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BACKGROUND

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LIST OF ABBREVIATIONS

BiH	Bosnia and Herzegovina
CUO	Waste Management Center
EEA	European Environment Agency
EU	European Union
EUROSTAT	Statistical Office of the European
FBiH	Federation of Bosnia and Herzegovina
FMOiT	Federal Ministry of Environment and Tourism
FPUO	Federal Waste Management Plan
Gg	Gigagram
kg	Kilogram
kg/stan/god	Kilogram/person/year
km	Kilometer
KM	Convertible Marka
km ²	Square kilometer
KS	Sarajevo Canton
m	Meter
m ²	Square meter
m ³	Cubic meter
MBO	Mechanical-Biological Treatment of Waste
OEEO	Discarded electric and electronic equipment
RCUO	Regional Waste Management Center
RDF	Refuse Derived Fuel
SBK	Central Bosnia Canton
SRF	Solid Recovered Fuel
t	Ton
t/god	Ton per year
TE	Thermal Plant
ZDK	Zenica-Doboj Canton

1 SUMMARY

The „Impact of the Municipal waste on the Environment in Zenica-Doboj Canton, Central Bosnia Canton and Sarajevo Canton“ document has been worked out in the framework of the all-encompassing project „Processing of Municipal waste as Alternative Fuel in BiH Cement Industry“, with the main aim to identify problems that arise from disposal of municipal waste and negative consequences of such a situation, as well as the possibility to utilize part of the municipal waste as raw material for recycling and production of alternative fuels. This documents has been drafted based on the BiH waste management data and the sectoral situation in the aforesaid cantons, as well as the expert assessment when evaluating negative impacts that need to be tackled by applying specific mitigation measures.

The documents covers six basic thematic areas: (i) definition, types and characteristics of waste and the components of the municipal waste management system, (ii) legal & legislative framework related to waste management in EU and BiH, (iii) current situation analysis of landfills and current practices in BiH and the aforesaid cantons, (iv) analysis of the municipal waste impact on the environment, (v) measures to mitigate adverse impacts of the municipal waste on the environment and, (vi) conclusions and recommendations.

The chapter on waste covering **definitions, types and characteristics of waste and the components of the municipal waste management system**, the waste is defined in accordance with the local laws and regulations „as all substance or objects, which are disposed of or are intended to be disposed of or are required to be disposed of“. Municipal waste is one of the twenty waste categories which is generated by households or which is composition-wise, similar to the household waste and often includes the waste generated as a result of commercial activities. Municipal waste is of various composition depending on the environment it is generated in, season of the year, type of settlement the waste is generated in, living standard and human customs and attitudes like level of population awareness of the need to select waste and create as little waste as possible. The studies and investigations recently undertaken in South-East Europe indicate that the main component of the municipal waste is organic waste the share of which in some municipalities reach as much as 2/3, to be followed by paper with the share of around 1/5 and plastics with 1/10. As a success indicators in waste management system operation one can note as follows: waste collection and transport, sanitary waste disposal and waste reuse and recycling.

Legal & legislative framework related to waste management in the EU and BiH, including European objectives and municipal waste management trends provides an overview of the relevant European and local laws and by-laws. Also indicated and explained are European directives of interest for the municipal waste management and material and/or energy recovery, namely: Directive (2008/98/EC) on waste, Directive 1999/31/EC on the landfills of waste, Directive 94/62/EC on packaging and packaging waste, Directive 2009/28/EC on the promotion of the use of energy from renewable sources, Directive 2000/76 EC on the incineration of waste, and the Directive 2010/75/EC on industrial emissions. Also analyzed was a Circular Economy Strategy by 2030, which sets a goal of fulfilling high objectives in municipal waste management related to reduction of waste disposed of at the landfill to a maximum of 10% of disposable waste, along with the reuse or recycling of at least 65-75% of the municipal waste.

Having in mind that the waste management falls under the entity's competences, the focus of local legislation analyses revolves around the laws and by-laws of the F BiH. The main waste management principles have identified, including prevention principles, responsibilities of waste generators and the „polluter pays“ principle, waste management goals and competences of the institutions for waste management in F BiH. Also under analysis were the strategic and planning documents of the F BiH and the three cantons in the framework of which we recognized the importance of establishing

of an integral waste management system in the F BiH/Cantons, along with the transition onto a regional concept of disposal, rehabilitation and closure of the municipal disposal sites, and repurposing of these sites into the centers for waste management, separation of recyclables from waste and/or carrying out the waste thermal treatment procedures.

Furthermore, the **current situation analysis of landfills and current practices in BiH and the aforesaid cantons** was carried out. According to the information at hand, annual quantities of the generated waste per capita over the past four years in BiH ranged between 314 and 35 t. Specific quantities of the generated municipal waste is 0.89 kg/household/day, which is much lower than the average daily waste quantity in the EU28 amounting to 1.3 kg/household/day, the difference mainly caused by the economic situation in the country and differing consumer habits. The data indicate a slight decrease in daily generation of waste from 0.95 to 0.89 per capita, and around 75% of the waste is being disposed of at the landfills. The problem with waste management includes a great number of wild disposal sites caused mainly by the insufficient coverage with the organized waste collection currently organized for as little as 55-59% of the waste. The waste disposal at landfills continues to be the main option for municipal waste management, and the recycling level in the F BiH is very low and far from the desired strategic goal of 30% that needs to be reached by 2018.

The current municipal waste management situation analysis by cantons has shown that the situation in all three cantons is rather similar to the general picture of the municipal waste management in BiH/F BiH. The waste management is delegated to the local utilities and is mostly carried out by one company per municipality, except in the Sarajevo Canton where only one utility is in charge of the waste management for all 9 municipalities. The waste management in the three cantons mainly includes the following: (i) local collection of municipal waste from containers emptied into the transportation vehicles, (ii) municipal waste transport to the disposal site, and (iii) disposal and spreading of the waste at the site. Municipal disposal sites in ZDK and SBK are non-sanitary sites that lacks collection systems for collection and treatment of leachates, as well as systems for collection and use of landfill gas. Sarajevo Canton has no municipal disposal sites but they dispose the municipal waste collected from all KS municipalities to a single regional landfill „Smiljevići“ where the aforesaid systems making this landfill sanitary are duly planned and partly built, but not in operation as yet. With regard to the mandatory closure of the municipal disposal sites, in the municipalities of ZDK and SBK¹ they started drafting the project documentation for disposal site rehabilitation and building of the attaching facilities aimed at transition to regional concept of waste disposal. In the SBK no regional sanitary landfill exists as yet, but one is about to be built at the location of the deserted open-pit brown coal mine at the border between Bugojno and Gornji Vakuf-Uskoplje municipalities. Four municipality of this canton dispose of their municipal waste at the regional landfill „Moščanica“, Zenica, ZDK. Four ZDK municipalities are using the services of the „Moščanica“ landfill, or 1/3 of the cantonal municipalities only. Mechanical – biological waste treatment plant is not to be found in either of the three cantons. The recycling level in the three cantons is 0.1% in ZDK, 2.2% in the KS and 8% in the SBK. The largest coverage with the organized collection of waste is in the KS amounting to 93%, followed by the ZDK with 69% and the SBK with 62%.

Within the **analysis of the municipal waste impact on the environment**, the most significant impacts of municipal waste on environment include leachate release from the disposal sites into the water and soil, biogas emission into the air, taking up the space and deterioration of the aesthetic values of the area. This chapter provides information on the situation with the environment components, where one needs to emphasize the lack of water and soil quality data, as well as the lack of data on air quality in most of the municipalities of the three cantons. The consultant used the relevant information on waste available in the environment studies for BiH, i.e. the area under consideration. By using the data on the quantities of municipal waste generated, quantity of the

¹ Except in the municipality of Dobretići not having a municipal landfill

municipal waste disposed of, the situation with communal disposal sites and „wild disposal sites“, the consultant has assessed the sensitivity of the environment components with regard to the given pressure by using the DPSIR² methodology

As already mentioned, most municipal disposal sites are non-sanitary sites lacking appropriate control and/or elimination of the aforesaid impacts. In all three cantons we observed that some of the disposal sites are in the immediate vicinity of the surface waterways or the leachate from the landfill body are released directly into the water streams without treatment. These practices exert great pressure and adversely affect the waters. None of the sites include the leachate treatment, and the „Moščanica“ landfill only features a system for waste water recirculation onto the landfill body as a temporary solution until the scheduled treatment facility is built.

Landfill sites, apart from the regional landfills „Moščanica“ and „Smiljevići“ have no impermeable bed in place, which gets the waste into direct contact with the soil. With regard to the emission into the air and climate impact caused by the methane release, the consultant made a calculation of the CH₄ emission for each of the cantons. The impact on plants and animals is assessed as neglectable because the disposal site locations are mainly devastated areas without any endangered species. Municipal waste has no potential of adversely affecting the material goods and cultural-historical heritage because none has been identified in the vicinity of the disposal sites in the aforesaid cantons.

The most complex impact of the municipal waste is exerted onto the population and human health by way of leachate impact on drinking waters and a failure to undertake daily covering of waste which generates awful smells off the site most probably accompanied by the spread of particulate matter carried by the wind, which could cause respiratory problems. Some municipal disposal sites are having problems with fires which could cause the release of dioxins and furans as a result of the waste burning, affecting the humans through inhalation and digestion. A large number of wild disposal sites in all three cantons could also contribute to the deterioration of the epidemics situation and through some other ways like free access to animals (most often stray dogs) who could be disease carriers, as well as the direct contact of the population with the waste.

Based on the identification of adverse impacts, an overview of **measures for mitigating the adverse impact of the municipal waste on the environment** is provided. The measures to mitigate the adverse impacts have been elaborated for the cantons specifically, by tackling both (i) general and (ii) technical measures of mitigation. Under the general mitigating measures the following is proposed: waste management planning at the level of the municipalities which have not developed their waste management plans, raising awareness of the needs to reduce generation of waste at the place of its generation in households and businesses, as well as encouraging the reuse of materials (for instance repair and usage of waste in so-called green entrepreneurship). Technical measures include: (i) technical equipment provision for utility companies and expansion of their services onto the areas not covered by the organized collection of waste, (ii) investments in infrastructure for separate collection of recyclables from waste, (iii) reducing quantities of waste to be managed by final disposal at the landfills by way of material recovery from waste (recycling) and/or thermal waste treatment, (iv) drafting an investment-technical documents (preliminary and final project) for rehabilitation and closure of all non-sanitary municipal disposal sites, (v) rehabilitation and closure of all non-sanitary municipal disposal sites and development of the facilities for decreasing the adverse impacts (leachate lagoons, degasification system, upper layer and slant section barriers, drainage ditches at the foot of the landfill to catch leachate etc.), (vi) transition onto the regional waste disposal at the sanitary landfills equipped with the leachate treatment systems and degasification of biogas from the landfill body, (vii) systemic removal of wild disposal sites through

² DPSIR is an acronym of English words: Driving Forces, Pressures, State, Impact, Responses

allocating one's own funds and collaboration with the non-governmental organizations involved in removal of wild disposal sites and promotion of these organizations in the local communities.

The situation in the waste management sector and its impacts have been viewed in aggregate and the major problems identified in the current waste management like dominant waste management through its final disposal at the disposal sites, very low level of recycling, lack of infrastructure for separate waste collection and lack of waste treatment infrastructure. Finally, we have elaborated the possibilities to use waste as raw materials for production of refuse derived fuel (RDF) whereupon we have analyzed the positive impacts of the waste quantity reduction on the environment, society and economy. Using the RDF by co-incineration in the cement industry, power plants, heat plants etc., would result in a number of advantages like energy recovery from waste, safe management of special types of waste, reduction of environment emissions, preservation of non-renewable resources and prolongation of the regional landfill life span, industries using RDF as additional fuel reduce their fuel costs and consequently the overall production costs, which contributes to the economic development. When purchasing RDF, the industries simultaneously contribute to the waste management cost reduction at the regional landfills, which certainly depends on the costs of capital, coal and price of the waste disposal.

The **conclusions and recommendations** summarize the facts learned about the impact of the municipal waste on the environment in the three cantons. Special emphasis is placed on accomplishing the strategic goals in the waste management sector with regard to the prevention of waste generation, recycling and reduction of the waste quantities to be finally disposed of, all followed by offering an overview of the possibilities for using a part of the municipal waste as raw materials for material and energy recovery, i.e. production of alternative fuel from waste. The measures for mitigation of the adverse effects of the municipal waste include the following: (i) improvement of the municipal waste collection system (encompassing the expansion of the area under service, development of the waste separation at the place of generation), (ii) development of infrastructure for municipal waste treatment (setting up a MBO waste plant within the regional landfills, recovery of material and/or energy through co-incineration of the refuse derived fuel – RDF) and (iii) reduction of finally disposed waste to the maximum of 1/3 of the total waste generated, along with the closure of municipal non-sanitary disposal sites, building of ancillary facilities and transition onto regional concept of waste disposal (final disposal at the regional sanitary landfills). One of the possibilities proposed for tackling the issues related to municipal waste management in the three cantons and the reduction of the waste finally disposed at the disposal sites include the production of fuel from waste within the plant for mechanical-biological treatment (MBO) of waste and co-incineration of such fuel in the cement industry. These plants are proposed to be built at locations containing large quantities of waste like regional landfills and in relative vicinity of the potential users of the refuse derived fuel. Due to the high costs of MBO plant construction, it is necessary to work out a detailed economic feasibility study on this topic.

2 INTRODUCTION

The „Impact of the Municipal waste on the Environment in Zenica-Doboj Canton, Central Bosnia Canton and Sarajevo Canton“ document was drafted under the framework of the project „Processing of Municipal Waste as Alternative Fuel in the BiH Cement Industry“. The project is implemented between 2015 and 2018. The project partners include German organization for international cooperation (GIZ) – program developer, Kakanj Cement Factory, REZ RDA Agency for Central Bosnia and Herzegovina and Faculty of Mechanical Engineering in Zenica. The project goal is to analyze the problems arising from the municipal waste disposal and adverse effects of such a situation, as well as the possibilities to use part of the municipal waste as raw materials for recycling and production of alternative fuels. The expected results of the „Processing of Municipal waste as Alternative Fuel in the BiH Cement Industry“ project include reduced quantities of fossil fuel used in cement industry, as well as reduced quantities of municipal waste at the disposal sites.

The main idea behind making the „Impact of the Municipal waste on the Environment in Zenica-Doboj Canton, Central Bosnia Canton and Sarajevo Canton“ document is to analyze the problems arising from the municipal waste disposal and piling and adverse effects of such a situation, as well as the possibilities to use part of the municipal waste as raw materials for recycling and production of alternative fuels. The analysis is intended for the representatives of the ZKD, SBK and KS local communities.

The subject document summarizes the (1) definition, types and characteristics of waste and the components of the municipal waste management system, (2) legal & legislative framework related to waste management in the EU and BiH, (3) current situation analysis of landfills and current practices in BiH and the aforesaid cantons, (4) analysis of the municipal waste impact on the environment, including a description of the area under reference with the emphasis on the aforesaid cantons and explanation of the impact on water, soil, air quality, plants and animals, population/public health, climate and material goods and cultural-historical heritage, (5) measures to mitigate adverse impacts of the municipal waste on the environment and, (6) conclusions and recommendations.

To make an analysis of the impacts of municipal waste on the environment, the consultant used the data available in the environment studies drafted in BiH, or the area under consideration, including State of the Environment Report in BiH 2012, as well as the Cantonal Environment Action Plans in ZDK, SBK and KS and other relevant documents. The consultant has taken the data from the aforesaid reports referring to the description of the area under consideration and the quality of the environment components. Using the data on the municipal waste quantities generated, quantities of municipal waste disposed of, state of disposal sites and „wild disposal sites“, the consultant has assessed the sensitivity of the environment components related to the given pressure by applying DPSIR³ methodology of the European Environment Agency focusing on waste disposal as D-driver and pressure that cause environment problems in the area under consideration. DPSI methodology assumes the cause-effect relations of the associated components of the social and economic system and environment, recognizes the chain of driving mechanisms of the specific pressures on the environment, consequences of those pressures, i.e. state of environment, which has a direct impact on the ecological system and cause a whole range of indirect impacts. All these adverse effects should be tackled by a responsible society with a number of measures targeting all the chain links, as illustrated by the chart below.

³ DPSIR is an acronym of English words: Driving Forces, Pressures, State, Impact, Responses

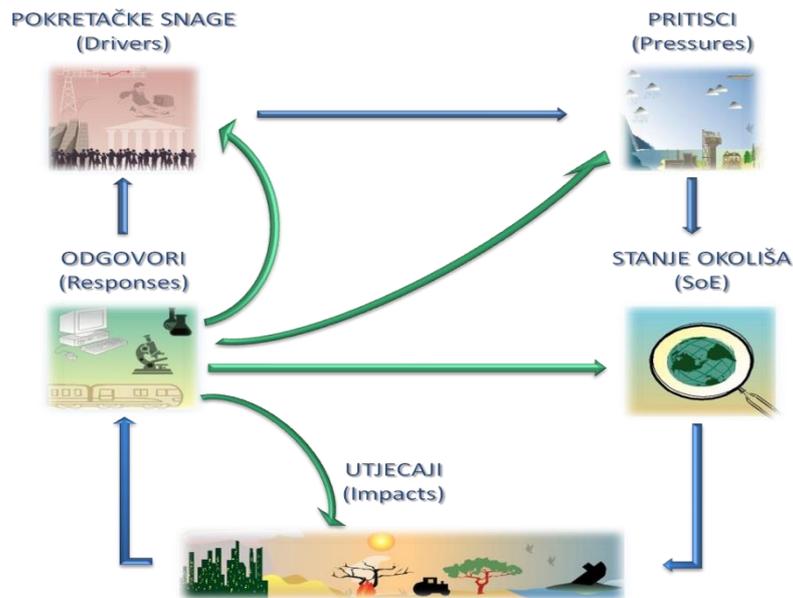


Figure 1: Interaction of society and environment according to the DPSIR methodology

Based on the identification of the given impacts, the measures are proposed to mitigate the adverse impacts of the municipal waste on the environment. The current situation and impacts are taken in aggregate so that the assumed scenario of using waste as raw materials for RDF production where positive effects of the reduction of waste quantities on the environment, society and economy were at the focus of analysis.

The document summarizes the facts learned about the impact of the municipal waste on the environment in the three cantons and discuss the possibility of using part of the municipal waste as raw materials for recycling and production of alternative refuse derived fuel.

3 WASTE

3.1 Definition of waste

Waste is generated as a consequence of human activities and it represents the loss of materials and energy. Increase of waste generation is connected to economic growth and increase in consumption. Waste and the manner in which it is managed cause emissions into water, air and soil, which can impact human health and the environment. The extent of that impact depends on the quantity and characteristics of waste, as well as on the manner in which it is handled. In order to decrease pressures on the environment, the society should provide adequate collection, transport and recycling, which requires extensive funding (State of the Environment Report of BiH 2012). According to Article 4 of the Law on Waste Management⁴, waste is defined as any substance or object which the holder discards or intends or is required to discard, belongs to one of the categories listed in the List of Wastes, adopted in a separate legal regulation.

3.2 Types of waste and their characteristics

Classification of waste is done according to the European Waste Catalogue and Annex II of the Directive 2008/98/EC. Waste could be classified in various ways:

- According to the activities that generate it
- According to the characteristics
- According to the composition.

EU Directive 75/442/EWG and amended directive 91/156/EWG determines the European catalogue of waste which came into force on Jan. 1, 1999 and whose aim is to establish a clear waste classification system within EU. The Catalogue classifies waste primarily by activities that generate it, but also according to the type of waste as regards to the process or place of production. The list of waste by type of waste additionally defines the hazardous waste in 295 categories which needs to be supervised in accordance with the waste classification under Basel Convention and waste classification according to the United Nations.

European Catalogue classifies more than 1,000 types of waste, most of them being defined by the DIN Standards (Ger. *Deutsches Institut für Normung*).

Waste is classified by its characteristics and the source in twenty groups. The groups of waste and specific designation of waste are marked with six-figure key numbers. In order to manage the waste, a waste generator shall classify the waste according to the List of Wastes.

In complying with the European trends, BiH has issued the Rules on categories of waste with lists, according to the characteristics and source sectors (Table 1) and obligations of their implementation.

Table 1: Categories of waste according to the source branches ⁵

01 00 00	Wastes resulting from exploration, mining, quarrying and physical and chemical treatment of minerals;
02 00 00	Wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing, food preparation and processing
03 00 00	Wastes from wood processing and the production of panels and furniture, pulp, paper and cardboard

⁴Official Gazette of the FBiH, No. 33/03, 72/09

⁵BiH Statistics Agency, Determination of waste codes according to the list of wastes

04 00 00	Wastes from the leather, fur and textile industries
05 00 00	Wastes from petroleum refining, natural gas purification and pyrolytic treatment of coal
06 00 00	Wastes from inorganic chemical processes
07 00 00	Wastes from organic chemical processes
08 00 00	Wastes from the manufacture, formulation, supply and use (mfsu) of coatings (paints, varnishes and vitreous enamels), adhesives, sealants and printing inks
09 00 00	Wastes from the photographic industry
10 00 00	Wastes from thermal processes
11 00 00	Wastes from chemical surface treatment and coating of metals and other materials; non-ferrous hydro-metallurgy
12 00 00	Wastes from shaping and physical and mechanical surface treatment of metals and plastics
13 00 00	Oil wastes and wastes of liquid fuels (except edible oils, 05 and 12)
14 00 00	Waste organic solvents, refrigerants and propellants (except 07 and 08)
15 00 00	Waste packaging; absorbents, wiping cloths, filter materials and protective clothing not otherwise specified
16 00 00	Wastes not otherwise specified in the list
17 00 00	Construction and demolition wastes (including excavated soil from contaminated sites)
18 00 00	Wastes from human or animal health care and/or related research (except kitchen and restaurant wastes not arising from immediate health care)
19 00 00	Wastes from waste management facilities, off-site waste water treatment plants and the preparation of water intended for human consumption and water for industrial use
20 00 00	Municipal Wastes (Household Waste and Similar Commercial, Industrial and Institutional Wastes) Including Separately Collected Fractions

The Law on Waste Management of the F BiH, Annex III Framework Directive on Waste classifies waste according to the properties to hazardous, non-hazardous and inert. The waste composition could include various components some of which are of organic origin (like paper and cardboard, plastics, garden and wood waste, clothing, fibers, food waste...) and some inorganic (metals, glass, sand, dust, rocks...).

The Law on Waste Management of the F BiH defines and determines the following types of waste:

- "municipal waste" is waste from households, as well as other waste which is, because of its nature or composition, similar to waste from households;
- "hazardous waste" is any waste which is covered by separate regulations and which has one or more of the properties, which poses a risk to human health and to the environment due to its origin, composition or concentration, and which is listed in the list of wastes adopted by a separate regulation as hazardous;
- "non-hazardous waste" is waste which is not covered by the definition of "hazardous waste";
- "inert waste" is waste that does not undergo any significant physical, chemical or biological transformation. Inert waste will not dissolve, burn or otherwise physically or chemically react, biodegrade or adversely affect other matter with which it comes into contact in a way likely to give rise to environmental pollution or harm human health. The total leach ability and pollutant content of the waste and the eco toxicity of the leachate must be insignificant, and in particular not endanger the quality of surface water and/or groundwater;
- "Biodegradable waste" is any waste that is capable of undergoing anaerobic or aerobic decomposition, such as food and garden waste, and paper and paperboard;
- "Liquid waste" is any waste in liquid form, excluding sludge.

The local self-government units (cities and municipalities) are in charge of the municipal waste management. With this regard, each local self-government unit delegates its responsibilities onto its utility company entrusted to fulfill its waste management obligations.

3.3 Solid municipal waste

By definition, municipal waste „ is waste from households, as well as other waste which, because of its nature or composition, is similar to waste from households“. According to the Law on Waste Management of the F BiH, collection and treatment of municipal waste is carried out in accordance with the separate legal regulation on utilities. Cantonal regulations shall cover the establishment and operations of public waste services and the duties of municipalities in connection with such services. In practice, the waste from urban areas and commercial waste is defined as solid municipal waste.

The group 20 of the Rules on waste categories with lists includes municipal waste, which includes the mixed municipal waste and separately collected kinds of municipal waste including packaging waste. The municipal waste group is divided into sub-groups, whereby the asterix (*) designates the hazardous kinds of wastes (Table 2).

Table 2: Sub-groups of municipal waste according to the source branches⁶

20 01	Separately collected fractions (except 15 01)
20 01 01	Paper and cardboard
20 01 02	Glass
20 01 08	Biodegradable kitchen and canteen waste
20 01 10	Clothes
20 01 11	Textiles
20 01 13*	Solvents
20 01 14*	Acids
20 01 15*	Alkalines
20 01 17*	Photochemicals
20 01 19*	Pesticides
20 01 21*	Fluorescent tubes and other mercury-containing waste
20 01 23*	Discarded equipment containing chlorofluorocarbons
20 01 25	Edible oil and fat
20 01 26*	Oil and fat other than those mentioned in 20 01 25
20 01 27*	Paint, inks, adhesives and resins containing dangerous substances
20 01 28	Paint, inks, adhesives and resins other than those mentioned in 20 01 27
20 01 29*	Detergents containing dangerous substances
20 01 30	Detergents other than those mentioned in 20 01 29
20 01 31*	Cytotoxic and cytostatic medicines
20 01 32	Medicines other than those mentioned in 20 01 31
20 01 33*	Batteries and accumulators included in 16 06 01, 16 06 02 or 16 06 03 and unsorted batteries and accumulators containing these batteries
20 01 34	Batteries and accumulators other than those mentioned in 20 01 33
20 01 35*	Discarded electrical and electronic equipment other than those mentioned in 20 01 21, 20 01 23 and 20 01 35
20 01 36	Discarded electrical and electronic equipment other than those mentioned in 20 01 21, 20 01 23 and 20 01 35
20 01 37*	Wood containing dangerous substances
20 01 38	Wood other than that mentioned in 20 01 37
20 01 39	Plastics
20 01 40	Metals
20 01 41	Wastes from chimney sweeping
20 01 99	Other fractions not otherwise specified

⁶ BiH Statistics Agency, Determination of waste codes according to the list of wastes

20 01	Separately collected fractions (except 15 01)
20 02	Garden and park waste (including cemetery waste)
20 02 01	Biodegradable waste
20 02 02	Soil and stones
20 02 03	Other non-biodegradable wastes
20 03	Other municipal wastes
20 03 01	Mixed municipal wastes
20 03 02	Waste from markets
20 03 03	Street-cleaning residues
20 03 04	Septic tank sludge
20 03 06	Waste from sewage cleaning
20 03 07	Bulky waste
20 03 99	Municipal wastes not otherwise specified

3.3.1 Generation and composition of municipal waste

According to EUROSTAT and European Environment Agency (EEA), solid municipal waste mostly includes the household waste with a content of commercial waste (waste from areas used fully or partly for trade and business operations, or for recreation, sport, education or entertainment), non-hazardous waste from industry and waste from hospitals and clinics, which are, by nature and composition, similar to household waste, collected by or on behalf of the municipal authorities and disposed of through a waste management system. The municipal waste composition depends on the environment it was created in, season of the year, type of settlement the waste is generated in, living standard and human customs and attitudes like level of population awareness of the need to select waste and create as little waste as possible. Raw waste contains a high percentage of moisture, it is of low calorific value and has a wide range of particles and high content of ash.⁷

Daily and consequently annual mass of solid municipal waste per capita varies from country to country. In the developed countries the solid municipal waste mass is higher (1.3 kg/inhabitant/day), as related to mid-developed or underdeveloped countries (0.2-0.9 kg/inhabitant/day).⁸

This research carried out in the framework of the „Benchmarking on Solid Waste Management in SEE“ (2015) covering 10 local communities in 10 South East Europe countries indicates that the municipal waste mostly include the organic waste and its share in some municipalities is as much as 70%. The following category (up to 20%) is paper, followed by plastics (up to 10%). The members of the NALAS (Network of Associations of Local Authorities in South-East Europe)⁹ took part in this research.

