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AN ANALYSIS OF ROMANIA'S MUNICIPAL WASTE WITHIN THE EUROPEAN CONTEXT

Cristina IACOBOAEA
Technical University of Civil Engineering Bucharest, 124 Lacul Tei Ave, Bucharest, Romania
cristinai@utcb.ro

Oana LUCA
Technical University of Civil Engineering Bucharest, 124 Lacul Tei Ave, Bucharest, Romania
oana_luca@yahoo.com

Florian PETRESCU
Technical University of Civil Engineering Bucharest, 124 Lacul Tei Ave, Bucharest, Romania
florianp@utcb.ro

Abstract
The improper management of municipal waste may lead to soil, water and air contamination and it may also become a danger for human health. The quantity of municipal waste generated per capita in Romania is relatively low compared to other European Union countries. At European level, in 2010 municipal waste was treated as follows: 38% was landfilled, 22% incinerated, 25% recycled and 15% composted. In Romania approximately 94% of the municipal waste was landfilled and 6% reused and recycled, according to the Romanian National Environmental Protection Agency. To reach the targets set in the national and European waste legislation, Romania must make considerable efforts.
Keywords: Municipal waste, landfill, composting, incineration, recycling

1. INTRODUCTION

Waste regulation was a fundamental requirement of Romania's accession to the European Union and it led to the complete transformation of our national and institutional waste management legal framework. Unlike other EU member states that have had over 20 years to adapt their legal framework, Romania had to do it in an extremely short time (less than 5 years).

The first objective of the European Union policy for municipal waste management consists in lowering the negative effects of the waste generation and management on population health and on the environment.

As stated in art.4 from Directive 2008/98/EC, "The following waste hierarchy shall apply as a priority order in waste prevention and management legislation and policy: a) prevention, b) preparing for re-use,

c) recycling, d) other recovery, e.g. energy recovery and e) disposal". In spite of the fact that waste disposal stands on the last place of the hierarchy, it is the most used option at European level. Lack of monitoring and post-monitoring of landfills may result in possible adverse effects on environment and population health. Waste disposal can generate negative effects on environment such as: land use, bio-gas (CH4 and CO2 to which small quantities of hydrogen sulphide, CO, alkyl hydrosulphide, aldehyde, esters etc.), stench, birds, flies, rodent animals, leachate, risk of accidents (explosions, emissions), dust, and noise.

In Romania, waste disposal is the main option of municipal waste management. Thus, 94% of the total municipal waste is disposed in landfills each year.

2. A CHARACTERISATION OF MUNICIPAL WASTE IN THE EU AND IN ROMANIA

The Europeans' generation of waste increases constantly - in 2010 the quantity of waste reached 2.34 billion tons, which means over 5 tons of waste per person, according to EUROSTAT. Of this quantity 259.1 billion tons is municipal waste. The quantity of municipal waste within the European Union has increased constantly (Figure 1) in spite of the legislative efforts to reduce it. Some of the reasons for this growth are: economic growth, population growth, intense urbanization. The last years show a decrease of the quantity of generated municipal waste, probably as a consequence of the slowdown in the economic growth.

