

A Comparison and Development of Municipal Waste Management in Three Countries, Slovakia, the Czech Republic and Poland, with an Emphasis on the Slovak Republic [†]

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Abstract: In this paper, we compare the development and possibilities for improvement of waste management in three countries: Slovakia, the Czech Republic, and Poland. Waste management is part of the circular economy. The circular economy is the basis for waste management today. This applies to municipal waste management, too. In this paper, we work with data available in the Eurostat database. We mainly deal with municipal waste in the three chosen countries. The output of this paper is an assessment of indicators such as recycling rates and waste production. The outputs are documented graphically.



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1. Introduction

Any country produces waste, some more than others. The volume of waste depends on the number of inhabitants. The more developed countries have a higher rate of recycled waste [1]. In northern and western European countries, waste stocks almost do not exist. In eastern and southern Europe, more than a half of the waste is stocking [2], not excluding Slovakia. The municipal waste volume increases every year. An EU goal to be achieved by 2050 concerns the ecologic limits of the planet and waste-to-energy plants, used to generate electricity [1,2].

With the aim to achieve long-term sustainable development in the world, the available sources have to be used effectively. The circular economy (CE) and waste treatments help to solve the problem. Waste treatment helps to avoid and decrease the volume of waste, as well as the negative influences of the waste on the living environment. The goal of waste treatment is to prevent waste levels rising, to increase recycling, and to decrease waste landfilling. The goal of the circular economy is, after products and goods life cycles end, to use them again to create something new. In this way, the rising levels of waste are decreasing.

The EU's long-term goal is to transform European societies, avoiding or decreasing the levels of waste rising and waste recycling into energy sources. This presents a key tool for providing effective energy use and sustainability in the EU.

The circular economy helps to provide healthy living environments without any waste or permanent use of the sources. Moreover, environment biodiversity is protected. Society produces a decreasing volume of greenhouse gases. According to EC goals in

2015, legislation started to be transmitted from the linear economy (LE) to a new one—the circular economy. This brought about other goals in circular and waste economies, such as recycling, stocking, waste avoiding, and increasing producers' responsibilities, repeating the use of sources, etc.

Municipal solid waste (MSW) nowadays presents as an inevitable factor of society and economic entities. With an aim to be ecologically sustainable, any country should have to be responsible for waste management, considering the aim of fulfilling of the mentioned goals [3].

Waste hierarchy presents one of the key factors of how to prevent waste rising in the EU [4], including recycling, the limitation of the waste's influence on the living environment, reducing resource consumption and decreasing costs [5]. Waste treatment has to be performed by solutions, considering the principles of living environment protection and material recovery [6].

Nowadays, waste management should be incorporated into the circular economy with increasing interest. The development of an efficient waste management system in the country presents a preparation period of the circular economy. The effectiveness of the circular economy is the theme of a number of studies in the literature [7]. For example, Martinho and Mourao reviewed scientific literature from the view of the CE concept in the EU, and found there was increasing importance and interest in the concept, as well as in a number of publications in chosen countries and organizations [8].

Waste treatment can be analyzed from different levels. From the level of municipalities, in almost all EU countries it is financed by local taxes or by a property tax. Radvan evaluated the mentioned conditions of the Czech Republic, Slovakia, and Poland, and found its revenue could be used for the waste management of municipalities [9]. In many municipalities, waste ends up in landfill in quite considerable volumes, with low levels of collection and recovery. This is the case in Dubrovnik's research [10]. From the levels of organizations' waste volumes, Sharma et al. pointed to the factors contributing to the transition of the prerequisites of the LE to the CE in SMEs [11]. The CE presents a good competitive advantage and sustainability of SMEs. Their study found low CE implementations in SMEs, suggesting tools for increasing CE implementations.

As for the territorial study of waste management, Pacurariu et al. analyzed the system of indicators, used for the monitoring of the transition to the CE, as being efficient and relevant in connection with the EU's sustainability [12]. Presently, countries also outside the EU, such as Russia, start to be orientated to circular and green economies when their companies transition to circular businesses as healthy and efficient business strategies. Fedotkina et al. conducted a study in Russia, trying to find the best waste management techniques [13]. One of the factors, helping to prevent waste levels from rising in the EU, was the application of a waste hierarchy [4], including recycling and reducing of sources of consumption [5]. Waste treatment should help to protect the environment and to contribute to material and energetic recovery [6].