⁷ Psomopoulos, 2014

⁸ (1) Eurostat, Municipal waste generation and treatment, by type of treatment method

(2) Ministry for Urban and Spatial Planning and Environment of the Bosnian-Podrinje Canton Goražde, Waste Management Plan for the Bosnian-Podrinje Canton Goražde 2013-2018, 2013

⁹ NALAS, Benchmarking on Solid Waste Management, 2015 - Draft

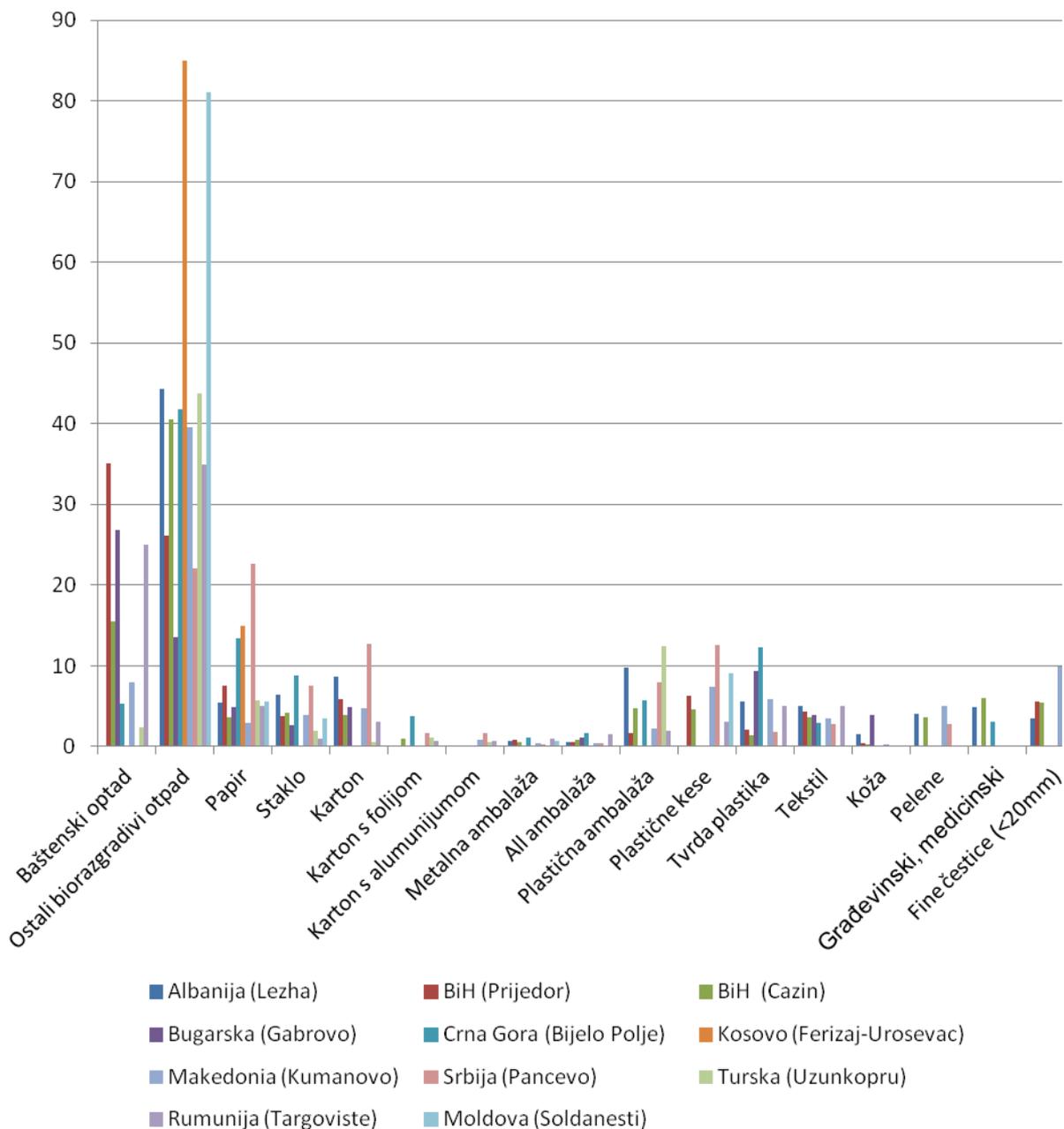


Figure 2: Composition of waste in the local communities of 10 South-East Europe countries¹⁰

The waste composition data helps the community assess the appropriate material management strategies and provide guidelines for implementation of the solid waste management hierarchy. The percentage of materials like paper, metal, glass and plastics in the waste streams indicates the success rate in waste separation at its source. The same refers to the percentage of organic substances collected for the purpose of biological treatment of waste.

¹⁰ NALAS, Benchmarking on Solid Waste Management, 2015

3.3.2 Collection and transport

Main success indicators for waste collection operation under the framework of waste management system, presented on the basis of data obtained from the utility companies, include:

- Coverage of area by waste transportation services
- Number of waste collection containers
- Waste transport frequency
- Separate waste collection
- Collection of bulky waste.

Coverage of the area by waste collection directly indicates the generation of municipal waste in that particular area.

Main task of the waste management system is to make sure the municipal waste remains in and around the place of its collection as short as possible. With this regard, the transport frequency is determined. The waste transport frequency is determined individually by the utility companies based on the municipal waste generation. The frequency is set in the way that waste transportation costs are matched with the waste collection containers capacities in the most economical way.

The number of municipal waste collection containers testifies to the capacity of utility companies to handle the entire quantity of the generated waste. Small number of containers directly affects the poor coverage and increase in transport costs, given the increased frequency of removal. Matching the waste collection capacities and the transport efficiency is one of the priorities of integral waste management system. The shortage of waste collection containers results in collection of waste in plastic bags scattered around the collection sites or, even worse, the waste gets dropped from the bags and carried away by animals.¹¹

The Mediterranean Commission for Sustainable Development (MCSD) has defined an indicator of the waste collection service coverage (MCSD-109-R). Due to a significant problem of illegal disposal in developing countries, as well as in underdeveloped regions of Europe, monitoring of this indicator has been introduced, as it is thought that coverage with collection and waste disposal service is a basic civilization achievement, just like access to water supply and sewage systems (FMOIT, 2010). In BiH, coverage by these services varies significantly.¹²

The waste transportation as a financial component of the waste management is one of the most important items in the system operation costs. Number of vehicles aligned with the needs to transport the collected quantities of waste to the disposal sites, its condition and maintenance, distance from the disposal site, and transport frequency are some of the main parameters for optimization of the transportation component in the framework of the integral waste management system. Integral concept of waste management enhances the waste transportation efficiency since the principles of this concept prioritize the reduced quantities of waste transported to the remote disposal sites resulting in reduced transportation costs and future needs for procurement of new vehicles. Also, the so-obtained raw waste economic value as goods will increase the income and provide for further investments in the system development.

3.3.3 Waste disposal

EU requirements for the landfills of waste

The framework EU regulation related to disposal of waste is Directive on landfill of waste (1999/31/EC). The overall aim of the Directive is to reduce as far as possible negative effects on the environment by way of stringent operational and technical measures for landfills of waste. This

¹¹ Waste Management Plan for the Bosnian-Podrinje Canton Goražde 2013-2018

¹² UN Economic Commission for Europe, Overview of the State of Environment-Bosnia and Herzegovina, 2011

Directive specifies the standards for landfill location, and requires separate locations for hazardous, non-hazardous and inert waste. The Directive specifies the kinds of waste that cannot be disposed of at the landfills (liquid waste, used tires with some exceptions, the waste that is, under the conditions of landfill, explosive, corrosive, oxidating, flammable or very flammable, contagious medical or other clinical waste, or any other kinds of waste not complying with the criteria of acceptability provided in the Supplement II of the Directive).

Directive on landfills provides guidelines for changing the waste disposal methods and sets goals for reduction of biodegradable municipal wastes disposed of at landfills. Those goals for the member countries are as follows:

- By 2010 biodegradable municipal waste going to landfills must be reduced to 75% of the total amount produced in 1995
- By 2013 biodegradable municipal waste going to landfills must be reduced to 50% of the total amount produced in 1995
- By 2020 biodegradable municipal waste going to landfills must be reduced to 35% of the total amount produced in 1995¹³.

On December 19, 2002 the Directive was supplemented by the Council Decision (2003/33/EC) setting criteria and procedures for waste acceptance at landfills.

Landfills and waste management permit

In accordance with Article 12 of the Law on Waste Management¹⁴ a permit should be obtained for waste treatment and disposal. The permit under Article 12, par. 1 of this Law contains:

- Type and quantity of waste to be treated and/or disposed
- General technical requirements for operation, monitoring and control plan
- Methods of treatment
- Precautions to be undertaken
- Information on waste origin, destination and treatment as well as types and quantities of such waste.

Permit is issued for a five-year period and may be extended for the same period of time if no conditions under which it was issued have not been changed.

Landfills are classified into landfills for hazardous, non-hazardous and inert waste, in accordance with Article 34 of the Law on Waste Management. Only those wastes defined within the waste management permit could be disposed of at the landfills. To operate a landfill, it is necessary to obtain a waste management permit. On this basis, the following shall be determined:

- category of landfill
- the list of accepted waste and total quantities specified to be disposed of at the landfill
- requirements for the landfill preparation, landfilling operations and monitoring and control procedure, including contingency plans, as well as provisional requirements for the closure and after-care operations
- requirements for waste acceptance procedures
- the obligation of the applicant to report at least annually to the competent authority on the types and quantities of waste disposed of and on the results of the monitoring program.

The costs of waste disposal are established against the quantity and type of waste by „polluter pays“ principle.

The waste management hierarchy, within the EU framework directive, provides clear guidelines on waste management to the member countries as well as the country aspiring to become EU

¹³ Federal Waste Management Plan 2012-2017

¹⁴ Official Gazette of the FBiH, No. 33/03, 72/09

members. The waste disposal is the least desired option. According to EUROSTAT's data for 2011, 6 member states have landfilled less than 3% of their municipal waste, 18 of them have lost more than 50% and some of them even more than 90% of their resources by disposing their municipal waste at landfills. These data indicates the success rate differences when it comes to waste management inside the EU¹⁵.

As a matter of fact, the waste disposal is a necessity because each of the pre-treatments produces a part of the final products that needs to be disposed of, but this should not be the only way of waste management. The final disposal of waste should be preceded by various treatments to use the waste potentials through recycling, composting, getting energy from waste etc.

Sanitary landfills are the facilities under 24-hour supervision, where the wastes are disposed of in cells – once it is disposed, the waste is being spread, compacted and covered in soil on a daily basis. The construction of landfill includes the proper selection of building site (impermeable and stable bed), laying a protective geomembrane to protect the soil from leachate, establishing a system for collection and treatment of leachate and precipitation waters, collection and handling the landfill gas through degasification system, constant monitoring of the waste disposal, and regular operation and maintenance.

Unlike sanitary landfills as the only safe way of handling wastes, the current practice of waste disposal in BiH covered in detail in chapter 4 includes non-regulated disposal sites, both legal and illegal („wild“), as the most inadequate way of waste management. In addition to releasing great quantities of greenhouse gas into the air, they jeopardize plants, animals, soil and water. The process of decomposition of the biological waste in uncontrolled conditions results in leachate that could reach the underground water through the soil. These processes develop greenhouse gas methane (CH₄) which, in same quantities, generates much more climate changes than CO₂.

3.3.4 Reuse and recycling

Reuse and recycling constitute one of the basic principles of cleaner production concept that includes a continued application of integral preventive environment protection strategy to the processes, products and services in order to increase efficiency and reduce risks for humans and environment.

In order to prevent generation of waste and reduce quantities and harmful effects of waste on human health and environment, its reuse and recycling is highly recommended. Article 4 of the Law on Waste Management define reuse of waste as „ any operation by which waste is used for the same purpose for which it was conceived“.

The extension of the life span of the products by their reuse is the influential measure for reduction of the quantities of generated waste. In this way one promotes sustainable development followed by a range of environment benefits like reduction of waste quantities, reduction of green gas emissions, reduction of pressure on the natural resources, but also social benefits like fighting poverty by offering non-expensive products to low-income households, creating new jobs (collection, sorting, testing) etc.

Recycling is a material recovery from waste and its reuse as material. It includes collection, separation, treatment and manufacturing of new products from used objects or materials. One of the ways to reduce waste quantity is a separated collection at the place of origin. Recyclable fractions of household waste are collected by way of separate collection that could be organized in a number of ways:

¹⁵ European Commission, Proposed amendment to the Directive 2008/98/EZ on waste

- Recycling yard (RD) includes facilities intended for separation and temporary storage of special types of wastes. They have storage tanks of 11,100 to 5,000 liters where, depending on the size and type, different kinds of usable waste are being collected separately. RD can be set up as self-standing facilities or as part of the larger waste management facilities (reloading stations, waste management centers)
- Green islands may be placed in a number of collection sites in the neighborhoods with tanks and containers for specific types of waste.
- Containers for separate collection of waste could be placed along with the existing facilities for mixed waste collection.

Another way of separation of recyclable raw materials of the mixed municipal waste could be done by a sorting facility for mixed wastes. This kind of separation of recyclables from mixed wastes does not require any primary separation. In this way, it is possible to prolong the life span of the sanitary landfill by reducing quantities for final disposal. Sorting facility for mixed municipal waste (which also represents the „M“ phase of mechanical-biological waste processing) is often put in place in the waste management system in local communities that have not developed a primary separation of recyclables from waste. This sorting system can separate up to 45% of the recyclable material that has its own market value. The remaining material that has no market value or could not be treated in any other way, is finally disposed of at landfill.

Figure 3 illustrates the waste treatment in the EU-28 between 2011 and 2015 indicating a mild increase in recycling when compared to final disposal of waste the percentage of which dropped during the aforesaid time period.

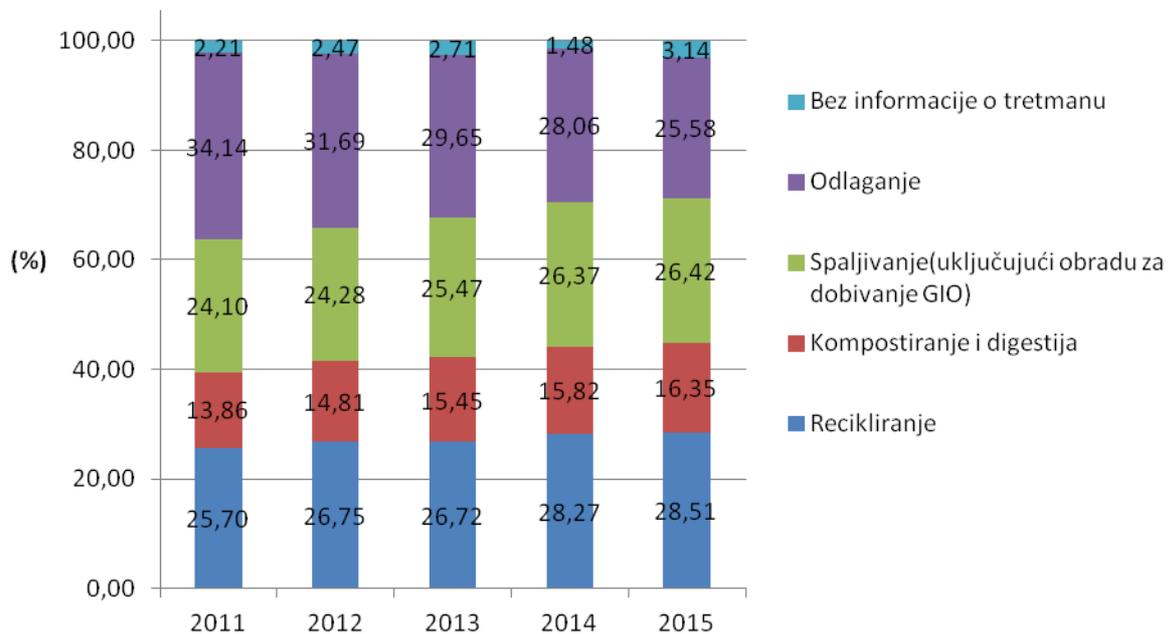


Figure 3: Waste treatment in the EU-28¹⁶

¹⁶ Eurostat, Municipal waste generation and treatment, by type of treatment method

4 LEGAL FRAMEWORK

4.1 EU Legal Framework

Directive on waste (2008/98/EC) sets a legal framework for waste management in the EU. This Directive sets the measures for protection of environment and human health by preventing or minimizing the effects of production and waste management and minimizing the overall effects of the use of resources, and improvement of efficiency of that use. The Directive sets the waste prevention as first priority. The member countries shall adopt their Waste management national plans. When implementing those plans they should observe the waste management hierarchy as defined by the Directive and not cause harmful effects for environment, particularly water, air, soil, plants and animals, and without causing nuisances through noise and odors.¹⁷ This Directive does not envisage for each member country to have its own waste management facility, but emphasizes the need for self-sufficiency of local communities in terms of operations of landfilling and reuse of waste in the facilities nearest to the place of generation.¹⁸ (Vavić and assoc., 2014.)

The Waste Incineration Directive (200/76/EC) substituting the previous directives on hazardous waste incineration (94/67/EC) and household waste (Directive 89/369/EEC and 89/429/EEC), and integrating them into one document. This directive is aimed at preventing or reducing, as far as possible, the negative effects on environment caused by waste incineration or co-incineration. Specifically, this should reduce pollution caused by emissions into air, soil, surface and underground waters, while reducing adverse effects on human health. The directive sets rules by which the refuse derived fuel could be used in the incineration plants or industrial facilities like cement factories, as a replacement for primary fuel (coal, lignite, oil...). It sets the limit values of emissions and requirement for monitoring of pollutants of air like dust, nitrogen oxide (NO_x), sulfur dioxide (SO₂), chlorohydrogen (HCl), hydrogen fluoride (HF), heavy metals etc. The directive defines a difference between incineration and co-incineration plants. So the incineration plant is any stationary or mobile technical unit designed for thermal treatment of waste with or without using the heat generated from combustion. This includes incineration by waste oxidation, as well as other thermal processes like, pyrolysis, gasification or plasma technology. The waste co-incineration plant (like cement factories, power stations or steelworks) is any stationary or mobile technical unit designed for generation of energy or production of material products which (i) uses wastes as primary or additional fuel, (ii) includes thermal processing of waste aimed at disposal of waste at the landfill.¹⁹

Directive on packaging and packaging waste (94/62/EC). This directive is aimed at harmonizing national regulations for packaging and packaging waste management to prevent its impact on environment in all member states, as well as third countries or to reduce that impact and secure a high level of environment protection, on one hand, and to secure functioning of the internal market and avoid trade obstacles and violation or limitation of competition within the Community, on the other. To this end, this directive sets measures primarily aimed at preventing the production of packaging waste, and the second basic principle includes reuse of packaging, recycling and other forms of packaging waste processing, thereby reducing the amount of finally disposed waste.

Directive on the promotion of the use of energy from renewable sources (2009/28/EC) promotes the use of energy from renewable sources, as well as savings of energy, along with the increase of energy efficiency. The directive is an important part of the sets of measures required for reducing greenhouse gas and meeting the requirements of the Kyoto Protocol to the the United

¹⁷ Official Journal of the EU, 15/Sv. 34, L 312/3, available at: <http://eur-lex.europa.eu/legal-content/HR/TXT/HTML/?uri=CELEX:32008L0098&from=EN>

¹⁸ Vavić I. and others, 2014

¹⁹ Official Journal of the EU, 15/Sv. 34, L 332/91, available at: <http://eur-lex.europa.eu/legal-content/HR/TXT/HTML/?uri=CELEX:32000L0076&from=EN>

Nations Framework Convention on Climate Change. This directive defines refuse derived biogas and biomass as biodegradable part of products, wastes and organic remains, as well as biodegradable components of industrial and municipal waste. So, like Directive 2001/77/EC, this directive support a development of market for solid refuse derived fuel.²⁰

Directive on the landfills of waste (1999/31/EC). Directive on the landfills of waste (1999/31/EC) intends to prevent or minimize the adverse effects of the landfills of waste on the environment, particularly on the surface waters, underground water, soil, air and human health. It introduces the requirements for reducing quantities of biodegradable waste disposed of and sets technical and organizational conditions the landfill must comply with.

Directive 2010/75/EU on industrial emissions requires permits for industrial and agricultural activities causing a great deal of pollution. This means the permits must take into account the overall environment impact of a facility in order to avoid the shift of pollution from one media like air, water or soil onto another. The priority should be given to preventing pollution by intervention at the source and providing for well-thought use and management of natural resources. The directive sets a number of requirements that will provide for use of best available technologies BAT, i.e. best techniques for preventing and reducing emissions, technically feasible and economically viable within the sector.²¹

Circular Economy Strategy. European Commission has adopted an ambitious set of measures for achieving Circular Economy, including revised proposals of the law on waste which is supposed to encourage European transition toward circular economy aimed at promoting global competitiveness of European companies, promotion of sustainable economic growth and creation of new jobs. The Circular Economy Strategy includes Action Plan to set up a specific and ambitious action program including measures covering the entire cycle: from production and consumption of waste to development of the market for secondary raw materials. The proposed activities will contribute by closing the product life span „loop“ to increase recycling and reuse, which will bring about benefits for both environment and economy.

These changes include the revised goals as follows:

- By 2030 not more than 10% of the waste could be landfilled
- By 2030 at least 65% of the municipal waste should be prepared for reuse and recycling
- By 2030 at least 75% of the packaging waste should be prepared for reuse and recycling (min. 65% by 2025), 7 member states are entitled to additional 5 years (2035).

To achieve those goals, the following incentive measures are envisaged:

- Selective waste collection
- Tax burden on waste landfilling and incineration
- Shift from the existing MBO technology
- No financial assets for excessive capacities (MBO and incineration plants)
- Investments in new technologies
- Proactive approach at the national (supportive laws), and more importantly – regional and local level (education, projects, implementation)
- Financing (Horizon 2020, Structural funds, social, regional development, rural development, environment, Erasmus).

Amendments have been proposed for the following directives:

- Directive 2008/98/EC on waste

²⁰ Official Journal of the EU, 15/Sv. 011, L 140/16, available at: <http://eur-lex.europa.eu/legal-content/HR/TXT/HTML/?uri=CELEX:32009L0028&from=en>

²¹ Official Journal of the EU, 15/Sv. 015, L 334/17, available at: <http://eur-lex.europa.eu/legal-content/HR/ALL/?uri=CELEX:32010L0075>

- Directive 1999/31/EC on the landfills of waste
- Directive 94/62/EC on packaging and packaging waste
- Directive 2000/53/EC on end-of life vehicles
- Directive 2006/66/EC on batteries and accumulators
- Directive 2012/19/EU on waste electrical and electronic equipment

4.2 National legislation

In the F BiH waste management is regulated by the Law on Waste Management (Official Gazette of the F BiH No. 33/03 and 72/09).

In its Article 1, the Law covers all the waste categories except radioactive waste, gaseous effluents emitted into the atmosphere and waste water, as well as all waste management activities, operations and plants.

Article 2 defines the objective of the Law to encourage and provide the basic conditions for the prevention of production, recycling and processing of waste for re-use; the extraction of secondary raw materials and possibly of energy thereof; and safe disposal.

Article 3 emphasizes the priorities related to the waste management, whilst taking into account the environment benefits, technical feasibility for application of best available technology, as well as economic feasibility. The waste management shall be carried out in the way to take into account the prevention of pollution and the minimization of the consequences for human health and the environment, by implementing the following measures:

- Without risk to water, air, soil and plants and animals,
- Without causing a nuisance through noise or odors
- Without adversely affecting the countryside or places of special interest

In order to accomplish the objective and whilst taking into account the prevention of pollution and the minimization of the consequences for human health and the environment, the waste management shall be done in a way to secure:

- The generation of wastes and especially the hazardous characteristics of such waste is reduced to a minimum,
- The reduction of the quantities of wastes shall be properly managed, taking into consideration special waste streams,
- Wastes shall be treated in a way to ensure recovery
- Those wastes which are not subject to reuse or recovery shall be disposed of-incinerated or disposed of in landfills in an environmentally sound way.

The provisions of Article 5 defines basic principles of waste management, including:

- Prevention – the production of waste should be avoided or at least the quantity and harmfulness of waste produced should be minimized in order to reduce risk to human health and to the environment and to avoid environmental degradation.
- Producer responsibility – producer is responsible for selecting the most environmentally sensitive solution in line with the characteristics of the product and production technology, including the life-cycle approach and the use of best available techniques as appropriate,
- Polluter pays principle – producer or holder of waste shall cover the costs of prevention, of the recovery and disposal of waste, including aftercare and monitoring.

The Law includes the provisions on waste management planning, whereby the competent authorities are responsible for working out waste management plans including strategic goals and elaborated priorities, general technical requirements, list of measures to be undertaken etc.

These provisions envisage drafting a Strategic waste management plan in the F BiH as integral part of the Environment Protection Strategy. Waste management strategy for a six-year period is to be adopted by the F BiH Parliament at the proposal of the F BiH Government.

In addition to the Federal Plan, the provisions of Article 9 and 10 provides for adoption of the waste management plans in cantons, but those plans must be harmonized with the F BiH Strategy of waste management. Cantonal regulations shall define tasks of the municipalities in drafting the municipal waste management plans that need to include at least the following:

- programs on the collection of hazardous wastes from households;
- strategic plans for utilization of any of the components of municipal waste;
- programs to reduce the percentage of biodegradable waste and packaging waste in municipal waste;
- programs to raise awareness of the public on waste management issues;
- siting of waste management installations;
- co-operation with other municipalities to achieve the set objectives.

Article 15 covers the general regulations concerning waste management and states, inter alia, as follows:

- The waste produced shall be utilized only if it is ecologically beneficial, technically and economically feasible to do so,
- Wastes shall be disposed of only if the use of its material and/or its energy is not possible under the existing technical and economic conditions and if the costs of recovery are unreasonably high compared to the costs of disposal.

Article 25 includes municipal waste management provisions with the emphasis on collection and treatment of municipal waste to be made in accordance with the special regulation on public waste service, establishment and operations of public waste services are defined by cantonal regulations, households are obliged to collect waste generated by them and to hand it over to the public service provider, and in the case of hazardous waste to selective collection points (centers) or to a person having special authorization for operating waste management services, and the waste producers other than households shall use the public service for wastes generated by them that is the same and/or similar to household waste by its nature.

Provisions of Article 26 state that cantonal regulations shall include requirements concerning selective waste collection and treatment, where the public service operations include:

- waste collection from households and other premises producing municipal wastes;
- treatment of municipal wastes including the management of recovery and/or disposal,
- selective waste collection points, as appropriate.

Provisions of Article 29, 30 and 31 cover waste treatment, collection and utilization respectively, where the waste treatment facility operator will be considered as producer of waste in case of waste produced during treatment operations, and the operator shall record data concerning the waste taken or produced by him and shall report to the respective authorities according to special legal regulations, at least once a year. The operator of waste collection system collects wastes from producers and holders and transports these to a collection facility, transfer station or to the place of reuse and recycling, treatment or disposal. The operator of waste collection may also take over wastes from holders at the collection site. The utilization of wastes might be undertaken by material

and energy recovery. The products originated from the utilization of waste shall not cause greater environmental load than that caused by the products from primary raw material.

In addition to the aforesaid law, there is a number of by-laws concerning waste management, out of which we could single out the following as particularly relevant for the topic:

- Rules on categories of waste with lists (Official Gazette of the F BiH No. 9/05)
- Rules defining how to handle hazardous wastes not included in the list of wastes or the content of which is unknown (Official Gazette of the F BiH NO. 9/05)
- Rules on conditions for operating waste incineration plants (Official Gazette of the F BiH No. 12/05)
- Regulation defining obligations of waste operators and producers to report on implementation of the supervision, monitoring and record keeping programs according to the conditions of the permit (Official Gazette of the F BiH No. 31/06)
- Rules on transboundary movement of wastes (Official Gazette of the F BiH NO. 07/11)
- Decision on ratification of the Convention on transboundary movement of hazardous wastes and their disposal (Official Gazette of the F BiH No. 31/00).

Rules on transboundary movement of wastes (Official Gazette of the F BiH NO. 07/11), regulate import, export and transportation of wastes in the Federation of Bosnia and Herzegovina, which is of importance for both producers and importers of RDF. These Rules define general principles of transboundary movement of hazardous and non-hazardous wastes, border crossings for transboundary movement of hazardous and non-hazardous wastes and lists of hazardous and non-hazardous wastes in the transboundary transportation. Each consignment of non-hazardous wastes imported from/imported in the F BiH shall be accompanied by the form given attached to the Rules, to be submitted to the FMOiT in two copies and the contract between importer and operators authorized for management of the waste imported/exported.

Institutionally speaking, the activities covering the wastes are under the competence of the Federal Ministry of Environment and Tourism (FMOiT), sectoral ministries of cantons, and part of the competences fall under the units of local self-governments (cities and municipalities).

Table 3 illustrates the institutional framework of the waste management system in accordance with the effective laws and regulations.

Table 3: Institutional competences for waste management in FBiH

Institution / Entity	Waste-related competences
FBiH Parliament	Adopts Federal laws and Federal Environment Protection Strategy
FBiH Government	Adopts Federal Waste Management Plan (2012-2017) and Regulations, and coordinate through Federal Ministry of Environment and Tourism all waste management activities
FBiH Environment Fund	Co-finances plans, programs, projects and similar activities relevant to waste management system operation
Environment Advisory Council	Plays an advisory and consultative role and propose the competent cantonal ministries for environment protection. Members of the Environment Advisory Council are appointed by the FBiH Government
Cantonal Assembly	Adopts Waste Management Plan and cantonal laws
Cantonal Government	Coordinate through a sectoral ministry all waste management activities in the canton
Cities and Municipalities	Take care of municipal waste management
Other stakeholders	Waste producers, importers of products and wastes, companies in charge of waste management, consultancies, expert institutions and organizations and relevant associations.

Cities and municipalities take care of the municipal waste management. All municipalities, 79 of them, in the F BiH, have one or more utility companies: KJKP, JKP, JP and KP. Some municipalities have more than one waste management company. The waste management companies exist also in those municipalities which do not have a local landfill to dispose of their wastes, but transport them to a location outside their own municipality.²²

4.3 Goals to be accomplished in the field of waste management, strategic and planning documents

4.4 Strategic and planning documents

Adoption of the Waste Management Strategy and Plans is particularly important for Bosnia and Herzegovina since on the basis of these documents the prerequisites are created for making changes that would gradually lead to resolution of the current problems, improve the system and streamline the future practice in BiH toward accomplishing a desired objective, namely sustainably waste management and harmonization with the prevailing practice in the EU countries.

4.4.1 Federal environment protection strategy

Federal environment protection strategy has a major role on the BiH path to accomplishing its goals: joining EU, as well as the stabilization process and adjustment of the F BiH to the sustainable development concept. This strategic document includes a number of major principles and guidelines for achieving sustainable development as provided in the Law on Environment Protection and it covers the ten year period (2008 – 2018).

Some of the principles and guidelines the Strategy is based on include:

- Principle of substitution - every operation which might adversely affect the environment should be replaced by the operation which will imply substantially less risk or danger
- Principle of integration – protection of environment and improvement of the environment quality need to be integral part of any environment development policies
- Principle of precaution and prevention – careful and cost-effective management of the environment
- The reduction of the utilization, loading and pollution of the environment, the prevention of its impairment, and the improvement and restoration of the damaged environment
- Initiatives taken by the public and public participation in the activities aimed at the protection of the environment
- Coordination of economy and integration of social and economic development in line with the environment protection requirements.

The concept of setting goals and measures for all components of the Strategy is adjusted to the uniform approach for all sectors. Most chapters of the Strategy has a specific umbrella goal which is of general nature and testifies to all the Strategy provisions being focused on a single joint objective to accomplish the environment protection, promotion and encouragement for sustainable use of natural resources through establishing an integral system of natural biological and geomorphological diversity management. As each of the area includes a number of complex matters that are tackled as a whole, the strategic goals are defined for each component.

Adoption of the Federal Waste Management Strategy is envisaged by Article 48 of the Law on Environment Protection the Environment Protection Strategy is an integral part of. The Strategy sets goals and measures in terms of waste management, the state of the environment in F BiH (2008).

