achieve a better quality of the environment and a sustainable circular economy, using as few non-renewable natural resources and hazardous substances as possible to improve the health of the population.

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DOI: 10.18421/TEM93-36

<https://doi.org/10.18421/TEM93-36>

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*Received:* 29 April 2020.

*Revised:* 04 August 2020.

*Accepted:* 11 August 2020.

*Published:* 28 August 2020.

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It is in line with the 'Agenda 2030 for the Sustainable Development' of the United Nations, which contains the most comprehensive set of global priorities for achieving sustainable development and connects the three dimensions - economic, social and environmental [1].

Waste policy is an important part of environmental policy and its main objectives are to reduce waste generation, maximize recycling and re-use, reduce the incineration of non-recyclable materials, gradually reduce the landfill of non-recyclable waste, and ensure full implementation of waste measures in all Member States. The basic documents in Slovakia in which EU measures were implemented include the "Waste Management Program of the SR for 2016 - 2020" and the "Waste Prevention Program of the SR for 2019 - 2025". Their aim is to increase the recovery rate of waste with a view of preparing it for re-use and recycling and to promote waste prevention. Those programs are based on the waste hierarchy defined in Directive 2008/98 / ES of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain directives (Waste Framework Directive) with the aim of bringing landfilling to its lowest level. The study by Eriksson et. al., 2005, shows that reducing landfill in favour of increased recycling of energy and materials leads to positive environmental impacts, lower consumption of energy resources and lower economic costs [2].

The basis of successful recycling is waste separation. Separation of municipal waste is an activity in which the municipal waste components are mechanically separated and placed in separate containers for this purpose. In general, separation at the point of generation of municipal waste forms the basis for successful recycling. There is also the possibility of complex treatment of mixed municipal waste on automated sorting lines, but the purity and quality of the separated municipal waste components cannot compete with separation at source. In addition, it requires high investment and operating costs [3]. Therefore, municipal waste should be separated in every household. Saphores and Nixon (2014) pointed out the factors influencing separation [4]:

1. External factors (demographic and socio-economic factors)
2. Internal factors (attitudes, beliefs, standards)
3. System characteristics (system costs, collection method, frequency, payments ...).

Slavik et al. in the Czech Republic, conducted a research into the impact of these factors on household behaviour and their willingness to separate municipal waste components. They concluded that the external factors were mainly influenced by socio-economic factors - for example environmental behavior of households (the social pressure of the community, or children to separate waste), charging policy (fees), or the convenience of using the available waste management infrastructure [5]. Among the internal factors, the public's awareness of the importance of waste separation plays a key role. The last set of factors characterizing the system shows that it is important to create a separate collection system that citizens will perceive as comfortable [6].

For example, a study conducted in Sweden on food waste showed that after the sorting facility was installed in households, the amount of separately collected food waste, as well as the ratio of resource separation increased significantly. The results emphasize the importance of the convenience and existence of the infrastructure needed to segregate waste as important factors in the recycling of household waste, but also underlines the need to address these aspects of waste generation, i.e. at home [7].

In order to achieve greater success in the separation of municipal waste, attention must also be paid to the environmental awareness of the population. Raising environmental awareness will increase public participation in governance. Takáčová, Miškufová (2015) state that increasing the environmental awareness of the population is possible through intensive promotional and educational activities [3]. In addition to environmental education in schools, it is also possible to use other methods, e.g. promotion, internet platforms, advertisements. The media, including social media, also play an important role in shaping our beliefs and attitudes in waste separation.

One of the possible effectual tools to guide decisions and influence people's behaviour is 'the nudge methodology' [8]. 'Nudging' is a theoretical concept of behavioural economics based on a positive influence on choice. It is mostly used in the private sector in the area of marketing, but its use can also be seen in the area of public administration. 'Nudging' is any link in the architecture of choice that predictably changes human behaviour without prohibiting any possibility or significantly altering economic incentives [9].