Zorkociova and Paluskova measured the CE indexes in the EU with the aim to find out the trend of the indexes' developments, comparing them to the frame of V4 countries [14]. The results of the study show the need for continuous monitoring to provide greater efficiency and sustainability. Chovancova and Vavrek made a study of economic developments' dependence on energy consumption, also in V4 countries, finding that all analyzed countries should increase their speeds in implementing CE and waste treatment policies, regarding the need of energy [15]. Vokal and Stoch searched for waste management in V4 from the view of radioactive waste, and found differences in different countries [16]. Lacko et al. [7] found relations between waste treatment and CEs in V4. The results of the study show that V4 countries do not belong to the category of advanced countries in the sense of recycling and CE use [1,2].

Zaleski and Chawla discussed CE implementation in Poland to find out ways for improving the quality of municipal waste management before the COVID-19 pandemic [17]. The aim of this paper is to analyze the situation in post-pandemic countries, not only in

Poland, but also in the Czech Republic and Slovakia. This research provides data on V4 countries, contributing to overcoming the challenge of Martinho and Mourao by providing data according to individual countries [8]. Similarly, as was Pacurariu et al.'s, the paper's ambition is to analyze the CE and waste management in V4, as well as to discover whether the situation in 2023 has changed [12].

2. Methodology

The goal of the paper is to investigate the development of the presented situation. Research data are from Eurostat and analyzed in JMP 15 by © SAS Institute Inc. Analysis had been performed according to the following processes:

1. Analysis of production of the waste in municipalities in the Czech Republic, Slovak Republic and Poland in graphic expression-cartographer;
2. Graphic analysis of recycling rate-trend analyses;
3. Graphic summary of analysis of recycling rate of municipal waste with regard to trends of development;

In Figure 1, a flow chart about the development of research steps and the outcomes which were achieved can be seen.

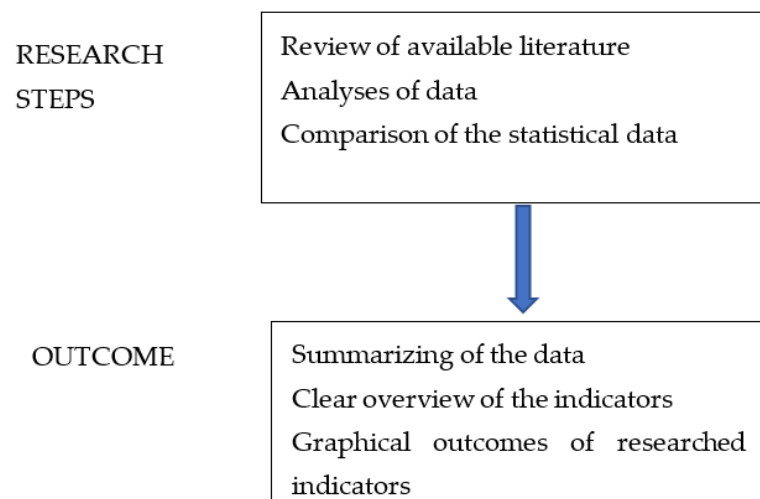


Figure 1. Flow chart of research steps and outcomes of the study, using our own processing.

3. Results

The EU goal is to protect the environment, support ecologic activities and stimulate ecological economy development. The long-term goal is for greater recycling in society, minimizing the rise of waste, and increasing the recycling of waste. In the research, the mentioned aspects have been analyzed in individual EU countries.

For the results, we evaluated the amount of municipal waste generated for the selected countries in kilograms per capita.

There is a demonstrable link between household consumption and municipal waste production in European economies, but also worldwide.

3.1. The Production of Municipal Waste in the Czech Republic, Slovak Republic and Poland

According to Figure 2, municipal waste production in Slovakia is growing the fastest of any EU country. In 2019, the average Slovak discarded of a record 435 kg of waste in waste bins. Meanwhile, the EU's reform package for the transition to a circular economy sets two targets for 2035: to recycle at least 65% of municipal waste and to increase landfill by no more than 10%. In 2019, according to data from the Slovak Statistical Office, Slovakia generated 2.37 million tons of municipal waste. Over the last ten years, there has been an increase of more than 30%. The production of municipal waste is growing fastest in the EU. And, it looks set to grow further. According to the analysis, municipal waste

production goes hand in hand with consumption growth. Every purchased good and often service is sooner or later a source of waste. As consumption grows, so does the production of waste [18]. The total waste production in the Czech Republic in 2022 reached 38.5 million tons.