²²Enova d.o.o., 2016

The overall goal could be achieved by implementing measures envisaged within the following strategic goals (SC) of municipal waste management:

- reducing risks to the environment and human health and establishing priority infrastructure for integrated waste management (SC 7.1)
- Reducing waste for final disposal, along with efficient utilization of resources (SC 7.2)
- Ensuring system implementation through legal, institutional and economic framework (SC 7.3)
- Ensuring systematic monitoring of the environment quality assessment parameters (SC 7.4)

The strategic goals includes the operational goals, as specific and measurable changes to be accomplished during the implementation of the Strategy measures and will contribute to achieving the overall goal and strategic goals.

For the purpose of this report, the strategic goal 7.2 is of particular interest within which the following operational goals (OG) have been defined:

- To set up a separate waste collection system in all F BiH municipalities (OG /2.1)
- To collect and recycle the packaging waste (OG 7.2.2.)
- To separately collect bio waste from gardens and parks (OG 7.2.3.)
- To set up regional waste management centers (RWMC) in all regions (OG 7.2.4.)

The aforesaid goals put the emphasis on separate collection, reuse and recycling, in other words, on setting up an integrated waste management system aimed at reducing quantities of municipal waste scheduled for final disposal.

A network of local sites for separate collection, recycling yards, reloading stations and/or mechanical and biological waste treatment plants for the regions assessed as economically viable, as well as regional waste management centers are all part of the single integrated system.

The models of association of municipalities of one canton into joint regions vary and do not include the mandatory association in the territory of the same canton and/or entity. Number and locations of regional centers depends on economic factors, so the goal of efficient development of this concept includes determination of economic factors and proposing the best solution.

Regional waste management centers are made up of at least the following components:

- Sanitary landfill
- Recycling yards for taking separate fractions and waste brought by individual waste producers (legal entities, households)
- Pre-treatment plant, separation of secondary raw materials and recycling
- Separate storages for taking hazardous waste from municipal sources
- Mechanical-biological waste treatment plant (MBO).

Implementation options for operational goals, and thereby a strategic goal are manifold. So, several municipalities can group together into a single joint waste management center (CUO) and for each municipality to have its own recycling yard. Other options include municipalities having their own recycling yards, or those remote municipalities separately collecting waste and bringing it to the regional CUO (RCUO) for sorting and disposal of the remaining quantity. The MBO concept has developed as a result of a desire to reduce the quantity of biodegradable waste being disposed of at landfills, and to have the automatic separation system provide for recovery of useful raws from waste. The chart of a regional concept in the territory of a canton is illustrated in Image 4.

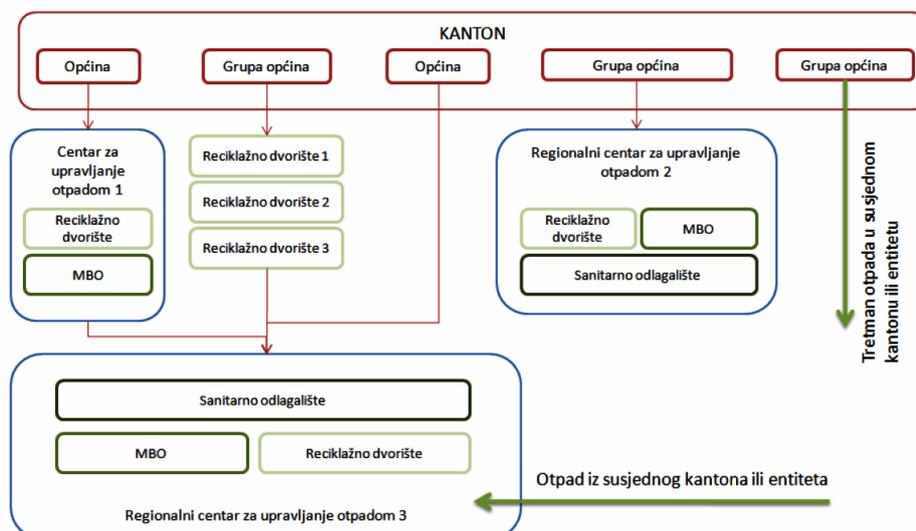
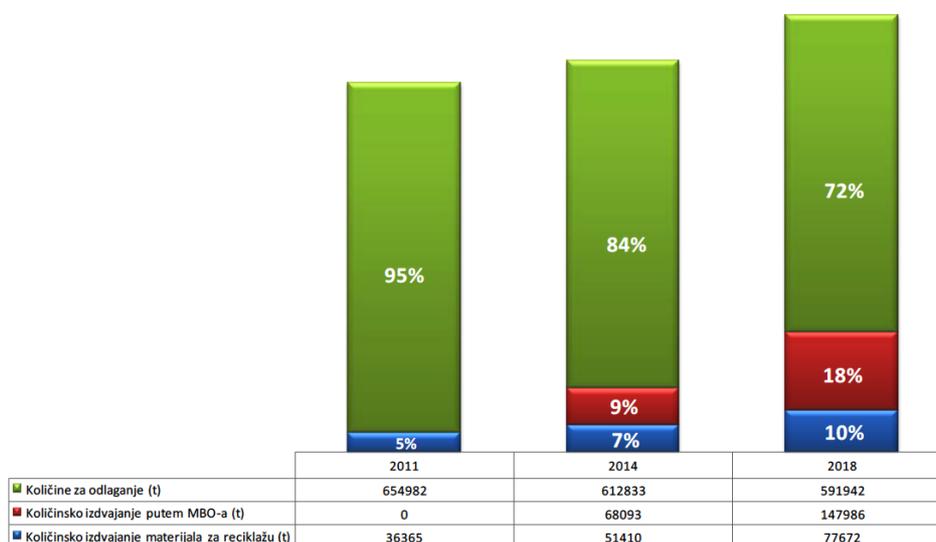


Figure 4: Chart of a regional concept in the territory of a canton²³

As part of the cantonal plans elaborated below, it is important to include the measures of drafting a feasibility study to choose the optimal MBO technology in line with the expected goals and local peculiarities. The MBO technology is expected to be cost-effective primarily in larger urban centers where big quantities of waste are being collected. Quantity-wise it is possible to separate 20-50% of the total collected wastes per center, depending on the technology applied and the waste composition. The total expected effects in the F BiH is 10% in mid-term and 20% in long-term period (Graph 1).



Graph 1. Expected effects of the waste disposal reduction by putting in place measures for selective collection and setting up MBO-e²⁴

²³ FMOIT 2010

²⁴ ibid.

4.4.2 Federal waste management plan (2012-2017)

The drafting of the Federal waste management plan (FPUO) is envisaged by Article 6 of the Law on Waste Management (Official Gazette of the F BiH No. 33/03 and 72/09). Federal plan is the implementation document of the Strategy and it provides guidelines for management of various types of waste in the F BiH, the main goal of which is to set up an integral waste management system. The waste collection system in the F BiH should be organized as an integral endeavor encompassing all stakeholders at both regional and local level. The proposed chart is depicted by Figure 5.

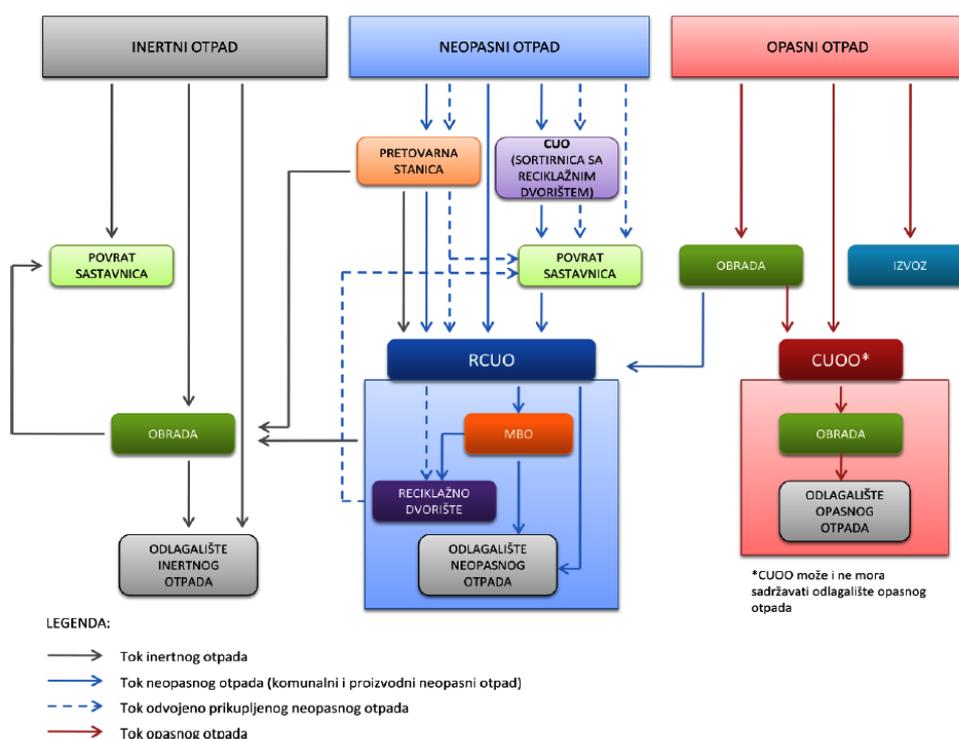


Figure 5: The proposed waste collection system organization²⁵

In accordance with the F BiH Waste Management Strategy 2008-2018, the Plan provides that the integral waste management system follows a regional concept, i.e. it is generated in several municipalities which band together into regions covered by the Cantonal waste management plan.

Part of the municipal waste shall be collected by separate collection system (green islands, RD) and once the special regulations are passed for specific categories of waste (packaging waste, waste tires, discarded electrical and electronic equipment etc.) and their application. Separately collected waste could be directly transported for recovery of material or energy, i.e. to the reloading station (PS), waste management center (CUO) or even a regional waste management center (RCUO), to be processed there for material or energy recovery. The mixed municipal waste is collected through organized collection network organized by companies authorized for municipal waste collection. The collected waste is then transported to CUO, PS or RCUO:

The waste collected in CUO or PS is transported to RCUO located at some distance from human settlements. Apart from the waste collected in CUO or PS, the RCUO takes the waste collected through organized waste collection network in the nearby areas. Various activities are going on in the RCUO (Figure 6) with regard to waste treatment before its final disposal at the non-hazardous waste disposal site. These activities include:

²⁵ FMOIT, 2011

- Acceptance and treatment of sorted or unsorted waste
- Acceptance and storage of waste that can be reused or recycled
- Acceptance, temporary storage and handing over of hazardous waste from households
- Acceptance, temporary storage and distribution of waste than can be reused
- Disposal of the processed waste

The term „processing“ of waste primarily means sorting of waste. Given that FPUO is adopted for a five-year period, this Plan envisages setting up a sorting facility within RCUO. This options provides for upgrading of a system in terms of future establishment of mechanical-biological treatment of waste (MB) since the sorting facility stands, to a certain extent, for „M“ in the MBO technology.



Figure 6: Elements of RCUO²⁶

The Law on waste management provides for an optional construction of inter-municipal landfills. The final decision on concept selection (regional or inter-municipal) depends on the provisions of the cantonal waste management plans. Practical experience has shown that direct transportation of waste is cost-effective for the distances of up to 30 km from the waste generation source to the landfill, in some regions they have to build reloading stations. The framework proposal for reloading station locations, as well as their orientation to a specific RCUO is depicted in Figure 7.

²⁶ FMOIT, 2011

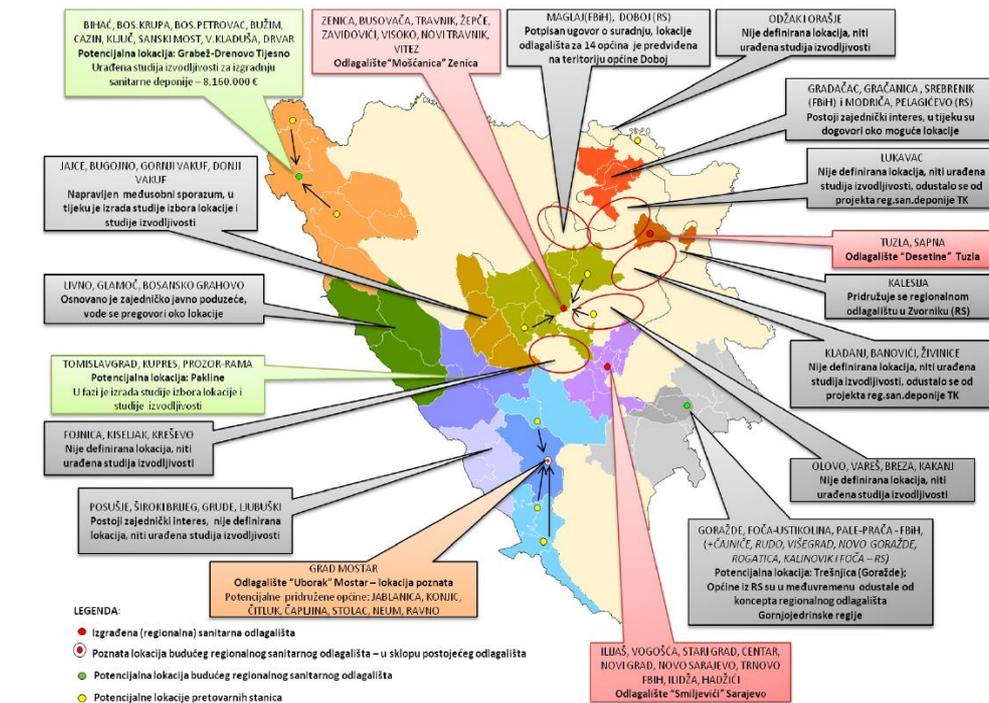


Figure 7: Regional concept of building RCUs in the FBiH²⁷

According to the Action Plan presented in the FPUO the following activities are planned within RCUs by 2018:

1. Signing inter-municipal contracts on joint establishment and utilization of the future RCUs and/or CUs (by 2012)
2. Making plan to inform the public on the planned activities to build RCUs and/or CUs – targeted campaign (by 2012)
3. Drafting a localization and feasibility study on RCUs including landfill for specific regions, and location and feasibility study on PS/CUs. The site is to be entered into the spatial-planning documents (2012-2013)
4. Drafting the Environment impact study and all documents for all RCUs and PS/CUs. Obtaining required permits (2012-2014)
5. Building sanitary landfills within RCUs (2013-2016)
6. Setting up a small-sized MBO system within RCUs in stages (sorting facility and composting zone (according to the RCUs setup time frame).

Obviously, the implementation of these activities is in arrears and the new waste management plan will have to revise it and set more realistic time frame for its implementation.

4.4.3 Cantonal waste management plans

Drafting waste management plans for cantons falls under the cantonal legal obligations and constitutes an instrument all relevant municipal authorities need to agree upon, because this is the basis upon which they are going to plan their activities and investments in the waste management sector. The Plan sets and streamlines waste management goals in line with economic, social and cultural development of the canton.

²⁷ FMOIT, 2011

The cantonal waste management plans have been adopted in the Canton of Sarajevo, Una-Sana Canton, Zenica-Doboj Canton, Central Bosnia Canton and Bosnian-Podrinje Canton (Table 4). In two cantons, Herzegovina-Neretva and Tuzla, they adopted draft waste management plans, whereas in the remaining three cantons no activities have been launched to adopt ones.

Table 4: Overview of the cantons that adopted their waste management plans

No.	Canton	Date of adoption	Period covered
1.	Zenica-Doboj	23.01.2009.	2009-2018
2.	Bosnian-Podrinje	29.04.2014.	2013-2018
3.	Una-Sana	14.07.2014.	2014-2019
4.	Sarajevo	November, 2014.	2014-2019
5.	Central Bosnia	January, 2015.	2015-2020

Zenica-Doboj Canton was first to adopt the waste management plan in accordance with the Action Plan of measures under the Federal Environment Protection Strategy and it is one of the cantons that has a functioning sanitary landfill.

Seven cantons have prepared their feasibility studies for regions and set locations based on the investigations for waste management regional centers, whereas three cantons have not launched activities to do so. One of the reasons for this delay in adoption of the cantonal plans is related to problems in setting locations for sanitary landfill for several municipalities in the cantonal territory.

Table 5 gives an overview of activities under the adopted cantonal waste management plans in the cantons, concerning solving specific waste management issues at the cantonal level and accomplishing the strategic goal with regard to reduction of waste for final disposal, along with more efficient use of resources, and operational goal of setting up regional waste management centers.

Table 5: Overview of the cantonal waste management plans with the emphasis on construction of RCUO and MBO

Document	Short description of problem	Scheduled activities
Waste management plan for the Una-Sana Canton 2014-2019.	<p>The main issues in the municipal waste management:</p> <ul style="list-style-type: none"> ▪ Insufficient coverage of the USK municipalities with organized municipal waste management, ▪ Large number of wild landfills, ▪ The service fees for municipal waste management is not „cost-effective“. 	<ol style="list-style-type: none"> 1. Drafting a feasibility study, project design document and obtaining required permits for construction of the first phase of RCUO and setting up a small-sized MBO system (sorting facility and composting zone, 2017-2018; 2. Construction of the first phase of RCUO – sorting facility and composting zone, 2019.

Document	Short description of problem	Scheduled activities
Waste management plan for the Zenica-Doboj Canton 2009-2018.	<p>The main issues in the ZDK municipal waste management include:</p> <ul style="list-style-type: none"> ▪ Inadequate coverage with the municipal waste collection services which directly affects the uncontrolled disposal of a part of the generated municipal waste, ▪ The unknown number of wild landfills and their impacts on the environment and human health, ▪ The lack of technical conditions for separation of larger quantities of recyclables from waste and their marketing, as well as reduction of final quantities of waste for disposal (recycling islands, recycling yards, MBO) 	<ol style="list-style-type: none"> 1. To remove illegal landfills and rehabilitate the areas they were located in 2. Overview of the current situation and check the feasibility of removal and rehabilitation of landfills with detailed action plan – as integral part of the municipal plans 3. Mechanical-biological treatment of waste (MBO) – Activities envisaged within the waste management centers, 2009-2010.
Waste management plan for the Bosnian-Podrinje Canton Goražde 2013-2018	<p>Main municipal waste management issues in the BPK:</p> <ul style="list-style-type: none"> ▪ Non-sanitary municipal landfills and lack of prerequisites for fast transition onto sanitary landfilling, as provided by the effective laws, ▪ The locations of existing waste disposal sites most of which are located by the water streams, ▪ Lack of municipal waste collection capacities (bins, containers etc.), ▪ Lack of technical conditions for separation of larger quantities of recyclables from waste and their marketing, as well as reduction of final quantities of waste for disposal (green islands, MBO). 	<ol style="list-style-type: none"> 1. To draft localization and feasibility studies for PS/CUO for specific regions; To enter locations into the spatial planning documents; To draft feasibility studies on introduction of specific components within PS and setting up CUO, 2014 2. Environment Impact Assessment Study and project design documents for all RCUO and PS components. To obtain required permits, 2013-2014. 3. Final works and commissioning of a new landfill (part of the future RCUO) 2015
Waste management plan for the Sarajevo Canton 2014-2019.	<p>The main issue in the KS is lack of space available for new infrastructure and expansion of the landfill. A potential solution is building of an MBO plant that could produce RDF. Also planned is to investigate possibilities to produce RDF and recovery of resources by using energy from wastes.</p> <p>In this planning period, they plan to draft a feasibility study to investigate MBO plant feasibility including:</p> <ul style="list-style-type: none"> ▪ Study on types and quantities of waste based on the samples taken. ▪ Feasibility study on selection the best waste treatment solution, that needs to help chose the best available technology for the Sarajevo Canton, location (RCUO or else), institutional arrangements, investments and operational costs, modes of financing, impact on the environment of each of the options under elaboration. One alternative is so-called „business as usual“ and continuation of the waste landfilling, including separation of usable raws at 	<ol style="list-style-type: none"> 1. To remove wild landfills and rehabilitate the areas of their location (100% by 2019) 2. To set up a Regional waste management center (2014-2019.)

Document	Short description of problem	Scheduled activities
	<p>the existing sorting plant. This study will consider the function of the sorting plant at the RCUO location as related to the time of drafting the study. The study is planned after the construction of the waste separation system in the Canton, so the preliminary data on the effects will be well-known.</p>	
<p>Waste management plan for Central Bosnia Canton 2015-2025</p>	<p>In SBK there are no recycling yards built, so in order to extract useful components from waste, building of the recycling centers needs to be planned. Municipalities of Travnik, Novi Travnik and Vitez signed back in 2014 a Memorandum of Understanding on building an intermunicipal reloading station for municipal waste including recycling yard aimed at transporting their wastes to the regional landfill Moščanica, Zenica. The following steps include: finding a location and space for this facility, entering the site into the municipal spatial-planning documents, developing project design documents, obtaining all required permits and construction of the facility.</p> <p>In order to establish an integral waste management system in the SBK, setting up a proper infrastructure is scheduled on the basis of the regional concept, including: a network of local sites (green islands), a network of larger sites (CUO), reloading stations, and RCUO including a regional sanitary landfill (RSD). In September 2012, a „Feasibility Study for Regional Sanitary Landfill of Waste in SBK“ was drafted. According to the Feasibility Study for RSD, Region 1 (Municipality of Jajce, Donji Vakuf, Gornji Vakuf-Uskoplje, Bugojno) the preferred location for RSD construction is the Gračanica site (Municipality of Gornji Vakuf-Uskoplje). Within RSD, a PS in the Municipality of Jajce is to be built. At the RSD location, a space for future expansion (future RCUO) is designated to accommodate some facilities in the future (composting facility, sorting facility, MBO plant).</p>	<ol style="list-style-type: none"> 1. To build RSD at the specified location in SBK – I Phase of RCUO construction (2017-2020) 2. II Phase of RCUO construction – setting up a small-sized MBO system (sorting facility and composting zone (20121-2025)

The Audit Office of the Institutions of F BiH has found a delay in implementation of the activities of adoption of Waste management plans at the lower levels. At the municipal level, the waste management plan was adopted by 21 municipalities or about 27% of all municipalities²⁸.

The lower level authorities which adopted their Waste management plans have inadequately implemented their planned goals, whereas in most cantons or municipalities these documents have not been adopted at all. In addition, most of the cantons and municipalities have not drafted their

²⁸ Audit Office of the Institutions of the F BiH, 2015.

feasibility studies for the region or specified locations for waste management regional centers, based on the investigations.

The key role of the waste management plans is to establish a sustainable waste management i.e. to define waste streams and treatment options. It was noted that the basic document that needs to define waste management streams and its treatment at the Federal, cantonal and municipal level has not been adopted in most cases.

At the BiH Federation level, no institution has been established to monitor developments in the waste management sector, as a good practice of the neighboring countries who established their Environment Protection Agencies.

According to the data available on types and quantities of waste in the BiH Federation, the current data do not provide a full picture for monitoring the achievement of goals set under the waste management plan²⁹.

4.5 European waste management trends

The basic principle of the European waste legislation is observing the waste hierarchy. This approach is a key method for harvesting ever larger useful raws from waste, whereby recycling plays a very important role. It is exactly how to achieve sustainable development by preserving resources for future generations and consequently by reducing pressures on environment.

The data shown in this chapter have been obtained from the databases of the European Environment Agency (EEA) and EUROSTAT, and they include 32 EEA countries: EU-28 member states, Island, Norway, Switzerland and Turkey, as supplemented by the data for the Western Balkans countries.

4.5.1 Quantities of waste generated per capita

The total quantity of municipal waste generated in the EEA countries has dropped by 3% and the average production per capita by 7% in the period between 2004 and 2014. However, there is no uniform trend by countries; the municipal waste generated per capita dropped in 19 countries, and rose in 16 countries (Figure 8).

²⁹ *ibid.*

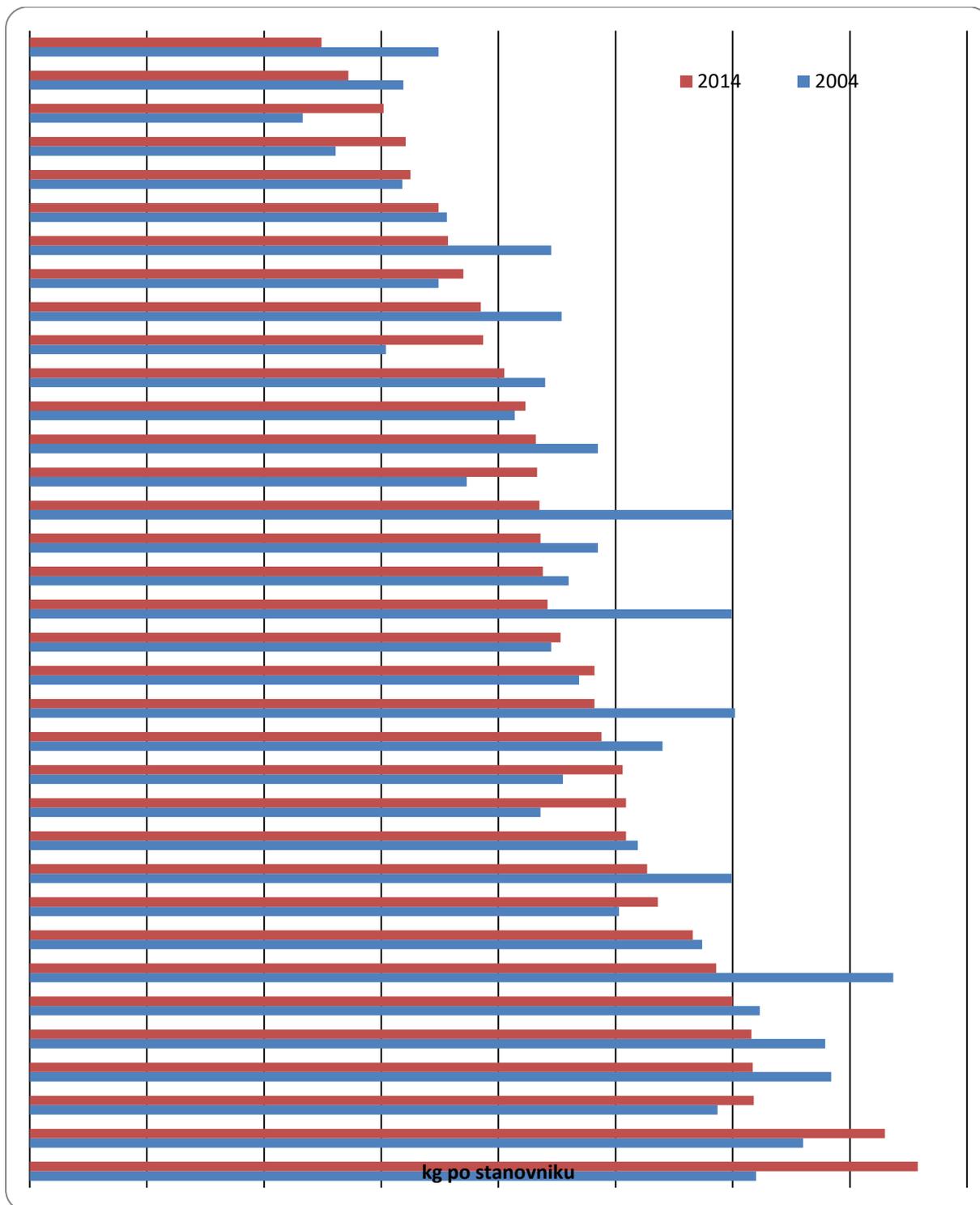


Figure 8: Quantities of waste generated per capita in 35 European countries³⁰

In 2014, the quantity of waste generated per capita was highest in Denmark and Switzerland, and lowest in Poland, Romania and Serbia. This indicates that the developed countries tend to produce more waste per capita, whereas the well-developed tourism contributes to the rise in quantities of waste per capita (Cyprus, Malta).

³⁰ European Environment Agency, Municipal waste management across European countries, 2016.

4.5.2 Recycling rate

The recycling rate is a great indicator for demonstrating a country's progress in the waste management system, and accordingly, it clearly shows the compliance with the waste management hierarchy and goals set concerning waste treatment. The framework directive on waste has set a goal on municipal waste recycling rate of 50% by 2020 in the member countries.

Between 2004 and 2014 in the EU-27 and Norway, the municipal waste recycling rate rose by 13%, whereby this upward trend indicates the improved municipal waste management system. In 2014, 44% of the totally produced municipal waste in EU-27 and Norway was recycled, including composting and anaerobic digestion treatment.

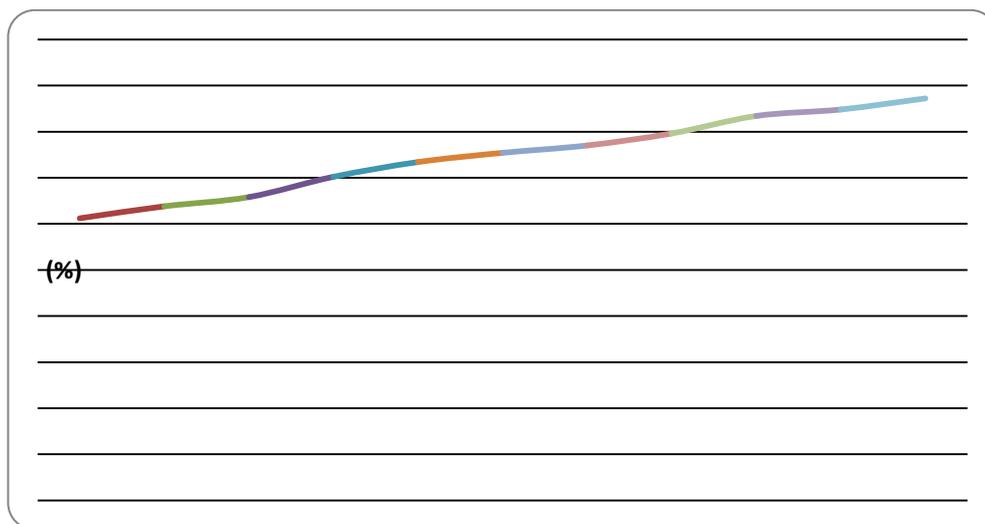


Figure 9: Upward recycling trend in Europe between 2004 and 2014³¹

A difference between countries with the highest recycling rate and those with the lowest recycling rate is huge: Germany with the recycling rate of 64% in 2014 and Serbia with the recycling rate of 1%. Six countries: Germany, Austria, Belgium, Switzerland, Netherlands and Sweden have reached the recycling rate of more than 50%. Ten countries have made some major progress by having their recycling rate increased by more than 15% between 2004 and 2014 (Czech Republic, Cyprus, Hungary, Italy, Latvia, Lithuania, Poland, Portugal, Spain and the United Kingdom). In nine countries no upward trend in recycling has been noted (Figure 10).

