

## ALTERNATIVES IN WASTE MANAGEMENT DEVELOPMENT IN SLOVAKIA COMPARED TO GERMANY

Daniela Palaščáková, Gabriela Kol'veková

Technical University of Kosice, Faculty of Economics, Nemcovej 32, 04001 Košice, Slovak Republic

### Abstract

*Waste management in all its forms is one of many domains that contributes heavily to an existing environmental situation. European waste management and its development trends are followed by new member states of European Union that fall behind about five or even ten years. The main causes of pollution in environment in Slovakia are: high rate of waste generation, high proportion of solid waste and its relatively low level of recycling and reuse as a secondary source and unsystematic waste management, to name but a few. The aim of the paper is to point out alternatives feasible for use in improving waste management in Slovakia. Alternatives come out of comparison with Germany. At the same time, alternatives were conditioned as an optimum between sustainable development and costs need to implement such alternative solutions, which were suggested in order to improve situation in waste management.*

**Key words:** *waste management, recycling, landfilling, environment*

### 1. INTRODUCTION

Environmental values essentially belong to cultural profile of a modern man. The need for the acceptance of environmental values caused the interest of economic public in the problem of values and led to consideration of the possibility to establish new emerging values into the already existing values systems. The significance of interconnection of indices consist in understanding of men's thinking. If people created values, which negatively do not influence the environment, then the interest in any limits in relation to environment would be faint. Taking responsibility for our own acting simply consists in the creation of goods in accordance with environment (Šmolková 2013).

The use of the opportunities, which bring the environmentally value chains along mostly by more efficient use of resources, decreasing amount of waste and the transformation of waste into new goods and services, requires environmental innovations, new mediators and mediating services. Small and medium sized enterprises (hereinafter just "SME") and businessmen need a positive environment to be able to join new sector relationships, which enable them the transition to circular economy. The concept of environmental innovations itself is relatively "young", coming to the fore at the turn of 20<sup>th</sup> and 21<sup>st</sup> century. However, there are many definitions of environmental innovations from significant authors dealing with this problem and the execution of research in this field, such as Klemmer et al. (1999), Rennings (2000), Andersen (2002), Triebswetter & Wackerbauer (2008) and others.

One of the fields, which significantly participate in the state of environment, is waste management in all its forms. Waste, which has been considered as the final destination of many goods, is becoming a worth material within the effort of sustainable environment. Thanks to the recycling, waste helps to protect the environment, effective use of resources, contributes to GDP growth and employability and reduces the emissions. Every country manages it in a different way.

There are more ways how to manage the waste (collection, recovery, separation, etc.). This article cannot cover and handle the whole problem of waste, which is very extensive and interfere with all other areas of economic activity, therefore we focused mainly on their landfilling and recycling. Wassenhove (2011), as well as Malčėková & Šimek (2014), or Grant, Trautrim & Wong (2013), consider landfilling waste disposal as less beneficial possibility from environmental point of view, but even from the point of view of the product value. We have chosen landfilling, because only the Slovak Republic (hereinafter just Slovakia) actually struggles with tons of landfilling waste and at the same time, based on its comparison to Germany, it's possible to draw attention to the imperfection of Slovak system of

landfilling. Recycling significantly influences landfilling, because more waste is recycled, less landfilling we need. From the point of view of recycling, Slovakia is clearly behind the countries of Western Europe. Based on the obtained data in Slovakia in comparison to Germany, we try to assess the actual situation and suggest the solutions, how to improve the situation.

The goal of this article is to warn of the alternatives, which are possible to apply when improving the waste management in Slovakia and suggest the possibilities to find the optimum between sustainable development and the costs necessary for its realization.

Regarding the goal, the following research question has been formulated: *What are the negatives of the waste management in Slovakia and what are the possibilities of the solution of this problem in a way to have the suggested modifications economically more beneficial?*

The following was covered within the scope of issue in question:

- Waste management based on the principles of sustainable development (Agenda 21)
- Waste management, which is integrated (incorporation of all sorts of waste and functional elements of waste management), respecting needs and possibilities of region, flexible (able to respond to changes) and proactive (able to foresee the changes);
- Waste management in accordance with requirements formulated by principles of the European Commission (hereinafter just “EC”) and documents processed during the preparation of Slovakia to join the European Union (hereinafter just “EU”);
- Application of the legislation of the Slovak Republic and accepted conceptual documents (conceptual materials processed by the Ministry of Environment (hereinafter just “ME”), the National development plan, etc.);
- Waste management with clearly defined goal and methods of verification of their implementation through indicators;
- Waste management with sufficient time perspective (at least 10 years), in relation to the development of EU;
- Waste management using the method of the participation of professionals in the creation of conception (e.g. workshops with subjects of waste management in the region);
- Waste management based on economic aspects and criteria (the principle of polluter holds, cost-effective solutions, etc.)

