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INDUSTRIAL AND COMMUNAL SUSTAINABLE WASTE MANAGEMENT IN HUNGARY

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Abstract

Consumption and related waste production is an integral part of our daily lives. The waste generation worldwide depends on the economic strength of the given region/country, and it increases from year to year. More and more attention is drawn to the re-use, recycling, reutilization of the waste which are driven mainly by environmental concerns and economic interests. Regional waste management systems have been established in Hungary with the support of EU funds, which process the waste according to European standards. In addition to this in January 2013 new Waste Management Act was introduced in Hungary, with the main objectives to increase the rate of recycling and to significantly decrease the proportion and amount of waste taken for final disposal at landfill sites. By the development of waste handling techniques and the harmonisation of the legal environment and instruments to the European standards the Hungarian waste management has achieved a restructuring phase, where the core issues of the sustainable waste management are considered and implemented.

Key words: waste management, waste policy, waste utilization

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1. Introduction

The waste and its handling and disposal are as old as the humanity. Parallel with the first settlements, first disposal sites/landfills had also appeared, where wastes were mainly burnt presumably to lower the quantity and to get rid of the unpleasant odour of the waste. In the ancient times drainage systems were constructed, cesspools were used and organic wastes were used as fertilizers. The ancient Rome had sewerage system (Cloaca Maxima), even charges had been levied for the users connecting onto that. The spreading epidemics in the middle ages (plague, cholera) were in strong correlation with the inappropriate waste management and the problems stemming from that.

Modern waste management systems had spread in Europe in the 19th century and the first

dedicated facility for waste burning was established in Nottingham, England in 1874. By the beginning of the 20th century more than 200 such plants had been operating in the USA and in Europe. The growing population, as well as the spread of industrialization resulted in a sharp increase in the quantity of the waste. New waste management technologies were introduced and put into operation.

In 1987 the UN specified the sustainable development in the Report of the World Commission on Environment and Development as the follows: “Humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs” (UN Documents, 1987). One of the three pillars of the sustainable development is the environment pillar which is standing on a very labile base.

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The social and economic growth need to be realized in such a way that does not damage the state of the environment and uses its resources in sustainable and reasonable way.

According to the waste management hierarchy outlined by the European Parliament the most important issue is the prevention of waste generation, and disposal of the waste at disposal facilities/landfill sites must be drastically reduced.

2. Statistic data of waste management

The quantity and quality of the generated municipal solid waste depends on several factors. Differences can be seen in the quantities of the generated waste according to countries, economic development of the regions, extent of the industrialisation, social and cultural orientation of people and local weather conditions as well. Such changes can be observed in the waste management strategies of countries as well.

Generally speaking, the more economically developed countries produce more waste than the less developed countries. It can be observed that people living in urban areas produce twice as much waste as people living in rural areas.

2.1. Quantity of the produced waste

Nowadays the produced municipal solid waste (MSW) can be estimated to 1.2 billion T/yr and according to preliminary estimations it can reach 2.2 billion T/yr by year 2025 which represents a figure of 1.42 kg waste/capita/day (Hoornweg and Bhada-Tata, 2012).

In Fig. 1 countries were selected according to GNI (Gross National Income) and quantity of MSW (municipal solid waste) was indicated for years 2010

and 2025. It can be seen from the data that countries with lower income produces less waste, and also that according to estimation the quantity of the produced MSW is growing faster than in the more developed countries, however, still does not reach the quantity of that of the high income countries.

The wealthier countries – such as OECD countries – produce a significant amount of waste. According to the example of Hungary on the basis of waste figure 1.92 kg/day/capita the amount of the generated waste reached 6.8 million T in year 2010 (counting with 9.8 million habitants). Based on the estimates in the more developed countries the quantity of MSW will not raise significantly by 2025. Also significant difference can be observed in the efficiency of waste collections in various countries (Table 1).

2.2. Composition of waste streams

Considering the global streams of MSW the organic waste is produced in the largest quantity which represents almost the 50% of the total amount (Fig. 1). In Fig. 1 the compositions of wastes are compared in the European Union, USA and in the developing countries. Organic waste is generated in large amounts in the developing countries. In the economically developed countries and regions (USA, NL, EU27) the proportion of paper waste is considerably high. If countries are summarized according to their Gross National Income, the composition of the waste streams can be given as summarized in Table 2.