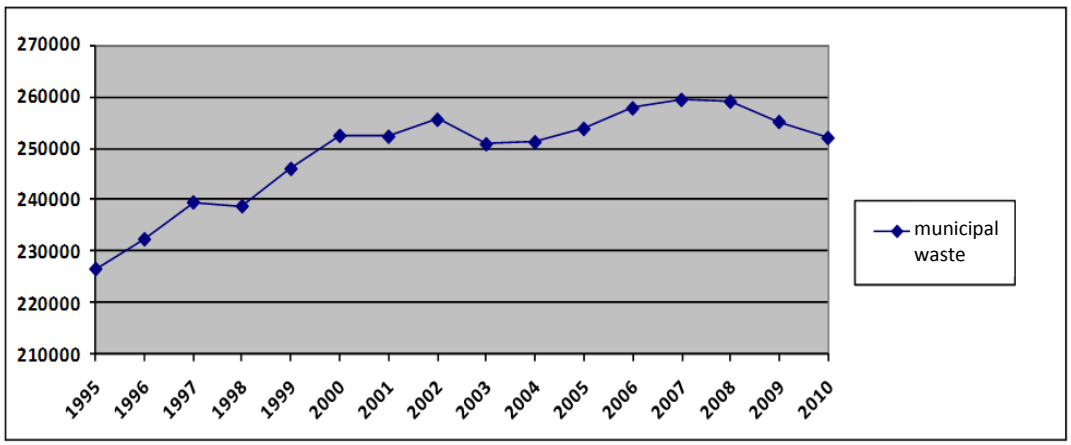

FIGURE 1 - PRODUCTION OF MUNICIPAL WASTE IN EU 27 (1995 – 2010) (THOUSAND TONS)
Source: http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database

The European Union intends to shift this trend by enforcing prevention and efficient resource use policies and by encouraging sustainable consumption. Decoupling waste production from economic growth is one of the main objectives and has already started in countries like Germany or the Netherlands.

Theoretical and Empirical Researches in Urban Management
Volume 8 Issue 4 / November 2013

The quantity of municipal waste generated per capita in one year varies significantly in the EU countries from 300 kg/capita year (Poland, Latvia, Slovakia) to 750 kg/capita year (Cyprus, Switzerland, Denmark) (Figure 2). Romania, with an average municipal waste generation index of 365 kg/year is among the EU countries that produce relatively low amounts of municipal waste. The amount of generated municipal waste is only an estimation due to the lack of weighing systems in certain landfills and to the fact that not the entire amount of waste is collected.

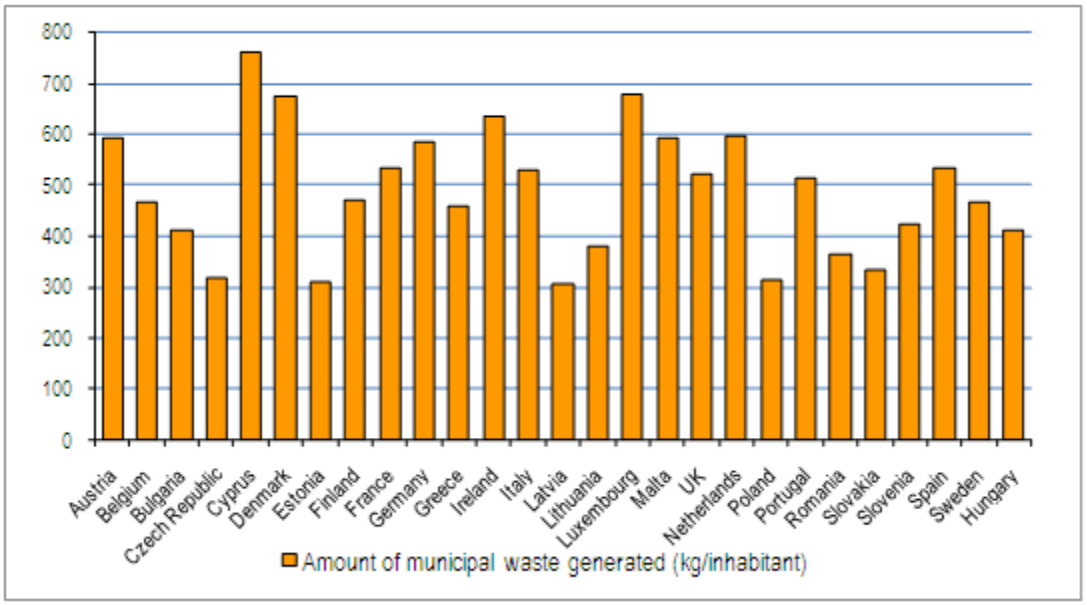

FIGURE 2 - GENERATION OF MUNICIPAL WASTE IN 2010 IN THE EUROPEAN UNION COUNTRIES (KG/CAPITA YEAR)
Source: Eurostat http://europa.eu/rapid/press-release_STAT-12-48_en.htm?locale=en

In 2010, the total amount of waste generated by Romania was of 191,844,507 tons, of which 99.7% were non-hazardous waste. Of this amount, 7,073,427 tons were municipal waste, i.e. 3.69% of the total amount.