³¹ European Environment Agency, Waste recycling, 2016.

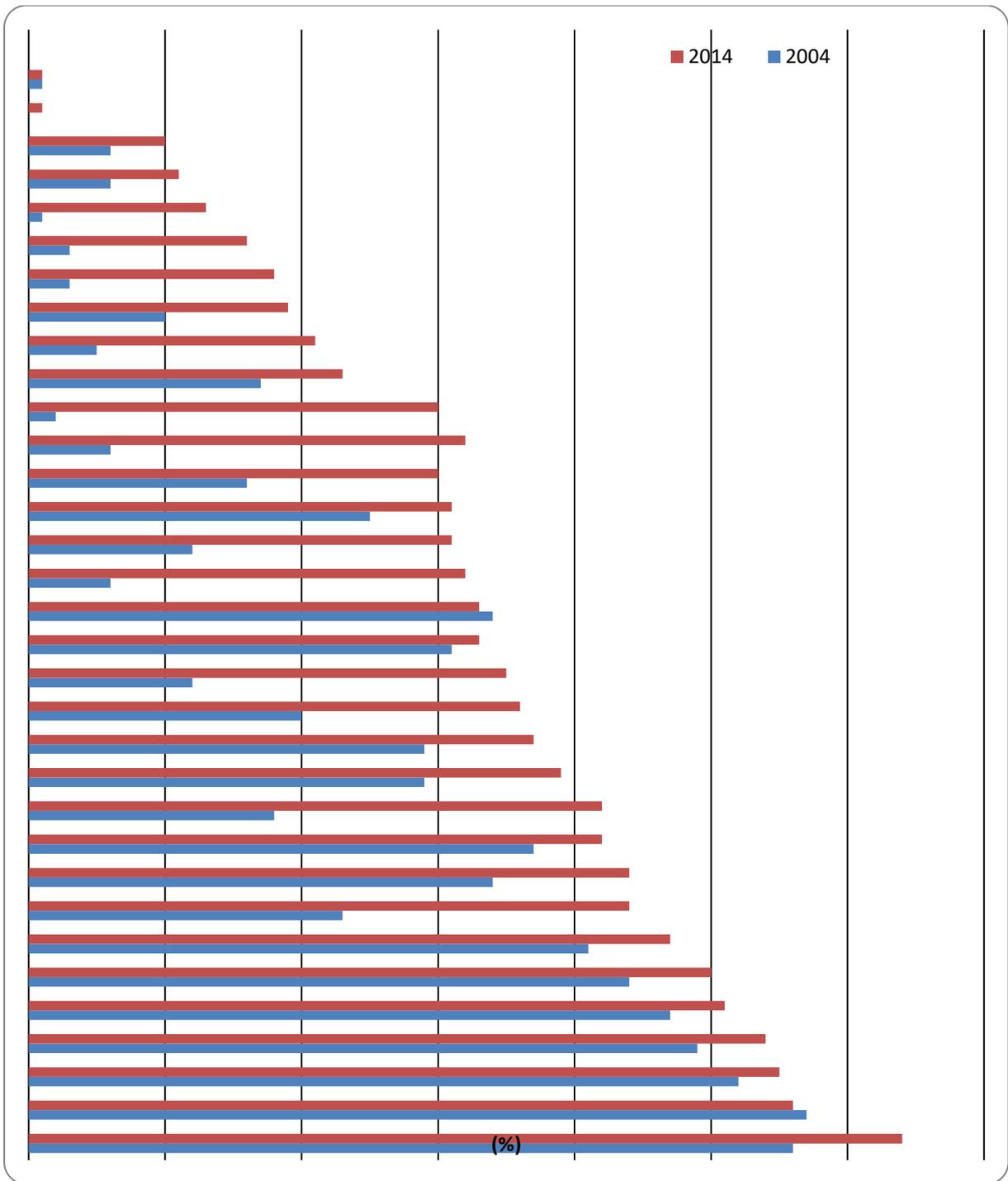


Figure 10: Recycling and composting rate in 35 European countries (2004 – 2014)³²

³² European Environment Agency, Waste recycling, 2016.

4.5.3 Greenhouse gas emissions from waste management sector

In its reports, EUROSTAT specifies that the Secretariat of the United Nations Framework Convention on Climate Change (UNFCCC) involves a breakdown of emissions from solid waste disposal into three subcategories:

- Sector 6A - landfill;
- Sector 6C - incineration without energy recovery; and
- Sector 6D³³ - other treatments such as fermentation/composting.

Figure 11 shows the estimated share of the three waste disposal operations in GHG emissions in 2011

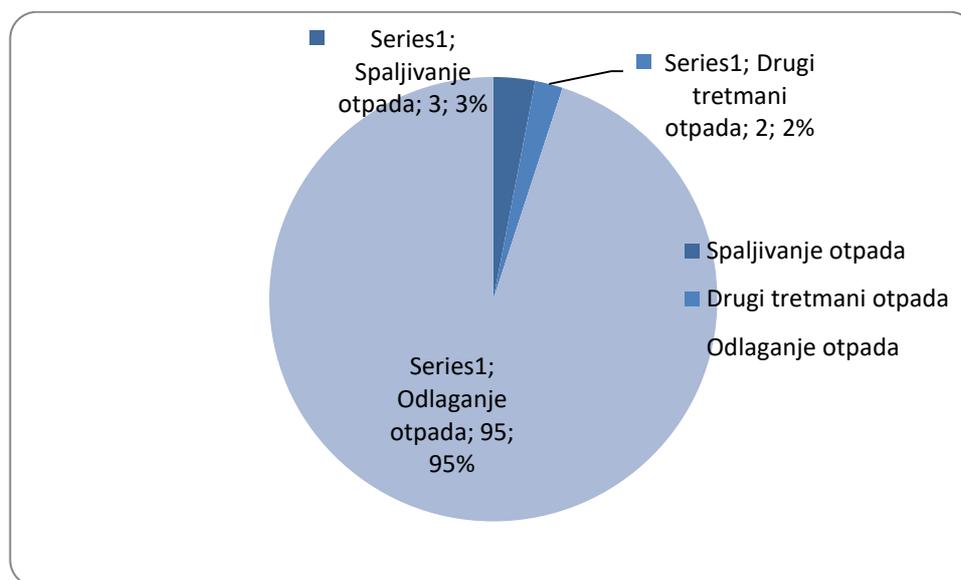


Figure 11: Estimated share of the three waste disposal operations in GHG emissions³⁴

In the early 1990's, greenhouse gas emissions from landfill decreased slowly. Between 1995 and 2005, there was a high rate of reduction, but since 2005 there has been slower progress in cutting emissions. Over the reporting period, total EU-15 emissions from incineration without energy recovery and other treatments have remained quite stable, at approximately 5 million tons CO₂ equivalent a year. Emissions from incineration without energy recovery are declining, whereas those from other treatment activities are rising.

Developments in GHG emissions per capita in the landfill sector for each EU-15 country are shown in Figure 12. Overall, these fell by 51 % from 1990 to 2011. Spain, Greece and Portugal show higher emissions in 2011 than in 1990. In 2011, emissions in Spain, Finland, the United Kingdom, and Portugal were significantly higher than the EU-15 average. Per-capita emissions in Belgium and Luxembourg were just half the EU-15 average in 2011.

Figure 13 gives an overview of the GHG emissions from landfill in 2011 in the other Member States than EU-15 Member States and the candidate countries. GHG emissions from landfill in the EU Member States that joined the EU in 2004 and after are in general (with the exception of Romania) higher than, or close to the EU-15 average (in the cases of Estonia, Poland, Croatia, and Slovenia).

³³ Eurostat, Greenhouse gas emissions from waste disposal, 2014.

³⁴ Eurostat, Greenhouse gas emissions from waste disposal, 2014.

Only Bulgaria, Cyprus, Slovakia, Malta and Hungary rank significantly above the average. Overall, the EU-28 average differs only slightly from the EU-15 average.

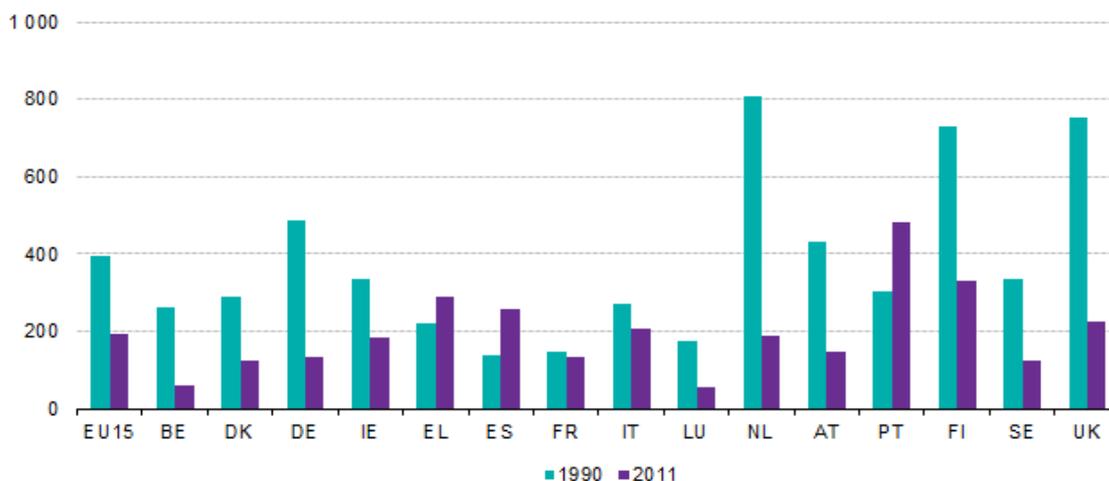


Figure 12: Per-capita GHG emissions in 1990 and 2011 for landfill, EU-15 Member States (kg CO2-eq / year per person)³⁵

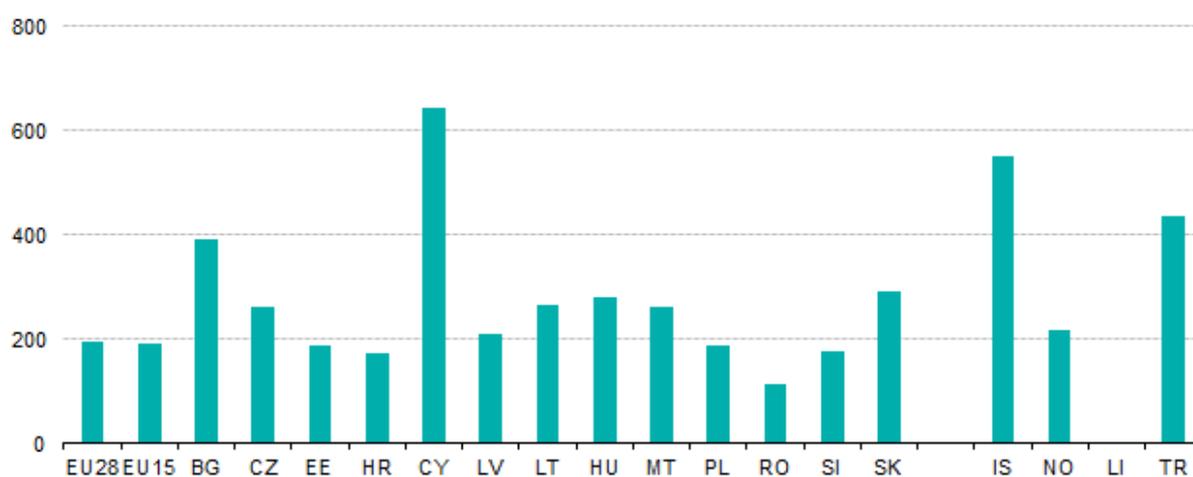


Figure 13: Per-capita GHG emissions in 2011 for landfill, non-EU-15 countries (kg CO2-eq / year per person)³⁶

By adopting Landfill Directive 1999/31/EC, the a powerful tool was introduced for reducing the amount of biodegradable municipal waste going to landfill. It is this fraction of the waste that accounts for GHG methane emissions. Article 5 of the Directive sets targets for reducing the volume of biodegradable municipal waste sent to landfill (Chapter 3.3.3)

From the existing Eurostat data it is not possible to track the reduction in biodegradable municipal waste, as only the total amount of municipal waste sent to landfill is monitored. Twelve of the EU-15 countries fail to meet the targets set in 2006. Figure 14 shows the percentage of landfilling of biodegradable municipal waste in 2006, 2009 and 2010, and the targets laid down in the Directive for the landfills of waste.

³⁵ Eurostat, Greenhouse gas emissions from waste disposal, 2014.

³⁶ Eurostat, Greenhouse gas emissions from waste disposal, 2014.

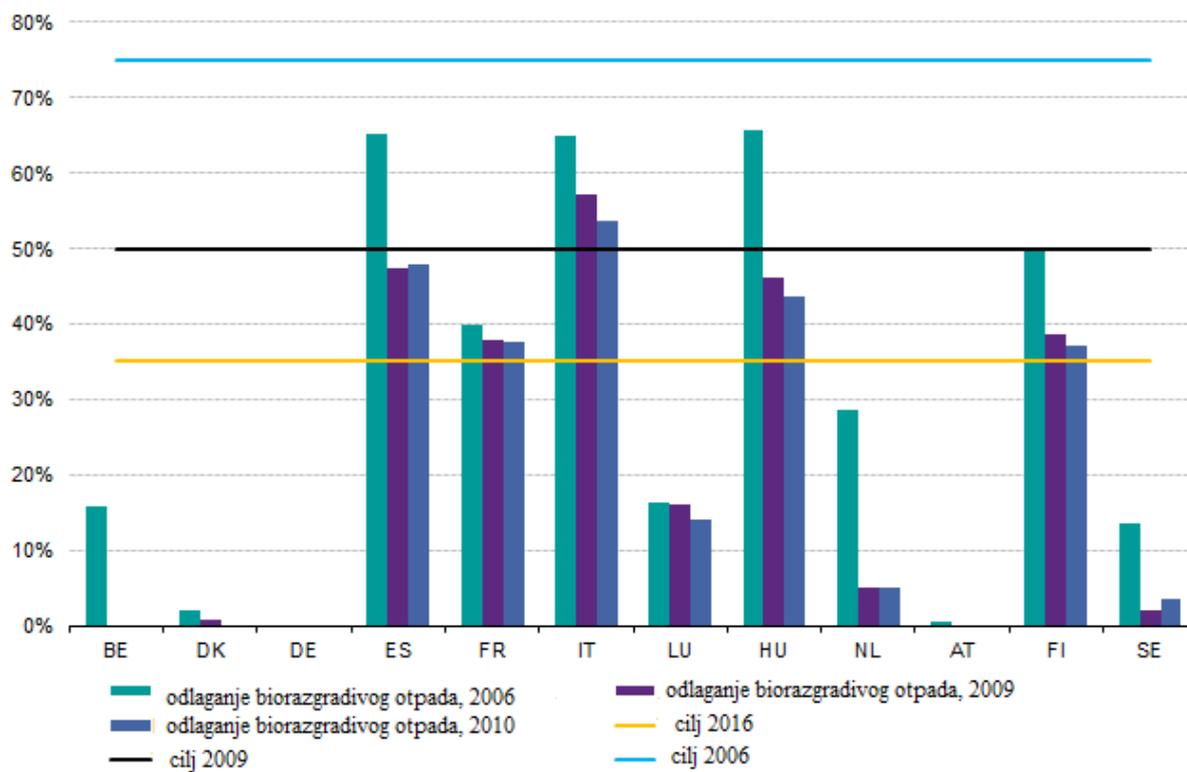


Figure 14: 2006, 2009, 2011 landfilling of biodegradable waste as a percentage of the 1995 biodegradable waste generation³⁷

³⁷ Eurostat, Greenhouse gas emissions from waste disposal, 2014.

5 ANALYSIS OF THE STATE OF MUNICIPAL WASTE MANAGEMENT IN BIH

5.1 National level

5.1.1 Monitoring and data collection

In BiH, data collection, monitoring and reporting in the waste management sector is lagging behind other environment sector like water and air management. BiH is the only Western Balkans country not capable of producing waste data for the state as a whole. The municipal waste data collection is not properly structured. There are several levels of data collection, but those are not adequately interrelated, and, though some efforts have been made to collect data, this has not been done systematically, which only compromise their accuracy when presented or reported.³⁸

According to the Law on waste management of the Republic of Srpska, the competent body for collecting waste management data is Environment and Energy Efficiency Fund of the RS. The Rules of waste data collection and registration (Official Gazette of the RS No. 71/5) have been recently adopted. The Laws on waste management in the Federation and Brčko District do not cover waste data collection or registration.

The F BiH Environment Protection Fund and the RS Environment and Energy Efficiency Fund are collecting data on the solid municipal waste system from cantons, municipalities, public and private utility companies and waste landfills, including data of the quantity of generated/produced waste, as well as the types of waste. These data are used for comprehending the actual situation in the waste management sector in the two entities. The entity statistics agencies are collecting data on generated and landfilled waste and so obtained data are used for statistical purposes.

The improvement of the municipal waste data accuracy and establishing a reliable data collection and reporting system is one of the key challenges. The first precondition for achieving this goal is installing a weighing scale at as many landfills as possible. The second precondition is to fully implement the uniform data collection practices. The municipal waste data can be improved only if these two preconditions are fulfilled.

5.1.2 Municipal waste production

According to the statistical data, annual quantity of the produced waste per capita slightly varies between 314-352 t in the period between 2012 and 2015 (Table 5, Figure 15). Specific quantity of the daily municipal waste produced in 2015 was 0.89 kg/person/day which is much lower than the average daily quantity produced in the EU28 amounting to 1.3 kg/person/day, mainly as a result of the economic situation in the country, i.e. lower GDP and different consumers' habits.

Table 6: Quantities of municipal waste generated in BiH in the time period 2012-2015³⁹

Year	Produced municipal waste (t/year)	Annual quantity of waste per capita (kg)	Landfilled waste (t)
2012	1.302.866	340	925.740
2013	1.191.267	314	897.666
2014	1.334.522	352	988.768
2015	1.248.718	326	954.163

³⁸UN Economic Commission for Europe, Overview of the State of Environment-Bosnia and Herzegovina, 2011

³⁹BiH Statistics Agency, Public collection and disposal of municipal waste 2012,2013,2014 and 2015

The quantities of landfilled waste are much lower by around 350,000 t per year than the quantities of generated waste (Figure 15)

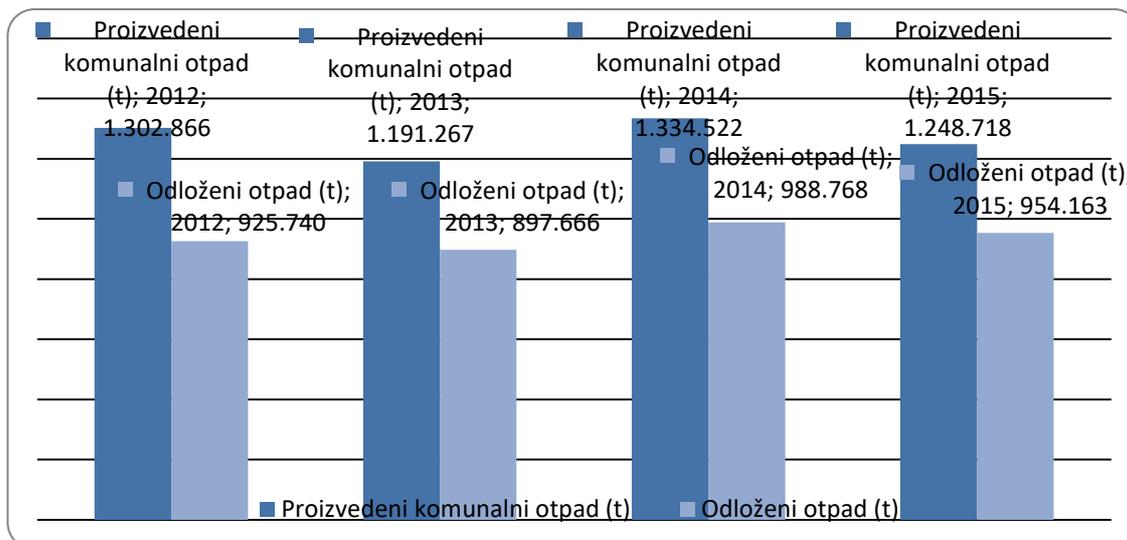


Figure 15: Quantities of generated and landfilled waste in BiH⁴⁰

The data of 2015 indicate a slight decrease in daily generated waste per capita, from 0.95 to 0.89 (Table 7). In 2015, 954,163 tons of waste was disposed at landfills, or 3.5% less than the year before. Though in terms of quantities, it is somewhat less waste disposed of, the landfilling percentage increased compared to the year before from 74% to 76.4%. The aforesaid data are clear indicator that the waste landfilling is still the prevailing option of municipal waste management.

The recycling rate remains very low, and thereby far from the goals set: the recycling rate of 30% in the F BiH by 2018 (Environment Protection Strategy of the F BiH 2008-2018) and 23% in the RS by 2026 (RS Waste Management Strategy 2016-2026). In BiH, there is no waste incineration plant, so, no thermal treatment of waste is carried out, and only a small quantity of waste is mechanically treated in the municipality of Konjic and the city landfill „Desetine“ (Municipality of Tuzla) – the useful fractions are separated manually from municipal waste, and the remaining unused quantities are disposed of at the landfill.

Table 7: Waste management indicators in BiH (2014-2015)⁴¹

Indicator No.	Indicator	Unit	2014	2015	Source
1	Total population	Number	3,827,343	3,531,159	Census of population, households and apartments in Bosnia and Herzegovina 2013 – Final Report (BiH Statistics Agency, Sarajevo, June 2016)
2	National income	\$	4780	4680	http://data.worldbank.org/
3	Daily quantity of produced municipal waste	kg/day	0.95	0.89	-
4a	Municipal waste landfilling	%	74	76.44	-
4b	Municipal waste disposal at „wild“ disposal sites	%	24.6	23.5	-

⁴⁰ BiH Statistics Agency, Public collection and disposal of municipal waste 2012,2013,2014 and 2015

⁴¹ NALAS: Benchmarking on Solid Waste Management, 2015 - Draft

Indicator No.	Indicator	Unit	2014	2015	Source
4c	Recycling	%	0.28	0.28	-
4d	MBO treatment of municipal waste	%			
4f	Thermal treatment of municipal waste	%			
5	Recycling rate	%	14	N/A	-
6a	Sanitary regional landfills	Number		6	State of the Environment in BiH Report (Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina, 2012) Federal Waste Management Plan 2012-2017 (Federal Ministry of Environment and Tourism, 2012) Draft Waste Management Strategy in RS, 2016-2025 (Ministry of Spatial Planning, Civil Engineering and Ecology, 2016)
6b	Municipal landfills	Number		93	State of the Environment in BiH Report (Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina, 2012) Federal Waste Management Plan 2012-2017 (Federal Ministry of Environment and Tourism, 2012) Draft Waste Management Strategy in RS, 2016-2025 (Ministry of Spatial Planning, Civil Engineering and Ecology, 2016)
6c	Illegal ("wild") disposal sites	Number		cca 590	State of the Environment in BiH Report (Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina, 2012) Federal Waste Management Plan 2012-2017 (Federal Ministry of Environment and Tourism, 2012) Draft Waste Management Strategy in RS, 2016-2025 (Ministry of Spatial Planning, Civil Engineering and Ecology, 2016)
6d	Inert waste disposal sites	Number		1	State of the Environment in BiH Report (Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina, 2012) Federal Waste Management Plan 2012-2017 (Federal Ministry of Environment and Tourism, 2012) Draft Waste Management Strategy in RS, 2016-2025 (Ministry of Spatial Planning, Civil Engineering and Ecology, 2016)

5.1.3 Municipal waste collection infrastructure and the rate of coverage

Cities and municipalities take care of the municipal waste management. All municipalities in BiH have one or more utility companies: KJKP, JKP, JP and KP. Some municipalities have more than one waste management company. The waste management companies exist also in those municipalities which do not have a local landfill to dispose of their wastes, but transport them to a location outside their own municipality

Local municipal waste management and municipal landfill management is the responsibility of the local self-government units (JLS), i.e. cities and municipalities, and other stakeholders authorized by the municipality for waste management. More specifically, operational-executive responsibility of municipal waste management at the level of municipalities in the F BiH is entrusted to competent utility companies .

Activities of waste management utility companies in the F BiH is reduced to three basic activities:

- local collection of municipal waste from containers emptied into the transportation vehicles,
- municipal waste transport to the municipal disposal site,
- disposal and spreading of the waste at the municipal landfills, i.e. official municipal waste disposal sites

According to the Federal Waste Management Plan 2012-2018, the coverage of waste collection services is very low and is set at 63% for 2011. As observed, the public waste collection coverage for households decreased in the previous four years (Figure 16), particularly if this rate is compared to the ones in 2009 and 2010 when it amounted to 67% and 68% respectively. The rural households not covered by the waste collection services organize collection and transport by themselves, and dispose of the collected waste at the wild landfills.

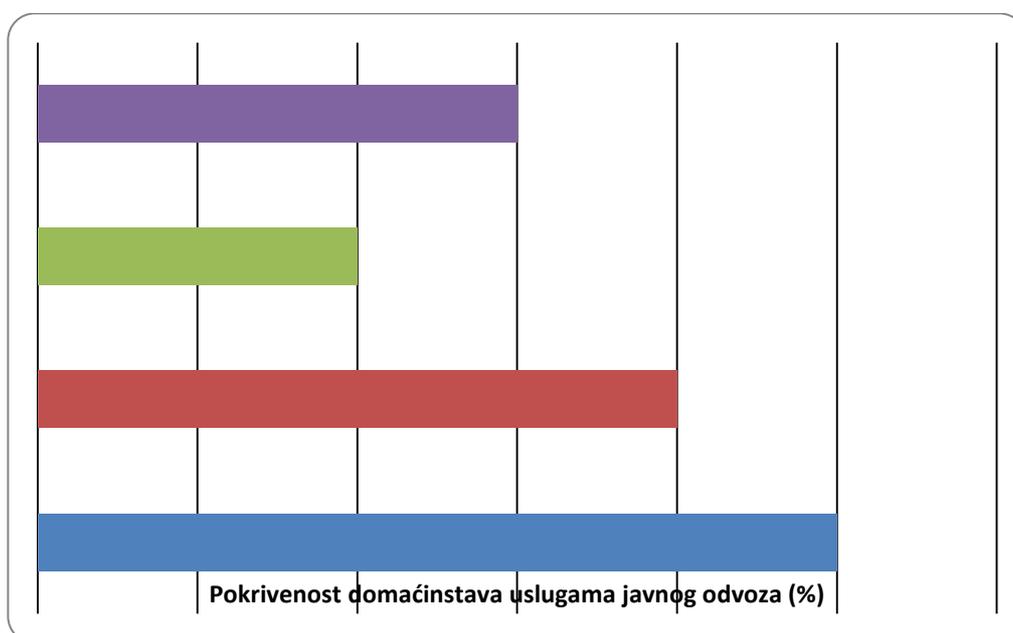


Image 16: Coverage of households with the public waste collection services in BiH (2012-2015)⁴²

⁴² BiH Statistics Agency, Public collection and disposal of municipal waste 2012,2013,2014 and 2015

5.1.4 Waste landfills in BiH

At present, there are 5 active regional sanitary landfills and 1 under construction:

- Cantonal landfill “Smiljevići” Sarajevo; GPS: latitude 43°21' S i longitude 18°21' I
- Regional landfill “Ramići” Banja Luka; GPS: latitude 44°86' S i longitude 17°15' I
- Regional landfill “Eko-Dep” Bijeljina; GPS: latitude 44°45' S i longitude 19°10' I
- Regional landfill “Mošćanica” Zenica; GPS: latitude 44°10' S i longitude 18°00' I
- Regional landfill “Uborak” Mostar; GPS: latitude 43°38' S i longitude 17°88' I
- Regional sanitary landfill Kurevo Prijedor (under construction); GPS: latitude 44° 93' S i longitude 16° 64' I.

Other municipal waste landfills are mainly open style and are located in the areas not developed according to the principles of hygienic-sanitary landfills, i.e. they have no barriers protecting soil, water or air. Great majority of those fail to control leachate and gases. The waste is occasionally covered with inert material by dredgers (State of the Environment in BiH Report 2012).

According to estimates, there are 93 municipal waste landfills in BiH not complying with the required technical requirements for minimizing their impact on humans and environment, so this problem needs to be treated as seriously as the one of illegal disposal sites. There is only one inert waste landfill, in the municipality of Neum. The Law on waste management requires that the landfill permit should include the type of landfill (municipal or hazardous waste), as well as the type and quantity it is going to accept. However, in reality, the existing landfills accept all kinds of waste without reducing it to municipal waste only, including hazardous household waste, medical, animal and industrial wastes. (NALAS, State of the Environment Report – UN Economic Commission for Europe).

Current estimates indicate there are as much as 340 illegal landfills in the F BiH and 250 in the RS. However, the Federal Waste Management Plan 2012-2017 and the RS Draft Waste Management Strategy 2016-2025 estimates there are more than 1,8000 illegal waste landfills (Federal Environment Protection Strategy, NALAS). However, the real number could be even higher given the fact that many of those locations are not registered yet. Sometimes, municipal utility companies remove smaller wild disposal sites, but this gives rise to other wild landfills in other locations.