It can be seen from Table 2 that the proportion of the biologically active waste fraction decreases with the economic development, however, it increases the generation of the waste paper fraction.

Table 1. Efficiency of waste collection in various countries

	<i>Ethiopia (low income country)</i>	<i>Armenia (lower mid income country)</i>	<i>Lithuania (upper mid income country)</i>	<i>United Kingdom (high income country)</i>	<i>Hungary (high income country)</i>	<i>Netherlands (high income country)</i>	<i>USA (high income country)</i>
Waste generation (kg/capita/day) 2010	0.30	0.68	1.10	1.79	1.92	2.12	2.58
Waste generation (kg/capita/day) 2025*	0.65	1.20	1.50	1.85	2.00	2.1	2.3
Change (2010 – 2025)	217%	176%	136%	103%	104%	99%	89%
Average collection efficiency (percent collected) 2010	43%	80%	85%	100%	98%	100%	100%

*prediction

Table 2. Composition of the waste streams

	<i>Organic (%)</i>	<i>Paper (%)</i>	<i>Plastic (%)</i>	<i>Glass (%)</i>	<i>Metal (%)</i>	<i>Other (%)</i>
Low Income Countries	64	5	8	3	3	17
Lower Mid Income Countries	59	9	12	3	2	15
Upper Mid Income Countries	54	14	11	5	3	13
High Income Countries	28	31	11	7	6	17

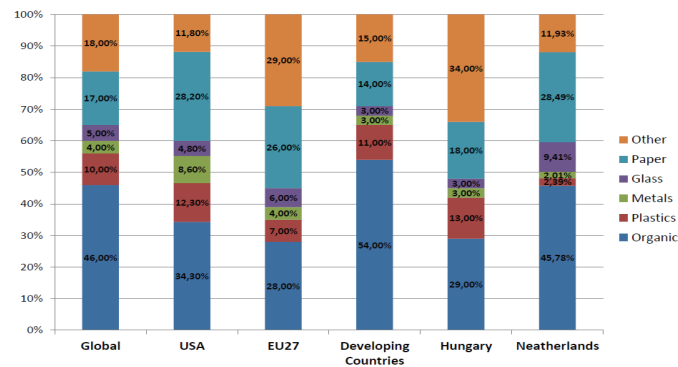


Fig. 1. Waste composition according to countries

The regulation on the waste management, landfill practices and handling of organic waste in the wealthier countries resulted in the prevention of getting organic waste into the waste taken for final disposal. However, the impact of the development is also that in countries having higher GNI the proportion of waste paper is significantly higher than that of the less developed countries. On the basis of the previous survey, it can be assumed that the higher GNI a country has, the less amount of organic waste is generated. If the countries of the European Union are considered it can be concluded that the above statement for the proportion of organic waste is not entirely correct (Table 3) (EEA, 2013).

Lithuania belongs to the upper mid-income countries based on gross national income, and Malta belongs to the high income countries list. However, if the proportions of the organic wastes are considered in these countries it can be concluded that Malta produces 3-3.5 times more organic waste relative to the organic waste generated in Lithuania. The reasons can be seen in the different structures of the economic environment. Lithuania has a highly developed agriculture. Almost 85% of country area is forests, pastures, meadows and arable land. Malta is an island nation, with its all advantages and disadvantages. Malta does not have large agricultural arable areas, so the utilization of the generated organic waste as secondary raw materials cannot be adequate.

2.3. Waste management procedures

If the global waste management procedures are examined, it can be concluded that nearly 50% of the generated MSW is disposed in landfills (Fig. 2). Each year nearly 150 million T of waste are reinvested into the economic cycles.

Similar amounts of waste are used to produce energy. Unfortunately the uncontrolled, environmentally inappropriate dumping of waste exhibits a high risk for the ecosystem. The dumping of waste also reached 70-75 million T/yr. A study has been carried out in 2013 on the waste management of the EU27, Croatia, Iceland, Norway, Switzerland and Turkey. Considering the distribution of the different waste treatments between 2001 and 2010 it can be stated that the proportion of the recycling is growing, the incineration is more or less standing on a steady level whilst the landfill practice has been reduced (in accordance with the EU Directives) (Fig. 3).