From January 1, 2016, new Law on waste no. 79/2015 Coll. holds in Slovakia, which brings radical changes to the system of waste management in Slovakia. Among the most positive ones belongs the motivation of self-governments to greater separation and the recovery of waste. Program of waste management in Slovakia 2016 – 2020 refers to 60% of separated waste in 2020. The package of measurements adopted by EC in December 2015 entitled *Circular Economy package* plans to decrease the rate of landfilling in EU to the maximum of 10% by 2030.

## 2. MATERIAL AND METHODS

The analysis of present state was carried on the basis of capacity indicators: the amount of overall landfill waste, amount of municipal and recycling waste and the number of landfills. Following the presented indices, the state of waste management in Slovakia was compared to Germany in 2004 – 2015, i.e. since Slovakia joined EU, till 2015 (in some cases till 2014), when we obtained available data, as data in both countries were calculated per capita. In comparison of the amount of landfill waste calculated per capita in Slovakia, we used mostly data of the Ministry of Environment of the Slovak Republic and its two documents, namely *Program of waste management in the Slovak Republic for 2011 – 2015* and *Program of waste management of the Slovak Republic for 2016 – 2020*. Data for Germany were sourced from statistical yearbooks of Federal Statistical Office (Statistisches Bundesamt), while in some cases, the most recent values were published only for 2013. Therefore, the estimation was done through an

exponential compensation of the values in 2014 according to Brown, as well as for Slovakia (see Table 3).

The below formula was applied: (Mikolaj, Klučka & Vančo 2005)

$$\hat{y}_{t+1} = \alpha y_t + (1 - \alpha)\hat{y}_t$$

Where:  $\hat{y}_{t+1}$  is a new presumption,

$\alpha$  compensating constant from interval (0,1),

$y_t$  new comparison,

$\hat{y}_t$  presumption from the period t.

We selected the value 0,6 as compensating constant  $\alpha$  that means we focused more on the last observation than on the last presumption during the assessment.

From European legislative norms, following were taken into consideration in this paper: the Regulations of European Parliament and the European Council 2006/12/ES from April 5<sup>th</sup>, 2006 on the waste and from the Slovak legislative, the Law no. 17/1992 Coll. on environment and the Law no. 79/2015 Coll. on the waste and the amendments and the completion of some laws.

### 3. ESSENTIAL CHARACTERISTICS OF SLOVAKIA AND GERMANY FOR THE PURPOSES OF COMPARISON

By the time Slovakia joined the EU, the situation in the field of the waste management has changed not only in the field of the legislation, but even in the field of practical fulfillment of requirements of European law. In order for Slovakia to contribute to a sustainable growth in EU, it must use resources in more intelligent and sustainable way. It is obvious that linear model of economic growth, which Slovakia relied on in the past, does not meet needs of present modern societies in global world anymore. Many natural resources are limited, therefore we have to look for environmentally and economically sustainable way of their utilization (Antošová, Fabiánová & Weiss 2011).

For the purposes of comparison of data from Slovakia, we retrieved data from Germany, because both countries are economically tied closely together, more than any time before. Slovakia and Germany have almost ideal conditions for the development of economic cooperation, which results from several individual characteristics. Both countries are fully established members of EU, thus the part of integrated European market. Mutual geographic closeness as well as many cultural and civilization intersections between both countries play its role. No wonder Germany holds the position of the most important trade partner and a key investor in Slovak economy upon these facts as well as mutual persisting interest of both countries. From the Slovak point of view, we also have to emphasize the economic-political importance and “soft power” of regional brand of V4, which currently presents the most significant business partner (in export and import at the first place) for Germany. The fact that a combined GDP of V4 countries theoretically presents the 15<sup>th</sup> largest economy in the world plays an undeniable role in this progressive relation (Newsletter of Slovak-German business and industrial chamber). Germany and its economy with its standards presents the motivator worth to follow from our point of view – at least in terms of the fact that successfulness of economy does not consist only in good looking statistics, but mostly in the satisfaction and the profit of all its agents.

