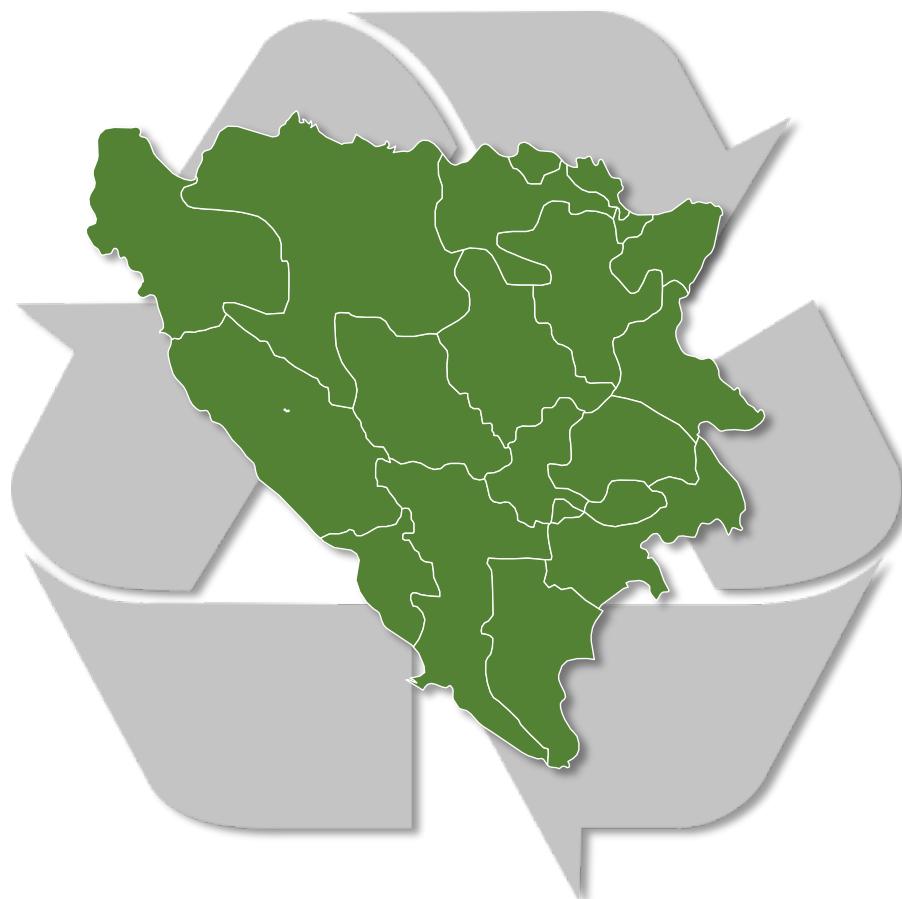




Bosnia and Herzegovina
Building Long-term Sustainability for Integrated Solid Waste
Management Technical Assistance

Municipal Solid Waste Management Sector Review
Strategic Directions and Investment Planning up to 2025



PART C

BRCKO DISTRICT

LIST OF ABBREVIATIONS

BD	Brcko District
CAPEX	Capital expenditure
CII	Commercial, institutional, industrial
EC	European Commission
EP	Environmental Protection
EPR	Extended Producer Responsibility
EU	European Union
FBiH	Federation of Bosnia i Herzegovina
GDP	Gross Domestic product
HH	Household
ML	Municipal Landfill
MSW	Municipal Solid Waste
MSWM	Municipal Solid Waste Management
M+R	Maintenance and Repair
OPEX	Operational expenses
PA	Public Awareness
PET	Polyethyleneterephthalate
PPP	Public Private Partnership
RDF	Refuse Derived Fuel
RL	Regional Landfill
RS	Republika Srpska
SWM	Solid Waste Management
SSWMP	Second Solid Waste Management Project
TS	Transfer Station
VAT	Value Added Tax
WEEE	Waste Electrical and Electronic Equipment
WFD	Waste Framework Directive
WIS	Waste Information System

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The study was performed by a World Bank team led by Ms. Kremena Ionkova and included international and local experts in waste management, namely Mr. Gerard Simonis, Dr. Ali Reza Abedini, Dr. Irem Silajdzic and Dr. Drazenko Bjelic as well as Mr. Igor Palandzic, Ms. Lejla Arnautovic and Mr. Senad Sacic.

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Suggestions and recommendations provided in this report are subject to the limitations inherent to availability of site-specific information, and based on authors assessment, experience and knowledge about the situations in BiH.

The findings, interpretations, and conclusions expressed herein are those of the authors and do not necessarily reflect the views of the Board of Executive Directors of The World Bank or the governments they represent.

PREFACE

For the preparation of this study information was obtained during the many field visits and discussions with operators and municipalities. Furthermore, use has been made of existing information such as the Grontmij and Sweco reports prepared in the framework of SIDA financed projects, the State, Entities and Brcko District Waste Management Strategies, completed questionnaires from waste collection companies and operators, EU reports and regional studies. As far as possible, conclusions, recommendations and especially the many cost calculations were discussed and confirmed with operators in the field in order to obtain reliable and practical results. The study benefitted from the team's extensive experience in the field of solid waste management both locally and worldwide, and especially in the EU member states and many EU accession states, which have gone through the process BiH is starting now. For the first time in BiH, this report presents a financial assessment of current waste management costs, and calculations on the financial impacts of harmonisation with EU legislation and shifting up in the waste hierarchy.

During the preparation of this study the team encountered a strong conviction among many of the counterparts in BiH that investments in infrastructure would suffice to solve the problems in the sector. The team would like to emphasize that in the absence of strong institutional and financial framework at all levels for planning, implementation and operations it will be difficult to achieve sustainable waste management operations. In this respect, the team believes that substantial capacity building is needed at all levels. The setting up of public-private partnerships would greatly accelerate the development of efficient and effective waste management practises. A carefully prepared phased and prioritised implementation scheme addressing the prevailing problems in the field of solid waste management should be the basis for future development. The team is hopeful that this study will contribute to a better understanding of the prevailing conditions in FBiH and required actions in order to avoid disappointments as experienced in other countries under similar circumstances and in order to advance the sector in line with the EU Acquis in an environmentally and financially sustainable manner.

ABSTRACT

This report includes an assessment of the current municipal solid waste situation in BiH including investments and actions needed for improvement. For the first time special attention was paid to the cost aspects also taking into account the impact of EU accession requirements on the costs. Many of the most recent EU member states have undergone the same process as now experienced by BiH such as the need to improve the environmental conditions for waste disposal, improvement of the waste collection coverage, introduction of waste separation and recycling and consequently the resulting cost increases. These improvements will require extra investments leading to higher costs/ton for the waste generator following the EU principle of "Polluter pays" as incorporated in the BiH legislation. In spite of the fact that this principle is a legal requirement, Ministries and Municipalities remain reluctant to accept the fact that current tariffs have to be increased. Instead, it is assumed that the environmental conditions can be improved by maintaining the current tariff level, which is only 0.5% of the household spendable income while internal practises indicate 1-1.5%.

In order to minimize the required tariff increase an assessment was made of the cost aspects of current operations. The study reveals that actual costs are rather high which might indicate in-efficiency but at the same time it appears that municipalities don't have a clear cost allocation system for solid waste services (waste collection and disposal) as they carry out also other services such as street cleaning, snow cleaning, etc. In addition, the current tariff for households includes a 17% VAT surcharge while in international practises especially within EU member states the waste services for households are excluding VAT as tariff is considered to be a tax. An additional cost element for waste collection companies in BiH is the responsibility for concluding contracts with households and the collection of tariffs. This creates an extra financial risk for the companies in view of non-payments. International practises indicate that household tariffs are collected by municipalities (tax payment) on basis of a Municipal Regulation. Waste collection company collects only fees from commercial/institutional entities on basis of individual contracts. Substantial cost reductions could be achieved in case municipalities would take over the tariff collection from households and in case the government would introduce exemption of VAT payment for households. This would also lead to reduction of subsidies now paid by some municipalities for municipal waste management.

The report also shows that costs will be reduced in case larger quantities of waste could be handled through cooperation of municipalities. Cost calculations are presented in the report comparing single municipal services with regionalized services for both waste collection and disposal. It appears that substantial cost reductions can be achieved especially for waste disposal assuming that municipal landfills mandated to comply with the EU design criteria (Directives) such as installation of bottom liner, leachate collection and treatment. However, establishment of regional landfills would result in extra transport costs for some municipalities. To reduce these costs implementation of transfer stations could be recommended. In the report calculations are presented showing that use of transfer stations would result in cost reductions only in case collection trucks have a small capacity, distance to regional landfill is more than 50km, distance between collection area and transfer station is minimal and the investment cost in transfer stations are very low. In addition, road conditions should allow high capacity truck transport between transfer stations and the regional landfill and annual volumes of waste should not be small. The report concludes that implementation of transfer stations requires a careful site-specific analysis.