Studying the waste management in different countries it can be seen, that with the higher level of economic development the sustainable waste management technologies are spreading. For example in Denmark more than 50% of the waste is used for producing energy. Generally in poorer countries the waste handling is implemented in not a proper way and unfortunately a large amount of waste is flowing in an uncontrolled way into the environment, causing massive ecological damage (Table 4).

3. Directives of the European Union on waste and related regulations

The current legal regulation system on waste of the autonomous international legal personality called as European Economic Community founded by the Rome Treaty (1957) at the beginning of the European integration, then as European Community after the Maastricht Treaty (1992), has been developed during the period of more than three and a half decades since the first legal rule in this field had been passed (Fig. 4).

Table 3. MSW disposed in landfill

Per cent of bio-waste in the municipal waste	Countries
Less than 20 %	Lithuania, Norway and Slovenia
Between 20 % and 30 %	Bulgaria, Denmark, Ireland, Hungary, Latvia and Switzerland
Between 30 % and 40 %	Germany, France, Italy, Sweden, United Kingdom, European average
Between 40 % and 50 %	Austria, Belgium, Czech Republic, Estonia, Finland, Luxembourg, the Netherlands, Poland, Romania and Spain
Between 50 % and 60 %	Greece, Portugal, Slovakia
Between 60 % and 80 %	Malta

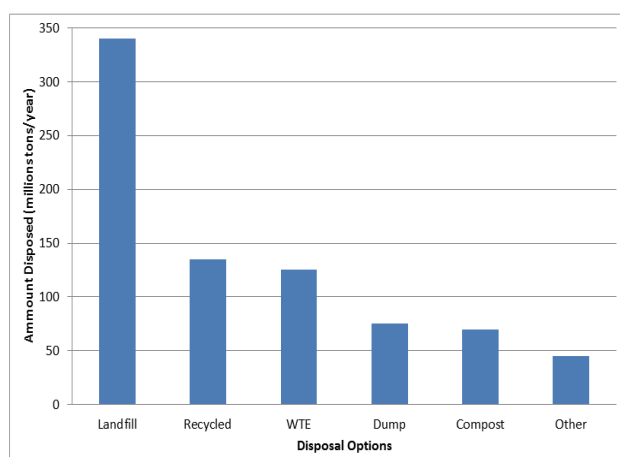


Fig. 2. Generated MSW disposed in landfill

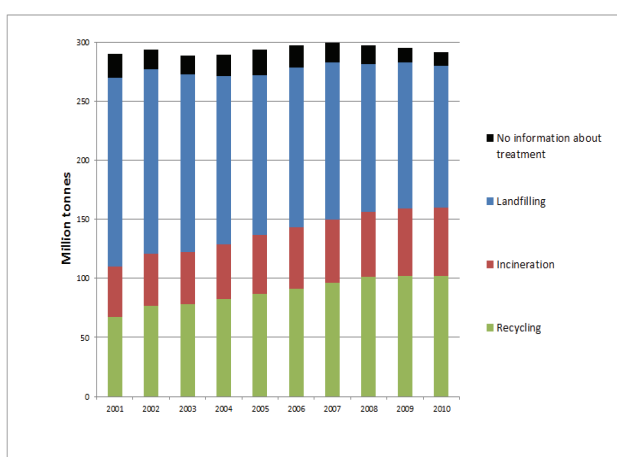


Fig. 3. Development of municipal waste management in 32 European countries (The figure covers the EU-27 Member States, Croatia, Iceland, Norway, Switzerland and Turkey) between 2001 and 2010 (EEA, 2013)

Table 4. Waste disposal technologies of different countries

	<i>Cambodia (LI)</i>	<i>Paraguay (LMI)</i>	<i>Poland (UMI)</i>	<i>UK (HIC)</i>	<i>USA (HIC)</i>	<i>Netherlands (HIC)</i>	<i>Denmark (HIC)</i>
Dumps	100%	42%	0%	0%	0%	0%	0%
Landfills	0%	44%	92%	64%	54%	2%	5%
Compost	0%	0%	3%	9%	8%	23%	15%
Recycling	0%	0%	4%	17%	24%	25%	26%
Waste to energy	0%	0%	0%	8%	14%	32%	54%
Other	0%	14%	0%	1%	0%	17%	0%

Fig. 5 exhibits the principal legal frameworks of regulations by taking into account their subsequent relationship and their ideal order (Bandi, 2001).