It is very important to remark that in case of Slovakia and Germany, we talk about the countries, which are of a different area size, population and different rate of GDP production. In order to focus on the comparison of waste management between Slovakia and Germany, it's necessary to command data from other fields such as demography, social statistics, GDP, or country area. Therefore, we focused in this article on the comparison of the situation in Slovakia with Germany in relation to:

1. Population number,
2. GDP number,
3. Number of landfill waste per capita,
4. Number of registered landfills per capita,
5. Number of recycling waste.

We followed the presumption that Germany administers the waste management better than Slovakia. After reviewing the population number and GDP size, we looked closer at the fact, whether Germany is really able to deal with waste, number of landfills and waste recycling better.

### 3.1. Comparison by population

According to the article of EU entitled *The Life in EU* (2016), EU is located in the area of 4 million km<sup>2</sup>. Germany is the fourth largest EU country of the area 357 300 km<sup>2</sup>. Slovakia is approximately 7-times smaller with the area of 49 000 km<sup>2</sup>. In order to compare Slovakia and Germany, we had to calculate other indices per capita. If we did not do it, the result would be absolute numbers, from which we couldn't deduce any conclusions.

Country	Year											
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Germany	82,5	82,5	82,4	82,3	82,2	82,0	81,8	81,8	80,3	80,5	80,8	81,2
Slovakia	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4	5,4

**Table 1.** Development of population in Germany and Slovakia in 2004 – 2015 (in mil.)

Source: own elaboration according to Eurostat: Population on 1 January

According to Table 1 for the period between 2004 till 2015, the population number was varying at intervals from 80 to 83 million in Germany, while we can observe a declining tendency of the population from 2012. In Slovakia, the population has been increasing during this period, but it did not reach 100 000 inhabitants in its absolute numbers in the last 12 years, therefore, number 5,4 million is presented in Table 1 during all observed years. Data for 2015 say the population of Germany is approximately 15 times higher than the Slovak one.

### 3.2. Comparison by GDP

GDP is an essential measure of economic activity of both countries, hence we considered it for the further development. It is defined as a value of all goods and services produced by residential units of certain territory (usually a state) for the observed period of time (usually one year). Capacity index of GDP per capita, according to the standards of purchasing power, is expressed in the relationship of average of all 28 EU countries. The average of 28 EU countries reaches the value of 100. If the country index is higher than 100, the level of GDP per capita is higher than the average of all 28 EU countries and vice versa.

Country	Year										
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Germany	116	116	115	116	116	115	119	122	122	122	124
Slovakia	55	56	59	62	67	72	71	73	73	75	76

**Table 2.** The amount of GDP of Germany and Slovakia by Purchasing Power Standards in 2009 – 2014

Source: own elaboration by Eurostat: GDP per capita in PPS

As we can see in Table 2, values for Germany in 2004 up to 2014 are higher than 100, averagely in 18 units. In Slovakia, values of GDP are approximately in 32 units lower on average than the average of 28 EU countries is in this period of time. However, we can see a positive tendency in both observed countries in this time period.

After the comparison between Slovakia and Germany from the point of view of the population number and GDP size is done, we came to the conclusion that Germany, as a greater economy, has larger GDP per capita, what makes other presumption for better waste management.

### 3.3. Comparison by the amount of landfill waste per capita

Slovakia belongs among the landfilling powers at the map of Europe. According to Eurostat, Slovakia landfilled more municipal waste in tons in 2009 than Germany, Netherlands, Belgium, Denmark, Sweden and Austria all together. This unfavorable position post is the result of Slovak way of building a “modern” waste management. Absolute dependency, mostly of the producers of municipal waste, on the landfills’ capacities has not declined neither after Slovakia joined EU, in spite of the adoption of European regulations to national legislation and almost 20-years of financial support of various national and international resources on waste management.

There are three main reasons for this:

1. Landfilling is the cheapest of all the ways of waste disposal;
2. Slovakia does not reach the long-term results of waste recycling to achieve the diversion of significant part of landfilled waste;
3. The absence of sufficient capacities for energetic recovery of waste. Waste, which is not separated and materially recovered has no place to be disposed, therefore is uselessly landfilled.

In Table 4 data, we can see that there were 136 waste landfills operated in Slovakia in 2009, where more than 2,6 mil. tons of waste were disposed. Thus, more than 80% of the production of municipal waste.