TABLE 1 - STRUCTURE OF WASTE GENERATED IN ROMANIA (THOUSAND TONS)

	2003	2004	2005	2006	2007	2009	2010
Municipal waste	7,923	8,199	8,640	8,866	8,895	8,442	7,073
Production waste	361,873	355,116	323,052	311,743	272,305	246,385	184,772
Total	369,796	363,315	331,692	320,609	281,200	254,827	191,845

Source: http://www.anpm.ro/informatii_privind_generarea_si_gestionarea_deseurilor-8130

It is noted a decrease of the total amount of generated waste, but also an increase of municipal waste, except for the years 2009 and 2010 (Table 1).

In 2010, the amount of municipal waste collected in Romania by the town halls' own specialised services or by the waste collection companies was of 5,823,315 tons. Around 70.38% of the population

was serviced by waste collection services, 85.06% of them in the urban regions. However, things differ considerably from one region to another. In Bucharest-Ilfov region the waste services covered up to 99.37% of the population, in the North-West region this percentage amounted to 84% while in the South-Western Oltenia region only 31.93% of the population benefited from waste collection services. The differences in the rural environment are even higher: in Bucharest-Ilfov 94.09% of the population benefits from waste collection services, in the Centre region this percentage amounts to 68%, in the North-Western region it is of 80.79% while in the South-Western Oltenia region only 6.76% of the rural population benefited from such services.

The amount of waste generated and not collected were estimated based on: (AEA Mediu Consulting, 2009)

- The waste generation indexes - 0.9 kg/capita/day in the urban areas and 0.4 kg/capita/day in the rural areas; these indicators were established by the Ministry of Environment and by the Romanian National Environmental Protection Agency during the drawing-up of the Regional Waste Management Plans in 2006;
- The area covered by waste collection services in the rural and in the urban areas (data provided by the Romanian National Environmental Protection Agency);
- The number of inhabitants in the rural and urban environment (statistical data).

The evolution of the quantity of collected and generated municipal waste in Romania is represented in Figure 3.