5.2 Situation analysis in Zenica-Doboj Canton, Central Bosnia Canton and Sarajevo Canton

5.2.1 Current situation in ZDK

5.2.1.1 Waste management operators

In 11 municipalities, the municipal waste operators are public companies. Only in Zenica the utility company is a private one (Table 8).

Table 8: List of municipal landfills and municipal waste operators including estimated quantities of landfilled municipal waste in ZDK⁴³

No.	Municipality/city	Municipal landfill	Municipal waste operator	Daily quantity (t)	Currently landfilled quantity (t)
1.	Breza	Koritnik ⁴⁴	JKP „Komunalno“ d.o.o.	19	38.700
2.	Doboj Jug	R.D. „Doboj“	JKP „Vis“ d.o.o.	7	-
3.	Kakanj	„Bare“	JKP „Vodokom“ d.o.o.	33	143.100
4.	Maglaj	„Nekolj“	JKP „Komunalno“ d.o.o.	16	76.320
5.	Olovo	„Gradina“	JKP „Bioštica“ d.o.o.	20	38.800
6.	Tešanj	„Bukva“	JKP „Rad“ d.d.	19,64	68.000
7.	Usora	(„Lipac“)	JKP „Usora“ d.o.o. Šivša	2,6 - 3	-
8.	Vareš	„Kota“	JKP „Vareš“ d.o.o.	7,6	134.818
9.	Visoko	„Očazi“ ⁴⁵	JKP „Visoko“ d.o.o.	20,4	196.580
10.	Zavidovići	„Ekonomija – Batvice“	JKP „Radnik“ d.o.o.	30,8	120.000
11.	Zenica	Regional landfill „Mošćanica“	KP „Alba Zenica“ d.o.o. Zenica	72	178.027
12.	Žepče	„Trebetovići“	JP „Komunalno“ d.o.o.	13	17.760

Table 9 below gives an overview of legal entities dealing with specific types of waste management in ZDK, 23 of them duly registered in the ZDK. In addition to those, the waste collection activities in this canton are carried out by other operators registered outside the ZDK.

⁴³ Catalogue of municipal waste landfill rehabilitation projects in the Zenica-Doboj Canton – Implementation of the goals under „Environment Strategy 2008-2018, February 2016.

⁴⁴ „Koritnik“ landfill is out of operations and is closed (covered) with inert material, and the municipality of Breza dispose of their municipal waste at the „Kota“ landfill in the municipality of Vareš.

⁴⁵ Mostly used for waste disposal, and municipal waste from the municipality of Visoko is transported to the „Mošćanica“ landfill, Zenica.

Table 9: Operators licensed for specific types of waste registered in the ZDK⁴⁶

No.	Type of waste	Operator in KS
1.	Paper and cardboard	- Sirovina EKO d.o.o. Maglaj - EKO Servis d.o.o. Tešanj - EKO Praktik d.o.o. Zavidovići - Alba d.o.o. Zenica
2.	Plastics	- Rudar Company d.o.o. Breza - Sirovina EKO d.o.o. Maglaj - EKO Plast d.o.o. Tešanj - EKO Servis d.o.o. Tešanj - EKO Praktik d.o.o. Zavidovići - Alba d.o.o. Zenica -PET Servis d.o.o. Zenica
3.	Metal wastes	- Sirovina EKO d.o.o. MAglaj - ILMA d.o.o. Tešanj-Jelah - Garocompany d.o.o. Visoko - Đ.S. Komerc d.o.o. Visoko - Converzion d.o.o. Visoko - MIKI PROM d.o.o. Visoko - Sjedić Avdo Visoko - B.M. otpad d.o.o. Zavidovići - CIBOS d.o.o. Zenica - Dilaver d.o.o. Zenica - Salvis Trans d.o.o. Zenica - Binela d.o.o. Zenica -Tola d.o.o. Zenica - Fajem d.o.o. Zenica - Demetra d.o.o. Žepče
4.	Tires	- SINTEX d.o.o. Doboju Jug - Ramić d.o.o. Tešanj-Jelah
5.	RDF/GIO	- CIBOS d.o.o. Zenica
6.	OEE0	- CIBOS d.o.o. Zenica

5.2.1.2 Collection and transport

Utility companies do not cover all the households with waste collection services, so it is assumed that the non-collected waste ends up in the wild disposal sites. A little more than half the number of households in the ZDK is covered by the waste collection services. Those are mainly the urban households and a number of those from easily accessible rural areas. As the waste production in urban areas is higher than the one in rural areas, one could say that most of the municipal waste is collected, but there are certain quantities that end up in the wild disposal sites.

⁴⁶ Ministry for Urban Planning, Transport and Communications and Environment of the ZDK, Cantonal Environment Action Plan ZDK 2017-2025 – Draft

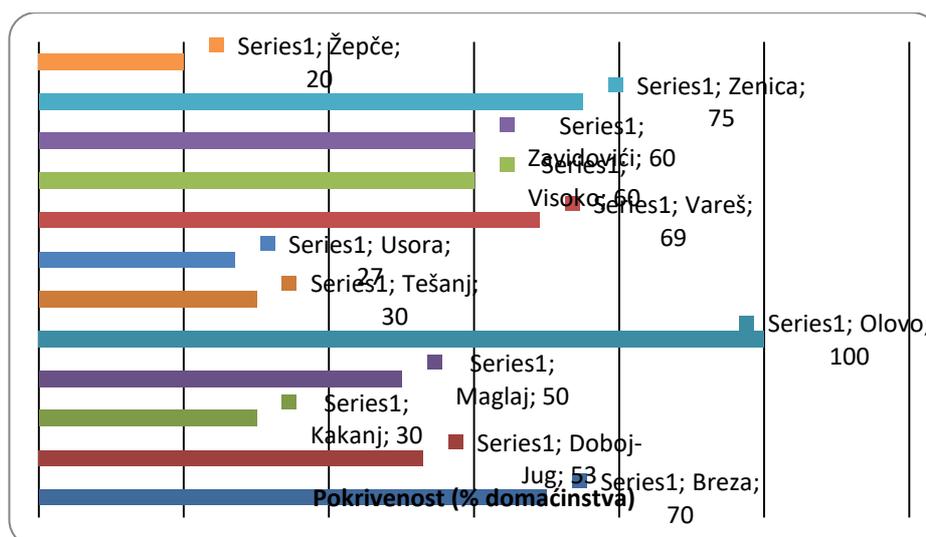


Figure 17: Coverage of the ZDK households with public waste collection services⁴⁷

In some municipalities one can observe the shortage of waste collection containers, which results in collection of waste in plastic bags scattered in and around the collection containers, which is the worst situation that leads to generation of bulk waste at the collection spots.

The waste from core urban areas is collected more frequently, whereas the wider urban areas are covered less frequently. The planned waste collection frequency by municipalities is adequate and do not constitute an issue for the efficient operation of the system.

Table 10: Waste collection frequency in the ZDK municipalities⁴⁸

Municipality	Core urban area	Wider urban area
Breza	Every day	1x a week
Dobojug	1x a week	---
Kakanj	Every day	2x a month
Maglaj	2x a week	1x a week
Olovo	12 x a month	4x a month
Tešanj	2x a week	1x a week
Usora	1x a week	---
Vareš	20 x a month	2-4x a month
Visoko	4x a month	4x a month
Zavidovići	20 x a month	---
Zenica	Every day	3x a week
Žepče	1x a week	---

The existing refuse fleet by municipal and cantonal utility companies indicates poor average conditions when it comes to municipal waste transportation efficiency. The first problem is inadequate number of transport vehicles. This problem is present in 7 of 12 municipalities, which results in lower waste collection efficiency and mostly leads to congestion of the collection spots or lower level of collection coverage. Another major problem is the advanced age of vehicles. Most of the vehicles are 15-25 years old, which in terms of fuel consumption and maintenance have adverse

⁴⁷ Zenica-Doboj Canton Waste Management Plan 2009-2018

⁴⁸ Zenica-Doboj Canton Waste Management Plan 2009-2018

impact on the financial component of the system. Also, frequent breakdowns at the obsolete vehicles could cause inadequate functioning or reduced volume of operations for some specific period of time.

5.2.1.3 Waste treatment

There is only one Regional Landfill (RD) „Moščanica“ in the ZDK as a central point for most cantonal municipalities which dispose their wastes there, including a few municipalities of the SBK. However, due to a great distance and high costs, some ZDK municipalities (Doboj Jug, Usora and Tešanj⁴⁹) are oriented toward the planned Regional landfill in Doboj (RS).

The regional landfill of municipal waste “Moščanica” is located at the former open pit mine Moščanica about 16 km away from the city of Zenica. The building plot accommodating the landfill has a shape of irregular polygon with an area of approx. 26 ha of enclosed area. The closest residential detached houses are located at a distance of around 750 m from the landfill entrance gate. At the present time, besides the city of Zenica, there are other municipalities that dispose of their waste at the Regional sanitary landfill such as: Visoko, Žepče and Zavidovići from ZDK, and Travnik, Novi Travnik, Vitez and Busovača.

RD Moščanica is designed to handle waste starting from 2008 for the next 25 or 30 years. Regional landfill was built according to the effective EU directives and standards and as such, it complies with the safety-sanitary waste disposal requirements. In addition to the disposal plateau, the following structures have been built at the Regional landfill:

- Concrete fence;
- Entry booth, weighing scale and canopy;
- Cardboard and PET baling halls;
- Leachate discharge lagoons;
- Fire fighting (hydrant) system;
- Head office;
- Workshop and garage structure;
- Landfill gas collection and burning system.

Nine of twelve ZDK municipalities are oriented toward RD „Moščanica“. The remaining 3 municipalities are oriented toward RD „Doboj“. Due to large distances of over 60 km from the regional landfill, some municipalities still fail to dispose of their wastes in the regional landfills (Table 11, Table 12.).

Table 11: ZDK municipalities oriented toward RD „Moščanica“

No.	Municipality	Distance (km)
1.	Breza**	69,00
2.	Kakanj*	20,00
3.	Maglaj*	52,00
4.	Olovo*	115,00
5.	Vareš*	90,00
6.	Visoko	57,00
7.	Zavidovići	69,00
8.	Grad Zenica	16,00
9.	Žepče	57,00

⁴⁹ Municipality of Tešanj is currently disposing of their municipal waste at the municipal landfill of "Bukva".

**Municipalities that have not adopted the regional waste disposal concept yet, and still dispose of their wastes in the municipal landfills*

***Municipality of Breza is trying to decide whether to dispose of its municipal wastes to „Smiljevići“ or „Mošćanica“ landfill*

Table 12: ZDK municipalities oriented towards the RD Doboj

No.	Municipality	Distance (km)
1.	Doboj Jug	7,00
2.	Usora	17,00
3.	Tešanj	20,00

Municipal landfills are non-sanitary and have a limited capacity for acceptable handling of sufficient quantities of municipal waste in the forthcoming period (Table 13). Federal waste management strategy envisages that municipal non-sanitary landfills currently in use are to be rehabilitated and closed by 2018, and disposal operations to be rechanneled to the regional sanitary landfilling concept. For some municipalities in the ZDK and SBK, FMOiT has, pursuant to the Law on waste management (Official Gazette of the F BiH No. 33/03 and 72/09), Law on Environment Protection (Official Gazette of the F BiH No. 33/03 and 38/09), and Law on Administrative Procedure (Official Gazette No. 2/98 and 48/99), passed a Decision on closing municipal landfills, whereby each municipality was given a deadline to close its municipal landfill. No punitive measures are provided in case of failure to observe the requirements of the Decision.

Table 13: State of the municipal waste landfills in the ZDK municipalities⁵⁰

Municipality – Landfill	Description of state of the landfill
Breza- „Koritnik“	Type of disposal site: non-sanitary disposal site Landfill „Koritnik“ is at the location of former open-pit coal mine Koritnik. The waste has not been disposed at this landfill since 2012. The landfill area is covered with waste rock material from the coal processing in the nearby coal processing plant.
Doboj Jug – no municipal landfill	Municipal waste disposed of at the Doboj landfill (RS)
Kakanj-„Bare“	Type of disposal site: non-enclosed non-sanitary disposal site No permit available. Disposal site is under 24-hour surveillance. The wastes disposed of are spread by the existing machinery, namely two combined SKIP machines According to the disposal area estimate, another 800.000 m ³ could be used for continued disposal, which would be sufficient for the forthcoming period of 15-20 years. However, non-sanitary nature of the disposal site prevents it from being used on the long run.
Maglaj-„Nekolj“	Type of disposal site: enclosed non-sanitary disposal site. It is under 8-hour surveillance per day at least The landfill site covers the area of 60.000m ² and the estimate of additional disposal area available runs at 38.500 m ² . The disposal site has one bulldozer to handle the wastes disposed of.
Olovo-„Gradina“	Type of disposal site: non-enclosed non-sanitary. Does not have a site surveillance or machinery required for handling the wastes disposed. The site area assigned for waste disposal is around 4.000 m ² and this is sufficient for a long time disposal at this site.
Tešanj-„Bukva“	Type of disposal site: enclosed non-sanitary. It has the 8-hour site surveillance per day. The area covered by the disposal site is 5.5 ha, whereas the free space for disposal is

⁵⁰ Zenica-Doboj Canton Waste Management Plan 2009-2018

Municipality – Landfill	Description of state of the landfill
	estimated as sufficient for the next 15 years. The heavy machinery used at the site includes compactor and bulldozer.
Usora– no municipal landfill	Municipal waste disposed of at the Doboj landfill (RS)
Vareš-„Kota“	Type of disposal site: non-enclosed non-sanitary It has an entrance ramp that provides a certain amount of the site control The disposal site has waste handling machines.
Visoko- „Očazi“	Type of disposal site: non-sanitary disposal site. The waste has not been disposed of at this site since 2009/2010 when it was closed without any rehabilitation or recultivation. The site is covered with inert material from the nearby gravel pits owned by „Asfaltgradnja“ Company Visoko.
Zavidovići – „Ekonomija“	Type of disposal site: non-enclosed non-sanitary It is under 14-hour surveillance per day (in summer, but a bit shorter in winter). The disposal site has no exploitation permit or any other work permit, but it has made an Adjustment Plan. The disposal site has its own machines (1 bulldozer, 1 trencher, 1 dumper).
Zenica- „Siđe“	Type of disposal site: non-sanitary disposal site. The site was closed back in 2012/2013, followed by the site rehabilitation, relocation of waste in order to install the bed buffer layers and recultivate the surface area.
Zepče- „Trebetovići“	Type of disposal site: non-enclosed non-sanitary. The disposal site is not issued a use permit, but has an Adjustment Plan. It is under a 16-hour surveillance per day. The wastes are handled with the machines including 1 bulldozers owned by the operator, and additional machines are hired as needed.

In the ZDK there is a large number of smaller and bigger wild disposal sites of municipal waste (Table 14). It is because of the inadequate coverage of all households with the waste collection services.

Table 14: Estimated number of wild disposal sites, PUO ZDK ⁵¹

Municipality	Estimated number of wild disposal sites
Breza	50
Dobo jJug	20
Kakanj	Data unavailable
Maglaj	15
Olovo	100
Tešanj	50
Usora	10-15
Vareš	Estimate: 30 m ³ /year in uncontrolled disposals
Visoko	200
Zavidovići	100
Zenica	100
Žepče	50
Total	695-700

Separate waste collection in the ZDK is carried out in a very small quantity. According to the data of the Waste management plan of the Municipality of Zenica, 2010, in the Zenica municipality there are four recycling yards to separately collect paper, glass and plastics. These recycling yards were installed by the „ALBA“ utility company as a Pilot project in the vicinity of four elementary schools. ALBA Zenica collect 2,000 tons of paper and 100 tons of plastics per year.

⁵¹Ministry for Urban Planning, Transport and Communications and Environment of the ZDK, ZDK Waste Management Plan , 2009

5.2.2 Current situation in the SBK/KSB

5.2.2.1 Waste management operators

In the 12 municipalities of the Central Bosnia Canton, all waste management operators are public companies. The largest quantities are disposed of in the municipality of Bugojno (Table 15).

Table 15: List of municipal landfills and municipal waste operators including estimated quantities of landfilled municipal waste in the SBK⁵²

No.	Municipality	Municipal landfill	Waste management operator	Daily quantities (t)	Currently landfilled (t)
1.	Bugojno	„Dubočine-Talin gaj“ i „Donji Boganovci“	JKP „Čistoća“ d.o.o.	30	60.000
2.	Busovača	„Klokoti“	JKP „Komunalac“ d.o.o.	18	24.000
3.	Dobretići ⁵³	-	-	-	-
4.	Donji Vakuf	„Ornice“	JKUP Čistoća d.o.o.	18	9.100
5.	Fojnica	„Mut –Plane“	JKP „Šćona“ d.o.o.	15	28.040
6.	Gornji Vakuf – Uskoplje	„Batuški Lug“	JKP „Radovina“ d.o.o.	27	45.300
7.	Jajce	„Kruščica“	JKP „Čistoća i Zelenilo“ d.o.o.	21	23.800
8.	Kiseljak	„Berberuša“	JP „Vodovod i kanalizacija“ d.o.o.	-	38.000
9.	Kreševo	„Dubrave“	JKP „Komunalno“ d.o.o.	2,3	4.800
10.	Novi Travnik	„Mitale“	JKP „Vilenica-Čistoća“ d.o.o.	20	22.000
11.	Travnik	„Ovčarevo“ ⁵⁴	JKP „Bašbunar“ d.o.o.	40	44.400
12.	Vitez	„Paljike - Hum“	JKP „Vitkom“ d.o.o.	24	24.960

Table 16 below gives an overview of operators dealing with waste and objects similar to municipal waste, or which is disposed of along with the municipal waste, including data on the types of wastes collected. In addition to 19 operators registered in the SBK, the waste collection activities in this canton are carried out by other operators registered outside the SBK.

Table 16: Operators licensed for specific types of waste registered in the SBK⁵⁵

No.	Type of waste	Operators in the SBK
1.	Paper and cardboard	- EKO-industrijski otpad ZIZI d.o.o. Travnik - Eko-forma d.o.o. Bugojno - Sirovinametall d.o.o. Bugojno
2.	Plastics	- Pabs Plastiks d.o.o. Vitez - EKO-industrijski otpad ZIZI d.o.o. Travnik - Eko-forma d.o.o. Bugojno - Sirovinametall d.o.o. Bugojno

⁵² Catalogue of municipal waste landfill rehabilitation projects in the Zenica-Doboj Canton – Implementation of the goals under „Environment Strategy 2008-2018, September 2016.

⁵³ There is no municipal landfill, and the waste is not disposed of at any other official landfill in the neighbouring municipalities.

⁵⁴ Enclosed landfill which is not used for disposal of municipal wastes

⁵⁵ Ministry of Spatial Planning, Civil Engineering, Environment, Return and Housing of the SBK, Cantonal Environment Plan 2015-2025, 2015.

No.	Type of waste	Operators in the SBK
		- Fecos d.o.o. Jajce
3.	Metal wastes	- Lucius d.o.o. Vitez - Binela Komerc d.o.o. Vitez - Ćamil d.o.o. Donji Vakuf - Bešić d.o.o. Bugojno - Salvis-Trans d.o.o. Kiseljak - Sirovinametal d.o.o. Bugojno - EKO-industrijski otpad ZIZI d.o.o. Travnik - Kim Tec d.o.o. Vitez - CIBOS d.o.o. PJ Novi Travnik - Glob-Metal d.o.o. Kiseljak - Plemeniti metali d.o.o. Kiseljak - Jajce Alloy Wheels do.o. Jajce
4.	Glass	- Kristal d.o.o. Vitez - EKO-industrijski otpad ZIZI d.o.o. Travnik - Sirovinametal d.o.o. Bugojno - Fecos d.o.o. Jajce - Eko-forma d.o.o. Bugojno
5.	Waste textile	- Eko-forma d.o.o. Bugojno - Eko-forma d.o.o. Bugojno - Pabs Plastics d.o.o. Vitez
6.	OEEO	- CIBOS d.o.o. PJ Novi Travnik - Sirovinametal d.o.o. Bugojno - GROSS d.o.o. Jajce
7.	Tires	- TNP Protekt d.o.o. Kreševo - Sirovinametal d.o.o. Bugojno - Manual d.o.o. Bučići, Novi Travnik - Marino-Commerce d.o.o. Kreševo - Lucius d.o.o. Vitez - Glob-Metal d.o.o. Kiseljak - Fecos do.o. Jajce

5.2.2.2 Collection and transport

The coverage rate of the population with the services of waste collection and transportation in the SBK canton is 62%. Municipality of Bugojno and Gornji Vakuf – Uskoplje have the highest and the municipality of Kiseljak and Busovača the lowest coverage of the population with this service. Municipality of Dobretići does not offer this service at all.

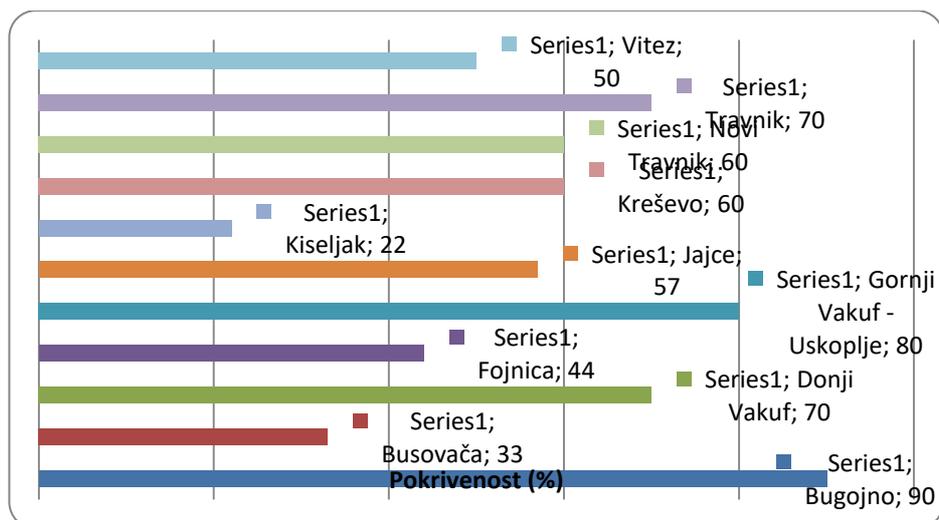


Figure 18: Coverage of SBK households with public waste collection services⁵⁶

The planned waste collection frequency by municipalities is adequate and do not constitute an issue for the efficient operation of the system.

Table 17: Waste collection frequency in the SBK municipalities⁵⁷

Municipality	Core urban area	Wider urban area
Bugojno	Every day	1x a week
Busovača	1x a week	1x a week
Donji Vakuf	6-8x a week	1x a week
Fojnica	2x a week	1x a week
Gornji Vakuf - Uskoplje	2x a week	1x a week
Jajce	Every day	1x a week
Kiseljak	6x a week	1x a week
Kreševo	Every day	1x a week
Novi Travnik	Every day	1x a week
Travnik	Every day	1x a week-2x a month
Vitez	3x a week	1x a week

According to the data of the SBK waste management plan, municipalities of Travnik, Kiseljak and Bugojno are short of waste collection containers. In the municipality of Dobretići, the level of equipment for rendering waste collection and transportation services is the lowest of all. In this municipality there is only one container which is occasionally emptied by the operators from Jajce municipality. The average age of vehicles used for collection and transportation of waste in the SBK is 18 years. Frequent breakdowns of the obsolete vehicles could be the reason for poor functioning or reduced volume of operation of the system for a specific period of time. Besides, the large loading capacities vehicles are convenient for utility companies to efficiently render the service in the low-lying parts of the SBK municipalities. The problem arises in the sloped areas (municipalities of Donji Vakuf, Travnik) where access is not provided for the larger garbage trucks, so they need to engage smaller vehicles that could be operated in the narrow streets, but the municipality does not have ones.

⁵⁶ Waste Management Plan for the Central Bosnia Canton 2015-2025.

⁵⁷ Waste Management Plan for the Central Bosnia Canton 2015-2025.

5.2.2.3 Waste treatment

In the SBK there is no regional landfill, and for this area they planned to build a Regional landfill „Gračanica“ that will be located at the border between Municipality of Gornji Vakuf-Uskoplje and Bugojno at the site of the „Gračanica“ Coal Mine, the settlement of Humac, for which the project design and environment documentation is currently under way. Since there is no landfill in the cantonal administrative area, most of the municipalities dispose of their wastes at the municipal landfills, whereas some of them dispose of their waste at the RD „Moščanica“. Municipalities which have closed their municipal landfills (covering them by inert material) and transport all their waste to the R.D. „Moščanica“ landfill include Busovača, Travnik, Vitez and Novi Travnik.

All municipal landfills in the SBK are non-organized and non-sanitary, and all of them are in the process of developing their investment, technical and environment plans of rehabilitation (closure), as well as construction of the ancillary facilities adjusted to the regional waste disposal concept. Municipality of Dobretići has no municipal landfill in its territory. All the SBK municipalities have their waste management adjustment plans developed and they were granted the decisions of the FMOiT having them approved. Also, the municipal landfills in Bugojno, Gornji Vakuf-Uskoplje, Donji Vakuf, Jajce, Vitez and Busovača are currently making or have finished their design, technical and environment plans as a precondition to obtaining urbanization permit, and their rehabilitation is under way. The deadline set for the rehabilitation of all municipal landfills in the SBK according to the currently available design, technical and environment documentation is 2011-2018.

In the SBK territory, there is no other waste management and treatment facilities like rendering plants, thermal processing of the by-products of the animal origin, incineration facility, reloading stations etc.

According to the data of the Cantonal Waste Management Plan 2015-2025 in the SBK, 473 wild disposal sites have been identified where they mostly disposed of municipal, construction and bulky waste. Most of the landfills are in a highly inaccessible terrain, in streams or depressions, and their removal or cleaning is quite difficult. Most of the wild disposal sites are in the municipality of Travnik, and the least of them in the municipality of Gornji Vakuf-Uskoplje. Six of twelve municipalities are drafting their wild landfill elimination programs, and each of them allocate funds for removal of the wild disposal sites (Table 18).

Table 18: Overview of the locations accommodating illegally disposed wastes, so-called „wild landfills“ (SBK Cantonal Plan 2015-2025)

No.	Municipality	Number of wild landfills (2013)	Municipality is having a wild landfill removal program	Municipality is allocating funds for wild landfills removal program
1.	Bugojno	16	Yes	No
2.	Busovača	12	Yes	Yes
3.	Dobretići	6	No	No
4.	Donji Vakuf	47	No	No
5.	Fojnica	38	Yes	Yes
6.	Gornji Vakuf - Uskoplje	1	No	No
7.	Jajce	24	No	No
8.	Kiseljak	27	Yes	Yes
9.	Kreševo	23	No	Yes
10.	Novi Travnik	43	Yes	Yes
11.	Travnik	166	Yes	Yes
12.	Vitez	70	No	No

Table 19: Overview of the infrastructure available for waste separation in the SBK Canton (SBK Cantonal Plan 2015-2025)

No.	Municipality	Green islands		Recycling centers/recycling yards	Authorized and licensed SBK operators	Bulky waste centers	Other facilities
		Operating	Under construction				
1.	Bugojno	-	1	-	3	-	-
2.	Busovača	-	-	-	2	-	-
3.	Dobretići	-	-	-	-	-	-
4.	Donji Vakuf	-	1	-	1	-	-
5.	Fojnica	-	-	-	-	-	-
6.	Gornji Vakuf - Uskoplje	-	-	-	-	-	-
7.	Jajce	-	-	-	3	-	-
8.	Kiseljak	-	12	-	3	-	-
9.	Kreševo	-	-	-	2	-	-
10.	Novi Travnik	4	9	-	1	-	-
11.	Travnik	-	-	-	1	-	-
12.	Vitez	6	-	-	-	5	-

Waste selection and separation in the SBK municipalities is almost non-existent. Only Vitez and Novi Travnik municipalities have installed separate waste collection containers. There is a total of six green islands in Vitez and four green islands in Novi Travnik. This infrastructure is run by the utility companies JKP „Vilenica-Čistoća“ d.o.o. Novi Travnik, and JKP „Vitkom“ Vitez. In the municipalities of Vitez, Travnik and Novi Travnik, in their urban core area, in addition to plain containers, the utility companies are installing netting baskets for disposal of paper, cardboard and PET packaging. In Vitez, alongside the containers, they installed metal ash bins at several locations.

In the municipalities of Bugojno and Donji Vakuf, there is a procedure under way to install green islands (one per each municipality), i.e. to install them and obtain required permits. Also, municipality of Kiseljak is in the process of construction and procurement of equipment for 12 green islands, and the municipality of Novi Travnik for another 9 green islands. In the municipalities of Travnik and Novi Travnik they press the cardboard, PET packaging and other plastic items within the public utility compound, and this is sold to companies dealing with this kind of waste. Municipality of Donji Vakuf, UNDP and Ekopak d.o.o. Sarajevo have entered into agreement on construction and fitting-out of the recycling yard in the municipality of Donji Vakuf. In the SBK Canton there are 21 waste management operators having their waste collection and sorting sites which obtained the required permits. These operators of special kinds of waste have sorting units within their compounds where they separate useful raw materials and sell them in the market for recycling, so, in principle, their locations constitute a form of simple recycling yard (SBK Cantonal Plan 2015-2025).

5.2.3 Current situation in the Sarajevo Canton (KS)

5.2.3.1 Waste management operators

KJKP RAD is the only operator licensed to collect the municipal waste from citizens. This company is owned by the Sarajevo Canton. KJKP RAD is authorized to collect, transport and landfill wastes, maintain the landfill, clean and wash the public areas, as well as to carry out other activities related to waste management.

In the KS, 20 operators are registered and licensed for waste management by the Ministry of Spatial Planning and Environment. Those are mainly private companies dealing with collection and purchase of raw materials. In addition to these operators, working in the KS are also those operators who are registered outside the KS.