Germany, as a country, is larger than Slovakia, regarding the population and even the area size, therefore it is natural that there is more waste produced in its territory. In Table 3, we focused on what is the amount of waste in Slovakia and Germany, which has been landfilled and what was the overall production in 2005 – 2014. Beside of this, we can even see the percentage definition of landfill waste in proportion to the overall waste. As we presented in the second part of the article, because of the inaccessibility of data (published only up to 2013) for 2014, we present estimated amounts only. We used the method of exponential equalization of values by Brown for the calculation of approximate computation of other cycle. We set a value of 0,6 as an equalizing constant  $\alpha$ , what means that we focused more on the last observation than on the last prediction in our estimation.

Year	Slovakia				Germany			
	Measured unit				Measured unit			
	Landfilled waste		Overall waste		Landfilled waste		Overall waste	
	in 1K tons	in %	in 1K tons	in %	in 1K tons	in %	in 1K tons	in %
2005	4 117	38	10 929	100	45 665	7	331 900	100
2006	6 909	48	14 507	100	38 727	10	372 900	100
2007	5 563	51	10 934	100	43 161	9	386 900	100
2008	4 562	40	11 492	100	41 599	11	388 932	100
2009	4 080	48	8 523	100	35 442	10	365 496	100
2010	3 809	40	9 534	100	34 038	9	379 390	100
2011	4 115	40	10 284	100	36 899	9	393 057	100
2012	4 014	46	8 668	100	36 963	10	387 113	100
2013	4 938	50	9 859	100	42 054	11	392 300	100
2014*	4 581	48	9 599	100	39 930	10	390 185	100

**Table 3.** The amount of landfilled waste and overall waste in Slovakia in comparison to Germany

Source: own elaboration by ME SK and Federal Statistical Office

The results in Table 3 suggests that overall amount of waste in Slovakia was mostly produced in 2006, whereas the lowest value was reached three years later. Average value in 2005 – 2013 is 45% in this index that means we dispose almost a half of the overall waste to landfill. If we look at the fact how much waste was produced in Germany in 2008 to 2013, we can see that the most of waste was produced in 2011 – 393 057 tons. Percentage rate of landfill disposed waste and overall waste indicates that values ranged from 9 to 11%. A tenth of overall waste in Germany is landfilled. In comparison to Slovakia, this index is lower. These values range from 38 – 51% in Slovakia, what is greater compared to Germany.

The value of overall waste in Slovakia in 2013 was 9 859 000 tons. If we calculate these numbers per capita, it shows that one inhabitant of Slovakia produces approximately 1,83 tons annually. It is interesting that if we calculate the same in case of German inhabitant in 2013, as they had the amount of waste approximately 392 300 000 tons, we find out that German citizen produces 4,87 tons of waste annually, that is more than twice more than in Slovakia. This fact can be explained by the level of GDP, what means if the production is higher, there is even more unnecessary waste.

### 3.4. Comparison by the number of registered landfills per capita

According to Kohútová and Mižák from the Slovak Agency of Environment (SAE), all registered landfills within the territory of Slovakia are listed by the Registry of waste landfills, which has been intensively built in 1992 within the project State Geological Institute of Dionýz Štúr (hereinafter just “SGIDŠ”) “Maps of land availability for waste landfills” for the whole territory of Slovakia. The Ministry of Environment of the Slovak Republic continued in the project during the period of 1993 – 1994. The registration of landfills was performed in all Slovak regions within this task. Annual upgrading of the landfill registry is performed upon the reporting by employees of District Office (DO), Departments of environmental care (DEC), Division of waste management. The term for submitting the updated data was set for February 28 last year. From April 1, 2008, there was a Map server SGIDŠ open to public access within the task GeoIS, where the landfills application is available as well. In Table

4, you can see the number of landfills, which were operated in Slovakia in 2009 – 2015. There were no older data disclosed.

Region	Year / landfills number						
	2009	2010	2011	2012	2013	2014	2015
Bratislava region	13	12	11	11	7	7	6
Trenčín region	17	11	11	10	15	15	15
Trnava region	12	15	15	14	16	15	13
Nitra region	22	17	17	19	20	20	20
Žilina region	18	16	16	16	16	14	14
Banská Bystrica region	20	16	16	16	16	16	16
Prešov region	18	16	16	17	17	18	18
Košice region	16	15	15	15	17	17	17
<b>Total number of landfills in SK</b>	<b>136</b>	<b>118</b>	<b>117</b>	<b>118</b>	<b>124</b>	<b>122</b>	<b>119</b>

**Table 4.** The number of landfills in Slovakia in 2010 - 2015

Source: own elaboration by ME SK

As we can see in Table 4, there were 119 waste landfills registered in Slovakia in 2015, whereof the most of them were in Nitra region (20), which dominates in the number of landfills now and even in previous years. Waste landfills are relatively equally distributed throughout the whole territory of Slovakia, except of the smallest Bratislava region in terms of the land area, where the number of landfills is the lowest. Regarding the population number in Slovakia, 5,4 million inhabitants and overall number of waste landfills in 2015 (119), one waste landfill falls on almost 44 000 inhabitants. Compared to 2009 (136), since we obtained available data, there are 17 landfills registered less in Slovakia in 2015.