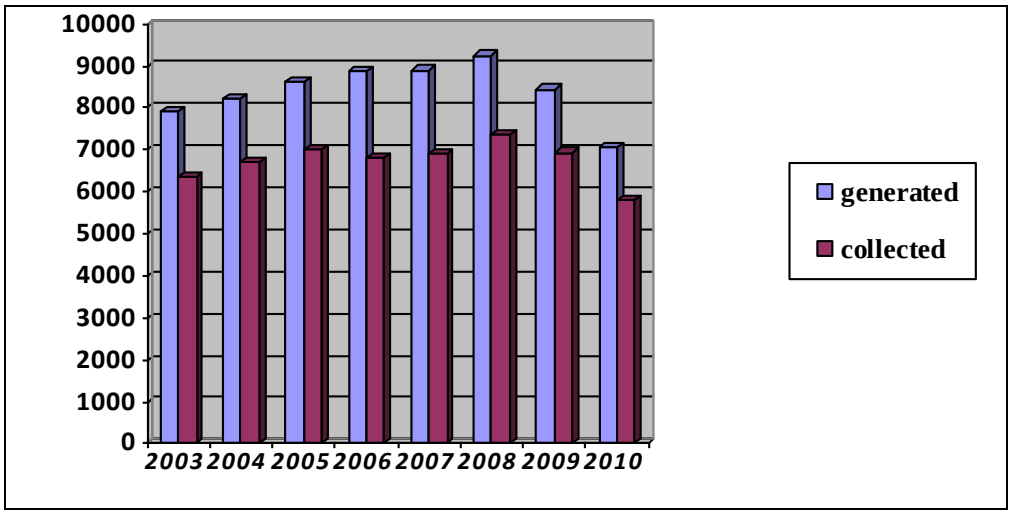

FIGURE 3 - VARIATION OF THE AMOUNT OF GENERATED AND COLLECTED MUNICIPAL WASTE (2003-2010)
Source: http://www.anpm.ro/informatii_privind_generarea_si_gestionarea_deseurilor-8130

Theoretical and Empirical Researches in Urban Management
Volume 8 Issue 4 / November 2013

The amount of generated and collected municipal waste varies from one year to the other but there is a general growth tendency determined both by the growing consumption and by an increase in the proportion of people who benefit from centralised public waste collection services. In 2009 and 2010 we notice a decrease in the amount of municipal waste due to the economic crisis and to the significant drop of the people's purchase power. The amounts of collected and re-used municipal waste broken down per main categories for the years 2005-2010 are represented below in Table 2.

TABLE 2 - AMOUNTS OF COLLECTED AND RE-USED MUNICIPAL WASTE

Waste categories	Quantity 2005 Thousand tons		Quantity 2006 Thousand tons		Quantity 2007 Thousand tons		Quantity 2008 Thousand tons		Quantity 2009 Thousand tons		Quantity 2010 Thousand tons	
	Col.	Re-used	Col.	Re-used	Col.	Re-used	Col.	Re-used	Col.	Re-used	Col.	Re-used
Household and similar waste	5557	136	5363	40,4	5243	64,4	5669	56,8	5283	62	4572	245
Municipal services waste	1001	9	972	0,5	945	1,4	889	15,3	982	39	754	51
Construction and demolition waste	467	0	474	0	734	6,8	813	23,1	674	84	497	155
Total	7025	145	6809	40,9	6922	72,6	7371	95,2	6939	185	5823	451

Source: http://www.anpm.ro/informatii_privind_generarea_si_gestionarea_deseurilor-8130

In the structure of urban waste, the highest share is represented by household waste (75-80%), followed by municipal services waste (10-12%) while the construction and demolition waste has the lowest share.

Currently, in Romania there is no mandatory requirement to keep a record of construction and demolition waste (from producer to user and to the disposal in landfills, if applicable) in order to have an accurate database reflecting the market reality and showing clearly the collection and re-use rate of this waste category. On the other hand, construction and demolition waste is disposed of at old municipal landfills without weighing systems and quite often the waste is thrown on fallow lands, therefore the recorded data is not exactly accurate. (Iacoboaea et al., 2010)

The composition of Romania's household waste varied in the last years, with the highest share covered by biodegradable waste (Table 3); in 2010, biodegradable waste accounted for about 56% of the total amount of collected household waste; paper, paperboard and plastic also had important shares.

TABLE 3 - EVOLUTION OF HOUSEHOLD AND SIMILAR WASTE COLLECTED IN ROMANIA

Years / Components (%)	2003	2004	2005	2006	2007	2008	2009	2010
Paper and paperboard	11	11	11	11	11	11	12	10
Glass	10	9	11	11	12	7	5	4
Plastic	4	3	3	3	3	8	10	10
Metals	5	5	5	5	6	4	3	2
Biodegradable waste	50	49	48	46	45	58	57	56
Other waste	20	23	22	24	23	12	13	18

Source: http://www.anpm.ro/informatii_privind_generarea_si_gestionarea_deseurilor-8130

A country's development influences the composition of its household waste. As the country is more developed, the amount of paper and plastic materials generated is higher and the amount of organic matter is lower. Differences may be noticed in the waste composition of different countries worldwide (Figure 4).