Another aspect that was analysed is the requirement of waste separation and sorting. Following numerous field visits and discussions with municipalities it appeared that there is lack of awareness

about cost and benefits of separation and sorting of dry recyclables. Municipalities presented plans for setting up of “waste management centres” including landfill, sorting lines and other treatment facilities without prior calculation of the resulting costs/ton. This approach is clearly reflected in implementation of a few sorting lines by various single municipalities throughout BiH. All of these facilities are generating costs mainly due to low annual quantities handled, as well as use of sub-standard and low quality sorting- operations. Dry recyclable sorting lines can be revenue generating only if sufficient quantities (at least 3,000 tons/year) of pre- segregated dry recyclables are handled when small percentage of rejects are resulted. This is also pointing into the need for cooperation between municipalities. It should be noted that BiH is a scarcely populated country with more than 140 municipalities and thus small waste quantities for each single municipality. As shown by international practises, cooperation between small municipalities in waste collection and transportation is required to achieve larger waste volume operations and to lower the overall cost/ton, resulting in recycling initiatives to become more financially attractive. In addition, regional cooperation in BiH would make waste management more attractive for potential private partners with associated investments. Future role of the Municipalities is foreseen to be shift away from direct waste collection and disposal services and become shareholders of regional companies for collection and disposal, raising public awareness and dealing with potential complaint.

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C1 WASTE QUANTITIES AND TYPES

C1.1 Introduction

Multiple data sources and information from previous sector reports and assessments were used for the purpose of this study. Where possible, the data were benchmarked with other two entities in Bosnia and Herzegovina as well as countries with similar socio-economic conditions.

In this report Municipal Solid Waste (MSW) is defined as Municipal Waste (MW) generated by households and similar type of waste in nature and composition generated by commercial, institutional and industrial sector excluding municipal construction and demolition waste and waste from municipal sewage network and treatment.

C1.2 Population

The report “Census of population, households and dwellings in Bosnia and Herzegovina, 2013: Final Results”¹, following the national census in October 2013 was used to provide the population data and their distribution to urban and rural population. Table C1-1 presents the summary data on population distribution in Brcko District (hereinafter called “BD”) indicating 83,516 citizens. In urban settlements live 45,516 citizens (54.50%) in a suburban (semi-urban) and rural areas live 38,000 citizens (45.50%).

Table C1-1: Population in BD

Entity	Population	Urban population	% Urban population	Rural population	% Rural population
Brcko District	83,516	45,516	54.50	38,000	45.50

C1.3 Waste generation

Waste generation in BD was estimated on the basis of the review of official publications, available studies, interviews with key stakeholders, questionnaires and benchmarking. Table C1-2 gives the average waste generation rate as included in the Environmental Protection Strategy of Brcko District in BH 2016-2026 (hereinafter called “EP Strategy”). No further specifications on waste generation are given in the EP Strategy for urban and rural areas.

Table C1-2: Waste generation rate in BD²

	Average MSW generation per capita (kg/day)
EP Strategy of Brcko District in BH 2016-2026	0.8

The waste generation data from the Republic of Serbia have been used for comparison having in mind similar socio-economic environment and waste management structure as well as the fact that the annual quantities of municipal waste generated in Serbia are based on real measurement of waste in referent local self-government units³. On average, in the Republic of Serbia 0.87 kg of municipal

¹ Census of population, households and dwellings in Bosnia and Herzegovina, 2013: Final Results, Agency for Statistics of Bosnia and Herzegovina, June 2016, available at http://www.popis.gov.ba/popis2013/doc/RezultatiPopisa_BS.pdf

² Environmental protection strategy of Brcko District in BH 2016-2026, available at http://www.bdcentral.net/index.php/ba/trezor-akti/doc_details/7656-environmental-protection-strategy-of-brcko-district-in-bh-for-the-period-2016-2026

³ University of Novi Sad (2009) Determination of waste composition and estimated of waste amount in order to define strategy of recycling waste management in the framework of sustainable development in Serbia <http://www.sepa.gov.rs/download/otpad.pdf>

waste is generated per capita/day (318 kg/cap/year). According to the National Waste Management Strategy⁴ for Serbia urban population on average generates 1 kg of waste per capita per day, whereas rural population generates on average 0.7 kg of waste per capita per day. In RS municipal waste generation is 272 kg/cap/year⁵. Based on questionnaires received during preparation of the present study, average municipal waste generation in urban areas in RS was approximately 1.05 kg/cap/day.

Daily generation of waste per person in BiH according to the Agency for Statistics would be 0.86 kg/capita/day⁶. The figures of the Agency should be taken with some caution as (i) approximately 35% of the population is not covered by regular waste collection services and these amounts are estimated by the Agency and (ii) only regional landfills have weigh bridges and the quantities at the remaining landfills are estimated on basis of truck size and number of daily disposals.

Combining the data and information given above, the present MSW generation rates are proposed as in

Table C1-3 taking into account 54.50% urban and 45.50% rural population.

Table C1-3: Proposed MSW generation rates in BD as per 2013

Urban MSW generation kg/capita/day	Rural MSW generation kg/capita/day	Average kg/capita/day
1.05	0.55	0.82

Based on data from Table C1-1 and Table C1-3, the amounts of waste generated in BD are calculated and presented in the Table C1-4**Error! Reference source not found.** including urban, rural and total waste generation in 2013. It is calculated that in BD 83,516 inhabitants produce around 25,073 tons of waste per year.

Table C1-4: Amounts of waste generated in BD (2013)

Entity	Population	Urban waste (tons/year)	Rural waste (tons/year)	Total waste (tons/year)
Brcko District	83,516	17,444	7,629	25,073

The distribution between urban and rural waste in BD is graphically displayed in Figure C1-1. These distributions are used for the forecast of waste generation.

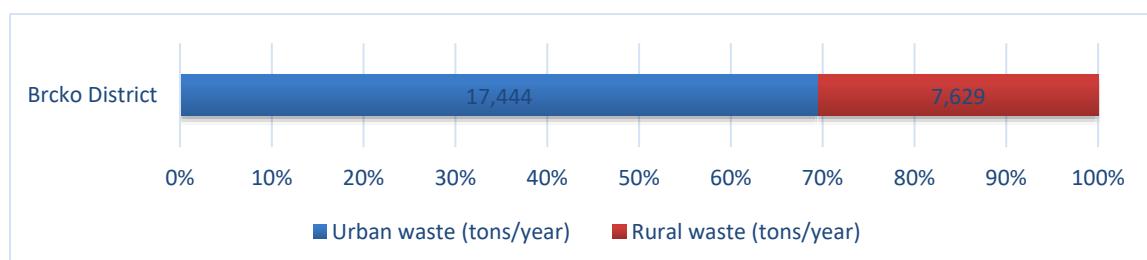


Figure C1-1: Urban and rural waste in BD (%)

⁴ Republic of Serbia National Solid Waste Management Strategy 2010-2019

⁵ Environment, Statistical year book 2015, RS Institute of Statistic, available at

http://www.rzs.rs.ba/static/uploads/bilteni/godisnjak/2015/05stn_2015.pdf

⁶ First Realise 2015, Agency for Statistic of BiH, available at http://www.bhas.ba/saopstenja/2015/KOM_2014_001_01_bos.pdf

C1.4 Waste composition

To assess current MSW composition, existing information obtained from PU "Komunalno Brcko" is summarized and presented in Table C1-5.

Table C1-5: Waste composition in BD⁷

Waste Components (BD)	(%)
Organic	39
Plastic, PET, foil	12
Paper/Cardboard	25
Aluminum cans	4
Glass	6
Hazardous waste	1
Others	13
Total	100

According to the composition of the waste, the single dominant fraction in municipal solid waste in BD is organic waste from kitchens and gardens (approximately 39%), while the dry recyclables (plastic, glass, paper/cardboard, aluminum cans, PET, foil, metals) accounts for approximately 47% of municipal solid waste.

C1.5 Forecast of waste generation

Four factors are considered for the simulation of the waste generation forecast: (i) population growth (ii) household income growth, (iii) urbanization process and (iv) increase in waste coverage from average 81% up to 88% in 2025. The following assumptions are used for the forecast of waste generation.