Nowadays, the promotion of environmental behaviour of city dwellers is one of the biggest sustainability challenges. As a result of this challenge, Linder, Linhdahl and Borgström (2018) have also implemented behavioural knowledge to promote food waste recycling in urban households. The aim of this study, conducted in Sweden, was to find out whether 'nudge' in the form of an informational leaflet based on theories of environmental psychology and behavioural economics could be effective in promoting food waste recycling in urban areas. The results indicate a statistically significant increase in recycled food waste after the use of the factsheet, in comparison to before the use of the leaflet [10].

Social entrepreneurship and social enterprises also bring another view of the issue of separation. Despite the great diversity of perceptions of social entrepreneurship and social enterprises there is some consensus of understanding of these terms in literature. Social enterprises often arise in response to the failure of the state to provide services exclusively to profit-oriented enterprises. Social enterprise was also perceived as an instrument of active labour market policy.

The central concept in the field of social enterprises is the achievement of measurable "positive social impact", which is in accordance with Act no. 112/2018 coll. on the social economy and social enterprises, as amended, modified as a fulfilment of public interest or community interest. Achieving public or community interest can be achieved by the provision of a socially beneficial service. In terms of our focus on waste separation, all of the above-mentioned attributes of socially beneficial services are fulfilled.

Unlike Slovakia, the Czech Republic does not have a legislative definition of social enterprises, while the number of social enterprises is multiple times higher than in Slovakia. Separation in the Czech Republic is devoted to the social enterprise TRIANON (association), which employs twenty-seven employees with disabilities in two work programs. In the "Separation for Recycling" program (since 2004), employees analyse small electrical components and metals from already separated electrical equipment. The second work program "Digitization and Shredding" was established in 2015 to support the employment of disabled women with secondary and tertiary education from the region. In addition to addressing the issue of separation, the association provides long-term employment opportunities to people with disabilities, thus contributing to reducing unemployment and creating regional development and overall integration of these people into the daily life.

Zahra et al. (2009), appeal to social entrepreneurs to discover and take advantage of opportunities to promote social wealth through the creation of new businesses or the recombination of existing organizations. The author refers to the social entrepreneur in the field of waste as "social bricoleur", which means doing what is at hand. These 'social bricoleurs' operate in the context of local social needs and draw on locally available resources. They respond to the unmet needs of communities, helping to create and increase social wealth in different parts of the world [11].

Most literature on social entrepreneurship discusses whether the social or economic dimension is of primary importance. Many studies point to the dynamic dimension of socio-environmental entrepreneurship. An interesting approach to waste separation, through three informal social enterprises can be seen in developing countries, in Kisumu (Kenya). Their initiatives are characterized as social micro-enterprises that have managed to survive and grow. Due to the weaknesses of local governments, many of these neighbourhoods are poorly connected to basic services such as collection and treatment of household waste [12]. In this area, even low-income residents do not remain passive, but initiate and support activities aimed at providing and improving waste management services, which also create new employment opportunities. Social micro-entrepreneurs and the involvement of the urban population contribute significantly to improving the health of low-income people, creating jobs and increasing income among the poor.

Engaging in any of these forms requires, in addition to perseverance and leadership, knowledge of formal procedures and often sufficient financial resources. In these countries, in most cases, social entrepreneurs dealing with waste collection and separation have some form of financial and moral support from local government and other organizations in projects or funds, but in most cases, this is not sustainable in the long run.

Rather, environmental policies will be accepted and implemented if we all understand that: "Changing our mindsets and worldviews is the most urgent course of action we must undertake to cease acting on the world in a destructive way. This is our most urgent task, and we all have a responsibility to pursue it." [13].

## 2. Methodology, Analysis and Results

The aim of this paper is to illustrate the current state of municipal waste separation and potential methodologies for use in increasing the separation. In fulfilling the aim of the paper, we started with a review of literature and strategic documents concerning the separation of municipal waste with the aim of analysing the procedures and highlighting the results of separation in other countries. The data analysis itself was performed on the basis of data obtained from the Statistical Office of the Slovak Republic at the NUTS 3 level (for individual self-governing regions in Slovakia since 2010).