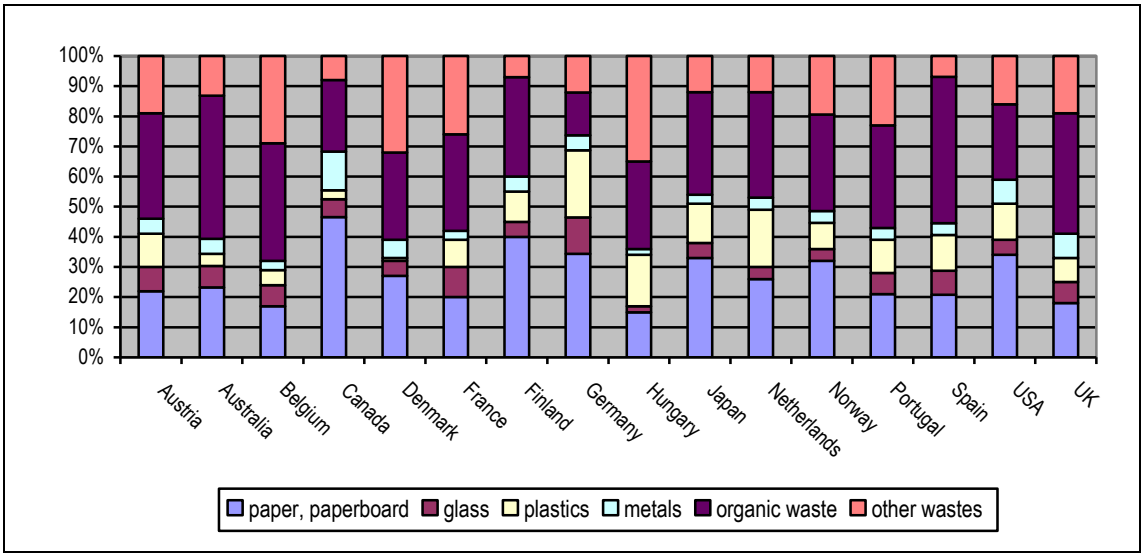

FIGURE 4 - COMPOSITION OF MUNICIPAL WASTE
Source: http://www.ppienergygroup.com/composition_municipal_waste_latestyear.pdf

3. MUNICIPAL WASTE TREATMENT METHODS

In the EU 27, 502 kg of municipal waste was generated per person in 2010, while 486 kg of municipal waste was treated per person. This municipal waste was treated in different ways: 38% was landfilled, 22% incinerated, 25% recycled and 15% composted.

The municipal waste treatment methods vary considerably from one country another, as shown in Figure 5.

Theoretical and Empirical Researches in Urban Management
Volume 8 Issue 4 / November 2013