Regulation covering waste management of the European Union and providing the underlying principles, professional and institutional elements, is based on Directive 2006/12/EC of the European Parliament and of the Council consolidating the former Council Directive 75/442/EEC and its amendments (EC Directive, 2006), as well as Council Resolution 97/C 76/01 on a Community strategy for waste management. Hungarian harmonisation of all these legal rules was established by the Act XLIII of 2000 on waste management (Act, 2000).

This Directive was replaced by a new one, Directive 2008/98/EC of the European Parliament and of the Council on waste and repealing certain directives entered into force on 12 December 2008 (EC Directive, 2008). In line with this, member states had to harmonise their legal system on waste management according to this new Directive by 12 December, 2010 – Hungary complied with it by passing the new Act CLXXXV of 2012 on waste (Act, 2012).

Directive 2008/98/EC is a horizontal regulation aiming at to integrate the complex regulation of waste, which represents many formal and substantial changes compared to the previous framework directive. Polluter pays principle is still in force, and it is amended by provision on extended producer responsibility in Article 8. Article 16 of the

Directive covers the application of the principles of self-sufficiency and proximity.

There is an objective in Paragraph 2 that European Community as a whole should operate a network providing recovery and disposal of mixed municipal waste, and Member States should also be encouraged individually to comply with the aim of self-sufficiency. However, according to Paragraph 4, the principles of proximity and self-sufficiency shall not mean that each Member State needs to have the full range of recovery facilities within the Member State.

Article 4 of Directive 2008/98/EC extended the previous three-level hierarchy to a five-level priority order, so re-use is connected to prevention resulting in reduced waste generation, while preparation for re-use, recycling and other recovery (e.g. energy recovery) are represented as single level within the waste recovery. Community law declares hereby the priority of material and energy recovery. Article 4 of the Directive specifies compulsory application of waste hierarchy as priority order in legislation and policy. Annex I of the Directive lists disposal operations, Annex II contains recovery operations, but it is an incomplete list. Members States should elaborate their national programme regarding waste prevention at the latest by 12 December, 2013. Article 6 of the Directive specifies the criteria which define when the waste status terminates, and the substance or fraction cannot be considered as waste any more.

From of the new definitions introduced by the Directive 2008/98/EC, the “bio-waste” should be mentioned; Article 22 of the new Framework Directive deals with general issues of the treatment of bio-waste in order to increase the preparation of waste for re-use activities and recycling, Article 11 of the Framework Directive provides the following requirements in connection with separate waste collection:

- by 2015 separate collection should be set up for at least the following categories: paper, metal, plastic and glass;

- by 2020, the preparedness for re-use and the recycling of waste materials such as at least paper, metal, plastic and glass from households and possibly from other origins as far as these waste streams are similar to wastes from households, should be increased to a minimum of 50% by weight;

- by 2020, the preparedness for re-use, recycling and other material recovery, including backfilling operations using waste to substitute other materials, of non-hazardous construction and demolition waste excluding naturally occurring material defined in category 17 05 04 in waste the list should be increased to a minimum of 70% by weight.

In order to define equivalent environmental requirements for the treatment of individual waste types and to ensure neutrality of competition, the list

of wastes (called as List of Waste, LoW) has been introduced.