To create a circular economy, the European Union stresses the need for waste recycling. Member States agreed on the targets for recycled municipal waste and the extended waste separation as follows:

Table 1. Waste management objectives

Years	To 31.12.2023	From 1.1.2025	2030	2035
Recycling municipal waste		55 %	60 %	65 %
Extended separation	Bio-waste	Textiles Hazardous waste		

Concurrently, they will endeavour to ensure that, by 2030, all waste that can be recycled or otherwise recovered, in particular municipal waste, is not accepted in landfills and that by 2035 the amount of municipal waste landfilled will not exceed 10% of total municipal waste [14].

Table 2. Per capita municipal waste (kg) and recycling rate (%) [15]

	2010	2011	2012	2013	2014	2015	2016	2017	Change in %
EÚ 28	504	497	486	479	478	480	483	486	-3,57
Recycling	38,3	39,2	41,1	41,7	43,4	44,7	46	46,4	8,1
Slovakia	319	311	306	304	320	329	348	378	<b>18,50</b>
Recycling	9,1	10,3	13,3	10,8	10,3	14,9	23	29,8	<b>20,7</b>

The status of municipal waste generated and recycling rates in the European Union and Slovakia are shown in Table 2.

The data show that even though Slovakia is well below the European average with municipal waste production, the amount of municipal waste per capita is increasing.

This is an increase of more than 18% over the period analysed. Despite the increasing trend, the recycling rate is relatively low and Slovakia is one of the countries that still disposes of large amounts of waste. The reasons for this include very low landfill, municipal waste collection, and insufficient separation. Municipal waste management in Slovakia is the responsibility of the municipality, which is obliged to:

- a) ensure the collection and transport of mixed municipal waste generated in its territory, including the provision of collection containers

- corresponding to the municipal mixed waste collection system in the municipality,
- b) ensure the introduction and implementation of separate collection of biodegradable waste
- c) to ensure the introduction and implementation of separate collection of municipal waste for paper, plastics, metals, glass and multi-layered composite materials based on cardboard.

Based on the above, we analysed how much, and what waste has been separated in Slovakia since 2010. We considered only separated waste - paper, glass, plastics, metals and biodegradable waste - as sorted components. The figures are shown in Table 3., which shows that in 2010 sorted components accounted for 12% of total municipal waste, in 2017 almost 27%, with the most significant increase in the last two years. There was a reduction of the proportion of mixed municipal waste in the total municipal waste by 2, 71%, which can be evaluated positively.

Table 3. Amount of municipal waste in Slovakia (in tonnes) (processed according to [16])

	2010	2011	2012	2013	2014	2015	2016	2017
Separated municipal waste	217629	222463	243933	223835	2612045	294510	404788	575710
% of separated municipal waste in total municipal waste	12,03	12,59	13,93	12,83	14,27	15,60	20,72	26,94
Mixed municipal waste	1209369	1199692	1177881	1167391	1183054	1193688	1184729	1176580
% of mixed municipal waste in total municipal waste	66,87	67,89	67,28	66,92	64,64	63,21	60,65	55,06
Municipal waste	1808506	1766991	1750775	1744429	1830167	1888456	1953478	2136952