Figure 2. Municipal waste production in kilograms per inhabitant; source: our own processing.

Compared to the previous year, 2019 (37.4 million tons), this is an increase of approximately three percent. However, there has been a decline in municipal waste, i.e., millions of tons of waste were generated by households. The volume of municipal waste in the Czech Republic fell by 2.5% year-on-year to 5.7% (see Figure 2).

Per inhabitant of the Czech Republic, 536 kg of waste was generated. According to the most recent data from the Czech Statistical Office, the share of landfilled municipal waste was 48.4% in 2020. On the other hand, the recycling rate was reported at 43.7% and around 8% of municipal waste was recovered into electricity or heat in waste-to-energy plants (WEEE) last year. This is due not only to the sorting and subsequent recycling of waste, but also to the long-standing existence of waste-to-energy facilities [18,19].

Municipal Solid Waste in Poland; A Short Overview

MSW generation per capita increased in 2004–2005 to 319 kg. In 2005–2012, it remained at this level. Waste rising decreased to 272 kg in 2014; however, there was a recorded consequential increase to 336 kg in 2019. The lowest level occurred in 2014 (272 kg per capita), followed by decreasing due to a waste prevention program (WPP) in 2011. This trend can be influenced also by population and household expenses. The MSW rising in Poland of 336 kg per capita per year is under the EU average of 502 kg. The effect of WPP in 2011 cannot be objectively evaluated, since it reflects the global economic crisis, which is affecting waste increases as well [20,21].

From 2012, the recycling of paper, glass, metal and plastics was formally implemented in Poland (by Regulation of the Environment Ministry) through the preparation for re-use and recovery by other methods of waste fraction recycling (Journal of Laws of 2012, item 645). This triggered an increase in material recycling. This coincided with an energy recovery trend with high caloric waste fractions, mainly in the cement industry. This resulted in a waste landfilling decrease from 9194 Gg in 2004 to 5218 Gg in 2020. However, in 2017, the trend reversed—there was a recorded increase in waste landfilling in 2017–2019. Only a slight reduction had been recorded in 2020 [21,22].

3.2. A Comparison of the Three Chosen Countries: The Czech Republic, the Slovak Republic and Poland

Comparing the countries of the Czech Republic, Slovakia and Poland, Poland clearly produces the smallest amount of municipal waste. This is followed by the Slovak Republic, and the last country of the three is the Czech Republic.

If we want to see a development in municipal waste management, we need to look at the relevant indicator—the municipal waste recycling rate. The municipal waste recycling rate shows how waste from final consumers is used in the circular economy as a source of materials. Municipal waste rises mainly due to the final consumers, including households and other sources of waste, similar in origin and nature. It is recorded at the level of around 10% of total EU waste. However, its heterogeneous composition creates the challenges for municipal waste (MW) management. MW recycling rates present a good indicator of the MW management quality, measuring the recycled MW shares in the total rise of MW.

Material recycling, composting and anaerobic treatments are included in the recycling criteria. The ratio is shown in percentage. This indicator shows a trend that is positive over time, which means that it is increasing, and this is the case in all of the countries surveyed. Recycling rates are increasing in all of the selected countries. This may be due to the growing importance of the circular economy and to the fulfilment of EU commitments under existing agreements.

The EU average recycling rate is higher than in the three countries studied, but, looking at the trend over the last 20 years, the EU average recycling rate is half that of the Slovak Republic, the Czech Republic and Poland (see Figure 3).