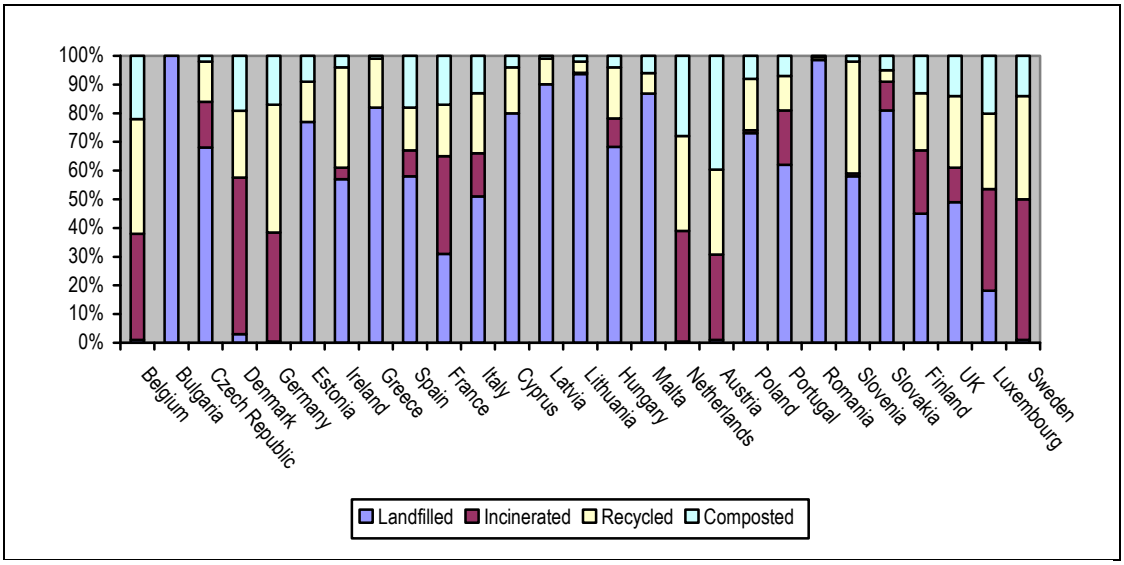

FIGURE 5 - VARIATIONS IN THE TREATMENT METHODS USED IN THE EU COUNTRIES
Source: http://europa.eu/rapid/press-release_STAT-12-48_en.htm?locale=en

3.1 Recycling

The European Union favours recycling through the legislative texts drown up in the field of waste management. According to the 2008/98/EC Framework Directive, EU member states must organise separate collection systems at least for paper, metal, plastic and glass by 2015. Preparative targets are imposed for waste re-use up to minimum 50% of the total mass for household and similar waste by 2020 and also for re-use, recycling and other material re-use operations, including waste-using filling operations for at least 70% of the mass of waste coming from construction and demolition activities. For packaging it was established as per the 94/62/EC European Directive, as amended, to recycle at least 55% of the total weight of packaging materials contained in the packaging waste, at least 60% for glass and paper-paperboard, at least 50% for metals and at least 22.5% for plastic of the weight of each type of material contained in packaging waste.

For Electric and Electronic Equipment Waste (EEEW) a new directive was adopted 2012/19/EU which introduces higher collection, re-use and recycling targets. If now the collection rate is 4 kg/inhabitant, in 2016 the minimum collection rate shall be 45%, calculated based on the total weight of the WEEE collected in one year, expressed as a percentage of the average weight of the electric and electronic equipment which entered the marked in the three previous years. From 2019 onwards, the annual collection rate shall be 65% of the average weight of electric and electronic equipment which entered the market in the three previous years in each member state or, alternatively, 85% of the WEEE volume generated in that state.

The European countries with the best recycling performances (Germany, Belgium, Sweden, and The Netherlands) have almost nothing to landfill. The countries with the lowest amounts of recycled waste (Bulgaria, Romania, Lithuania, and Slovakia) landfill over 90% of the collected waste. In 2008 the EU industrial branches dealing with waste management and recycling had a turnover of 145 billion EUR, i.e. approximately 2 million jobs. (European Commission, 2012)

The European Commission tried to explain the performances of the European states which managed to turn waste into resources and the conclusion was that they combined several economic instruments:

- Charges for waste disposal and treatment:
- Landfill taxes and fees (and restrictions/bans to provide context for the charges);
- Incineration taxes and fees (and restrictions/bans to provide context for the
- charges);
- Pay-as-you-throw (PAYT) schemes; and
- Producer responsibility schemes for specific waste streams (notably packaging, WEEE, ELV and batteries). (European Commission, 2012)

3.2 Composting

Composting is the highest form of recycling, as waste is turned into compost, which can then be used to stabilise lands, to lower the land erosion potential and to improve them with humus.

In Austria waste composting is the main method used for waste treatment. Composting is also widely used in the Netherlands, Belgium, Denmark, Spain, France, Switzerland and Germany. Composting is very little used or is not used at all in Bulgaria, Romania, Greece and Latvia (fig. 5).