Population growth. Although a negative population growth has been recorded in BD since 2002⁸, for the purpose of this report it is assumed that the population number will not change up to 2025 year. Therefore, the forecast is using the results of the 2013 Census as a referent i.e. a population of 83,516 inhabitants⁹.

Household income growth. Household consumption was selected as a representative measure of household income growth. Table C1-6 presents the average monthly consumption expenditure per households in BAM for 2004, 2007 and 2011¹⁰.

Table C1-6: Average monthly household consumption for 2004, 2007, 2011 in BAM

Household consumption	2004	2007	2011	Increase rate
Brcko District	1339.52	1318.47	1585.26	18.34

⁷ Project of Landfill Management, PU"Komunalno Brcko", November 2015

⁸ Population, Statistical year book 2015, RS Institute of Statistic, available at http://www.rzs.rs.ba/static/uploads/bilteni/godisnjak/2015/05stn_2015.pdf

⁹ Census of population, households and dwellings in Bosnia and Herzegovina, 2013: Final Results, Agency for Statistics of Bosnia and Herzegovina, June 2016, available at http://www.popis.gov.ba/popis2013/doc/RezultatiPopisa_BS.pdf

¹⁰ Household budget survey in BiH, Agency for Statistic of Bosnia and Herzegovina, 2007, 2011, available at <http://www.fzs.ba/index.php/anketa-o-potrosnji-domacinstava-kucanstava-apd/>

In the seven years' period, from 2004 to 2011, the household consumption increased by 18.34%. For the waste generation forecast, it is assumed that household consumption will continue to grow about 2.5% per year.

Table C1-7: Urbanization rate in BD 1991 vs. 2013

Urbanization rate	1991(%)	2013 (%)	Increase rate (%)
Brcko District	47.25	54.50	7.25

Urbanization increase rate in BD over the time span of 22 years is 7.25% (see Table C1-7). It is expected that no significant growth will occur in the period until 2025 and current urbanization rate (54.50% urban and 45.50% rural) will be taken as a reference value.

Table C1-8 presents the results for the waste generation forecast during 2013-2025. International experience indicates that 1% household income growth results in 0.5% urban waste generation per capita growth and 0.25% growth for rural waste generation per capita.

Table C1-8: Waste generation forecast for BD 2013-2025

	2013	2025	Change/year
Population	83,516	83,516	0%
Household consumption (BAM/year)	19,986	26,879	2.5%
Urbanization%	54.50	54.50	0%
Urban Population	45,516	45,516	0%
Rural%	45.50	45.50	0%
Rural Population	38,000	38,000	0%
Urban SW kg/cap/day	1.05	1.22	1.25%
Rural SW kg/cap/day	0.55	0.60	0.63%
Urban Waste (t)	17,444	20,268	1.25%
Rural Waste (t)	7,629	8,322	0.63%
Total Waste (t)	25,073	28,590	1.11%

During the period 2013 and 2025, the average annual waste growth rate is 1.11%. The average waste generation is expected to increase from 0.82 kg/cap/day to 0.94 kg/cap/day.

Figure C1-2 presents the overall waste generation in BD for reference and forecasted year.

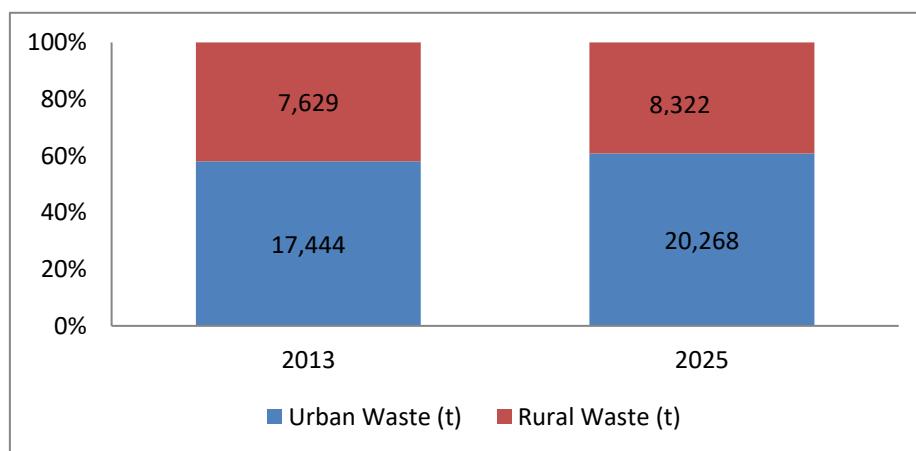


Figure C1-2: Waste generation forecast 2013-2025

Based on the information obtained from the PU “Komunalno Brcko”, approximately 3% of the total waste quantities disposed of at landfills is coming from private industry enterprises as non-hazardous waste. For total waste disposal 3% will be added to the municipal waste quantities in 2013 and 3.5% for 2025 assuming 1.11% growth/year.

It is expected that in the future, the MSW collection coverage will increase from 81% up to 88% in 2025 (In 2013 about 19,800 tons was landfilled or a collection coverage of 81%).

Thus, the overall forecast of waste is presented in Table C1-9.

Table C1-9: MSW and waste from industries, forecast 2013-2025

	2013	2025
MSW (t/y)	25,073	28,590
Enterprises' waste (t/y)	752	1,001
Total (t/y)	25,825	29,591

C1.6 Forecast of waste composition

Besides waste generation, waste composition will also change as a result of the economic growth of the country. European statistics¹¹ demonstrate that as income grows dry recyclables (mostly packaging) grow 50% faster than the overall waste growth on a per capita basis, while organic fraction is decreasing. Similarly, United Nations Environmental Program (UNEP) in its publication on green economy¹² suggests that packaging waste increases with Gross Domestic Product (GDP) and income growth, while the organic fraction decreases in parallel.

Future waste composition will have an important role in determining the type of waste management required at the local and national level. The following assumptions are made in order to forecast the most probable waste composition. It is assumed that dry recyclables fraction will grow 50 percent faster than the overall waste generation per capita. Per capita waste generation will grow from 300 to 342 kg/cap/year, which is around 14% increase in 12 years (Table C1-10). The increase in the recyclable fraction generated per capita, for the same period, will be approximately 21%.

Table C1-10: Recyclable waste generation per capita 2013-2025

	2013	2025
Waste kg/cap/year	300	342
Dry Recyclables kg/cap/year	141	172
% of recyclables	47%	50%

Table C1-11 presents the forecasted changes in waste composition.

¹¹ Generation and recycling of packaging waste (CSI 017/WST 002 - Assessment published Nov 2012

¹² Green Economy Report, UNEP, 2011

Table C1-11: Waste generation per capita/day in different streams 2013 and 2025

	2013	2025
Average kg/cap/day	0.82	0.94
Organics	39%	36%
kg/cap/day	0.32	0.34
Recyclables	47%	50%
kg/cap/day	0.39	0.47
Other	14%	14%
kg/cap/day	0.11	0.13

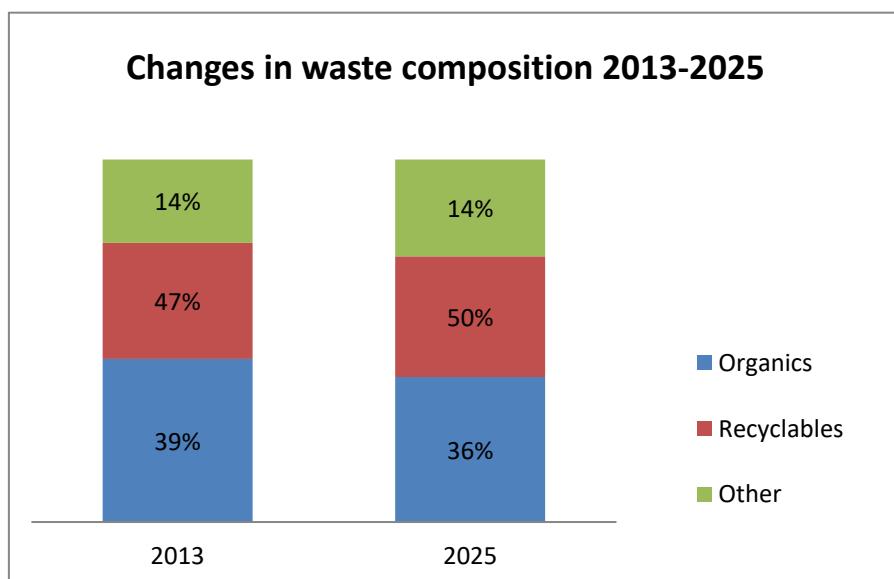
**Figure C1-3: Changes in municipal waste composition 2013-2025**

Table C1-12 presents the expected urban and rural municipal waste divided in the three different streams (organics, recyclables, other).