Table 20: Operators licensed for specific types of waste registered in the KS

No.	Type of waste	Operator in the KS
1.	Paper and cardboard	- INOS - TRADE d.o.o. Sarajevo - HAREX d.o.o. Sarajevo - CIBOS d.o.o. Sarajevo - PAPIR SERVIS d.o.o. Sarajevo
2.	Plastics	- INOS - TRADE d.o.o. Sarajevo - HAREX d.o.o. Sarajevo - PAPIR SERVIS d.o.o. Sarajevo - TRGOSIROVINA d.o.o. Sarajevo - SPOJLER d.o.o. Sarajevo - BOSNAPLAST d.o.o. Sarajevo
3.	Metal wastes	- INOS - TRADE d.o.o. Sarajevo - HAREX d.o.o. Sarajevo - AIDA COMMERCE d.o.o. Sarajevo - AHSUN sirovinacomerc d.o.o. Ilijaš - TRGOSIROVINA d.o.o. Sarajevo - MELTAL d.o.o. Sarajevo - SPOJLER d.o.o. Sarajevo - EKOSIROVINA d.o.o. Visoko, Podružnica Rajlovac - SJAJ TPOM d.o.o. Sarajevo - NEEX d.o.o. Sarajevo, Podružnica Vogošća
4.	Glass	- INOS - TRADE d.o.o. Sarajevo - HAREX d.o.o. Sarajevo - TRGOSIROVINA d.o.o. Sarajevo - SPOJLER d.o.o. Sarajevo

5.2.3.2 Collection and transport

Collection and transport of municipal waste is carried out according to the Operational and work plan, in accordance with the Law on Communal Hygiene.⁵⁸ The coverage rate of the Sarajevo Canton with the waste collection and transport is over 95%.⁵⁹ This service in the four urban municipalities are offered to all inhabitants, whereas the coverage of the service in suburban areas is a bit lower. The lower coverage is related to weekend houses or private houses not having the technical preconditions for waste collection. However, these citizens are offered a possibility to dispose of their wastes in the nearest containers. In some municipalities there are locations not having sufficient containers capacities, some other are not covered by regular collection and transportation

⁵⁸ Law on Communal Hygiene, (Official Gazette of the Sarajevo Canton No. 11/97)

⁵⁹ Data obtained from the KJKP RAD d.o.o. Sarajevo.

of the municipal waste, whereas some areas do not have an adequate access for municipal waste trucks.

When it comes to the coverage rate of the Sarajevo Canton with the municipal waste collection and transport, some issues could be well observed. Table 21 gives a short overview of the situation with the service coverage rate in nine KS municipalities.

Table 21: Coverage of the KS municipalities with public waste collection services KS⁶⁰

Municipality	Description of municipal waste collection and transport services coverage
Stari Grad	All households are covered by waste collection service. The problem lies in occasionally irregular collection, as well as in narrow streets which make the waste collection more difficult. This especially refers to hilly and densely populated areas but also to flat areas in the city center.
Novi Grad	At the location of the neighborhood of Švrakino Selo II, there is a long lasting problem in the street of Vejsila Čurčića from No. 103 to 119 and street Ferida Srnje where the municipal waste is not collected at all. The reason for this is the unpaved streets. In MZ Otoka, MZ Saraj Polje in Nedžarići, MZ Dobrinja C, MZ Dobrinja D, MZ Alipašin Most, MZ Briješće, MZ Dobroševići, it would be necessary to increase the number of containers and bins, since the existing number is inadequate compared to quantities of municipal waste generated which eventually ends up scattered around the containers due to overfilling. In MZ Naselje Heroja Sokolje, the problem lies in the newly-formed streets not included in the bulky and municipal waste collection and transport system, such as: Naselje Zabrđe, Humačka Ploča, Reljevodvor, Perivoje and Smiljevići.
Centar	The entire territory of this municipality is covered by waste collection and transport services and all the citizens are provided with these services. In sloped parts, due to streets and slopes width, it is not possible to reach every single household and wherewith the citizens are allowed to dispose of their waste in the waste collection container usually set up at the beginning of the street. In the low-lying areas of the municipality, the waste is collected in containers with a capacity of 1.1 m ³ . The frequency of waste collecting is three to six times a week depending on the zone from which the waste is collected. In slope parts of the municipality, the waste is collected two or three times a week whereas in the center, the waste gets collected six times a week.
Novo Sarajevo	The coverage of services is at a high level and the time periods specified for the municipal waste collection are sufficient, as well as the number of bins which satisfies the needs of the local population.
Vogošća	The coverage of services is satisfactory, except for the municipal waste collection at hilly parts of the municipalities with narrow roads which prevent the specialized trucks for municipal waste collection from driving down these roads. Therefore, the only possible solution is for the citizens to bring the municipal waste in bags to the containers 1000 m away.
Ilijaš	Some villages (mountainous parts of the municipality) are not included in the program of municipal waste collection, but the waste is disposed of inadequately (by burning it or disposing to the joint landfills). Solid waste is regularly collected from the urban and suburban parts of Ilijaš, whilst in the rural areas, the waste is collected only from the local communities of Ljubina , Srednje, Čevljanovići and Bijambare. At certain places, there are no containers installed. The causes of this problem are irresponsible citizens on one hand and underdeveloped capacity of operators covering these areas, on the other.
Hadžići	In this municipality, the containers are set up at all spots, with the exception of the several places impossible to access with special vehicles for waste collection (such as: Luke, Doljani, Dragovići and Mokrine).
Iliđža	In the municipality of Iliđža, the waste is collected through 11 road sections formed by streets and priorities. Out of 11 existing sections, 9 of them get their waste collected and transported in bins (containers), and in the other two sections, waste is collected and transported in household recycling bins. The waste collection in central parts of the Municipality of Iliđža is

⁶⁰ Sarajevo Canton Waste Management Plan 2014-2019.

	carried out each day, whereas in other parts of the municipality, three times a week.
Trnovo	Based on the data obtained from the local government, the coverage by municipal waste collection services in this municipality is satisfactory.

The total of 78 special vehicles for waste collection is engaged in the activities of waste transport, with an average age of 14.8 which means that it is of utmost importance to renew the rolling stock and to purchase special vehicles for municipal waste collection from inaccessible areas and for collection of waste from special bins and containers for selective collection. When it comes to the infrastructure, the locations for containers of 1.100 l capacity are of huge importance for the municipal waste collection. Around 8,000 containers are placed at approximately 2,000 locations. However, a significant number of containers is set up at inadequate locations such as: pavements, roads, green areas etc. In order to solve this problem, municipalities have, in cooperation with KJKP RAD, started building the stand-alone spots for placing containers. In the past 10 years, since the beginning of this project's implementation, 555 of covered and 396 of open-air spots were built.

5.2.3.3 Waste treatment

Municipal waste from KS (all 9 municipalities) is disposed of at the Regional landfill "Smiljevići" located at Buća Potok, municipality of Novi Grad Sarajevo in the Adema Buće Street No. 422 in Sarajevo, which also includes the main (official) gate entrance to the landfill. The landfill is fenced by 2.5 m concrete walls

The regional landfill meets the basic requirements which guarantee a minimal adverse impact on the environment. Current area of the landfill is about 60 ha. However, there is a room for its expansion to 94.5 ha with a protective belt. In 2016, the construction started of the new disposal area of 15,000 m², as well as expansion of the waste recycling hall and installation of a new truck weighing scale.

In addition to disposal areas, there are also other structures at the landfill site such as:

- Gate booth and a scale;
- Administration building,
- Landfill gas power plant;
- Waste sorting plant;
- Weather station;
- Vehicle maintenance workshops;
- Car wash;
- Leachate treatment plants;

In the course of the research conducted in the municipalities of KS, the continuous emergence of illegal landfills is one of the major problems in the field of waste management. Illegal landfills are mainly formed at the same locations as a result of irresponsible residents' habits. Another particular problem is posed by illegal landfills at the privately owned locations. However, the waste at these landfills cannot be collected without the permission to enter private property.

It is important to emphasize that the so-called illegal landfills in KS, are more like local smaller landfills/dumpsites. They should not be mixed with the municipal non-sanitary landfills present all across BiH, at which municipal utility companies dispose of waste (with a temporary permit or even without a permit), without taking into account the impact on the environment and human health.

In 2013, KJKP RAD recorded landfills in all the Sarajevo Canton municipalities (around 100 illegal landfills whose unit strength changes because KJKP RAD, in cooperation with the municipalities, rehabilitates landfills, but at the same time, the new ones emerge).

Table 22: Number of recorded illegal landfills in the KS municipalities in 2013⁶¹

Municipality	Number of illegal landfills recorded	Municipality	Number of illegal landfills recorded
Municipality of Stari Grad	30	Municipality of Vogošća	17
Municipality of Centar	0	Municipality of Ilijaš	12
Municipality of Novo Sarajevo	3	Municipality of Hadžići	0
Municipality of Novi Grad	3	Municipality of Trnovo	0
Municipality of Ilidža	33	Total number of illegal landfills: 98	

At the landfill, in 2017, a sorting plant for selected waste was built with EU funds. The main purpose of this plant is paper, cardboard, PET packaging and nylon foil selection from the total mass of municipal waste disposed of at the landfill. This project has faced numerous problems. The waste collected in containers for selective waste collection is disposed of at the waste sorting plant to improve the cleanliness of selected municipal waste components. Materials disposed of at the sorting plant include paper, cardboard and plastics – nylon foil collected by two small open vehicles that drive to the center, along with the malls and office buildings where they collect the aforesaid secondary raw material. The sorted secondary raw material (paper, cardboard, PET packaging, nylon foil) get pressed in bales, stored in sorting plant and sold to the customers with whom KJKP RAD has signed a contract. The capacity of the sorting plant is 3-4 t of waste per hour, i.e. 80 t per day (1/5 of the total municipal waste that gets disposed of at landfill). The plant “Održavanje” (Maintenance) KJKP RAD regularly operates the sorting plant, that is, all the machines and devices in the sorting plant. The only thing that the sorting plant lacks is a warehouse for baled secondary raw material intended for sale. The plan is to build a canopy-covered warehouse outside the sorting plant.

In Sarajevo Canton, there are no adequate local stations for separate waste collection. In several KS municipalities, there are 560 containers for separate collection of paper, cardboard and PET packaging:

- Municipality of Novo Sarajevo – 300;
- Municipality of Novi Grad – 66;
- Municipality of Ilidža – 60;
- Municipality of Stari Grad – 28;
- Primary and high schools in KS – 68;
- Business companies in KS – 38.

However, the containers for paper and plastics, regardless of reason (insufficient education, residents’ irresponsible behavior, inadequate containers etc.), no longer serve their purpose and residents dispose of de facto all the mixed municipal waste in them.

According to the report by operators which have the permit for waste management in KS, in 2012, approximately 500 t of plastics was collected, therefore the annual quantity collected in KS does not exceed 1.8% of the total quantity of the plastics generated.

There are no independent recycling yards that function as a link between the citizens, authorized collectors and authorized waste management facilities and/or RCUO in Sarajevo canton. Biological treatment of waste is not carried out at all. The mechanical treatment takes place only in the form of the sorting plant at the landfill „Smiljevići“, however, its capacity is inadequately filled.

⁶¹ Sarajevo Canton Waste Management Plan 2014-2019.

5.3 Current practice assessment

5.3.1 Zenica-Doboj Canton

In the ZDK the waste collection and transportation services coverage level is between 20% in Žepče to 100% in Olovo. Most municipalities have a service coverage of about 50% which has a direct impact on uncontrolled disposal of a part of the produced municipal waste. In the canton, there are around 700 illegal landfills, mainly for the disposal of municipal, construction and bulky waste. In ZDK, there is no systematically organized and planned waste selection and recycling, and almost all selected municipal waste gets disposed. Zenica is a positive exception with the highest recycling rate. The ZDK municipalities lack waste collection and handling equipment. The transport vehicles are obsolete and poorly functioning. Municipal landfills, except the one in Zenica, are non-sanitary and non-enclosed. The rehabilitation works do not unfold as scheduled because of lack of funds and infrastructure to transition onto the regional landfill.

5.3.2 Central Bosnia

In SBK the amount of waste collection and transport services is around 62%, which directly affects the uncontrolled disposal of one part of municipal waste generated. In the canton, there are around 473 illegal landfills, mainly for the disposal of municipal, construction and bulky waste. There is no systematically organized and planned waste selection and recycling in the Canton, and almost all the waste gets disposed of. The municipalities do not have an adequate waste collection and treatment infrastructure. In the municipalities of Travnik, Kiseljak and Bugojno, there is a noticeable lack of waste collection containers. Transport vehicles are outdated and in a poor condition. Municipal landfills are non-sanitary, and need to be rehabilitated and closed. However, the rehabilitations are not carried out as planned, since the funds and infrastructure for transition to regional landfill are not provided. Almost no measures are undertaken to reduce the quantity of waste (for final disposal and treatment), and therefore no resources for recycling are used either.

5.3.3 Sarajevo Canton

By analyzing the current state of the environment in Sarajevo Canton, it was found that a functional but incomplete infrastructure has been established in the current system of municipal waste management. Since the European strategic objectives require 90% of coverage in terms of waste collection and transport services, and the current state in KS amounts to over 95% , it may be concluded that KS has a functional system of municipal waste management in terms of waste collection, which is in accordance with the law. The amount of municipal waste transport services is considerably high, but uneven in the KS municipalities. The coverage is the highest in the downtown municipalities, and the lowest in municipalities with plenty of dispersed settlements, such as Ilijaš and Trnovo. The quantity of collected material in KS does not exceed 29% of paper and cardboard quantities generated. At the landfill „Smiljevići“, there is a sorting plant of municipal waste with the capacity of 80 tons/day, but its efficiency is about 3% of the potential capacity. In KS, there are no adequate local stations for separate waste collection. The highest number of containers are placed in the municipality of Novo Sarajevo.

5.4 The role of informal sector

„Informal sector in solid waste management“ refers to individuals, groups or private sector (micro) enterprises working in the waste management services and valorization, whose activities are neither

organized, sponsored, financed, recognized, taxed, managed, nor reported upon by the formal solid waste authorities.⁶²

In many developing and transition countries, waste management infrastructure and organization system is inadequate. Consequently, municipalities and formal operators cannot ensure the coverage of all households, or guarantee effective recycling or other processing that have minimal effects on the environment or waste disposal. In many of these states, informal sector greatly contributes to the waste management and resource efficiency by collecting, sorting, trading and sometimes even processing of the waste materials.

In BiH, basically in all its municipalities, there are waste collectors who largely operate on their own and who take out the solid waste fractions from the collection bins to sell them on. This sector has not been officially recognized or acknowledged by the local authorities, although these actors make a significant contribution to the waste management system quality.

Most frequently, the waste collectors in the informal sector include low-income communities having incomes below poverty line; low-educated persons, unqualified and unemployed persons. What waste collectors mostly seek are the waste fractions of metal, PET and paper, which they take out of the waste collection bins or directly from the waste landfills (Table 23).

Table 23: Informal sector in waste management in the BiH municipalities

Canton	Municipality	Whether recognized by the local authorities	Collectors in informal sector	The most sought-after fractions of solid municipal waste
ZDK	Žepče	NO	<ul style="list-style-type: none"> • Low-income communities having incomes below poverty line • Low-educated and unqualified persons • Unemployed persons 	<ul style="list-style-type: none"> • metal • paper
	Olovo	NO	Unemployed persons	<ul style="list-style-type: none"> • paper • PET
	Breza	NO	Unemployed persons	<ul style="list-style-type: none"> • paper • PET
	Vareš	NO	Unemployed persons	<ul style="list-style-type: none"> • metal
	Zenica	NO	<ul style="list-style-type: none"> • Low-income communities having incomes below poverty line • Unemployed persons • Women and children 	<ul style="list-style-type: none"> • PET • metal
	Usora	No informal sector dealing with waste collection ⁶³		
SBK/KSB	Jajce	NO	<ul style="list-style-type: none"> • Low-income communities having incomes below poverty line • Low-educated and unqualified persons • Unemployed persons 	<ul style="list-style-type: none"> • metal
	Vitez	NO	<ul style="list-style-type: none"> • Low-educated and unqualified persons • Unemployed persons 	<ul style="list-style-type: none"> • PET • metal • paper

⁶² Economic Aspects of the Informal Sector in Solid Waste Management, Main Report: Volume 1, Research Report, 2010; prepared under contract to GTZ and the CWG, 29 October 2010.

⁶³ JKP "Usora" d.o.o. Usora is dealing with transportation of municipal waste only.

Canton	Municipality	Whether recognized by the local authorities	Collectors in informal sector	The most sought-after fractions of solid municipal waste
	Bugojno	NO	<ul style="list-style-type: none"> • Low-educated and unqualified persons • Unemployed persons 	<ul style="list-style-type: none"> • PET • paper
	Gornji Vakuf-Uskoplje	NO	<ul style="list-style-type: none"> • Low-income communities having incomes below poverty line • Low-educated and unqualified persons 	<ul style="list-style-type: none"> • PET • paper • hard plastics
	Novi Travnik	There is no informal sector collecting waste ⁶⁴		

One can come to a conclusion that the waste collectors in informal sector in BiH come as a result of the unfavorable social and economic situation in the municipalities, and pose no competition to the public utility companies in waste collection. There are no official data on the waste quantity extracted by the informal collectors from the municipal waste streams, and the share of this sector in the waste management system is neglectable.

It is necessary to work on raising awareness of the public and local authorities on the informal sector's activities, where it is of importance to recognize the role and significance of the collectors of waste as useful tool in the waste management organization system. The collectors are socially vulnerable group and the society needs to consider ways of having them integrated into the formal waste management sector in order to improve their working and living conditions.

⁶⁴ JKP „Vilenica-Čistoća“ d.o.o. Novi Travnik is dealing with transportation of municipal waste only.

6 IMPACT OF MUNICIPAL WASTE ON THE ENVIRONMENT

6.1 Introduction

The waste management practice in the three cantons so far shows that the wastes are mostly disposed of at landfills, but very small percentage of it was disposed at the sanitary landfills „Smiljevići“ and „Moščanica“. Even in this case, due to lack of landfill emission control infrastructure, there are adverse impacts making high pressure on the environment. The adverse impacts of the inadequately disposed wastes on the environment, as well as that of the waste disposed of at the regulated landfills which lack appropriate emission treatment infrastructure include:

- **Emission of leachate** from the landfill body⁶⁵ into the soil and water (landfill filtrate) causing adverse impact on water and soil through temporary or permanent change in physical-chemical features of these living environments (one of the primary issues in municipal waste management to be tackled in practice at the landfills is leachate (landfill filtrate). The intensity of its production, and consequently its quantities, depend on a number of factors: landfill age, waste type, climate parameters etc. The landfill leachate occurs as a result of the precipitation waters passing through the landfill body causing extraction of soluble, colloid and suspended solids from waste. In other words, the landfill leachate is a polluted liquid drained through the deposited layers of wastes which absorbed great quantities of polluting substances from wastes, including products of chemical and biochemical reactions occurring in the landfill body. The leachate is composed of liquid entering the landfill body from outside, i.e. precipitation, infiltrated underground waters, as well as the water contained in the waste itself. The composition of the filtrate depends on the waste itself, the waste moisture contents, operational procedure of the waste spreading, climate conditions, as well as the phase of degradation the landfill is going through. So, the inert waste causes the generation of low-pressure filtrate, whereas the filtrate that originates from the hazardous waste has a wide range of components with highly unstable concentrations. The level of waste degradation also depends on the environment conditions like: pH, temperature, aerobic and anaerobic environment and types of micro organisms present. The filtrates from the hazardous waste landfills are characterized by the unstable concentrations of wide range, including salts, halogen organic components, traces of metal and a whole range of inorganic and organic compounds. Solid municipal waste disposed of at the non-hazardous waste landfills generates a filtrate of high organic load ((HPK > 20.000 mgO₂/l) which, several years later, drops to lower values ((HPK < 2.000 mgO₂/l). These landfills also generate high ammonia filtrates. The lower the content of the biodegradable waste in the landfill, the lower the concentration of HPK in the filtrate ((Hral, PK < 4.000 mgO₂/l) during the life of the landfill. In general, the filtrate from landfills disposing the inert wastes has lower concentrations of most organic and inorganic parameters).⁶⁶
- **air emissions** – As a result of anaerobic and aerobic degradation of waste (biogas – the share of biodegradable organic substances in untreated municipal waste being very high, as much as 65%), the biogas (landfill gas) is generated. The waste degradation could occur with the presence of oxygen in the upper layers of waste, or without presence of oxygen in the lower layers of waste, but most frequently, these two phases are taking place simultaneously. The duration of specific phases depends on the type of waste, its compactness, moisture contents, temperature etc. The degradation of organic components of the waste in upper layers of the landfill takes 15 to 20 years, but much longer in the lower layers. The aerobic degradation of organic substance mostly generates CO₂. In the initial phase of the waste

⁶⁵ Refers to official municipal landfills and „wild disposal sites“

⁶⁶ Knežević N., Univeristy of Banja Luka, Faculty of Technology, Impact of the structure and level of degradation of the municipal waste on the composition of leachate from landfills and selection of the treatment procedures, 2012

degradation, carbon and oxygen still have a significant share in the biogas composition. Later on, the biogas composition is largely changed, so that in the final, so-called „anaerobic stable methane phases“, biogas contains mostly methane (around 55%) and carbon dioxide (around 45%) creating additional quantities of greenhouse gases (carbon dioxide CO₂– and methane - CH₄) which have a potential of causing climate changes (increase in annual temperature of the area, occurrence of temperature extremes, reducing level of precipitation and irregularity of seasons). The air emissions could occur as a result of distribution of particulate matter from the landfill body into the surrounding area, fires etc., which affect the air quality.

- **taking up space** as a result of the waste disposed, which is relevant for urban centers facing the lack of space, permanent loss of land due to contamination of the soil beneath the landfill, degradation of natural habitat and deterioration of esthetic value of the area by adversely affecting the visual qualities of the landscape.

The impacts of the municipal waste on the population/human health could be divided into:

- direct, sensory perceptible impacts – municipal waste could cause odors, waste ignition could **lead to fires** at landfills and surrounding areas, risk of explosions caused by inadequate degasification systems (these impacts have a lower potential for major risk for people because of the population's reaction to accidents)
- indirect, sensory imperceptible impacts – consumption of drinking water contaminated by leachate from the disposed municipal waste, particularly in the local water pipelines not being systematically monitored, breathing in suspended particles from the landfill body could cause respiratory problems, contamination of soil with heavy metals, and incomplete combustion of the municipal waste at low temperatures, could give rise, in addition to common CO₂ i H₂O_(g) , to other compounds like polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzo-p-furans (PCDFs) or, simply dioxins and furans, which are highly cancerogenic, mutagen, teratogen, immunotoxic and hepatotoxic. Although the aforesaid compounds are present in all media: water, air, soil, due to its highly lipophilic nature, they are mainly accumulated in the fat-rich media – in food: dairy products, meat, fish. The consumption of living organisms occurs through inhalation and digestion (food). The aforesaid compounds are also characterized by bioaccumulation and bio magnification phenomena through food chain (these impacts have a higher potential of adverse effects on population and human health).

Given below is a detailed overview of the identified adverse effects on the environment, population/human health as related to the existing condition of the environment and the quality of its components in the Zenica-Doboj Canton, Central Bosnia Canton and Sarajevo Canton.

6.2 State of the environment and impacts of the municipal waste in the ZDK

Water quality In the ZDK, there is no sufficient data on effects of inadequate disposal of municipal waste on the quality of surface and underground waters, because no register is kept of the existing landfills, or landfill leachate quality control, up-to-date data on hazardous waste disposal, to indirectly assess the level of dangerous substance emissions.⁶⁷

Regional landfill „Mošćanica“ has a system for adjacent area precipitation and leachate catchment. There is no leachate filtering system but it is planned to be installed, and the leachate treatment is currently carried out by filtrate recirculation onto the landfill body by way of the leachate management system. Municipal landfill „Bukva“, Tešanj, has a system for leachate catchment and

⁶⁷Ministry for Urban Planning, Transport and Communications and Environment of the ZDK, Cantonal Environment Action Plan ZDK 2017-2025, 2016

treatment, but it is out of operation so the leachate is discharged from the pond directly into the Vranduk/Bukva stream. Other municipal landfills do not have leachate catchment and treatment systems, and the waste waters are discharged untreated into the surrounding area.

In the ZDK, some municipal landfills are located in the immediate vicinity of the surface waterways:

- On the streams cutting across the landfill body (piped up in case of „Bukva“ Tešanj and „Nekolj“ Maglaj) or in the base of the landfill („Gradina“ Olovo) – streams are listed as Class 2 water quality, which means those are the waters that can be used in their natural state for swimming and recreation, water sports, breeding fish (Cyprinidae) or which, once they go through standard treatment procedure – conditioning (coagulation, filtration, disinfection etc.) could be used for drinking or in food industry.
- 5 – 10 m away from the River Bosna (landfill „Očazi“ Visoko and landfill „Trebetovići“ Žepče), 1 km from the River Stavnja (landfill „Koritnik“ Breza) or 2 km from the River Bosna (landfill „Bare“ Kakanj) – these rivers are listed under Class 3, which means they can be used for irrigation, and once they go through standard treatment methods (conditioning) in industry, except in food industry.
- 500 m away from the River Krivaja („Ekonomija-Batovice“ Zavidovići) – listed under Class 2, which means those are the waters that can be used in their natural state for swimming and recreation, water sports, breeding fish (Cyprinidae) or which, once they go through standard treatment procedure – conditioning (coagulation, filtration, disinfection etc.) could be used for drinking or in food industry.

Soil quality and space Soil quality at the „Mošćanica“ landfill, as well as that of the non-sanitary landfills is not known. Thanks to the leachate collection system and precipitation ditches around the „Mošćanica“ landfill, they are brought back to the landfill body via a recirculation system, not affecting the soil quality in the surrounding area of the „Mošćanica“ landfill. It is assumed there are historic pollution around the non-sanitary landfills in this region caused by long-term disposal of waste in the area without the adequate infrastructure for leachate collection and control, yet, the data on historical pollution are not available. On the other hand, the ZDK Environment Action Plan⁶⁸ has recognized the uncontrolled waste disposal as one of the causes of the land contamination in the ZDK.

In addition to the aforesaid municipal waste landfill in the ZDK, there are around 700 registered wild landfills, and due to lack of data, we cannot speak about the soil quality at those specific locations, but certainly, there is a potential of contamination as this is the waste disposed of directly onto the soil. The total area under municipal waste landfills in the ZDK is 58 ha, or 0.017% (the data refers to registered landfills only, not including wild disposal sites) of the total area of the ZDK of 334,300 ha.

Air quality Current situation of the air quality in the ZDK can be assessed only in the Zenica area based on the parameters obtained through continuous measurements at the automatic measuring stations. In other ZDK municipalities there are no automatic measuring stations which could provide reliable data on the air quality parameters. Based on the statistical indicators available from measuring of the air pollutant concentration in Zenica, one can come to a conclusion that the most serious problems in the city were caused by SO₂ and particulate matter⁶⁹. Reported as main sources of air pollution in Zenica are industrial and energy plants using coal. The ZDK Cantonal Environment Plan has not recognized the connection between a poor municipal waste management and air quality. By comparing the direction of wind and SO₂ measuring results, it has been established that the largest quantities of this pollutants are coming to Zenica from the direction of Kakanj. At the

⁶⁸ Ministry for Urban Planning, Transport and Communications and Environment of the ZDK, Cantonal Environment Action Plan ZDK 2017-2025– Draft, 2016

⁶⁹ Federal Hydrometeorological Institute, Annual Air Quality Report for the Federation of Bosnia and Herzegovina 2015, 2016

same time, the highest concentrations of particulate matter in the Zenica's air comes from local sources.⁷⁰

In the ZDK, only „Moščanica“ landfill has a biogas degasification system installed, whereas the other ZDK landfills do not have it. The biogas utilization system is nowhere to be found in the ZDK landfills. Other possible effects on air quality come from the fires observed in Vareš and Zavidovići.

Climate When it comes to climate and climate change in the ZDK, the research of temperature changes 1961-2010⁷¹ has shown the summer months temperature increase of 0.08°C, whereas the temperature rise in the vegetation period (April-September) is as much as 1,0 °C. The most significant change in annual precipitations relates to the Doboj's surroundings (ZDK). Also present is the increased number of tropical days (those with Tmax>30 °C) in almost entire BiH territory.

The impacts of municipal waste on the climate is presented by the greenhouse gas emissions as biogas constituents due to aerobic and anaerobic degradation of municipal waste releasing greenhouse gases CO₂ i CH₄. As already mentioned, only „Moščanica“ landfill has a biogas degasification system, but not the one for incineration or exploitation of methane, so that methane from this and other cantonal landfills is freely ventilated into the atmosphere. As the emission of CO₂ from the landfills and waste disposed is considered neutral⁷², we shall elaborate below the impacts of the emissions of CH₄ being released as a result of the anaerobic degradation of the waste annually. The quantity of methane released during the degradation process is directly proportional to the share of degradable organic carbon (ROU) defined as share of carbon in various types of organic biodegradable waste.

The assessment of the impact of the landfill gas emissions on the climate is made by calculating the CH₄ quantity using a method for assessment of the greenhouse gas emission of the *European Bank for Reconstruction and Development - EBRD*⁷³ and guidelines of the *Intergovernmental Panel on Climate Change - IPCC*⁷⁴ for making a GHG inventory. The calculated quantities of methane released from the anaerobic degradation of waste in ZDK amount to 3.350,2 tCH₄/year:

$$\text{CH}_4 \text{ (t/year)} = [\text{MSW}_T \times L_0 - R] \times [1 - \text{OX}],$$

where L₀, methane generation potential in t CH₄/t MSWT is calculated as

$$L_0 = \text{MCF} \times \text{DOC} \times \text{DOCF} \times F \times (16/12).$$

For the adopted coefficient values MCF=0,6, DOC=1, DOCF=0,55, F=0,09, R=0 i OX=0, annual amount of waste generated in the ZDK of 83.754,1 t/year, the calculation is as follows:

$$L_0 = 0,6 \times 1 \times 0,55 \times 0,09 \times (16/12) = 0,04$$

$$\text{CH}_4 \text{ (t/year)} = [83.754,1_T \times 0,04 - 0] \times [1 - 0] = 3.350,2 \text{ tCH}_4/\text{year}.$$

According to the data stated by the Second National Communication of Bosnia and Herzegovina under the United Nations Framework Convention (BiH Council of Ministers, 2013), the waste disposal is recognized as one of the three main sources of CH₄ in BiH, and the total emission of CH₄ in BiH in 2013 generated as a result of waste degradation amounted to 47.05 Gg or 47.050 t.⁷⁵ The calculated annual quantity of CH₄ released in the ZDK is 7.2% of the total CH₄ released in the entire BiH.