In order to be able to evaluate the situation in Slovakia, we defined a fulcrum (base) as the core of our calculations. The fulcrum is data of the same character from the period of 2004 – 2013, till we obtained data in Germany.

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Landfills number	1 999	1 948	1 740	1 706	1 645	1 553	1186	1180	1 146	1 142

**Table 5.** The number of landfills in Germany in 2004 – 2013

Source: own elaboration by annual reports of Statistical Office (Statistische Bundesamt)

From the point of view of the number of landfills, there is a positive tendency of decreasing number of landfill land in Germany. Since 2004, the situation has been improving every year in Germany. In 2013, there were 1 142 landfills operating. This year, there is one landfill per 70 500 inhabitants. In comparison to Slovakia, Slovakia has more waste landfills per capita than Germany. We consider this index as very negative in waste management in Slovakia.

### 3.5. Comparison by the number of recycled waste

Among the main contributions of waste recycling belongs the protection of environment, material saving and economic effectiveness (Beňo 2011). Waste recycling in Slovakia means, by the Law no. 79/2015 Coll. on waste and the amendments and completion of some laws, every activity of waste recovery, by which the waste is processed to goods, materials or substances designed for an original purpose or other purposes. Recycling consists of repeated processing of organic material. It does not include energetic recovery and repeated processing into materials, which should be processed as a fuel or the activities of waste backfilling.

The following indicator is focused on the comparison of the recycling rate of municipal waste in Germany and Slovakia. Municipal waste consists to a great extent of household waste, but also can consist of similar waste, which results from the activities of SME, public institutions or villages' gathering. The second part of municipal waste can vary in different villages, countries, depending on the local system of waste management. Slovakia is significantly behind Germany regarding this indicator. As we can see in Table 6, Germany allocates the values of recycling rate of municipal waste over 60%, except of 2004, whereas Slovakia does not reach even the limit of 11%, except of 2012, when it allocated the value 13,3%. It means that there is the problem of recycling.

Country	Year										
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Germany	56,4	60,9	62,1	63,2	63,8	63,1	62,5	63	65,2	63,8	63,8
Slovakia	6,2	2	4,1	6,6	7,4	8,2	9,1	10,3	13,3	10,8	10,3

**Table 6.** Recycling rate of municipal waste in Germany in 2004 – 2014 (in %)

Source: own elaboration by Eurostat Recycling rate of municipal waste

In order to compare the recycling state between Germany and Slovakia, it is useful to classify even the indicator of recycling rate of municipal packaging waste. According to the law on packaging and the amendment and completion of some laws, which is sourced in the Regulation of European Parliament and the Council 94/62/ES from December 20, 1994 on packaging and packaging waste, a package is defined as a product, which is used for packaging the goods, their protection, manipulation with it, supply and presentation, from raw materials to product, from producer to consumer or customer. Package recycling is understood by law as every repeated processing of waste materials in production process for the original purpose or other purposes including organic recycling.<sup>1</sup>

Country	Year									
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Germany	69,6	68,2	66,5	66,9	70,5	73,5	72,7	71,8	71,3	71,8
Slovakia	37,6	29,8	36,3	61,1	47,7	59,9	45,7	62,4	68,1	65,9

**Table 7.** Recycling rate of packaging waste in Germany and Slovakia in 2004 – 2013 (in %)

Source: own elaboration by Eurostat: Recycling rate of municipal waste

<sup>1</sup> Law no. 119/2010 Coll. on packaging and on the amendments of law no. 223/2001 Coll. on waste and the amendments and completion of some laws as amended.

As seen in Table 7, Germany achieves better results than Slovakia even in this index, but the difference is not so noticeable here. Germany achieved a standard level of 70% from 2008 to 2013. Slovakia has increased the results of recycling packaging waste almost twice in recent years. Data from 2014 were not available. Thus not included in assessment of mapping the situation.