Table C1-12: Urban and Rural municipal waste composition 2015-2025

URBAN WASTE (tons/year)	2013	2025
Organics	6,803	7,296
Dry Recyclables	8,199	10,134
Other	2,442	2,838
Total	17,444	20,268
RURAL WASTE (tons/year)	2013	2025
Organics	2,975	2,996
Dry Recyclables	3,585	4,161
Other	1,068	1,165
Total	7,629	8,322

C1.7 Future waste management options

The EP Strategy was adopted by the Assembly of Brcko District. The strategy gives common objectives, but no specific targets with timeframe.

Table C1-13: Strategy objectives¹³

Objectives	Measures	Deadline
Establishment of integrated waste management system (waste generation, collection, separation, transport, recycling, secondary raw materials, disposal) with special emphasis on municipal waste	Promotion of cleaner production practice and reduction of waste generation	2019
	Establishment of system of separate collection and recycling of waste	2019
	Locating and phased construction of Waste Management Centre with all necessary facilities for integrated waste management	2019
	Development of financial model for integrated waste management	2023
	Prevention of wild dumps	2019

The timeframe mentioned in Table C1-13 are quite optimistic based on experience from EU member states and other countries in the region.

Considering the current baseline (81% collection coverage, almost no separation and recycling, poor basic service level including existing non-sanitary landfill) transformation of the waste management system in BD will require a coordinated effort at all administrative levels, significant development of human resources, increased public participation and quite important financial resources. Based on experiences from similar countries and conditions, as well as from RS and FBiH it is proposed to develop three scenarios – Optimistic, Realistic and Pessimistic. A forecast will be worked out for the three scenarios. The scenarios are given in Table C1- 14.

Table C1- 14: Three scenarios for the future of the waste management sector

Scenario	Optimistic	Realistic	Pessimistic
Collection Coverage	100% in urban areas in 2025 80% in rural areas in 2025 BD average: 91% in terms of population 94% in terms of waste generated	100% in urban areas in 2025 60% in rural areas in 2025 BD average: 82% in terms of population 88% in terms of waste generated	100% in urban areas in 2025 50% in rural areas in 2025 BD average: 77% in terms of population 85% in terms of waste generated
Source Separation	40% of the recyclables and 40% of the organics in 2025	30% of the recyclables and 20% of the organics in 2025	20% of the recyclables in 2025 No recycling for organics

¹³ Environmental protection strategy of Brcko District in BH 2016-2026, available at http://www.bdcentral.net/index.php/ba/treza-akti/doc_details/7656-environmental-protection-strategy-of-brcko-district-in-bh-for-the-period-2016-2026

Scenario	Optimistic	Realistic	Pessimistic
Organics Diversion*	40% x 36% = 14%	20% x 36% = 7%	0%
Recyclables Diversion	40% x 50% = 20%	30% x 50% = 15%	20% x 50% = 10%
Final Disposal	The residuals after organic and recyclables diversion. Besides the municipal waste, an additional 3.5% landfill capacity is required for the non-hazardous industrial waste	The residuals after organic and recyclables diversion. Besides the municipal waste, an additional 3.5% landfill capacity is required for the non-hazardous industrial waste	The residuals after organic and recyclables diversion. Besides the municipal waste, an additional 3.5% landfill capacity is required for the non-hazardous industrial waste

* For the organic fraction, it is assumed that there will be a market for good quality compost, and emphasis will be given to major organic fraction producers (schools, hospitals, restaurants, hotels, parks and green areas, etc.).

The following tables present the evolution of each scenario, in urban and rural waste, between 2013 and 2025.

Table C1-15: Optimistic scenario waste flows (tons/year)

Optimistic Scenario	2013	2025
Total Waste	25,073	28,590
Collection coverage	81%	94%
Total waste collected	20,309	26,875
Organics	7,920	9,675
Organic Source Separation	0	4,117
Recyclables	9,545	13,437
Direct collection (10%)	955	1,344
Source Separation	0	4,837
Other	2,843	3,762
MSW to landfills	19,354	18,995
Industrial waste	581	665
Total landfill capacity	19,935	19,660
Diversion rate	Negligible	34%

Table C1-16: Realistic scenario waste flows (tons/year)

Realistic Scenario	2013	2025
Total Waste	25,073	28,590
Collection coverage	81%	88%
Total waste collected	20,309	25,159
Organics	7,920	9,057
Organic Source Separation	0	1,811
Recyclables	9,545	12,580
Direct collection (10%)	955	1,258
Source Separation	2,577	3,396
Other	2,843	3,522
MSW to landfills	19,354	20,392
Industrial waste	581	714
Total landfill capacity	19,935	21,105
Diversion rate	Negligible	22%

Table C1-17: Pessimistic scenario waste flows (tons/year)

Pessimistic Scenario	2013	2025
Total Waste	25,073	28,590
Collection coverage	81%	85%
Total waste collected	20,309	24,302
Organics	7,920	8,749
Organic Source Separation	0	0
Recyclables	9,545	12,151
Direct collection (10%)	955	1,215
Source Separation	0	2,187
Other	3,510	4,003
MSW to landfills	19,354	22,115
Industrial waste	581	774
Total landfill capacity	19,935	22,889
Diversion rate	Negligible	10%

Table C1-18 presents the results of the three scenarios for years 2013 and 2025.

Table C1-18: Comparison of waste flows for the three scenarios for 2013 and 2025

2013	Optimistic	Realistic	Pessimistic
Landfill capacity (tons/year)	19,935	19,935	19,935
Organic source separation (tons/year)	0	0	0
Recyclables source separation	0	0	0
2025	Optimistic	Realistic	Pessimistic
Landfill capacity (tons/year)	19,660	21,105	22,889
Organic source separation (tons/year)	4,117	1,811	0
Recyclables source separation	4,837	3,396	2,187

Comparing the three scenarios, the following comments can be made:

- All three scenarios are based on the assumption of important improvements in collection coverage that must grow between 80 and 90 percent. The investments required for those improvements are significant and they need to be prioritized and implemented latest 2020 to reach the targets in 2025.
- All three scenarios assume the implementation of the EPR principle for packaging waste to support separation at source. For the organic fraction, in the realistic and optimistic scenarios, it is assumed that there will be a market for good quality compost, and emphasis has to be given to major organic fraction producers (parks/green areas, schools, hospitals, restaurants, hotels etc.). This will be much more effective and efficient than capturing organics/kitchen waste from households. Substantial public awareness education will be needed to achieve the separation percentages.
- All three scenarios involve substantial landfill capacities. The Optimistic Scenario requires a landfill annual capacity of 19,660 tons while the realistic one requires an annual capacity of 21,105 tons. It is clear that investments in new sanitary landfill development, expansion or upgrade of the current ones or transport of waste to another regional landfill are the core components of the waste management infrastructure required.

Future planning will be based on the realistic scenario.

C1.8 Shortcomings

Currently, District planning and guidance for the implementation of effective and efficient waste management systems are hampered by the lack of reliable data on waste generators, quantities, composition, recovery, recycling, disposal, stakeholders and so on. No weighing scale is available at the landfill and quantities are thus estimated. Additionally, waste sampling and analysis tests are very limited.

There is no waste separation system in BD. Waste source separation is a requirement stipulated by the law on waste that is incorporated in the EP Strategy to facilitate recycling. It is a District task to organize a system for waste sorting and establish an appropriate infrastructure to enable this process.

The existing landfill is operating as a dumpsite. Important investments and capacity building are required to improve the operational conditions.

C2 LEGAL AND INSTITUTIONAL FRAMEWORK

C2.1 Legal framework and policies

C2.1.1 General

On the basis of an arbitral award passed on 5th March 1999, the Brcko District of BiH (BD) was formed as the third separate administrative unit under exclusive sovereignty of the State. The territory of the District incorporates the entire territory of the municipality Brcko, as it was on January 1st 1991. According to the Statute of the district Brcko, Official gazette of BD, no. 1/00 and 24/05, the environmental protection is under the Brcko District authority.



Figure C2-1: Administrative Organization of Brcko District

Brcko District has adopted a series of laws governing environmental protection and related secondary legislation (regulations, decrees and decisions):

- The Law on waste management (Official gazette of Brcko district, no. 25/04, 1/05, 19/07, 2/08 and 9/09)
- The Law on environmental protection (Official gazette of Brcko district, no. 25/04, 1/05, 19/07, 9/09)
- The Law on air protection (Official gazette of Brcko district, no. 25/04, 1/05, 19/07 and 9/09).
- The Law on water protection (Official gazette of Brcko district, no. 24/04, 1/05, 19/07)
- The Law on nature protection (Official gazette of Brcko district, no. 24/04, 1/05, 19/07 and 9/09).