The list was established by the Commission Decision 2000/532/EC (EC Commission Decision, 2000) by consolidating the previous lists of hazardous and non-hazardous waste, and this Decision has been amended several times since its adoption. Currently there is also an amendment on the agenda in order to further specify concentration limits to be exceeded in order to classify the waste as hazardous. List of waste complying with Commission Decision 2000/532/EC is promulgated by ministerial decree of Ministry of Environment No. 16/2001, and the hazardous waste items are asterisked by introducing strict operational and technical requirements on landfills. The amended Council Directive 1999/31/EC (EC Directive, 1999) contains provisions for measures, procedures and guidance to prevent or reduce negative impacts on the environment. The main goal of Directive 2000/76/EC of the European Parliament and of the Council is to prevent and to limit the negative impacts from the incineration and co-incineration of waste on the environment (EC Directive, 2000). From 12 July 2007, transboundary movements of waste fall under different procedures and control, in line with Regulation 1013/2006/EC of the European Parliament and of the Council (EC Regulation 2006).

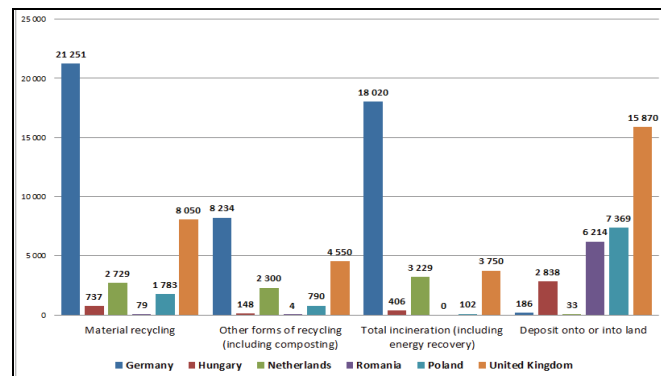


Fig. 4. Municipal waste treatment (thousand T)

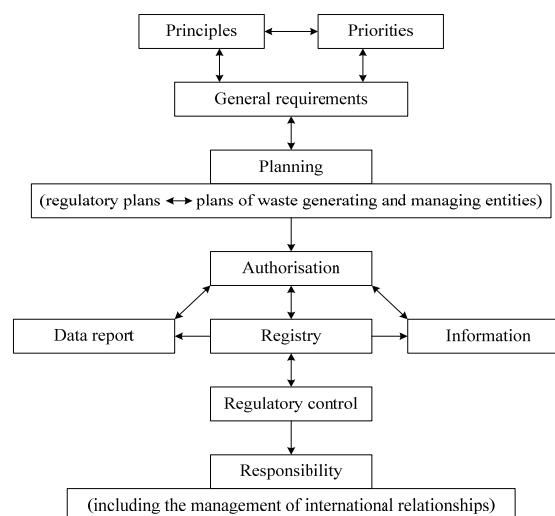


Fig. 5. Legal frameworks in the field of waste management regulation

The European Commission has proposed a new EU Environment Action Programme to 2020 (EC Environment, 2012) entitled "Living well, within the limits of our planet". It will guide the environment policy up to 2020. The proposal aims at to enhance Europe's ecological resilience and transform the EU into a sustainable green structure.

4. Waste management regulation in Hungary

The current national regulation system on waste, waste management activities and facilities is mainly based on the following acts:

- Act LIII of 1995 on the general rules of environmental protection;
- Act CLXXXV of 2012 on waste (Act, 2012);
- Act LXXXV of 2011 on environmental product fees (Act, 2011).

Act LIII of 1995 on the general rules of environmental protection contains provision on the establishment of an individual act on waste and Article 30 stipulates the following:

- the protection against the impacts of waste on the environment shall cover all substances, products;
- the user of the environment shall provide for the treatment (disposal, recovery) of waste;
- the rules on the treatment (disposal, recovery) of waste shall be applied also in the case of substances separated during the various cleaning or demolition operations, and of polluted soil that has become waste, as well as of disassembled products, or products to be disassembled.

As regards the economic regulation of environmental protection, it is an important provision of the Act that it determines fees payable for the use of the environment, as well as covering the costs of measures reducing loading and use of the environment. Similarly to other EU Member States, Hungary defaulted the harmonisation of the Directive 2008/98/EC of the European Parliament and of the Council (EC Directive, 2008); finally Hungary complied with this obligation by adopting Act CLXXXV of 2012 on waste (Act, 2012).