#### 4. DISCUSSION AND CONCLUSIONS

Based on the performed analysis, we came to the conclusion that waste management in Slovakia needs an upgrade in comparison to Germany and even other European countries. It's been proved in the field of landfilling that Slovakia disposes a great amount of overall waste production to a landfill. Recycled amount of waste is closely related to it. We definitely need to increase recycling rate in Slovakia, in order to achieve the overall improvement of environment, what belongs to essential goals of *Program of waste management in the Slovak Republic for 2016 – 2020*.

However, currently available statistics do not enable to make more detailed analysis of levels or tendencies of waste production. In some of the waste flows, mainly industrial and dangerous waste, it is complicated to perform reliable assessment of tendencies, what is a radical obstacle in creating relevant politics and an acute need to eliminate it comes to terms (Bussard 2005). We did not deal with problems such as removing illegal landfills, air pollution, or surface and underground water pollution, which are related to the problem of landfilling and recycling. There is a lot of imperfection in these segments that is necessary to review even from the financial point of view and which influences the state of environment in great extent.

Historical experience of Slovakia and future estimations suggest, that without any further political intervention, the overall waste production is increasing and this tendency will further continue in the upcoming years. Except of political and legislative arrangements, other initiatives contribute for the reduction of the waste amount. One of them is e.g. Program of Zero Waste. While EU mostly claims the prevention of waste production, the term "zero waste" is rather promoted "from below" by various non-profit organizations or cities and villages. However, Zero Waste International Alliance, ZWIA ([www.zwia.org](http://www.zwia.org)) in short, can be considered as an umbrella organization world widely.

Zero impact is considered as ethical, economic, effective and visionary goal of how to lead people towards the change of their lifestyle and practices in order to imitate sustainable natural cycles, where all waste materials are becoming the resource for further use. Program of zero waste could help to solve the problem of over-pollution of environment. In order to operate this program, it is necessary to keep several economic and system principles, while their performance is important to provide through a reverse logistics, as some authors suggest it, e.g. Stehlík (2003), Škapa (2005), Stock (1998), Sarkis & Sroufe (2004) and others.

In connection with the above mentioned fact one can suggest several alternatives on how to improve not very well situation in this field in Slovakia, e.g.:

1. *Abolishment of the landfilling of unseparated solid municipal waste and the application of the strategy of Zero waste to landfill in Slovak companies.* In 2015, there was the prohibition to landfill the unseparated solid municipal waste (SMW) adopted in Germany. There was 63 mil. tons of waste landfilled on average in the territory of Germany till 2004. After the application of prohibition, landfill waste disposal has been dramatically reduced in Germany since 2005. If we calculate average annual rate of landfilling in 2005 – 2014, we obtain the value worth of approximately 39 mil. tons of waste. It means, that the application of prohibition resulted into the reduction of landfilled waste in more than a third.

In Slovakia, we can suppose that after legislative prevention of similar character, similar improvement would occur. Subjects would be forced to stop disposing SMW to landfills and had to deal with it alternatively. We match the so-called strategy *Zero Waste to Landfill* with it, its one of the main presumptions is economic treatment and waste recycling. Material use of waste is legitimate regarding the world wide growing waste production and declining supplies of some primary goods, however, significant requirements is the development of more efficient technology

and technique for recycling and modification of these materials to satisfy input parameters of production. Among advantages of this strategy belong (Kuraš 2008):

- Continuous saving on expenses,
- Generating incomes,
- Improvement of environment,
- Competitive advantages of companies of this strategy in comparison to the companies, which do not have it implemented.

One of the possibilities how to improve the environment in Slovakia is to increase the awareness of people on this strategy and motivate companies to implement it. Motivational factor of companies, which would implement it, would be the means from Environmental and Recycling fund. Beside of abolishment of landfilling the unseparated SMW, there are even other possibilities of how to improve the waste management in Slovakia, among which we can classify even the increase of the fee for landfill disposing of SMW.

2. *Increasing the recycling rate in Slovakia.* In the field of waste recycling, Slovakia keeps too much behind Germany. Recycling rate of municipal waste is approximately 6-times lower in Slovakia than in Germany. We would follow up the year 2005, when landfilling of unseparated SMW was abolished in Germany, what caused extreme decrease of its landfilling. On the other hand, something had to be done with SMW. Its recycling was one of the alternatives, i.e. repeated use of second-hand materials. As we could see in Table 6, Germans were able to recycle 56,4% of municipal waste in 2004, while they kept already promoted increasing trend till 2014 and achieved the rate of 63,8%. They achieved a significant improvement of recycling state in the country by the abolishment of landfilling of unseparated SMW.