The Brcko District EP Strategy for period 2016-2026 includes the Brcko District Waste Management Strategy.

C2.1.2 Law on Waste Management

In Brcko District, The Law on Waste Management (Official Gazette of Brcko District, no. 25/04, 1/05, 19/07, 2/08 and 9/09) establishes a general framework for all aspects of solid waste management in Brcko District, primarily:

- Planning the waste management (waste management strategy, regional and local plans for waste management),
- License for waste management,
- Waste management supervision,
- Activity and responsibility related to the waste management (liabilities of the generator and reseller, waste collection system, treatment, collection, usage, transport, waste deposit, landfills, incineration)

The purpose of the Law on waste management is boosting and ensuring the most important work conditions:

- Preventing the waste generation,
- Processing waste for reuse and recycle,
- Separation of raw material from the waste and its usage in energy production, and
- Safe waste disposal

Based on this Law following statutory acts have been passed:

- The Rulebook on waste management that is not on the list of hazardous waste or whose content is unknown (Official gazette of Brcko District, no. 32/06)
- The Rulebook on content of the waste management adjustment plan for the existing treatment plant (Official gazette of Brcko district, no. 32/06)
- The Rulebook on conditions of the waste management responsibility transfer from the generator and reseller to the waste collection operator (Official gazette of Brcko District, no. 32/06)
- The Rulebook on issuing licenses regarding the minor businesses activities within the waste management (Official gazette of Brcko district, no. 32/06)
- The Rulebook on waste categories with lists (Official gazette of Brcko District, no. 32/06)
- The Rulebook on financial guarantees that can ensure cross border waste transport (Official gazette of Brcko district, no. 32/06)

C2.1.3 Transposition of EU legislation

The transposition status of EU legislation regulating municipal solid waste management is briefly presented in Table C2-1.

Table C2-1: Status of the transposition of the EU Waste Directives in BD

EU Directives	Transposition status in BD
Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives. Official Journal 312, 22/11/2008 P. 3–30	<p>In BD, currently in force is the Law on Waste Management (Official Gazette of the Brcko District, number 25/04, 1/05, 19/07, 2/08 and 9/09), which among other things regulates waste management planning based on the fundamental principles laid down by EU legislation. The Law establishes a general framework for all aspects of solid waste management and encourages prevention, recycling, reuse and usage of waste for energy recovery. Some of the definitions set in the Waste Framework Directive are transposed through the Law on Waste Management (waste, waste producer, waste holder, re-use). List of wastes is transposed through the Regulation on waste categories with lists Official Gazette of BD, No. 32/06).</p> <p>Establishing measures to encourage the re-use and recycling</p>

EU Directives	Transposition status in BD
	of waste (Art. 11) have not been implemented yet. Introduction of separate waste collection for at least paper, metal, plastic, glass (Art. 11) has not been implemented yet.
Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste, as amended by Regulations No. EC/1882/2003 and EC/1137/2008;	The Council Directive 1999/31/EC on the disposal of waste, stipulates the conditions and criteria for determining the location, technical and technological conditions for the design, construction and operation of landfills, the types of waste that cannot be disposed of in a landfill, criteria and procedures for the acceptance or rejection or landfilling, manner and procedure for the operation and closure of landfills, content and mode of operation of the landfill and subsequently maintenance after closure of landfills. These conditions have not been transposed yet.
Directive 2004/12/EC of the European Parliament and of the Council of 11 February 2004 amending Directive 94/62/EC on packaging and packaging waste - Statement by the Council, the Commission and the European Parliament Official Journal L L 47, 18.2.2004, p. 26–32	Conditions of this directive have not been transposed yet.
Directive 2006/66/EC of the European Parliament and of the Council of 6 September 2006 on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC , as amended by Directive No. 2008/12/EC and Directive No. 2008/103/EC; Commission Decisions 2008/763/EC, 2009/603/EC, 2009/851/EC;	Conditions of this directive have not been transposed yet.
Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment (WEEE), as amended by Directive No. 2003/108/EC, 2008/34/EC and 2008/112/EC;	Conditions of this directive have not been transposed yet.

C2.1.4 Brcko District Waste Management Strategy

The Waste Management Strategy is a part of the EP Strategy for Brcko district, BiH, for the period 2016-2026. The Strategy was prepared by the Department for Spatial Planning and Property-Legal

Affairs of the Brcko District Government. The Strategy evaluates the waste management current condition, sets long-term aims for waste management and ensures conditions for rational and sustainable waste management. The Strategy was adopted in 2017.

The Strategy contains mainly an analysis and assessment of the current waste management system with its shortcomings (legal, operational, financial, public awareness). No information is given on targets to be achieved for waste collection coverage, separation and recycling. However, 7 objectives are presented to improve the situation.

The objectives include:

- Adjustment of legal and sub-legal regulations with the EU regulations and international conventions (passing a new Law on waste management and adequate sub-legal acts in accordance with the EU Directives and international conventions).
- Institutional strengthening of management structure in the Brcko District in order to improve and approximate the waste management to the best EU practice (creating an efficient company for waste management and establishing a data base on waste and more efficient reporting).
- Setting an integral system for waste management (promoting the practice for cleaner production and decrease of waste generation, establishing a system for separate collection of waste and waste recycling, locating and phase based construction of waste management center with all necessary facilities for integral waste management, development of financial mode for integral waste management, as well as prevention of illegal dumpsites through enforcing inspection and cooperation with the population).
- Setting a system for industrial waste management (defining a legal framework for managing hazardous and non-hazardous waste, determining regulations and technical guidelines related to the making an obligatory plan for waste management and stimulating the decision-makers and plan-makers to create quality plans as soon as possible, also prevention and decrease of generated industrial waste by applying the ecological license instrument, and designing and constructing of the integral waste management center, as well as enforcing a constructional waste pretreatment).
- Setting a system for managing the waste from medical institutions and vet stations (conduct a revision and establish the regulations, prepare technical guidelines for managing the medical and vet waste, as well as hazardous waste, setting an information system for managing waste from medical, pharmaceutical, vet and hazardous waste by keeping a register on type and quantity of waste, waste separation and treatment of hazardous, contagious and other waste from medical and vet institutions, considering the possibility for construction of a plant for thermal waste treatment for medical and vet, as well as hazardous waste).
- Setting a system for managing agriculture and forestry waste (passing sub-legal acts on special requirements related to different types of waste from agriculture and waste that can be used in agricultural production, making guidelines for managing waste from agriculture and forestry, setting a register for waste generated on all registered farms and forestry economies, making a technical guideline for treatment of animal corps and animal origin waste, promotion of new and alternative technologies for using by-products from agriculture and forestry as raw material in other production sectors).
- Gradual improvement and gradual closure of existing landfills in the Brcko District (making a study on gradual improvement and gradual closure of existing landfills).

C2.1.5 Brcko District waste management plan

In accordance with the adopted Strategy for waste management it is necessary to make plans for waste management. As per the Law on Waste Management (Official gazette of Brcko District, no. 25/04, 1/05, 19/07, 2/08 and 9/09), the plan for waste management should include:

- A programme for collection of solid waste from households,
- Strategic plans for using components from communal waste,
- A programme for decreasing the percentage of biodegradable waste and packaging waste found in communal waste,
- A programme for increasing a public awareness for waste management, etc.

C2.2 Institutional framework

Brcko District is a self-managing administrative unit of Bosnia and Herzegovina, and is an official part of both entities. The legal power is in hands of the Brcko District Assembly, executive power is in hands of the Brcko district Government and court power is in hands of Brcko district courthouse.

By the Brcko District Statute the issues regarding environment (waste management), housing, urban and spatial planning, public services are under the Brcko District authority.

The following Departments are directly involved in waste management issues:

C2.2.1 Department for Spatial Planning and Property-Legal Affairs

The Department for Spatial Planning and Property-Legal Affairs within the Brcko District Government is responsible for execution of professional, administrative and other activities under their authority and which are related to:

- Spatial and urban planning,
- Issuing approval, licenses and other acts related to urban planning under the Department authority,
- Environmental protection and eco-licenses,
- Legalization of illegally built structures,
- Ownership-legal issues,
- Protection of cultural and historical structures and natural inheritance from the aspect of issuing urban approval and defining a procedure for establishing a list of protected structures,
- And other issues under the Department authority defined by the law and other regulations.