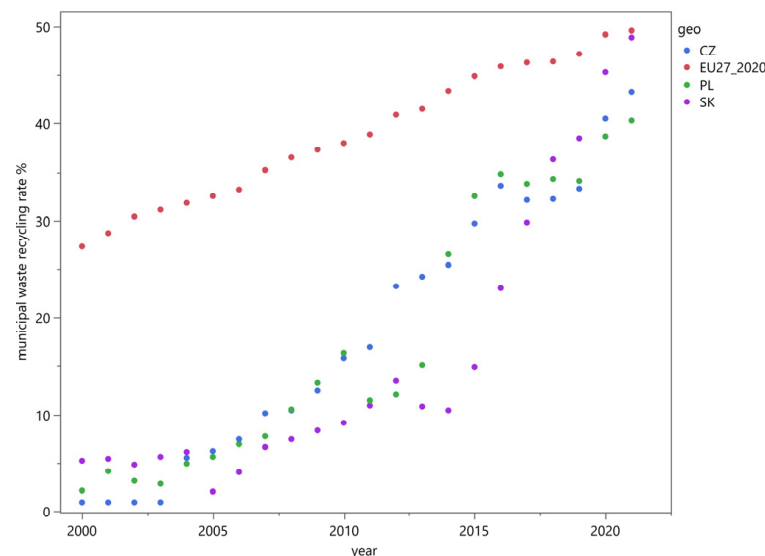


Figure 3. Development of waste recycling waste, using our own processing.

In Figure 4, we can see that the recycling rate is lowest in Poland, followed by the Czech Republic, and the highest recycling rate is in the Slovak Republic. Countries have to follow different protocols and documents. Slovakia must observe EU documents and recommendations to meet their environmental policy, such as the “Slovakian Waste Economy Program in 2021–2025” and the “Slovakian Program for waste avoiding in 2019–2025” [23]. The goal is to increase waste recovery with repeated use and recycling and support the minimizing of waste. The mentioned programs result from the decree of the European parliament and European council 2008/98/ES about waste and the EU Action Plan for a circular economy [24,25]. Part of the CE action plan is elaborated in the frame decree of waste; No 2018/851 (Year 2021) [26].

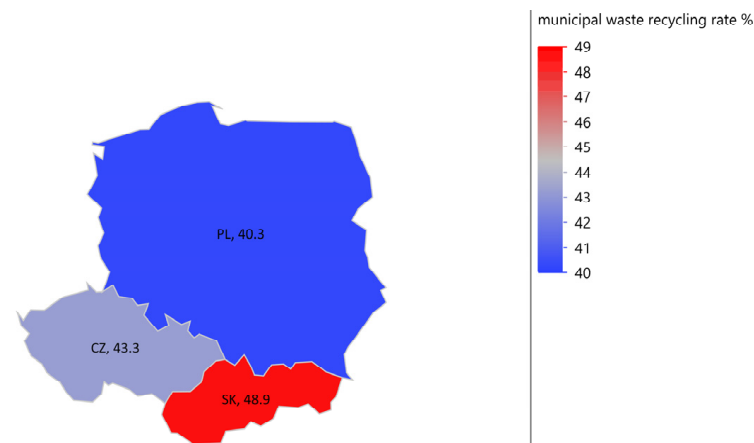


Figure 4. Cartograph of municipal waste recycling rate of chosen countries. Source: our own processing.

4. Conclusions

The separation of MW collection, especially of bio-degradable waste, still needs improvement and support. The highest investments in waste management were recorded in 2019. The trend followed the need to meet WM goals set by the EU. Investments aimed at the use of technological innovations to increase waste recovery rate, orientated toward reuse and recycling. Using the available database, this paper evaluated MW development and recycling in selected EU countries. The results show that, despite the increasing trend in MW, there is a positive development in waste recycling, having observed a positive trend in the analysed countries. In the assessment, the Czech Republic was the dominant country, generating the highest volume of municipal waste, but, on the other hand, it was the country with the second highest recycling rate among the countries compared. It should be highlighted in this comparison that Poland was the country that generated the least municipal waste and had the second highest municipal waste recycling rate of the countries compared [27,28]. Slovakia, with the second highest rate of waste production among the three monitored countries, was, however, in first place in terms of the recycling rate among our three monitored countries. The reasons for this situation are various, related to the standard of living and to the fact that MW production is directly dependent on social and economic indicators, especially GDP. Our evaluation of waste production and recycling can be used for the creation of governmental policies in the area of waste management, as well as for MW policies in individual municipalities. This paper presents partial results of the project, solving No ITMS 3131011T564 “Research of the RES implementation impacts to the processes of energetic management of the industries”, and is limited to the number of individual states. Future orientations of research could be directed to the representative best cities from the analyzed states, and compared with the best EU results, as well as directed towards detail legislative support of the presented area.

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