In spite of this, indeed, Slovakia holds its tendency of constantly rising recycling rate, but it recycled approximately 10% of municipal waste in 2014, what is rather low rate. If we adopted same measures in Slovakia as they did in Germany, it certainly would help to emphasize the growing tendency. Likewise, the adoption of higher fees for landfill waste disposal would influence the recycling in Slovakia, as well as the prevention of landfilling the SMW, but just in its lower rate. Except of this, the incomes to Recycling fund would increase, and it redistributes the financial sources and supports the projects focused on the recycling development.

3. *Implementation of the system Pay-as-you-throw (PAYT).* One of the key economic tools applied in waste management in Europe is the principle of broader responsibility of producers and importers (BRP). Others are taxation of landfilling and waste burning or charging in dependence on the waste amount (so-called system “pay-as-you-throw”). For the support of recycling in Slovakia, we would recommend the implementation of the system PYAT, which was adopted in Germany and is very successful so far. Thanks also to this system, Germans are able to achieve the limit of recycling of municipal waste of 60%. System works in a way that more waste we dispose, higher fees we pay for it. More waste is recycled, less we pay for waste and we protect our environment, what is a great presumption for keeping the sustainable development. This means that the fees for municipal waste would be paid depending on the type of disposed waste. If it is paid for municipal waste more in case it's not separated, all subjects would be motivated to separate the waste before they dispose it. For the support of the adoption of this system in Slovakia, we could use the sources from European Regional Development Fund (hereinafter just “ERDF”), European Social Fund (hereinafter just “ESF”), Environmental fund, Recycling fund, or other private sources. Thanks to this system, Slovakia could reach the recycling rate of waste as Germany has in a relatively short period of time.

Except of the above mentioned, it's important to make the people well aware through the campaigns focused on the protection of environment not only at national, but even international level. Waste management is not a problem related only to Slovakia or Europe, but it is related to the whole world. Our effort towards sustainability should be of a long-term character and should be concerned in all our

activities within our value chain. Therefore, it is very important to emphasize, that the possibilities to improve Slovak system of waste management, which we stated, can be applied in other countries.

## ACKNOWLEDGEMENT

This paper was written in connection with scientific project VEGA no. 1/0961/16. Financial support from this Ministry of Education's scheme is also gratefully acknowledged.

## REFERENCES

- Andersen, M 2002, *Organising interfirm learning e as the market begins to turn Green*, Kluwer Academic Publishers, Dordrecht, ISBN 978-90-481-5938-3.
- Antošová, M, Fabiánová, Z & Weiss, R 2011, 'Mechanism for supporting the use of renewable energy sources / Mechanizmy podporujúce využívanie OZE', *Acta Montanistica Slovaca*, vol. 15, no. 2 (2010), pp. 159-163, ISSN 1335-1788.
- Bussard, A *et al.*, 2005, *Spoločensky zodpovedné podnikanie – Prehľad základných princípov a príkladov*, Nadácia Integra, Bratislava.
- Európsky parlament, *Smernica Európskeho parlamentu a Rady 2006/12/ES z 5. apríla 2006 o odpadoch*, viewed 7 April 2016, <<http://eur-lex.europa.eu/legal-content/SK/TXT/PDF/?uri=CELEX:32006L0012&from=SK>>.
- Európska únia, *Život v EÚ*, viewed 14 April 2016, <[http://europa.eu/about-eu/facts-figures/living/index\\_sk.htm](http://europa.eu/about-eu/facts-figures/living/index_sk.htm)>.
- Eurostat, *Population on 1 January*, viewed 14 April 2016, <<http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tps00001&plugin=1>>.
- Eurostat, *GDP per capita in PPS*, viewed 14 April 2016, <<http://ec.europa.eu/eurostat/tgm/table.do?tab=table&plugin=1&language=en&pcode=tec00114>>.
- Eurostat, *Recycling rate of municipal waste*, viewed 16 April 2016, <[http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=t2020\\_rt120&plugin=1](http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=t2020_rt120&plugin=1)>.
- Federal Statistical Office, *Waste balance, Wiesbaden, Various volumes*, viewed <<http://www.umweltbundesamt.de/publikationen/data-on-the-environment-2015>>.
- Grant, DB., Trautrim, A & Wong, CHY 2013, *Sustainable logistics and supply chain management. 1st ed.* Kogan Page, London, ISBN 9780749468668.
- Klemmer, P, Lehr, U & Löbbe, K 1999, *Environmental Innovation*. Volume 3 of publications from a Joint Project on Innovation Impacts of Environmental Policy Instruments. Synthesis Report of a project commissioned by the German Ministry of Research and Technology (BMBF), Analytica-Verlag, Berlin.
- Kohútová, K & Mižák J *Register skládok odpadov – správa a aktualizácia*, viewed <[http://www.sazp.sk/public/index/open\\_file.php?file=CEI/EZ/RSO\\_SGUDS.pdf](http://www.sazp.sk/public/index/open_file.php?file=CEI/EZ/RSO_SGUDS.pdf)>.
- Kuraš, M 2008, *Odpadové hospodárství, Vyd. 1*, Ekomonitor, Chrudim, ISBN 978-80-86832-34-0.
- Malčeková, H & Šimek, V 2014, *Průvodce odpadovým hospodářstvím: praktická příručka*, Linde, Praha, ISBN 9788072019052.
- Mikolaj, J, Klučka, J & Vančo, B 2005, *Plánovanie a prognostika*. Žilinská univerzita v Žiline, Fakulta špeciálneho inžinierstva, ISBN 9788096914838.