The new Act encourages changes in approach: its main objectives aim at to generate less waste and to recover as much usable material for the waste generated as possible. The Act covers, inter alia, the establishment of separate collection schemes, increase of recovery rates, and extended producer responsibility. It develops further waste hierarchy system, which sets priority order within recovery options. Another important new element is the introduction of "life-cycle thinking".

It means that the manufacturer of a product should consider the use of the environment in the least possible extent already during the manufacturing process as well. The new Act more precisely defines the principle of extended producer responsibility, and it is also very important that the product should serve its utilisation function as long as possible.

The Act also sets definition on the by-products, and it also has provisions on the conditions of end of waste status.

In line with the Framework Directive, the new Act compulsorily introduces the separate waste collection scheme in Hungary, which should be launched by 2015. In order to reduce the amount and hazardous nature of waste, the new Act appoints the National Waste Management Agency (hereinafter: NWMA) to compile a six-year National Waste Prevention Programme as well as regional programmes, which determine the objectives and measures to be accomplished. The Act defines more transparent and unambiguous recording and data provision obligations.

A new regulatory element is that from 2013 the operators of landfills should pay waste disposal fee for the amount of waste, in the case of disposing municipal, construction and demolition, hazardous waste, and waste remained after recovery (Markó, 2012). The aim is to avoid waste disposal at landfill sites. Annex 5 contains unit prices, the fee is 3 000 HUF/T (100 EUR/T) – except for waste that could be further recovered, where the fee is 1 500 HUF/T (50 EUR/T) – in 2013. From 2014 to 2016 the payable fee annually increases by 3 000 HUF up to 12 000 HUF/T – except for waste that could be further recovered, where the fee increases by 1 500 HUF up to 6 000 HUF/T. Environmental product fee is one of the economic regulatory tools in environmental law. The aim of its application is to reduce the consumption of products generating large amounts of waste loading the environment by rising their prices, and as far as possible, to promote the consumption of substitute products, and on the other hand, to generate financial sources for waste management.

The current overall regulation in force is the Act LXXXV of 2011 on environmental product fees, which was adopted on 27 June 2011 (Act, 2011). Its scope covers the following products: batteries, packaging materials, petroleum products, electrical and electronic equipment, tyres and commercial advertising papers. The newly established NWMA manages the organisation of management of waste generated from products subject to product fee. NWMA is founded by the minister responsible for environmental affairs, exclusively owned by the Hungarian State, and the Agency is allowed to play its mediatory role pertaining to collection and recovery of waste generated from products subject to product fee through buying services or tendering.

It means that the Agency directly allocates a certain part of the state budget sources for this objective to public service providers, other market actors can use this source through tenders. The NWMA could control the activities of the beneficiaries, and monitor and evaluate waste management processes.

The most important annual task of the NWMA is to compile and implement the National Waste Collection and Recovery Plan.

The Plan contains waste recovery objectives necessary to fulfil by Hungary as a Member State, furthermore, ways of implementation, as well as state budget sources to be provided from product fee revenues. In 2011 the European Commission issued a communication on a Roadmap for moving to a competitive low carbon economy by 2050, known as decarbonisation roadmap. It is expected that Member States have to devise their own decarbonisation roadmaps too. The Ministry of National Development of Hungary establishes and operates a consultation forum for the stakeholders: professional organisations of sectors most interested in decarbonisation, governmental organisations and NGOs. In order to help this work, the Sectoral Study for the Domestic Decarbonisation Roadmap of Hungary (DDRH) has been compiled.

The objective of the study is to provide professional background for the consultation process, as well as the documentation of the emerging aspects during the consultations. After managing the consultations such sectoral development perspectives, scenarios should be elaborated, which could serve as a basis to “depict” the decarbonisation road for Hungary with due safety. Table 5 demonstrates the role of Hungarian waste management sector as emission source together with other sectors/activities (UN, 2010).

5. Hungarian regional landfill system

In 2002 – in the frame of PHARE HU9911-01 project – the state of the Hungarian landfills was investigated. The total project budget was 5.71 million Euro and 70% was covered by PHARE program. The work was carried out by a Dutch-Hungarian consortium. The aim of the project was to promote the introduction of the directives and to help the introduction of new measures. In the frame of the project the Hungarian solid waste disposal sites were assessed according to a specific methodology set also in this project. The survey revealed alarming conditions. According to experts, only 42 landfills

(and only after some kind of modernisation) out of 2667 sites were allowed to be operated after 2009.