In 2008 in the European Union compost was used in agriculture (approximately 50%), landscaping (up to 20%) and by private consumers (up to 25%). (CEC, 2008)

In developing countries the amount of biodegradable waste exceeds 50% (Troschinetz, A., Mihelcic, J., 2009), which makes it clear that composting is the best possible option to deal with municipal solid waste (Narayana, T., 2009)

Less than 0.5% of Romanian waste is composted. According to the National Environmental Protection Agency, in early 2011 there were 70 composting facilities and platforms built (licensed or in the process of licensing) to compost municipal biodegradable waste. Thus, the increase of composted waste may

Theoretical and Empirical Researches in Urban Management
Volume 8 Issue 4 / November 2013

continue in the following years. The composition of municipal waste in Romania, with over 50% of biodegradable waste, recommends composting as the main treatment method.

3.3 Incineration

Incineration reduces the amount of waste and sterilises hazardous elements while also generating thermal energy which may be recovered as heat (hot water/steam), electricity or a combination between them.

In 2010 in Europe, 13 million people were provided electricity and another 13 million were provided heat through the incineration of approximately 73 million tons of waste resulted after the re-use and recycling of household waste. (CEWEP, 2013)

The 2001/77/EC European Directive on waste incineration promotes the production of energy from renewable sources. The biodegradable part of municipal waste is considered biomass and implicitly a renewable energy source. Approximately 50% of the power generated from waste incineration is produced from renewable sources. The production of power from municipal waste incineration should contribute to reaching the European Union target - i.e. renewable energy should represent 20% of the total energy produced in 2020. Also, the EU strategy on climate change targets the reduction by 20% of greenhouse gas emissions until 2025 and waste management may participate to this target by 10% (45 million CO2 tons). Waste incineration should contribute to reaching the targets set by the EU Directive 1999/31/EC on the landfill of waste by lowering the amount of landfilled biodegradable waste.

For Denmark, Norway, Switzerland, Sweden, the Netherlands and France incineration is the main waste treatment method. There are, however, several EU countries that do not incinerate municipal waste: Bulgaria, Cyprus, Greece, Latvia, Malta (fig. 5).

So far, Romania has no municipal waste incineration facilities. There is, however, a form of waste re-use for energy purposes (in case of waste unfit for material recycling) in cement factories which are authorised to co-incinerate municipal waste.

3.4 Landfilling

Waste landfilling if the most widely used waste disposal method, although the most disadvantageous solution in terms of waste hierarchy. Through the European Directive 1999/31/EC on the landfill of waste the member states are obliged to establish national strategies to reduce the landfilling of biodegradable municipal waste while respecting the following targets:

a) to reduce the amount of biodegradable municipal waste going to landfills up to 75% of the total amount (by weight) produced in 1995, no later than 5 years since 16 July 2001;

b) to reduce the amount of biodegradable municipal waste going to landfills up to 50% of the total amount (by weight) produced in 1995, no later than 8 years since 16 July 2001;

c) to reduce the amount of biodegradable municipal waste going to landfills up to 35% of the total amount (by weight) produced in 1995, no later than 15 years since 16 July 2001;

These deadlines may be exceeded by maximum 4 years and Romania was granted this grace period of 4 years.

The amounts of biodegradable waste which Romania must reduce from landfilling (as per the European Directive 1999/31/EC) are described in the figure 6. In 2010 Romania has met the target reduction level of biodegradable municipal waste disposed in landfills. For 2013 it will have to reduce the amount by approximately 1.2 million tons (if the same generation index is maintained).