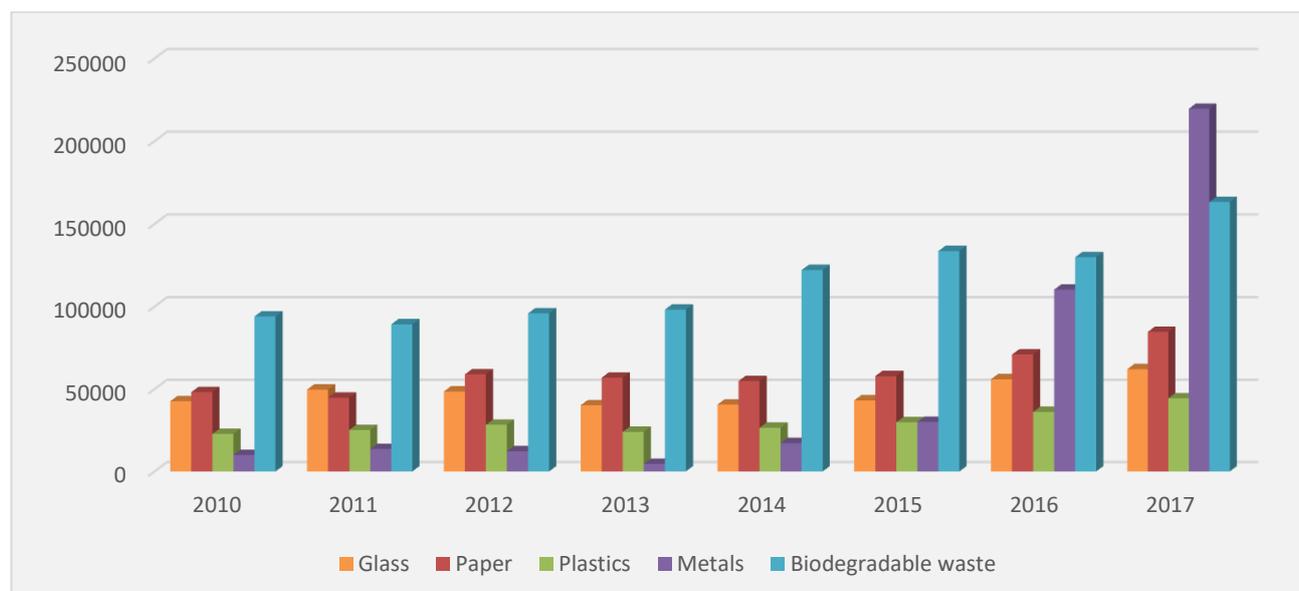


Figure 1. Separated municipal waste in Slovakia

The data shows that biodegradable waste components accounted for the largest share of sorted waste during the analysis period. The second sorted commodity is paper and then glass. The exception is the last two years, where metals are coming to the forefront. This can be attributed to better records associated with the purchase of metals. Since 2016, multiple composite materials have been added to the sorted waste components, which so far represent a small component of sorted waste, less than 1%. On

the other hand, plastics, which are very difficult to degrade in nature, make up a relatively small part of the separated waste. Therefore, the Government of the Slovak Republic adopted a measure related to the back-up of disposable packaging for plastic and metal beverages.

In the following part, we analysed the sorted collection of waste for individual regions. Figure 2. shows the amount of sorted components of municipal waste in 2010 and 2017.