The other landfills did not meet the requirements set by EU Directives. The survey also made proposals to develop a Hungarian waste management system whereby regional waste management systems had to be outlined 23 regional waste management systems were devised by the support of ISPA, Cohesion Fund and other EU sources (Fig. 6).

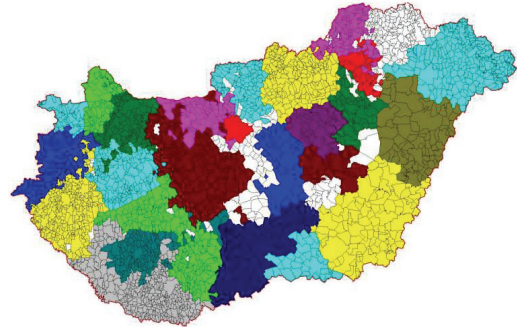


Fig. 6. Regional Waste Management Regions in Hungary

The systems formed according to the above mentioned had the following tasks and purposes:

- solution for waste management problems in a given region,
- providing complex solution for the collection, handling and disposal of the waste of the region,
- rehabilitation of closed landfill,
- application of selective waste management system for paper, plastic, metal, glass, biodegradable and hazardous waste,
- development of regional collection system (collection districts, transfer stations),
- reducing landfill capacity and land consumption in order to decrease the environmental impact,
- selective collection of the hazardous components of municipal waste and disposal or partial use as a secondary raw material, production and use of secondary raw materials e.g.: paper, plastic, metal, glass, compost.

Table 5. Significant emission sources in the context of DDRH

Sector/activity	Emissions from fuels	Emissions from technologies	Total emissions
		kT (CO ₂ equivalent)	
Public electricity and heat production	15 193	0	15 193
Residential and public heating	13 192	0	13 192
Transportation	11 870	0	11 870
Fertilizer use, land use	0	4 794	4 794
Animal husbandry, agriculture technologies	1 078	3 454	4 532
Waste management	0	3 687	3 687
Iron and steel production	395	2 247	2 642
Fugitive emissions	0	2 307	2 307
Cement and lime production	392	1 256	1 648
Petroleum refining	1 475	0	1 475
Chemical industry	736	516	1 252
Use of F-gases	0	1 150	1 150
Food processing	639	0	639
Paper industry	162	0	162
Brick, tile, ceramics and glass production	156	0	156
TOTAL	45 288	19 411	64 699
Net carbon storage of forests and biosphere	0	-3 241	-3 241
ALTOGETHER	45 288	16 171	58

These regional waste management regions were designed according the above mentioned criteria and can meet entirely the requirements set by the Hungarian and EU legislation.

These new systems can also contribute to the sustainable waste management by raising the ratio of recycling and also to lower the ratio of disposal.

6. Conclusions

It can be observed that there are significant differences in the quantity and composition of the wastes as well as in the waste treatment technologies in case of countries having different levels of economic development. Generally speaking, it can be concluded that there is a direct proportional relationship between the economic development and sustainable waste management.

The economic development of Hungary is aimed at to catch up with the Western European ones, and this fact is reflected in the waste management systems as well. However, the waste disposal is still one of the most widely used treatment technology in the country. Thanks to EU funds, from year 2000 a significant progress was achieved in the Hungarian waste management system. Regional landfill network has been established, and in this way almost 100% of the Hungary is supplied with modern waste management systems.

In the 2010's, several legislative initiatives have been introduced to deviate significant part of the waste from the landfills. Product fees and new waste law (introduced on the 1st of January 2013) are good examples of such kind of initiatives. Due to the efficient measures the waste management system in Hungary has been continuously developing, the recycling rate is increasing year-by-year, and in smaller extent the rate of the biological waste treatment and energetic utilisation of the waste is on increase as well.

The legislative changes and the continuous developments in the waste processing technologies supports Hungary to reach the ambitious goals of the sustainable waste management.

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