⁷⁰ Public Health Institute of the F BiH, State of the Population Health and Health Care in the F BiH, 2015

⁷¹ Second National Communication of Bosnia and Herzegovina under the United Nations Framework Convention (BiH Council of Ministers, 2013)

⁷² European Bank for Reconstruction and Development (EBRD), Greenhouse Gas Assessment Methodology, Version 7, juli 2010.

⁷³ European Bank for Reconstruction and Development (EBRD), Greenhouse Gas Assessment Methodology, Version 7, juli 2010.

⁷⁴ IPCC, Guidelines for National Greenhouse Gas Inventories, 2006

⁷⁵ Gg equals 1.000.000 kg, or 1.000 t

Given the already noted climate change trend, the quantities of CH₄ released from the municipal waste degradation and passive release of CH₄ into the atmosphere could contribute to intensifying climate change at the local and global level.

Population/public health When it comes to the leachate generated in the ZDK, they mostly end up in the environment without any pre-treatment (open waterways, soil), except in the case of „Moščanica“ regional landfill where the leachate is returned to the landfill body via a recirculation system. In the ZDK, the hygienic and sanitary condition of the water facilities and the drinking water quality control in terms of public health are not satisfactory, particularly in the local water pipelines. The most frequent potential drinking water polluters in ZDK are found to be unregulated and wild landfills.⁷⁶ In the vicinity of the Maglaj municipal landfill they registered two drinking water wells being used to supply water to the local population where leachate could have its direct adverse effects. Also, the plastic water pipes are cutting along the edges of this landfill. Taking into account the aforesaid facts, there is a potential of drinking water pollution and, consequently, the adverse impact on the human health.

Large number of wild landfills in the ZDK (700) and non-enclosed municipal landfills practicing no daily waste covering (for instance Olovo, Žepče, Zavidovići) could also contribute to the deterioration of the epidemic situation in some other ways, like through free access to animals (most often stray dogs) that could be disease carriers, as well as the direct contact of the population with the waste.

Other adverse impacts of the municipal waste on the population include odors released from the landfills often accompanied by the distribution of particulate matter carried by wind from the landfill body, which could cause respiratory problems (relevant to municipal landfills in Visoko and Kakanj located at 50-500 m air distance from the settlements). Some municipal landfills are facing problems with fires (for instance Vareš, Zavidovići) which could release dioxins and furans from waste burning, potentially affecting humans through inhalation and digestion.

Plants and animals In the vicinity of the „Moščanica“ regional landfill and the registered municipal landfills, no locations of importance for plants or animals have been observed. Those are mainly areas degraded by waste disposal or other kinds of human activities (for instance industrial areas). At the municipal landfills of Vareš, Maglaj and Olovo the presence of animals frequenting these locations in search for food was observed. Wild landfills are scattered around the whole territory of the canton, and they can have an adverse impact in terms of contamination of water/soil, but given their size and quantity of waste disposed, they cannot jeopardize the plants or animals. The ZDK Cantonal Environment Plan does not include information on wild landfills or other problems related to the municipal waste management within the officially declared nature monument „Tajan“.

Material resources „Moščanica“ regional landfill lies in the unpopulated area with the first house in the settlement of the same name south from the landfill located at around 1 km air distance. Some municipal landfills are located at 50-500 m air distance from the settlements (Visoko, Breza, Kakanj) and industrial zones (Zavidovići – Ekonomija/Batvice, Tešanj – Bukva, Vareš – lime split exploitation zone) at about 300-500 m air distance. One of the recognized adverse impacts on the material resources could be free distribution of methane in the space and its accumulation in the house basements which could potentially cause explosions. Adverse effects on the population come from fires, particularly the unfavorable wind rose, as in the case of Vareš. In addition to Vareš, the fires were observed in Zavidovići as well.

The nature monument „Crkva Majke Božje“ with the movable property in Olovo is at around 500 m air distance from the municipal landfill „Gradina“. However, according to geomorphologic properties of the compound and „Gradina“ landfill site, adverse effects of the disposed waste is not expected.

⁷⁶ Public Health Institute of the F BiH, State of the Population Health and Health Care in the F BiH, 2015

Given below is the overview of the Pressures, State of environment, Impacts and Responses of society when it comes to the impacts of municipal waste on the ZDK environment and population.

Table 24: Impact of municipal waste on the environment and population in the ZDK

Pressures	State of environment	Impacts	Responses
<p>PO1 – Production of municipal waste in the ZDK of 280 kg/person/year which makes the total of 121,382.8 t/person/year in ZDK (83,754.1 t/year of the collected waste and estimated additional 37,628.7 t/year of waste not covered by the collection system)</p> <p>PO2 – Coverage of the ZDK population with waste collection, transport and disposal is about 69%.</p> <p>PO3 – The total of 53.73% of the waste produced the ZDK is landfilled (44,050 t/year landfilled at „Mošćanica“ and about 700 t/year at the „Doboj“ landfill (RS).</p> <p>PO4 – Separately collected is about 4200 t/year of recycling waste, or 0.09% of the totally generated waste.</p> <p>PO5 – Increase in municipal waste quantities of around 102.2 t/year.</p> <p>PO6 – Around 37,628.75 t/year ends up at wild landfills, or 31% of the total annual quantity of waste of 83,754.1 t/year covered by the waste collection system.</p> <p>PO7 – There are about 700 wild landfills in the ZDK.</p>	<p>S01 – The quality of surface waters as main recipients of leachate from landfill body (pipelined streams in case of „Bukva“ landfill, Tešanj and „Nekolj“ Maglaj, or at the base of „Gradina“ landfill, Olovo) as well as quality of soil close to landfills and wild disposal sites is unknown.</p> <p>S02 – The total area of sanitary landfill „Mošćanica“ is about 20 ha of enclosed space, and 13 ha is scheduled and already used for waste disposal (landfill platform is 100% taken up, and the percentage of the volume filled is 40% of the designed capacity).</p> <p>S03 – The area under waste in the ZDK is 58 ha, or 0.017% (this information refers to registered landfills only, not including wild disposal sites) of the total ZDK area of 334,300 ha.</p> <p>S04 – These climate changes have been identified in the ZDK: temperature rise by 0.8%, precipitation variations, increase in number of tropical days, draughts and floods due to deteriorated pluviometric regime.</p> <p>S05 – Odors felt in the settlements in the vicinity of municipal landfills (relevant to municipal landfill of Visoko and Kakanj being at 50-500 m air distance from the settlements).</p>	<p>I01 – Contamination of the water streams and artificial accumulations as a result of discharge of untreated leachate from the non-sanitary municipal landfills and wild disposal sites into the environment, particularly:</p> <ul style="list-style-type: none"> ▪ At the streams cutting through the landfill body (pipelined in case of „Bukva“ Tešanj and „Nekolj“ Maglaj) or at the base of „Gradina“ landfill, Olovo ▪ At 5-10 m distance from the River Bosna (landfill „Očazi“ Visoko and landfill „Trebetovići“ Žepče), 1 km from the River Stavnja (landfill „Koritnik“ Breza) or 2 km from the River Bosna (landfill „Bare“ Kakanj). ▪ At 500 m distance from the River Krivaja („Ekonomija-Batovice“, Zavidovići) ▪ „Koritnik“ landfill, Breza, no longer in use, is located at the open-pit mine (PK) Koritnik that is occasionally flooded with the mine-based waters ▪ „Kota“ landfill, Vareš, is 500 m away from the artificial accumulation PK Smreka, located above the accumulation. <p>I02 – Contamination of soil due to penetration of leachate into the environment from the non-sanitary municipal landfills and wild disposal sites.</p> <p>I03 – Additional deterioration of the air quality due to particulate matter emissions.</p> <p>I04 – Current emission of 3.350,2 t CH₄ per year due to anaerobic degradation of</p>	<p>R01 – Construction of the leachate collection systems at the landfill of:</p> <ul style="list-style-type: none"> ▪ „Mošćanica“ where the leachate is brought via recirculation system back to the landfill body, and ▪ „Bukva“, municipality of Tešanj where leachate is collected, but also discharged untreated into the Vranduk stream. <p>R02 – Construction of a biogas degasification system at the „Mošćanica“ landfill and established monitoring of quantities and composition of landfill gas, but without using it, either by this or any other landfill in the Canton.</p> <p>R03 – Application of cell disposal system and daily covering of waste only at the „Mošćanica“ landfill.</p> <p>R04 – A hall was built for PET packaging and cardboard baling at „Mošćanica“ Zenica and „Bukva“ Tešanj landfills only.</p> <p>R05 – Setting up green islands in Zenica, Breza, Maglaj, Olovo and Tešanj.</p> <p>R06 – Individual municipal utility companies are removing wild landfills with their own assets, or in collaboration with the „Let's do it“ NGO.</p> <p>R07 – A Cantonal Waste Management Plan was developed and it envisages actions for resolving the issues of waste collection and disposal, along with the introduction of the recycling system.</p> <p>R08 – 7/12 have their Waste Management</p>

Pressures	State of environment	Impacts	Responses
		<p>municipal waste at the municipal landfills and „Mošćanica“ regional landfill (not including wild landfills) with the rising trend along with the increase in the quantity of the waste disposed.</p> <p>I05 – Faster than planned filling of the „Mošćanica“ landfill and a need for expansion in order to handle the rising waste quantities.</p> <p>I06 – Deterioration of the hygienic – epidemiological situation because of wild landfills in the ZDK, particularly in case of two water wells near „Nekolj“ landfill, municipality of Maglaj.</p> <p>I07 – Inconveniences for population caused by odors, particulate matter and potential risks of explosions.</p> <p>I08 – Impacts on the human health from fires (for instance Vareš, Zavidovići), as exposed to emissions of dioxins and furans during the burning of wastes, that affects the people through inhalation and digestion.</p>	<p>Plan</p> <p>R09 – All the ZDK municipalities having municipal landfills (9) started drafting project design documents for closure and rehabilitation of landfills and transition onto the regional disposal concept. One of those has drafted the Adjustment Plan (Breza), 6 municipalities have their preliminary designs developed (Maglaj, Olovo, Tešanj, Vareš), 2 municipalities have the main project design finished (Kakanj and Visoko).⁷⁷</p> <p>R010 – In addition to Zenica, only municipality of Visoko in the ZDK transports 100% of its waste to the „Mošćanica“ regional landfill, and the landfilling service at this sanitary landfill are used by other two municipalities: Žepče and Zavidovići (the share unknown).</p>

⁷⁷ Dobož-Jug and Usora do not have their municipal landfills, and municipal landfill in Zenica (Siđe) is closed

6.3 State of the environment and impacts of the municipal waste in the SBK

Water quality In the SBK, there is no regional sanitary landfill, and the municipal landfills are non-sanitary and do not have leachate catchment or treatment systems. The waste waters are discharged into the surrounding area untreated. In Donji Vakuf a drinking water well was registered in the vicinity of the „Ornice“ municipal landfill. Municipality of Dobretići has no municipal landfill and do not use the services of any other municipal landfill.

In the SBK, there is no data on impacts of inadequate municipal waste disposal on the quality of surface and underground waters, because there is no monitoring of the landfill leachate quality or up-to-dated information on hazardous waste disposal in order to indirectly assess the level of emissions of the hazardous substances from inadequate waste disposal.

In the SBK, some municipal landfills are in the immediate vicinity of water streams:

- The Kruščica stream is cutting through the landfill body (pipelined stream in the case of „Kruščica“ landfill, Jajce) - streams are listed as Class 2 water quality, which means those are the waters that can be used in their natural state for swimming and recreation, water sports, breeding fish (Cyprinidae) or which, once they go through standard treatment procedure – conditioning (coagulation, filtration, disinfection etc.) could be used for drinking or in food industry.
- At 500 m air distance from the River Rijeka – Grlovnica's confluent („Mitale“ landfill, Novi Travnik) – also listed under Class 2 waters,
- At 1 km away from the stream Jasenovac („Dubrave“ landfill, Kreševo, River Dragača (Mut-Plane“ landfill, Fojnica), 1 km from the River Kruščica („Batuški Lug“ landfill, Gornji Vakuf) and 1.5 km from the River Grlovnica („Mitale“ landfill, Novi Travnik) – also listed under Class 2 waters.

Soil quality and space The soil quality around the municipal landfills is unknown. As already mentioned, there are no leachate or precipitation catchment systems. It is assumed there are historic pollution around these landfills as a consequence of the long-time waste disposal in these areas without adequate leachate collection and control infrastructure. In addition to the aforesaid municipal waste landfills in the SBK, there are about 473 known wild disposal sites. Due to lack of data, we cannot speak about the soil quality at those specific locations, but certainly, there is a potential of contamination as this is the waste disposed of directly onto the soil. Some municipalities are rehabilitating the registered wild landfills, and six SBK municipalities have not allocated funds for removal of wild landfills at all. In the municipalities of Travnik, Kiseljak and Bugojno, the lack of containers for disposal of mixed municipal waste has been noted.

The total area under municipal waste landfills in the SBK is 14 ha, or 0.004% (the data refers to registered landfills only, not including wild disposal sites) of the total area of the SBK of 318,900 ha. The waste is disposed in most SBK municipalities in the total capacity, there is no systematically organized primary selection or separation of recyclables, municipal landfills have no sorting facilities and there are no green islands for primary selection by the population.

Air quality The current situation of the air quality in the SBK can be assessed only in the Jajce area based on the parameters obtained through continuous measurements at the automatic measuring station „Harmani“. In other SBK municipalities there are no automatic measuring stations which could provide reliable data on the air quality parameters. Based on the statistical indicators available from measuring of the air pollutant concentration in Jajce, one can come to a conclusion that the most serious problems in the city were caused by O₃ and particulate matter, to a much lesser

extent.⁷⁸ The main sources of pollution in the SBK are reportedly motor vehicle emissions, low-lying fire beds in winters and industrial plants.⁷⁹

In the SBK, no municipality has a biogas degasification system installed. The fires have been registered at the landfills of Fojnica, Kreševo, Gornji Vakuf-Uskoplje and Jajce.

Climate When it comes to climate and climate change in the SBK, the research of temperature changes 1961-2010⁸⁰ has shown the summer months temperature increase of 0.08°C, as in the rest of BiH, whereas the temperature rise in the vegetation period (April-September) is as much as 1,0 °C. In the period between 1961 and 2010, most of the BiH territory is characterized by slight increase in annual precipitations with the obvious trend of increased number of tropical days (those with $T_{max} > 30$ °C) in almost entire BiH territory. The impacts of municipal waste on the climate is presented by the greenhouse gas emissions as biogas constituents due to aerobic and anaerobic degradation of municipal waste releasing greenhouse gases CO_2 i CH_4 . As already mentioned, the SBK municipal landfills have no degasification or biogas utilization systems. The calculated quantities of methane released from the anaerobic degradation of waste in SBK amount to 1,808.2 t CH_4 /year:

$$CH_4 \text{ (t/year)} = [MSW_T \times L_0 - R] \times [1 - OX],$$

where L_0 , methane generation potential in t CH_4 /t MSWT is calculated as

$$L_0 = MCF \times DOC \times DOC_f \times F \times (16/12).$$

For the adopted coefficient values $MCF=0,6$, $DOC=1$, $DOC_f=0,55$, $F=0,06$, $R=0$ and $OX=0$, annual amount of waste collected and disposed of at the SBK landfills of 60,282.4 t/year, the calculation is as follows:

$$L_0 = 0,6 \times 1 \times 0,55 \times 0,06 \times (16/12) = 0,03$$

$$CH_4 \text{ (t/year)} = [60.282,4 \times 0,03 - 0] \times [1 - 0] = 1.808,5 \text{ t}CH_4\text{/year.}$$

The calculated annual quantity of CH_4 released in the SBK is 3.8% of the total CH_4 emission in BiH. As already mentioned, CH_4 which is passively released into the atmosphere could contribute to intensifying climate change at the local and global level.

Population/public health. When it comes to the leachate generated in the SBK, they mostly end up in the environment without any pre-treatment (open waterways, soil). In the SBK, the hygienic and sanitary condition of the water facilities and the drinking water quality control in terms of public health are not satisfactory, and the most frequent potential drinking water polluters in the SBK are found to be unregulated and wild landfills.⁸¹ In the vicinity of the Donji Vakuf municipal landfill they registered a drinking water well being used to supply water to the neighboring settlement of some 500 inhabitants where leachate could have its direct adverse effects, if it reaches the well. In the SBK there is a potential for drinking water pollution from the waste and consequently, for adverse impacts on human health. In addition, large number of wild landfills in the SBK (423) and non-enclosed municipal landfills with inadequate daily covering of the waste (Bugojno, Fojnica, Kreševo, Gornji Vakuf-Uskoplje, Jajce) could contribute to the deterioration of the epidemiological situation through intrusion of animals into the landfill area which could then become disease carriers. Also, there is a risk of population getting in contact with the waste.

Furthermore, the spreading of odors released from landfills, as well as the particulate matter carried by wind could be expected around the municipal landfills of Vitez, Busovača and Donji Vakuf, which

⁷⁸ Federal Hydrometeorological Institute, Annual Air Quality Report for the Federation of Bosnia and Herzegovina 2015, 2016

⁷⁹ Ministry of Spatial Planning, Civil Engineering, Environment, Return and Housing of the SBK, Cantonal Environment Plan 2015-2025, 2015

⁸⁰ Second National Communication of Bosnia and Herzegovina under the United Nations Framework Convention (BiH Council of Ministers, 2013)

⁸¹ Federal Hydrometeorological Institute, Annual Air Quality Report for the Federation of Bosnia and Herzegovina 2015

are at 100-150 m air distance from the human settlements. Municipal landfills in Fojnica, Kreševo, Gornji Vakuf-Uskoplje and Jajce are facing problems with fires which could release dioxins and furans from waste burning. It is important to note that the areas around the fire-risked landfills are unpopulated, so the direct inhalation of toxic substances is not possible, but exposure to dioxins and furans could take place through consumption of the food from the adjacent areas.

Plants and animals In the vicinity of the SBK municipal landfills, no locations of importance for plants or animals have been observed. The areas of landfills and around the landfills are mainly areas degraded by waste disposal, spreading of waste or the area that has already been changed due to industrial activities (industrial zone „Blatuški Lug“, Gornji Vakuf-Uskoplje). Some landfills are in the forest-rich areas with the observed presence of wild animals who roam the waste disposal plateaus in Fojnica, Kreševo, Jajce and Bugojno.

Wild landfills, though scattered around the whole territory of the canton, cannot have an adverse impact in terms of jeopardizing plants or animals. The adverse impacts are reflected in the contamination of the habitat and conversion of natural landscape into degraded areas, as well as taking up space. In the SBK, there is one officially protected natural area, the Nature Monument „Prokoško jezero“, which is not known for having issues with the municipal waste management, nor any wild landfills have been noted within the protected area.

Material resources. No elements of cultural-historical heritage have been identified in the vicinity of municipal landfills. Municipal landfills in Vitez, Busovača and Donji Vakuf are located at the 100-150 m air distance from the housing units (earlier in this study we have shown the risk of explosions caused by methane), whereas the municipal landfill in Gornji Vakuf-Uskoplje is located within the industrial zone „Blatuški Lug“.

Given below is the overview of the Pressures, State of environment, Impacts and Responses of society when it comes to the impacts of municipal waste on the SBK environment and population.

Table 25: Impact of municipal waste on the environment and population in the SBK

Pressures	State of environment	Impacts	Responses
<p>PO1 – Production of municipal waste in the SBK of 258 kg/person/year which makes the total of 97,229.68 t/person/year in SBK (60,282.4 t/year of the collected waste and estimated additional 36,947.28 t/year of waste not covered by the collection system)</p> <p>PO2 – Coverage of the SBK population with waste collection, transport and disposal is about 62%.</p> <p>PO3 –There is no regional landfill in the SBK. The regional landfill „Moščanica“ in the neighboring canton (ZDK) receives 12,583.36t/year, or about 13 % of the totally produced wastes in the SBK, or 21% of the waste covered by the collection system.</p> <p>PO4 – Separately collected is about 7,830 t/year of recycling waste, or 8% of the totally generated waste.</p> <p>PO5 – Decrease in quantities of waste generated by the population due to negative birth rate, by -369 t/year (increase in quantities of municipal waste is only possible due to rising living standard and industrial activities).</p> <p>PO6 – Around 36,947.28 t/year end up at wild landfills, or 38% of the total annual quantity of waste of 60,282.4 t/year covered by the waste collection system.</p> <p>PO7 – There are about 473 wild landfills in the SBK.</p>	<p>S01 – The quality of surface waters as main recipients of leachate from landfill body (pipelined stream of Kruščica at the „Kruščica“ landfill, Jajce) as well as quality of soil close to landfills and wild disposal sites is unknown.</p> <p>S02 – There is no regional landfill in the SBK.⁸²</p> <p>S03 – The area under waste in the SBK is 14 ha, or 0.004% (this information refers to registered landfills only, not including wild disposal sites) of the total SBK area of 318,900 ha.</p> <p>S04 – These climate changes have been identified in the ZDK: temperature rise by 0.8%, precipitation variations, increase in number of tropical days, draughts and floods due to deteriorated pluviometric regime.</p> <p>S05 – Odors felt in the settlements in the vicinity of municipal landfills (relevant to municipal landfill of Vitez, Busovača and Donji Vakuf being at 100-150 m air distance from the settlements).</p>	<p>I01 – Contamination of the water streams and artificial accumulations as a result of discharge of untreated leachate from the non-sanitary municipal landfills and wild disposal sites into the environment, particularly:</p> <ul style="list-style-type: none"> ▪ At the streams cutting through the landfill body (pipelined in case of „Kruščica“ landfill, Jajce) ▪ At 500 m distance from the River Rijeka – Grlovnica's confluent („Mitale“ landfill, Novi Travnik) ▪ At 1 km distance from the stream Jasenovac („Dubrave“ landfill, Kreševo), River Dragača, „Mut-Plane“ landfill, Fojnica), 1 km from the River Kruščica („Batuški Lug“ landfill, Gornji Vakuf-Uskoplje) and ▪ At 1.5 km from the River Grlovnica („Mitale“ landfill, Novi Travnik) <p>I02 – Contamination of soil due to penetration of leachate into the environment from the non-sanitary municipal landfills and wild disposal sites.</p> <p>I03 –Deterioration of the air quality due to particulate matter emissions.</p> <p>I04 – Current emission of 1,808.5 t CH₄ per year due to anaerobic degradation of municipal waste at the municipal landfills (not including wild landfills)</p>	<p>R01 – A Regional Landfill Feasibility Study was made for the SBK - region 1, with the proposed location of the deserted open-pit coal mine „Gračanica“ at the border between municipalities of Bugojno and Gornji Vakuf-Uskoplje.</p> <p>R02 – Separation of recyclables takes place thanks to „Eko-industrijski otpad ZIZI“ d.o.o. Travnik company.</p> <p>R03 – Some municipal utility companies remove wild landfill with their own assets, or in collaboration with the NGO „Let's do it“.</p> <p>R04 – A Cantonal Waste Management Plan was developed and it envisages actions for resolving the issues of waste collection and disposal, along with the introduction of the recycling system</p> <p>R05 - 7/12 municipalities have their Waste Management Plan</p> <p>R06 - All the SBK municipalities having municipal landfills (11) started drafting project design documents for closure and rehabilitation of landfills and transition onto the regional disposal concept. One of those has drafted the Adjustment Plan (Travnik), 7 municipalities have their preliminary designs developed (Bugojno, Busovača, Fojnica, Kiseljak, Kreševo, Novi Travnik, Vitez), 2 municipalities have the main project design completed (Gornji Vakuf-Uskoplje and Jajce), and 1 municipality (Donji Vakuf) have started</p>

⁸²The total area of sanitary landfill „Moščanica“ to which four SBK municipalities (Busovača, Travnik, Novi Travnik, Vitez) dispose of their wastes because there is no regional landfill in the SBK, is about 20 ha of enclosed space, and 13 ha is scheduled and already used for waste disposal (landfill platform is 100% taken up, and the percentage of the volume filled is 40% of the designed capacity)

Pressures	State of environment	Impacts	Responses
		<p>I05 – Faster than planned filling of the „Mošćanica“ landfill in the neighboring ZDK canton and a need for its expansion in order to handle waste quantities from the SBK.</p> <p>I06 – Deterioration of the hygienic – epidemiological situation because of wild landfills in the SBK, particularly in case of a water well „Ornice“, Donji Vakuf which supplies drinking water to the neighboring settlement of 500 people.</p> <p>I07 – Inconveniences for population caused by odors, particulate matter, inadequate covering of waste with inert material at the municipal landfills of Bugojno, Fojnica, Kreševo, Gornji Vakuf-Uskoplje, Jajce and potential risks of explosions.</p> <p>I08 – Impacts on the human health from fires (Fojnica, Kreševo, Gornji Vakuf-Uskoplje Jajce), as exposed to emissions of dioxins and furan, that affects the people through digestion.</p>	<p>the rehabilitation of the municipal landfill.</p> <p>R07 - Only municipality of Busovača and Travnik in the SBK transport 100% of their wastes to the „Mošćanica“ regional landfill (ZDK Canton), and the landfilling service at this sanitary landfill are used by other two municipalities: Novi Travnik and Vitez (the share unknown).</p>

6.4 State of the environment and impacts of the municipal waste in the KS

Water quality Cantonal landfill „Smiljevići“ built to handle the waste disposal in the Sarajevo Canton, has put in place the system for catchment of precipitation waters from surrounding area and leachate, as well as the filtering system which is out of operation. The waste waters are discharged completely untreated into the Žički potok stream, then into the Lepenički potok to end up in the River Bosna. The quality of Žički potok and Lepenički potok at the section where the landfill leachate drains into the water is not known, but one can assume with a degree of certainty it is the waste water collector of the deteriorated quality. The River Bosna downstream from the mouth of the Lepenički potok is listed under Class 3, which means this is the water that can be used for irrigation, and following the standard processing methods (conditioning) in industry, except in the food industry.

In general, chemical, biological and ecological status of the River Bosna downstream from the Miljacka mouth are assessed as poor, mainly due to excessive concentration of the water quality parameters surpassing the values prescribed by the laws and regulations, particularly for the organic matters, compounds of nitrogen and phosphorus, polyaromatic hydrocarbons (PAH), pesticides, organochloric pesticides (OCP) and heavy metals. This situation recorded back in 2011, 2012 and 2013 was caused by inadequate waste water management and lack of municipal and industrial waste water treatment⁸³. The aforesaid measurements have been carried out at the MS Reljevo (near BA_BOS_6) at the settlement of Reljevo and at the mouth of River Miljacka into the River Bosna (near BA_BOS_MILJ_1) around which no wild landfills exist. Yet, it is important to emphasize that the current poor quality of the River Bosna water is further deteriorated by the water from the Lepenički potok carrying the leachate from the „Smiljevići“ landfill.

Soil quality and space The soil quality around the „Smiljevići“ landfill is not known. Thanks to the leachate and precipitation water collection system around the landfill, it is assumed that the leachate do not jeopardize the quality of adjacent soil. Some reservations are advised when it comes to the historic pollution that had probably taken place as a result of the long-time disposal of waste in this area prior to installation of the leachate collection and control infrastructure. However, the data on historic pollution are not available. In addition to the „Smiljevići“ landfill, there is a number of smaller and larger wild disposal sites. Also, due to the lack of data, we cannot speak about the soil quality at those specific locations, but certainly, there is a potential of contamination as this is the waste disposed of directly onto the soil. The total enclosed area of the „Smiljevići“ landfill is around 60 ha, i.e. 0.023% of the total area of the KS of 127,700 ha (the data refers to registered landfills only, not including wild disposal sites).

Air quality The current situation of the air quality in the Sarajevo Canton can be assessed based on the parameters obtained through continuous measurements at the automatic measuring stations located in the same municipality as the „Smiljevići“ landfill. Based on the statistical indicators available from measuring of the air pollutant concentration, one can come to a conclusion that the most serious problems in the city are caused by SO₂ and particulate matter.⁸⁴ Reported as main sources of air pollution in Sarajevo are traffic and fire beds (smokestacks). The KS Cantonal Environment Plan has not recognized the connection between a poor municipal waste management and air quality

At the „Smiljevići“ landfill, there is a partly installed facility for degasification and utilization of biogas for generation of electricity and alternatively, by open-flame incineration. The degasification is currently out of operation because the system was damaged by the digging operations at the landfill

⁸³ Sava River Basin Management Plan (2016 – 2021) –Draft, Attachment 8 – Surface Waters Monitoring, Sava River Watershed Agency, 2016

⁸⁴Federal Hydrometeorological Institute, Annual Air Quality Report for the Federation of Bosnia and Herzegovina 2015, 2016

as ordered by the BiH Prosecutor Office within the search for missing persons, so that the reconnection and re-establishment of the system is expected once the case is closed.

Climate When it comes to climate and climate change in the KS, the research of temperature changes 1961-2010⁸⁵ has shown the summer months temperature increase of 0.08°C. The most positive change in annual precipitations relates to the central hilly areas of the KS, whereas the greatest deficit was observed in the southernmost parts of the KS (-80 mm or around 20%) . Also present is the increased number of tropical days (those with Tmax>30 °C) in almost entire BiH territory.

The impacts of municipal waste on the climate is presented by the greenhouse gas emissions as biogas constituents due to aerobic and anaerobic degradation of municipal waste releasing greenhouse gases CO₂ i CH₄. At the „Smiljevići“ landfill, the system of catchment and utilization of biogas is not in operation.