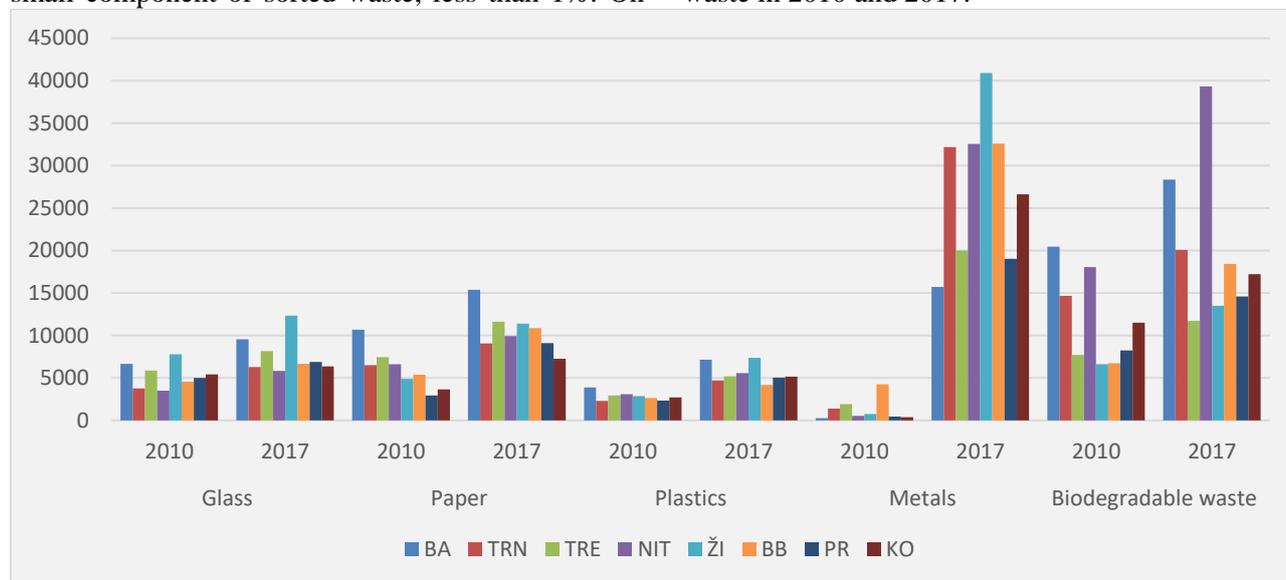


Figure 2. Separated municipal waste at NUTS3 level

From the graphical representation, it is clear that the most significant increase occurred variably in individual regions, primarily in the case of metals

and secondly in biodegradable waste. Table 4. provides more detailed information on the percentages of sorted collection in individual regions.

Table 4. Separate components of waste at NUTS 3 level in% (processed according to [17])

Years	Glass		Paper		Plastics		Metals		Biodegradable waste	
	2010	2017	2010	2017	2010	2017	2010	2017	2010	2017
BA	15,59	15,40	22,19	18,15	17,08	16,08	2,71	7,16	21,75	17,37
TRN	8,89	10,12	13,54	10,73	10,15	10,58	14,02	14,66	15,60	12,31
TRE	13,78	13,16	15,49	13,74	12,91	11,71	19,36	9,12	8,19	7,19
NIT	8,20	9,42	13,72	11,74	13,55	12,58	5,41	14,82	19,19	24,07
ŽI	18,28	19,85	10,18	13,46	12,55	16,60	7,53	18,62	7,05	8,27
BB	10,72	10,72	11,22	12,84	11,60	9,45	42,58	14,84	7,18	11,28
PR	11,79	11,08	6,09	10,76	10,24	11,34	4,56	8,67	8,78	8,95
KO	12,76	10,27	7,57	8,58	11,92	11,66	3,83	12,12	12,26	10,56

From the table it is clear that glass undergoes separation the most in the Žilina region while paper and plastics are separated the most in the Bratislava region. For metals, there is a significant change over time. In 2010, the Banská-Bystrický region sorted up to 42, 58% of metals compared to other regions, but in 2017 the Žilina region had the highest rate of metal separation.

Biodegradable waste is largely separated in the Bratislava and Nitra regions. The dominant regions in the field of municipal waste separation are the Bratislava and Žilina regions. In the case of biodegradable waste, it is the Nitra region, which is also the most connected with agriculture.

### 3. Discussion

The high proportion of municipal waste disposed of by landfilling is the biggest negative factor in waste management, which requires a change in favour of recycling and reuse of such waste. Therefore, the Government of the Slovak Republic adopts specific measures concerning, for example:

1. Legislative amendments - Act 312/2018 amending Act 79/2015 on Waste, which was created in 2019, as well as the aforementioned Advance Deposit Act 302/2019, which is due to be enforced on 1 December 2019 and the directive itself is to be implemented on the 1<sup>st</sup> of January 2023,
2. Economic instruments - which are related to an increase in the fee for depositing waste in landfills and tailings ponds. The increased fee was enforced in 2019 and is expected to be gradually increased annually until 2021.