For more efficient execution of activities under the Department's authority the following organizational sections are created:

- (1) Sub-department for spatial and urban planning, and environmental protection containing the following two services such as:
 - Service for spatial and urban planning and environmental protection; and
 - Service for legalization of illegally built structures
- (2) Sub-department for ownership-legal issues

C2.2.2 Public Utilities Department

The Public Utilities Department performs the following activities:

- Analysis of development trends in the communal domain
- Preparation of strategy concepts for communal service development
- Implementation of projects from the communal service development strategy
- Conducting supervision and reporting to the Government on communal strategy implementation
- Improving any modernization of communal infrastructure

- Preparation of draft laws and by laws
- Managing demands and offers related to the communal services and prices
- Managing, improvement and modernization of street illumination
- Performing other activities in accordance with the Statute and laws of Brcko district that are under this Department's authority.

For efficient execution of activities related to the Department for communal issues following organizational sections are created:

1. Sub-division for development and strategy of communal services
2. Sub-department for capital investments.

C2.2.3 Municipal enterprises

Public company „Komunalno Brcko“ is entrusted with performing services of general interest in Brcko District, apropos distribution of electric energy, production and distribution of water, maintenance and arrangement of public areas, collection, transport and deposit of communal waste. The work unit Cistoca is in charge of collection, transport and deposit of waste.

C3 EXISTING OPERATIONS

C3.1 General

In Brcko District about 83,517 inhabitants are living on an area of 493km² or 169 persons/km². The waste management services are the responsibility of the public company “Komunalno Brcko” being also responsible for electricity supply, production and distribution of water, maintenance of public areas, waste water treatment and street cleaning.

C3.2 Waste collection

The working unit Cistoca carries out the actual services for collection, transport and disposal of waste. Besides waste collection, the company is also carrying out street cleaning, snow removal and maintenance of green areas. “Komunalno Brcko” is directly reporting to the Assembly (elected parliament).

The waste collection system for households is a mix of (i) communal containers of 1,100 litres and (ii) the use of skip containers with a capacity of 5-7m³. The same type containers are used for the commercial and industrial Clients. Collection equipment consists of compactor trucks (6) of which 3 are leased, skip loaders (4) of which two are leased and three pick-ups. Waste is collected twice/week from households in the city and once/week in the rural parts. Collection is carried out for households 6 days/week or 300 days/year. No waste separation at source exists. The total annual waste generated is estimated at 25,000 tons. The waste collected from households is about 20,000 t/y or 67 t/day and about 800 t/y from industries. The collection coverage can thus be calculated at 80%. The collection capacity of the trucks is indicated in Table C3-1. The leased trucks are rather new i.e. from 2013 while the trucks owned by Brcko Utility Company are 15 years old. From this table, it can be concluded that the available load collection capacity (81t/d) is sufficient to meet the demand (67 t/d).

Table C3-1: Collection capacity

Truck type	Number	Capacity (ton)	Total/day	Trips/day	Availability	Total (ton)
Compactor	3	7.3	21.9			
	1	2.6	2.6			
	1	6.8	6.8			
	1	7.2	7.2			
Total			38.5	2	85%	65
Skip truck	2	9.5	19	1.5	85%	24
	1	10.0	10.0	1.0	70%	7
	1	7.0	7.0	1.0	70%	5
Grand total		Including load efficiency 80%				81

The capacity of the reported containers (excluding any 120 litre and 240 litre containers) is indicated in Table C3-2. It can be concluded that the capacity is sufficient to justify 2/week collection from households and CII sector.

Table C3-2: Container capacity

Type	Number	Capacity		Efficiency	Actual storage Capacity (tons)
		M ³	Tons ¹		
1,100 litre	500	550	110	90%	99
5-7m ³	134	804	160	90%	144
Total					243
Collection		20,000/300=67 t/d x 3.5 days (2/week collection) =233 tons			

¹ 0.2t/m³

The total staffing involved in waste collection and disposal is reported at 57 persons or 2.75 persons per 1,000tons. The Key Performance Indicator for efficient services is 2 persons/1,000tons.

C3.3 Waste disposal

About 95% of the collected wastes in BD are disposed at a non-sanitary landfill without a weighing scale. Available data about waste quantities are estimated on basis of truck volume and assumed waste density. Landfill daily operational activities are done using a compactor (2005), an excavator (2004) and a rented bulldozer (1985). The landfill is located very close to the city center (2.5 km) and to the river (50 meters). A study was carried out to review alternative disposal sites for BD. Three possible scenarios were identified as (i) upgrading the existing landfill, (ii) a site in Kladje, and (iii) a site in Barnjaci. It appears that there is public opposition against all three options that were identified. Discussions are going on to transport waste to the sanitary RL in Bijeljina as a temporary solution until a new site is found and a new sanitary landfill is constructed. In addition to municipal waste, the current Brcko landfill is also receiving small amounts of industrial waste (reported to be about 3% by weight).

Main problems as reported by the EP Strategy of Brcko District can be summarized as follows:

- Tariffs are considered to be low to cover the actual costs
- Public awareness is low
- Financing is lacking
- Regular training and staff capacity building is needed
- Landfill is located very close to the city center (2.5km) creating a health risk for the population (water, air, soil) in addition there are numerous illegal dumpsites
- Lack of reliable data on waste quantities disposed as there is no weighing scale
- Low operational skills (environmental monitoring, waste acceptance procedures, waste covering, etc.)

C4 FINANCIAL ASPECTS

C4.1 Tariffs

The main revenues for collection, transport and disposal of waste from households are tariffs to be paid by the waste generator. Brcko District has a fixed tariff per household being BAM 5.64/hh/m excl. VAT and BAM 6.6/hh/m incl. VAT or BAM 79/hh/year or BAM 88/ton based on a waste generation of 0.9t/hh/year assuming a family size of 3.09 persons and a waste generation rate of 0.8 kg/cap/day. The current average spendable income of the households is approximately BAM 1,672/month. It can be concluded that the tariff paid by households for waste management is 0.4% of the spendable income, while international norms indicate 1-1.5%, as is the case in most EU member states. The average tariff collection rate improved over the period 2013-2016 from 65% up to 99% when utility company “Komunalno Brcko” became the tariff collector.

The tariff has not been increased since many years. Komunalno Brcko complains that tariffs are too low to cover the actual costs. Komunalno Brcko is preparing tariff calculations to be sent to the Assembly for approval but there is reluctance to increase the tariffs for households for economic and political reasons. Comparison with FBiH and RS (see Table C4-1) shows that the tariffs in BD are lowest among the entities.

Table C4-1: Tariff comparison in BiH

BAM/ton	FBiH	RS	BD
Average tariff incl. VAT	113	142	88
Excl. VAT	97	121	75

Tariffs for municipal waste from the commercial and institutional sector are calculated per m² and per activity. The tariffs vary from BAM 13.2/m²/m for newsstands down to BAM 0.35/m²/m for budget institutions. The commercial/institutional sector can also be charged per container and the tariff for a 5-7m³ container varies between BAM 71.48-104.13 incl. VAT depending on the distance. The average tariff is BAM 88/container for 5-7m³ incl. VAT that is substantially lower than the household tariff, which is BAM 88/ton. Currently all services are subject to 17% VAT both for the households and for the CII sector.

Komunalno Brcko reports that 90% of the actual population is being invoiced. A total number of 18,889 invoices are issued covering 58,556 inhabitants. This means that the current population is 58,556/0.9=65,000 inhabitants. The Census 2013 indicates a total of 83,500 inhabitants. It is reported that about 18,500 inhabitants could be living abroad and/or a substantial number are disposing illegally their waste. The average waste generation rate can thus be estimated at 20,000/65,000= 307kg/cap/y or 0.84kg/cap/day which is similar to what is mentioned in the EP Strategy.

C4.2 Costs

In addition to waste collection and disposal services the waste collection company can also be engaged for street cleaning, snow cleaning, green areas/parks maintenance. These services are organizationally and financially not always clearly divided from waste collection and disposal services; this hampers in many cases clear cost control for waste management services. In practice, the income from other services could compensate the losses in the field of household waste collection. The annual costs for SWM services are indicated in Table C4-2 while also a comparison with FBiH and RS is given.

Table C4-2: Annual costs (BAM) for waste collection services

Item	Amount (BAM)	%
Salaries	1,021,354	43.3
Administration	285,436	12.3
Fuel	230,754	9.8

Tyres/spare parts	40,600	1.7
Lease	687,516	28.9
M+R	40,000	1.7
Amortization	49,811	2.1
Total	2,346,471	99.8
Cost/ton	117	
Comparison with	FBiH	RS
Cost/ton (excl. VAT)	111	130

From Table C4-2 it can be concluded that amortization costs are very low (2%) and no cost item for disposal is given. Apparently, there is no separate cost accounting for disposal.