Ministerstvo životného prostredia SR, *Program odpadového hospodárstva Slovenskej republiky na roky 2011 – 2015*, viewed 18 January 2016, <<http://www.minzp.sk/files/oblasti/odpady-a-obaly/poh/poh2011-2015/poh-sr-2011-2015.pdf>>.

Ministerstvo životného prostredia SR, *Program odpadového hospodárstva SR na roky 2016 – 2020*, viewed 21 April 2016, <[http://www.minzp.sk/files/sekcia-enviromentalneho-hodnotenia-riadenia/odpady-a-obaly/registre-a-zoznamy/poh-sr-2016-2020\\_vestnik.pdf](http://www.minzp.sk/files/sekcia-enviromentalneho-hodnotenia-riadenia/odpady-a-obaly/registre-a-zoznamy/poh-sr-2016-2020_vestnik.pdf)>.

Newsletter Slovensko-nemeckej obchodnej a priemyselnej komory. *10 rokov JAHRE. Slovensko-nemecké obchodné vzťahy*, Slovensko-nemecká obchodná a priemyselná komora, Bratislava, viewed May 2015, <[http://www.dsikh.sk/fileadmin/ahk\\_slowakei/.../Newsletter/Newsletter\\_SNOPK\\_5\\_15.pdf](http://www.dsikh.sk/fileadmin/ahk_slowakei/.../Newsletter/Newsletter_SNOPK_5_15.pdf)>.

Rennings, K 2000, 'Redefining innovation – eco-innovation research and the contribution from ecological economics', *Ecological Economics*, vol. 32, no. 2, pp. 319-332. ISSN 0921-8009.

Sarkis, J & Sroufe, R 2004, *Strategic Sustainability: The State of the Art In Corporate Environmental Management Systems*, Greener Management International, pp.46, 29-40, ISSN 09669671.

Stehlík, A 2003, *Logistika – strategický faktor manažerského úspechu. 1. vyd.*, Studio Contrast, Brno, ISBN 80-238-8332-1.

Stock, JR 1998, *Development and implementation of reverse logistics programs*, University of South Florida, Florida.

Škapa, R 2005, *Reverzní logistika. 1. vyd.*, Masarykova univerzita v Brně, Brno, ISBN 80-210-3848-9.

Šmolková, E 2003, 'Environmental Values in Value Systems', *Filozofia*, vol. 58, no. 7, pp. 471-483.

Triebswetter, U & Wackerbauer, J 2008, 'Integrated environmental product innovation and impacts on company competitiveness: a case study of the automotive industry in the region of Munich', *European Environment*, vol. 18, no. 1, pp. 30–44, ISSN 0961-0405.

Van Wassenhove, LN 2011, 'Quality in Reverse', *Industrial Engineer: IE*, ISSN 1542894X.

Zákon č. 79/2015 Z. z. o odpadoch a o zmene a doplnení niektorých zákonov.

Zákon č. 119/2010 Z. z. o obaloch a o zmene zákona č. 223/2001 Z. z. o odpadoch a o zmene a doplnení niektorých zákonov v znení neskorších predpisov.

Environmental Performance Index <<http://epi.yale.edu>>, viewed 3 April 2017

Zero Waste International Alliance <<http://www.zwia.org>>, viewed 3 April 2017