The calculated quantities of methane released from the anaerobic degradation of waste in the KS amount to 80,000 tCH₄/year:

$$\text{CH}_4 \text{ (t/god)} = [\text{MSW}_T \times L_0 - R] \times [1 - \text{OX}],$$

where L₀, methane generation potential in t CH₄/t MSWT is calculated as

$$L_0 = \text{MCF} \times \text{DOC} \times \text{DOC}_F \times F \times (16/12).$$

For the adopted coefficient values MCF=0,6, DOC=1, DOC_F=0,55, F=0,09, R=0⁸⁶ i OX=0, annual amount of waste generated in the KS of around 200,000 t/year, the calculation is as follows:

$$L_0 = 0,6 \times 1 \times 0,55 \times 0,09 \times (16/12) = 0,040$$

$$\text{CH}_4 \text{ (t/year)} = [200.000_T \times 0,04 - 0] \times [1 - 0] = 8.000 \text{ tCH}_4/\text{year}.$$

The calculated annual quantity of CH₄ released as a result of the municipal waste degradation in the KS is 17% of the total CH₄ released in the entire BiH, which constitutes the most significant impact on the intensification of climate change when compared to other two cantons.

Population/public health When it comes to the „Smiljevići“ landfill, the leachate emissions end up in the open water streams. There are no registered water wells used for water supply in the vicinity of the landfill that could be directly affected by the leachate. Having in mind that the population living near the landfill is supplied with drinking water from the controlled central water supply system, there is no possibility of drinking water pollution and consequently, the adverse impact on human health. The recent protests of the people living in the neighborhood surrounding the landfill indicates the issues related to odors spreading from the landfill, most probably accompanied by particulate matter carried by wind from the landfill body, which could cause respiratory problems. Wild disposal sites in the Sarajevo Canton could certainly contribute to the deterioration of the epidemiological situation, particularly in terms of insect and pest propagation, as well as free animal access (most frequently stray dogs) that could be the disease carriers, as well as direct contact of the population with the waste.

Plants and animals The „Smiljevići“ landfill is located in the neighborhood of Buća potok. In the immediate vicinity to the landfill, no locations of importance for plants or animals have been observed. Those are mainly areas degraded by waste disposal or other kinds of human activities and plant and animal habitats typical of the urban areas. Wild landfills are scattered around the whole

⁸⁵Second National Communication of Bosnia and Herzegovina under the United Nations Framework Convention (BiH Council of Ministers, 2013)

⁸⁶ Although there is a methane burning torch at the „Smiljevići“ landfill, the system is currently not in operation and therefore the value taken as coefficient R is 0.

territory of the canton, some of which are found in the natural areas like Barica recreation site. The KS Cantonal Environment Plan does not include information on wild landfills or other problems related to the municipal waste management within the officially declared protected zone of the KS, but it mentions the problems posed by the location of wild landfills near water streams. These landfills could have adverse impact in terms of the contamination of the water/soil, but given their size and quantity of waste disposed, they cannot jeopardize the plants or animals.

Material resources The „Smiljevići“ landfill is located in the Buća potok neighborhood with the housing units nearby. One of the recognized adverse impacts on the material resources could include free distribution of methane in the space and its accumulation in the house basements which could potentially cause explosions

Given below is the overview of the Pressures, State of environment, Impacts and Responses of society when it comes to the impacts of municipal waste on the KS environment and population.

Table 26: Impact of municipal waste on the environment and population in the KS

Pressures	State of environment	Impacts	Responses
<p>PO1 – Production of municipal waste in the KS of 1.23 kg/person/day, or 450 kg/person/day which makes the total of 192,370 t/person/year in KS (178,904.00 t/year of the collected waste and estimated additional 13,466 t/year of waste not covered by the collection system)</p> <p>PO2 – Coverage of the KS population with waste collection, transport and disposal is about 93%.</p> <p>PO3 – The total of 93% of the waste produced the KS is at the „Smiljevići“ regional landfill.</p> <p>PO4 – Separately collected is about 4,176 t/year of recyclable waste, or 2.2 % of the totally generated waste.</p> <p>PO5 – Increase in municipal waste quantities of around 1,500 t/year.</p> <p>PO6 – Around 13,466 t/year ends up at wild landfills, or 7 % of the total annual quantity of waste of 178,904 t/year covered by the waste collection system.</p> <p>PO7 – There are about 100 wild landfills in the KS.</p>	<p>S01 – The quality of Žički potok and Lepenički potok waters (main recipients of leachate) as well as the soil quality of „Smiljevići“ landfill and wild disposal sites is unknown.</p> <p>S02 – The total area of the „Smiljevići“ landfill „“ is about 60 ha of enclosed space, with 30 already taken up.</p> <p>S03 – The area under waste is 30 ha, or 0.023% (this information refers to the „Smiljevići“ landfill only, not including wild disposal sites) of the KS area of 127,700 ha.</p> <p>S04 – These climate changes have been identified in the KS: temperature rise by 0.8%, precipitation variations, increase in number of tropical days, draughts and floods due to deteriorated pluviometric regime.</p> <p>S05 - Odors felt in the Buća potok settlement.</p>	<p>I01 – Contamination of the Žički potok and Lepenički potok, as well as of the River Bosna</p> <p>I02 – Contamination of soil due to penetration of leachate into the environment from wild disposal sites.</p> <p>I03 – Additional deterioration of the air quality due to particulate matter emissions.</p> <p>I04 – Current emission of 8,000 t CH₄ per year due to anaerobic degradation of municipal waste at the „Smiljevići“ landfill (not including wild landfills) with the rising trend along with the increase in the quantity of waste disposed.</p> <p>I05 – Faster than planned filling of the „Smiljevići“ landfill and a need for its expansion in order to handle the rising waste quantities.</p> <p>I06 – Deterioration of the hygienic – epidemiological situation because of wild landfills.</p> <p>I07 – Inconveniences for population caused by odors, particulate matter and potential risks of explosions.</p>	<p>R01 – Construction of the leachate control and treatment system at the „Smiljevići“ landfill (currently not in operation)</p> <p>R02 – Construction of a biogas degasification and utilization system at the „Smiljevići“ landfill (currently not in operation at most of the landfill because of damages resulted from the digging operations in search for missing persons, and degasification and open-flame incineration of methane works at the lower foot of the landfill only).</p> <p>R03 – Application of cell disposal system and daily covering of waste at the „Smiljevići“ landfill.</p> <p>R04 – Building of a sorting facility at the „Smiljevići“ landfill (2007) for separation of the recyclables from the mixed municipal waste (sorting facility operates with the limited capacity).</p> <p>R05- Setting up green islands in the KS</p> <p>R06 – KJKP „Rad“ is working on removal of the wild landfills, but those are re-established most of the time.</p> <p>R07 – A Cantonal Waste Management Plan was developed and it envisages actions for resolving the issues of waste collection and disposal, along with the introduction of the recycling system.</p> <p>R08 – 3/9 municipalities have their Waste Management Plan.</p>

7 MEASURES TO MITIGATE THE MUNICIPAL WASTE ENVIRONMENTAL IMPACTS

7.1 Introduction

In general, measures to mitigate adverse effects, i.e. prevent, reduce or mitigate adverse impacts of the municipal waste on the environment could be divided into:

- i. General mitigation measures
- ii. Technical mitigation measures.

The general mitigation measures include:

- Waste management planning at all administrative levels (Federal, cantonal, municipal)
- Setting up an integral waste management system
- Planning funds for introduction of an integral waste management system
- Observing other relevant legal regulations like those related to water, air and soil protection, in waste management
- Program of education and raising public awareness of the importance of adequate waste management.

The technical mitigation measures aimed at preventing adverse impacts of the municipal waste on the environment, Federal waste management plan 2012-2017 set the implementation of the following measures:

- Implementation of actions and measures contributing to the development of **waste collection system**, including expanded area under service, procurement of adequate containers for temporary disposal, procurement of adequate vehicles for waste transport
- In parallel with the waste collection system development, implementation of the activities to promote **separate waste collection**, including:
 - Primary waste separation at the site of production (population, industry) based on separate collection of usable waste, to form separate streams of various types of usable waste materials, as well as hazardous wastes (for instance paper, plastic and metal packaging, glass, biodegradable waste, discarded electric and electronic equipment, old tires, accumulators, old cars, old medicines, construction waste etc.)
 - Building of recycling yards (RD) equipped with adequate storage facilities, depending on their size and type, and used to collect various types of usable wastes
 - Building of green islands aimed at separate collection of recyclables from waste that could be set up at a number of collection spots in the neighborhoods, including storage containers and containers for specific type of waste (most often paper, plastics, glass)
 - Containers for separate waste collection could be placed along with the existing capacities for collection of mixed waste
 - Equipping utility companies with adequate vehicles for taking up separately collected usable waste of various types
 - Sorting of the recyclables from mixed municipal waste – in the communities that do not develop separate collection of recyclables at the place of production or

collection, this could be done at the sorting facilities within the waste management centers that could be built at the existing landfill compounds

- Development of a municipal waste **treatment system**. The waste treatment is a procedure to facilitate handling and improve usability of waste through mechanical, physical, thermal, chemical and biological process, including sorting, changing of waste properties to reduce its quantities and/or hazardous characteristics. In addition to separate waste collection, the waste treatment offers additional extraction of usable raws from waste, as well as harvesting energy from waste. There are two basic ways of waste treatment: mechanical-biological treatment (MBO) of waste and thermal treatment of waste. Most MBO facilities includes mechanical sorting of various waste components, its classification by size or some kind of pre-treatment (grinding, mixing) prior to biological treatment, but all within an integral waste treatment, recovery of material (recyclables) and creating preconditions for recovery of energy. The thermal treatment technologies include waste incineration, co-incineration in cement industry, pyrolysis, gasification and plasma technology. Thermal methods of waste management are aimed at reducing the waste volume, conversion of waste into the non-hazardous waste, and harvesting energy from waste. They include all the processes which help turn waste into gas, liquid, solid products resulting in release of thermal energy.
- Upgrading of the **waste disposal** system – handling waste by landfilling has the lowest priority in waste management, yet it is necessary, even in if the aforesaid waste treatment processes are in place, since each of the preceding steps produces a part of the final product that needs to be disposed of and cannot be used otherwise by recycling, composting, or as fuel etc.). Final disposal of waste needs to be done at the regional waste landfills observing the principle of sanitary waste disposal, i.e. this needs to be enclosed and controlled systems meeting the following requirements:
 - Proper choice of location – the land to build on should be stable
 - Construction of special water-tight bed (by laying low buffer layer) to protect the soil from leachate
 - Collection and treatment of leachate and precipitation waters
 - Construction of leachate treatment plant
 - Special way of waste disposal in cells where the waste is, once disposed of, spread out, compacted and covered with earth on a daily basis (daily cover)
 - Collection and disposal of waste via a degasification system by using a landfill gas (conversion of methane into thermal and/or electrical energy) or incineration of methane by open-fire before releasing it into the atmosphere
 - Continuous monitoring of waste disposal, quantities shipped in, monitoring of landfill gas, monitoring of treated leachate and daily operations and maintenance of the landfill.

Given the presented adverse effect of the municipal waste in the ZDK, SBK and KS, given below are the specific mitigation measures for these cantons resulting from the Responses indicators.

7.2 Measures to mitigate the adverse impacts of the municipal waste in the ZDK

Table 27 shows the measures to mitigate the adverse impacts of the municipal waste on the environment and population of the ZDK that need to be implemented in accordance with the strategic and planning documents in the F BiH/ZDK, as well as the already started projects of rehabilitation and closure of municipal landfills.

Table 27: Measures to mitigate the adverse impacts of the municipal waste in the ZDK

Mitigating measure		Who is to implement a mitigation measure
General mitigation measures	To draft Municipal waste management plans in the remaining 5 ZDK municipalities (Kakanj, Maglaj, Olovo, Tešanj, Usora)	Local self-government units
	To launch public awareness campaigns on the need to reduce the waste at the place of its production, both in households and industry (for instance house composting projects, reuse of waste instead of throwing it in the trash bins etc.).	Local self-government units and competent utility companies
	To promote reuse of the materials that could be reused after reparation and not being thrown away as waste through support to small companies (so-called green entrepreneurs) who could establish a small business based on the reparation and reuse of clothes, furniture, electronic and electrical equipment etc.	Local self-government units and competent utility companies
Technical mitigation measures	To technically equip the utility companies and enhance their capacities to increase quality and level of service including gradual extension of services onto the areas not covered by current waste collection system.	Competent utility companies
	To invest in the infrastructure for separate collection of recyclables from waste (installing more green islands in Zenica, Breza, Maglaj, Olovo and Tešanj and setting up green islands in the remaining 8 ZDK municipalities (Doboj-Jug, Kakanj, Maglaj, Usora, Vareš, Visoko, Zavidovići, Žepče)	Competent utility companies System operators
	To reduce quantities handled by final disposal at the landfills through material recovery from waste (recycling) and/or thermal treatment (for instance co-incineration of the refuse derived fuel (RDF) in cement industry aimed at prolongation of the working life of the „Moščanica“ regional landfill and implementing the municipal waste management organization plan at the ZDK/F BiH level.	Local self-government units and competent utility companies
	To develop investment and technical documents for rehabilitation and closure of all municipal non-sanitary landfills in the ZDK, as follows: <ul style="list-style-type: none"> • Breza – preliminary project, Technological Study, Environment Impact Study for the project of rehabilitation of the municipal landfill and Waste Management Plans (I Phase), Main Project Design and Detailed construction waste management plan (II Phase) Maglaj, Olovo, Tešanj, Vareš, Zavidovići, Žepče should	The said local self-government units and competent utility companies

Mitigating measure	Who is to implement a mitigation measure
develop their Main Project Designs and Detailed construction waste management plan (II Phase)	
To rehabilitate and close all non-sanitary landfills and build the facilities required for reducing adverse impacts (leachate lagoon, degasification system, buffer layer in the surface segment of the landfill and at slant sections of the landfill body, drainage ditches in the foot of the landfill for catching leachate etc.) aimed at preventing the contamination of surface and underground waters, soil, and adverse effects on population.	Local self-government units and competent utility companies
To build Waste Management Centers at the enclosed municipal landfills to reduce quantities of wastes to be transported to the regional landfill.	Local self-government units and competent utility companies
To set up a system of regular collection of remaining waste components from the remaining 8 ZDK municipalities to the „Mošćanica“ regional sanitary landfill or some other regional landfill.	Local self-government units and competent utility companies
To complete the system of using methane from biogas at the „Mošćanica“ regional landfill by incinerating methane at open-fire, along with the alternative use of methane for electricity generation, and complete the construction of the planned facility for treatment of leachate from the landfill body.	PD Regional landfill Mošćanica d.o.o. Zenica
To make a Procedure Paper in emergencies like fires and explosions.	Competent utility companies
To make a plan and remove registered wild landfills (700 of them) by systematic actions.	Local self-government units and competent utility companies
To install 1,1 m ³ and 5 m ³ containers at the locations of cleaned-up wild landfills aimed at preventing the re-emergence of new wild landfills at the same spots and preventing contamination of surface and underground waters, soil, air and adverse impacts on population.	Local self-government units and competent utility companies
To continue with systemic elimination of all other wild landfills that comes to life, to plan assets and collaborate with non-governmental organizations dealing with removal of wild landfills (for instance Let's do it). To encourage work of the like organizations in the local communities.	Local self-government units and competent utility companies

7.3 Measures to mitigate the adverse impacts of the municipal waste in the SBK

Table 28 shows the measures to mitigate the adverse impacts of the municipal waste on the environment and population of the SBK that need to be implemented in accordance with the strategic and planning documents in the F BiH/SBK, as well as the already started projects of rehabilitation and closure of municipal landfills.

Table 28: Measures to mitigate the adverse impacts of the municipal waste in the SBK

Mitigation measures		Who is to implement a mitigation measure
General mitigation measures	To draft Municipal waste management plans in the remaining 7 SBK (Travnik, Novi Travnik, Jajce, Gornji Vakuf-Uskoplje, Donji Vakuf, Dobretići and Bugojno)	Local self-government units
	To launch public awareness campaigns on the need to reduce the waste at the place of its production, both in households and industry (for instance house composting projects, reuse of waste instead of throwing it in the trash bins etc.).	Local self-government units and competent utility companies
	To promote reuse of the materials that could be reused after reparation and not being thrown away as waste through support to small companies (so-called green entrepreneurs) who could establish a small business based on the reparation and reuse of clothes, furniture, electronic and electrical equipment etc.	Local self-government units and competent utility companies
Technical mitigation measures	To technically equip the utility companies and enhance their capacities to increase quality and level of service including gradual extension of services onto the areas not covered by current waste collection system.	Competent utility companies
	To set up a system of organized waste collection in the municipality of Dobretići	Municipality of Dobretići JKP „Vodovod i kanalizacija“ d.o.o. Dobretići
	To invest in infrastructure for separate collection of recyclables from waste (installing green islands in all the SBK municipalities)	Competent utility companies System operators
	To reduce quantities handled by final disposal at the landfills through material recovery from waste (recycling) and/or thermal treatment (for instance co-incineration of the refuse derived fuel (RDF) in cement industry aimed at prolongation of the service life of the regional sanitary landfills to which the SBK municipalities are or will be oriented, and implementing the municipal waste management organization plan at the SBK/F BiH level.	Local self-government units and competent utility companies
	To develop investment and technical documents for rehabilitation and closure of all municipal non-sanitary landfills in the SBK, as follows: <ul style="list-style-type: none"> Travnik – preliminary project, Technological Study, Environment Impact Study for the project of rehabilitation of the municipal landfill and Waste Management Plans (I Phase), Main Project Design and Detailed construction waste management plan (II Phase) Bugojno, Busovača, Fojnica, Kiseljak, Kreševo, Novi Travnik and Vitez should develop their Main Project Designs and Detailed construction waste management plan (II Phase)	The aforesaid local self-government units and competent utility companies
	To continue with the already started rehabilitation of the municipal landfill in Donji Vakuf.	Municipality of Donji Vakuf JKUP „Čistoća“ d.o.o. Donji Vakuf

Mitigation measures	Who is to implement a mitigation measure
To rehabilitate and close all non-sanitary landfills in the SBK (remaining 10) and build the facilities required for reducing adverse impacts (leachate lagoon, degasification system, buffer layer in the surface segment of the landfill and at slant sections of the landfill body, drainage ditches in the foot of the landfill for catching leachate etc.) aimed at preventing the contamination of surface and underground waters, soil, and adverse effects on population and implementing the municipal waste management plan at the level of the SBK and F BiH.	Local self-government units and competent utility companies
To build Waste Management Centers at the enclosed municipal landfills to reduce quantities of wastes to be transported to the regional landfill.	Local self-government units and competent utility companies
To set up a system of regular collection of remaining waste components from waste to the „Moščanica“ regional sanitary landfill for those municipalities currently disposing of their waste in this landfill: Busovača, Travnik (100%), Novi Travnik and Vitez (percentage unknown).	Local self-government units and competent utility companies
To build a regional sanitary landfill at the former open-pit coal mine „Gračanica“ for the remaining 8 municipalities of the SBK (Bugojno, Dobretići, Donji Vakuf, Fojnica, Gornji Vakuf-Uskoplje, Jajce, Kiseljak, Kreševo) with all the accompanying facilities for biogas and leachate control.	Those local self-government units that are not disposing their waste at the regional landfill should sign an agreement on incorporating a company tasked to deal with setting up a regional landfill and operating the regional landfill, once it is built.
To make a plan and remove registered wild landfill (473 of them) by systematic actions.	Local self-government units and competent utility companies
To install 1,1 m ³ and 5 m ³ containers at the locations of the cleaned-up wild landfills aimed at preventing the re-emergence of new wild landfills at the same spots and preventing contamination of surface and underground waters, soil, air and adverse impacts on population.	Local self-government units and competent utility companies
To continue with systemic elimination of all other wild landfills that comes to life, to plan assets and collaborate with non-governmental organizations dealing with removal of wild landfills (for instance Let's do it). To encourage work of the like organizations in the local communities.	Local self-government units and competent utility companies

7.4 Measures to mitigate the adverse impacts of the municipal waste in the KS

Table 29 shows the measures to mitigate the adverse impacts of the municipal waste on the environment and population of the KS that need to be implemented in accordance with the strategic and planning documents in the F BiH/KS.

Table 29: Measures to mitigate the adverse impacts of the municipal waste in the KS

Mitigation measures		Who is to implement a mitigation measure
General mitigation measures	To draft Municipal waste management plans in the remaining 6 KS municipalities (Hadžići, Ilidža, Novi Grad Sarajevo, Stari Grad Sarajevo, Trnovo, Vogošća)	Local self-government units
	To launch public awareness campaigns on the need to reduce the waste at the place of its production, both in households and industry (for instance house composting projects, reuse of waste instead of throwing it in the trash bins etc.).	Local self-government units and KJKP „Rad“ d.o.o. Sarajevo
	To promote reuse of the materials that could be reused after reparation and not being thrown away as waste through support to small companies (so-called green entrepreneurs) who could establish a small business based on the reparation and reuse of clothes, furniture, electronic and electrical equipment etc.	Local self-government units and KJKP „Rad“ d.o.o. Sarajevo
Technical mitigation measures	To increase the coverage of the organized municipal waste collection from current 93% to 100% in order to prevent popping up of wild landfills for good.	KJKP „Rad“ d.o.o. Sarajevo
	To invest in infrastructure for separate collection of recyclables from waste and install more green islands in accordance with the Study on locations of recycling yards, niches, and green islands (currently under preparation by the KJKP „Rad“, 2016).	KJKP „Rad“ d.o.o. Sarajevo System operators
	To reduce quantities handled by final disposal at the landfills through material recovery from waste (recycling) and/or thermal treatment (for instance co-incineration of the refuse derived fuel (RDF) in cement industry aimed at prolongation of the service life of the „Smiljevići“ regional landfill and implementing the municipal waste management organization plan at the KS/F BiH level.	Local self-government units and KJKP „Rad“ d.o.o. Sarajevo
	To perform daily waste compacting and covering with inert material to prolong the service life of the „Smiljevići“ landfill and prevent spreading of the particulate matter from the landfill body into the surrounding area (relevant for the Buća Potok settlement).	KJKP „Rad“ d.o.o. Sarajevo
	To re-establish the degasification and methane utilization system at the „Smiljevići“ regional landfill.	KJKP „Rad“ d.o.o. Sarajevo
	To put in operation the built leachate treatment facility, as collected from the landfill body.	KJKP „Rad“ d.o.o. Sarajevo
	To make a Procedure Paper in emergencies like fires and explosions for the „Smiljevići“ landfill.	KJKP „Rad“ d.o.o. Sarajevo
	To remove registered wild landfills (around 100); to install 1,1 m ³ and 5 m ³ containers at the locations of the cleaned-up wild landfills aimed at preventing the re-emergence of new wild landfills at the same spots and preventing contamination of surface and underground waters, soil, air and adverse impacts on population.	Local self-government units and KJKP „Rad“ d.o.o. Sarajevo

Mitigation measures		Who is to implement a mitigation measure
	To continue with systemic elimination of all other wild landfills that comes to life, to plan assets and collaborate with non-governmental organizations dealing with removal of wild landfills (for instance Let's do it). To encourage work of the like organizations in the local communities.	Local self-government units and KJKP „Rad“ d.o.o. Sarajevo

7.5 Analysis of the cumulative impacts and mitigation measures

Taking into account the aforesaid impacts presented by cantons, one can draw a general conclusion that the adverse impacts of the municipal wastes on all components of environment and human health are present in all three cantons and that they are caused by the following:

- Relatively low coverage rate of organized waste collection (from 62% in SBK to 93% in KS)
- A large number of wild landfills (from 100 in KS to 700 in ZDK)
- Recycling rate ranges from 0.1% in ZDK to 8% in SBK
- More than 90% of wastes produced is disposed of at landfills
- Disposal sites are non-sanitary landfills which are only at the beginning of the process of project design documents and administrative procedures for obtaining required permits aimed at municipal landfill rehabilitation
- Current capacities of the „Moščanica“ regional landfill are not used by all the municipalities intended for in the ZDK; as to the SBK there is no sanitary regional landfill there
- 90% of landfill lack degasification or biogas treatment facilities (either gas exploitation to harvest heat and/or thermal power and electricity, or burning it by open flame)
- Total CH₄ emissions that result from the waste degradation in all three cantons is 13,159.7 t/year, i.e. 28% of the total CH₄ emissions from the waste sector in BiH.

The quantity of the municipal wastes produced per capita in BiH is on the rise, and this trend is expected to continue given the forecast development of tourism and industry, as well as for the changed consumer habits of the population. The pressure in terms of waste disposal at the existing landfills will rise, but to reduce it and prolong the service life of the regional landfills, it is necessary to establish a system of exploitation of its usable components.

Therefore, a special emphasis in the sector should be focused on the lack of waste separate collection systems as well as the lack of plants for waste usability recovery (no MBO plants, recycling rate not at the desired level) and energy recovery. To fulfill the goals with regard to the reduction of waste disposed of at landfills (by desirable 60% according to the EU standards), it would be necessary to build the waste treatment facilities (building of MBO plant). In the F BiH no sufficient plants exist to deal with processing of separated recyclables from municipal wastes, so the next desirable solution is waste thermal treatment by co-incineration in the high-energy plants which could be implemented by using refuse derived fuel to be produced in MBO plants. „Moščanica“ regional landfill in the ZDK and „Smiljevići“ regional landfill in the KS are recognized as appropriate locations for installation of MBO plant on the account of the quantities of waste they accept and good transit links with producers of waste and consumers of refuse derived fuel.⁸⁷

The advantages of refuse derived fuel use (for instance by co-incineration in cement industry, power plants, heat plants etc.) include energy recovery from waste, safe handling of special types of wastes, general benefits for the environment because of the reduced emissions, reducing global CO₂

⁸⁷ F BiH Environment Protection Fund, Feasibility Study on MBO construction and use for energy purposes, 2016

emissions, preserving non-renewable resources (fossil fuels), no need to install waste incineration plants and precious space is saved at the landfills. On the other side, industries using refuse derived fuel (RDF) as additional fuel reduce fuel-related costs and thereby their overall production costs, and their products become more competitive in the local and international markets which, in general terms, could contribute to the development of local communities. By purchasing RDF, industries also contribute to the reduction of costs for handling waste at the regional landfills, which certainly depends on the costs of capital, coal and costs of waste disposal.

8 CONCLUSIONS AND RECOMMENDATIONS

In the EU accession process, BiH shall have to meet the legal and technical requirements of the EU environment standards and norms, including a plan to reduce waste disposal at the municipal landfills. The European Commission has adopted an ambitious package of measures to achieve circular economy including revised proposals of the waste law aimed at encouraging European transition to circular economy in order to increase global competitiveness of the European companies, promote sustainable economic growth and create new jobs, all covered by the revised goals in EU waste management.

Unlike EU countries where the wastes are strategic resources that can be used as secondary raw material and energy, BiH is faced with complex and multifold problems in waste management. Resolution of these problems and orientation toward integral and up-to-date waste management are one of the prerequisites of the EU accession.

The BiH Federation, by adopting Federal Environment Protection Strategy 2008-2018 (Federal Ministry of Environment and Tourism, 2009), with the sub-component of Federal Waste Management Strategy and Federal Waste Management Plan 2012-2017 (Federal Ministry of Environment and Tourism, 2011) has laid a foundation for quality management of various kinds of waste. However, the implementation of these documents is not going as planned. Many municipalities failed to adopt their waste management plan in accordance with the guidelines of the aforesaid two documents, and most of the problems recognized are only at the initial stage of resolution.

Therefore, the F BiH, as well as the three cantons referred, still face major problems in terms of adverse impacts of the waste on the environment and human health: leachate emissions resulting in contamination of surface and underground waters and soil, biogas emissions, spreading of particulate matter, unpleasant odors, taking up space, and the changes in the natural environment. The measures recognized as necessary to mitigate the aforesaid impacts of the municipal waste include:

- Measures related to improvement of **municipal waste collection system** – extension of the service coverage areas, along with the improvement of waste separation (separation at the place of production, building green islands, providing municipal utilities with adequate equipment)
- Measures of **municipal waste treatment** – building MBO plants within regional landfills, recovery of materials (separation of recyclables) and/or energy (co-incineration of refuse derived fuel-RDF). Introducing MBO waste treatment could help maximize the quantities of renewable raw materials (metal, glass, plastics, paper etc.), produce compost, biogas, solid fuel from waste and, finally, produce bio-stabilized material for disposal. Within the MBO plant one can produce refuse derived fuel (RDF) to be used in high-energy facilities for energy recovery.
- Measures related to adequate **municipal waste disposal** in the maximum quantity of up to 30% - closing of municipal non-sanitary landfills, building of ancillary facilities and transition to regional disposal concept (final disposal at the regional sanitary landfills).

Taking into account the financial strength of the municipalities and utility companies who can hardly renew their vehicle fleet, let alone invest in separate waste collection and recycling system development, one of the ways to resolve municipal waste management in the three cantons of ZDK, SBK and KS could be using energy from waste in order to reduce quantities to be disposed of at landfills. Here it needs to be emphasized that the preconditions for having viable MBO plant is the availability of sufficient quantities of municipal wastes collected, as well as the market for the „products“. In other words, due to high MBO plant construction costs, they are best build at the

regional/cantonal landfills. When doing this, the system shall be viewed as integral and one should avoid building recycling system and MBO system at the same time, where the pre-separation of recyclables from waste like plastics, paper and cardboard, tires and textile in the municipal waste management centers would reduce quality of waste required for the RDF production. In this view, it is necessary to plan a scenario where the municipalities build the system of separation of organic components from waste and composting at the municipal waste management centers, and the remaining components that gives quality to the refuse derived fuel would be transported to the regional landfills. In the next stage, the costs of investment and operation of the RDF production plant need to be analyzed in detail, including costs of the separation itself (sorting), treatment (cutting etc.). According to rough estimates, this plant is economically viable, but this needs to be verified by a detailed study.

It is important to emphasize the role of the sectoral FMOiT which could adopt strategic decision on the ways to reduce the waste quantities finally disposed of at the landfills by construction of the MBO plant and co-incineration in the energy demanding plants, for this to be included into the planning and drafting of the new Federal Waste Management Plan 2018-2023, as already recognized within the existing Federal Waste Management Plan 2012-2017. In the framework of its annual public calls for allocation of public funds for waste management projects and transition to regional waste disposal concept, FMOiT could also plan allocation of financial assets for these particular projects, just as the BiH Environment Protection Fund could, if they recognize the importance of investments into the waste management infrastructure.

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