As the actual collection costs are difficult to assess an indicative cost estimate has been made for the collection of 20,000 tons by trucks with an average load of 6 and 10 tons and an average distance to the landfill of 10km. The calculations are shown in Annex C4.1. The results are summarized in Table C4-3.

Table C4-3: Collection costs (BAM/ton excl. VAT)

Distance to LF 10km	12m ³ truck (6 ton)	20m ³ truck (10 ton)
OPEX	15.6	18.3
CAPEX	25.2	24.1
Total	40.8	42.4

OPEX=operational costs; CAPEX= amortization costs.

The utility company carries out both waste collection and landfilling but there is no strict division between the costs for collection and landfilling. Landfill gate fees are not imposed as it is considered to be included in the tariff. An indicative calculation is made to assess the costs for a sanitary landfill receiving about 20,000 tons per year. The calculation is given in Annex C4.2 and the results are summarized in Table C4-4.

Table C4-4: Landfill costs (BAM/ton)

	OPEX	CAPEX	Total excl. VAT
20,000 t/y	26.81	37.13	63.94

The total cost for a WM system meeting all environmental criteria would thus be BAM 64/t for disposal and BAM 41/t for collection or BAM 105/ton excl. VAT as compared to the current costs of BAM 117/t excl. VAT and a tariff of BAM 75/t excl. VAT. It is emphasized that the reported actual cost of BAM 117/t might be doubtful as there is no separate accounting system for waste collection and disposal services.

C4.3 Main problems

Financing is the backbone for implementation of proper SWM services. The present problems in the field of financing can be summarized as follows:

- Tariffs are low to cover operational and amortization costs for a professional collection and sanitary landfilling system and consequently funds are not available for new investments. In addition, there is a political unwillingness to increase the tariffs.
- Amortization costs are hardly taken into account at the moment

- Cistoca as the WM operator is a part of the Brcko Utility Company and there is no separate accounting system and cost control for Cistoca. Moreover, there is no separate cost allocation system for collection and landfilling.
- Tariff calculation guidelines are missing which would facilitate cost control of both collection and disposal.
- VAT payment by households is making municipal waste management costly and is not according to practices generally adopted in EU member states and other countries (Municipal waste collection and disposal services for households is a tax). Waste separation activities are in its infancy. Public awareness raising programs and communication with waste generators hardly exist.

C5 REFORM PROPOSALS

The recommendations made in this chapter are based on the review of the current situation laid down in the previous chapters and on the Waste Management Strategy (as part of the EP Strategy) therefore the recommendations should be read together with the previous chapters and not in its isolation. Furthermore, the costs calculations are taking into account the targets as mentioned in the realistic scenario (see chapter 1). The calculations are indicative but meeting as near as possible the current cost levels by checking them with operators.

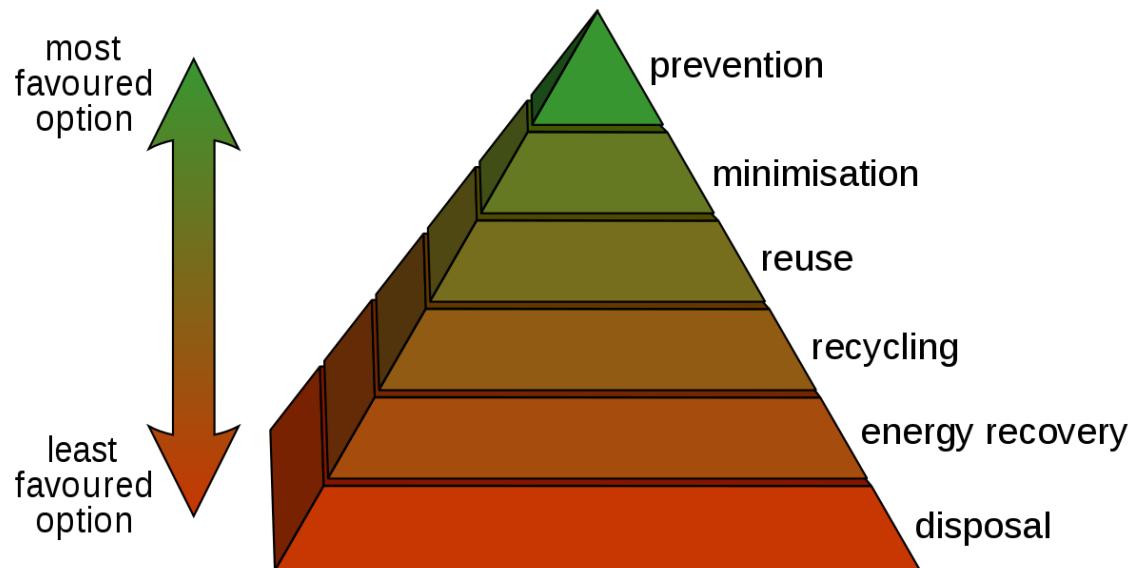
C5.1 Background

Bosnia and Herzegovina (BiH) have been recognized by the EU as a “potential candidate country” for accession. The obligations to be met include harmonization with the EU (environmental) Directives. Thereto the entities of BiH (Republika Srpska and Federation of Bosnia and Herzegovina) and Brcko District have prepared Waste Management Strategies. The main objectives of the Strategy for Brcko District are (i) harmonization of legislation with EU Directives; (ii) Institutional strengthening including the setting up of a Waste Information System with reporting and database management; (iii) establishment of an effective and efficient waste management company; (iv) Establishment of an Integrated Waste Management system including separation at source; (v) Prevention of waste dumps through inspection and cooperation with the population; (vi) Gradual recovery and closure of existing municipal landfill.

There are a number of main problems comprising:

- Current household tariffs for waste collection and disposal are the lowest in BiH and not sufficient to meet the requirements of the EU Directives. The local authorities are reluctant to increase current tariffs.
- The institutional capacity at municipal level is insufficient and needs strengthening to implement the required reforms. This includes legal, financial and operational aspects.
- No separation at source is implemented although some pilot projects are carried out
- Negative impact on the environment especially at the landfill
- Insufficient monitoring
- Insufficient public awareness and public cooperation
- Lack of reporting and database management
- Lack of reliable data for investment planning.

BD is in the process of harmonization its legislation with the EU Directives. Investments in waste management facilities have to comply with a vast array of complex EU Directives, of which the Waste Framework Directive (WFD) lays down requirements for all types of waste unless they are specifically regulated by other directives. The WFD in particular requires drawing up of waste management plans (national, regional, local) in accordance with relevant EU directives. Waste management plans have to consider the shifting up in the “waste hierarchy” away from final disposal to incineration (WtE), separation and recycling, re-use and finally prevention (Figure C5-1). Every step higher in the waste hierarchy involves extra costs and these costs have to be borne by the waste generator following the principle of “polluter pays”. Taking into account the economic conditions in Brcko District the leading principle in introducing reforms should preferably be based on the least cost option meeting the environmental criteria.

**Figure C5-1: EU Waste hierarchy**

All recommendations and calculations in this report will be based on the realistic scenario for 2025 as mentioned in chapter 1 including the following main principles:

- 88% of waste will be collected covering 100% urban population and 60% rural population.
- 30% of packaging waste in the household containers (45-50%) will be separated at source.
- No separation of organic waste is proposed up to 2025 in view of cost/operational aspects and priority to separation of packaging waste.

C5.2 Legal

LEGAL ISSUES	RECOMMENDATIONS
Laws Bylaws Strategies Plans Guidelines	<p><u>Laws</u> <i>The Law on waste:</i> A new Law on Waste is needed to be harmonized with the EU Directives</p> <p><i>The Law on hazardous and non-hazardous waste management:</i> To be adjusted to the EU Directives.</p> <p><i>Preparation of By Law on packaging and packaging waste:</i> separate collection of packaging waste and recycling, tasks and responsibilities of EPR Scheme, harmonization with the EU Directives.</p> <p><u>Data reporting/Waste Information System (WIS).</u> Setting up of data base on municipal waste with more efficient reporting Introduction through by-law of methodology for determining the waste quantity and composition. Alternatively, reference to the corresponding EU methodology can be made in amendments to the Law on Waste Management.</p>

LEGAL ISSUES	RECOMMENDATIONS
	<p><u>Development of a WMP.</u></p> <p>Within the EP Strategy for Brcko District 2016-2026 a Strategy for waste management has been developed and adopted in 2017.</p> <p>The plan for managing the waste in the District has not been made yet. This plan should be in accordance with the Waste management strategy for the District and with the Law on waste management. The plan must contain:</p> <ul style="list-style-type: none"> • Programme on collection of solid waste from households • Strategic plans for usage of fractions from the communal waste • Programme for decreasing the percentage of biodegradable waste and packaging waste in the municipal waste • Programme for increasing the public awareness on waste management, etc.
	<p><u>Technical specifications.</u></p> <p>Besides the legislation it will be necessary to prepare specific technical guidelines for implementation, such as:</p> <ul style="list-style-type: none"> • Technical specifications for designing and closing landfills, transfer station, recycling plant, etc.