These measures also have an impact on municipalities that dispose of municipal waste. In their universally binding regulations, they set the amount of the local fee for municipal waste and small construction waste. The determining factors of this fee are based on the real costs of municipalities for the management of municipal waste and small waste. This results in the need to increase this local levy if the municipality produces mixed municipal waste and landfills. Landfill charges are an effective economic tool to redirect waste flows from landfill to more acceptable ways of managing them [14]. By consistently increasing the environmental awareness of the public, the production of mixed municipal waste is expected to decrease, and separate waste that can be recovered and recycled is increasing, in line with the principles of circular economy.

We also see the answer to the challenges of separation in social entrepreneurship, which is often perceived as a reaction to the so-called 'institutional emptiness' where modern institutions provide insufficient or non-existing services or goods to specific target groups [17].

The social economy responds to specific problems and needs of citizens. It is becoming more prominent in the European countries due to its capacity to strengthen social cohesion, increase employment, generate and maintain social and economic structures, develop democracy, social innovation and foster local development [18].

Social enterprises are an important factor in local development because they can create employment opportunities for people with disabilities, social or cultural [19]. The representatives of the municipality should also perceive social enterprises dealing with the issue of waste separation as a benefit, not only for

the municipalities themselves, but mainly for the citizens. The very purpose of the existence of the municipality is identical with the general definition of social entrepreneurship. According to §1 paragraph. 2 of the Act 369/1990 of. from. on Municipal Establishment, as amended, the basic task of a municipality in the exercise of self-governance is to care for the universal development of its territory and the needs of its inhabitants [20]. Municipalities are therefore among the most important stakeholders in social entrepreneurship.

Social entrepreneurship and Smart City play a key role for the necessary, sustainable, more inclusive and economical approach to community development. Today, European cities face the challenge of combining competitiveness and sustainable development [21]. As Belanche, Casaló and Orús (2016) stated, cities are currently facing the challenge of attracting resources and improving the quality of life of their citizens [22]. In fact, the 21st century faced a global trend of increasing population concentration in a relatively small number of large cities [23]. Density of cities raises social problems where, in addition to informal development, we can also include waste management [23]. These cities have a higher demand for energy, transport, water, buildings and public spaces. Given these challenges, they need to be 'smarter', which, according to the European Parliament's Vision (2014), means that social well-being must be effective and sustainable. As Lee, Hancock and Hu stated (2014), smart cities are trying to "revive some of the city's structural (environmental and social) imbalances by effectively redirecting information" [24]. The concept also includes interactive and emergency management of the city and a better way to meet the needs of the population. The permanent goal is to create public value, as all projects and initiatives should be addressed to citizens [25]. The Smart City concept therefore addresses the issue of urban development as part of a triple sustainability approach that promotes social, economic and environmental emphasis [26]**Error! Reference source not found.**

### 4. Conclusion

Environmental quality is an important aspect of sustainable development. It is monitored and evaluated through many indicators in various areas of the environment. One of the researched areas is also waste, whose worldwide production is constantly growing. Therefore, it is necessary to minimize their negative effects on the environment and try to prevent the generation of waste as much as possible.

The Slovak Republic is still characterized by a relatively high rate of landfilling of municipal waste. The government is responding by approving higher

landfill fees, which will increase by 2021 and will depend on the level of waste separation.

Municipal waste management belongs to the public services, which in the Slovak Republic are in the competence of municipalities and their interest should be to increase public discipline in relation to the generation and sorting of municipal waste. A more efficient collection is influenced by a well-established collection system and the appropriate deployment of collection containers.

Smart technologies consist of installing sensors to collect data in containers waste to detect the amount and type of municipal waste. Such monitoring helps municipalities to optimize the collection system, and information can also be used to rework the size and geometry of waste bins for different areas **Error! Reference source not found.** Smart solutions provide a realistic view of the amount of waste, thus refining waste records not only for the community but also for individual households. Such data are then a good basis for charging for actually discarded waste.

#### Acknowledgement

*The article was prepared upon support of a research project: VEGA č. 1/0302/18 Smart cities as a possibility to implement the concept of sustainable urban development in the Slovak Republic.*

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