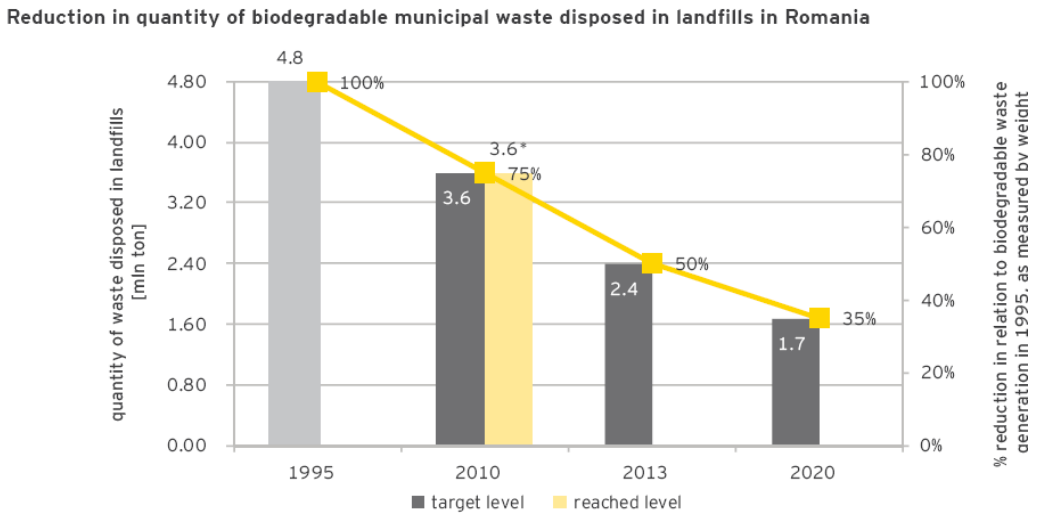

FIGURE 6 - REDUCTION IN QUANTITY OF BIODEGRADABLE MUNICIPAL WASTE DISPOSED IN LANDFILLS IN ROMANIA (SOURCE: ERNST&YOUNG, 2011)

The European Directives for packaging and incineration aim to reduce the amount of landfilled biodegradable waste by setting mandatory targets for recycling of packaging and for the production of energy from renewable sources (waste incineration being one option).

The countries that landfill over 90% of their waste are: Bulgaria, Romania, Lithuania and Latvia. The countries that landfill less than 1% of their waste are: Switzerland, the Netherlands, Austria, Belgium,

Theoretical and Empirical Researches in Urban Management
Volume 8 Issue 4 / November 2013

Sweden. According to the data from the National Environmental Protection Agency, in 2010 Romania landfilled 94% of its municipal waste, down from 99% in 2009.

In 2004 was carried out an assessment of the Romanian waste dumps. Following the results of this assessment, there were 240 waste deposits that were not compliant to the requirements of the European Directive 99/31/EC on the landfill of waste. During the process of adhering to the European Union, within the negotiations regarding the environmental issues, Romania decided to close 139 waste deposits until July 16, 2009 while the remaining 101 municipal waste deposits will be closed until July 16, 2017. For the latter, the operation and monitoring activities will be improved. Also, the necessary institutional measures were implemented for creating the closing fund and the post-closing monitoring fund. A number of 14 compliant waste landfills were operational in 2004. Two of them were closed because they ran down their waste disposal capacity. Between 2005 and 2012, 18 new landfills became operational. Thus, in 2012, there are 30 municipal waste landfills compliant to the waste management legal provisions. All of them are listed on the website of Romanian National Environmental Protection Agency, and this list is periodically updated. Each of them is operated based on an integrated environmental authorization, which includes specific measures in order to prevent or reduce the negative effects on the environment and, especially, on the pollution of surface water, underground water, air and soil.

4. CONCLUSIONS

Romania managed to transpose the European legislation into the national legislation but it must make considerable efforts to reach the imposed targets, especially to reduce the amount of municipal waste and to organize waste management activities according to waste hierarchy. Also, it must cut down on the amount of landfilled biodegradable waste, close the uncontrolled dumping sites and reach the targets set for the recovery and the recycling of packaging.

In order to have recycling services, Romania must have techniques and technologies instead of reintroducing materials in the productive circuit (as secondary raw materials), a market demand for the recycled materials and, last but not least, a wide-scale participation of consumers and producers. The improvement of the selective collection system is an essential prerequisite for reaching the recycling targets.

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Theoretical and Empirical Researches in Urban Management
Volume 8 Issue 4 / November 2013