C5.3 Institutional

Authority	Proposals
Department of Public Utilities	<p>Strengthening of Department by creating a SWM section</p> <p><i>Problem:</i> Present staff is very limited while they should be the initiator and accelerator for reforms implementation.</p> <p><i>Tasks:</i></p> <ul style="list-style-type: none"> • Preparation of amendments to legislation (Law on Waste management, Tax Code in view of VAT payments by households), further harmonization with EU Directives • Introduction of economic instruments (environmental tax on use of non-sanitary landfill, on use of 10 years and more collection vehicles) • Preparation of by- laws such as a Municipal Regulation on SWM • Preparation of guidelines (financial, technical, operational, etc.) • Setting up of WIS (reporting, database management) • Development of WMP based on WM Strategy • Setting up and leading a Work Group with all stakeholders as members on implementation of Reforms • Preparing operational manuals (EPR systems, landfill operation) • Consultation with stakeholders (population, operators, other entities in BiH, etc.) <p><i>Approach:</i></p> <ul style="list-style-type: none"> • Employ staff members and • Contract outside company for one year for in-house working, capacity training and transfer of know how. Specialists to include: (i) legal; (ii) financial; (iii) SWM; (iv) public awareness. <p><i>Contract party:</i> Municipality</p>

Utility company	<p>Assessment of operations</p> <p><i>Problems</i></p> <p>Operations are not clearly separated from other services of “Komunalno Brcko”. No clear cost allocation for the various waste management services (collection, disposal, street cleaning, green areas maintenance, etc.). Cost monitoring and efficiency assessment are difficult.</p> <p><i>Tasks</i></p> <ul style="list-style-type: none"> • Creation of an autonomous SWM section inside “Komunalno Brcko” with own accounting system and introduction of Key Performance Indicators. • Preparation of an operational assessment study for waste collection and disposal of current organization (Cistoca) including staffing per activity, planning, contracting and tariff collection, payment procedures, accounting with cost allocation, M+R activities, PA, supporting activities. <p><i>Approach</i></p> <p>Contract a specialized company with operational and consultancy experience in the field of waste collection and disposal.</p> <p><i>Contract party:</i> Brcko District</p>
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C5.4 Financial

To overcome present problems a number of changes are recommended based on prevailing international practices especially changes in the tariff calculation and strengthening of the accounting principles within Komunalno Brcko.

Tariff cost calculation guidelines are needed to achieve sustainable SWM systems with cost control mechanisms such as the introduction of Key Performance Indicators. The guidelines should take into consideration the following main aspects:

- Sound economic principles based on full cost recovery (direct costs, overhead costs, financing costs, etc.) unless the Municipality decides to subsidize partly the waste management services. The tariff should include future landfill closure costs. Furthermore, it should be decided if and which part of street cleaning costs has to be included in the tariff.
- Full amortization costs (depreciation and interest) should be taken into account with depreciation periods based on usable lifetime of the facilities. Normally this will be 20 years for civil works and 12 years for mechanical/electrical works and equipment.
- No VAT tax for households as tariff for public services is considered to be a tax. However, the tariff for the CII sector will be subject to VAT as it is considered to be a commercial service charge. VAT exemption for households is based on Article 13 of the EU VAT Directive 2006/112/EC stating amongst others “States, regional and local government authorities and other bodies governed by public law shall not be regarded as taxable persons in respect of the activities or transactions in which they engage as public authorities....” Although the Utility company in BD is transformed into a “limited company” there is no doubt that this company is operating under public law. Moreover, the market for household waste collection is a public activity in BD. VAT payment is a policy decision making waste management more expensive for the households which might result in the need for increased subsidies to finance the costs. In case national authorities are reluctant to introduce exemption of VAT on services it is recommended to discuss alternative taxation modes supporting the improvement of waste management such as introduction of landfill tax on the use of non-sanitary landfills to replace direct VAT payment on collection services. The introduction of a reduced VAT tariff for municipal waste management services could also be considered as is the case in some EU member states.

- No profit margin for public services to households while profit margin can be applied for services to CII sector.
- Services to be covered by the tariff should be well defined (collection, separation/sorting, disposal, street cleaning, PA campaigns, etc.). Tariff calculations could be based on the “Tariff setting methodology for the water supply and sewerage services in BiH” as recently developed by UNDP.

The current cost allocation system is not clear and no separate system exists for each activity carried out by Komunalno Brcko. Services by Cistoca might be subsidized by income from other services. It is proposed to set up an autonomous Cistoca for WM activities having its own cost allocation system. The system of Key Performance Indicators should be introduced for monitoring the efficiency of the operations. Furthermore, it is recommended that within Cistoca the cost allocation for collection and for landfilling will be separated.

Tariff collection from households is currently carried out by Komunalno Brcko together with collecting the tariffs for water and electricity supply. The collection coverage is reported to be 99% of the issued invoices. Payment obligations of the households should be laid down in a “Municipal Regulation” wherein also the tasks and obligations of the stakeholders (BD Government, Komunalno Brcko, Cistoca, waste generators) are defined. Tariff collection from the CII sector could be by the service provider (Cistoca) based on individual contracts. The overarching legal system inside EU member states is collection of tariffs by the municipality and not by the waste collector (see Figure C5-2) but the municipality might outsource the collection of the tariffs. There are several options for collecting the tariffs viz. (i) inclusion in other municipal taxes such as property tax or together with other public utilities provision charges such as heating, electricity; (ii) direct user charge; (iii) pay as you throw but in this case recording of waste quantities will be needed making the system more expensive. In general, less administrative costs are involved having a fixed rate/household (current system) however some differentiation by number of persons (e.g. three groups: 1 or 2 or 3 and more persons) should be introduced to create a reasonable contribution. The disadvantage of a fixed rate system is the lack of incentives for waste separation. It is worthwhile to investigate the feasibility of setting-up by the waste collector of so-called “buying points” for dry recyclables (plastics, paper/cardboard, metals/cans). Experience shows that economic incentives in low-income countries are a valuable instrument to increase waste separation.

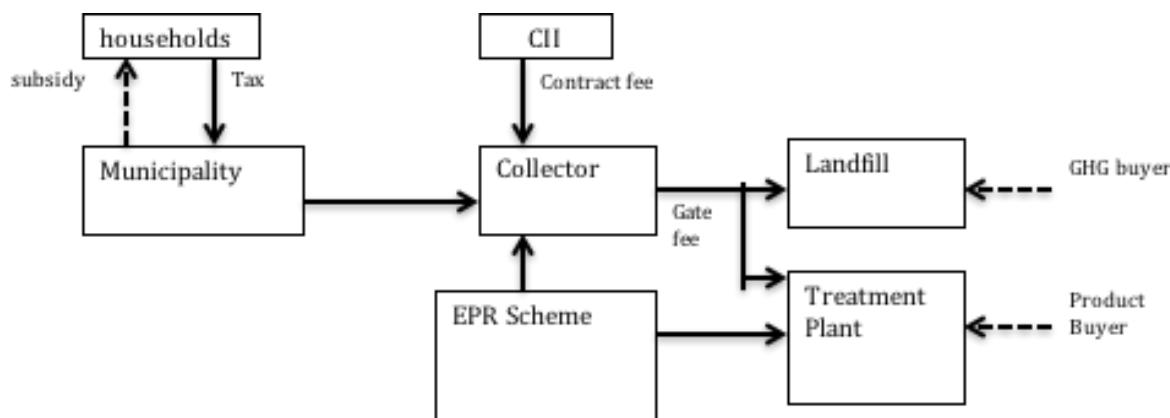


Figure C5-2: General payment flow inside EU member states

The proposed changes in the tariff calculation (no VAT) will have a positive effect on reducing any tariff increase. Moreover, it will be an incentive for private companies to conclude PPP's and to invest. Tariffs for the CII sector should normally be higher than for households (profit margin, affordability principle).

The existing tariffs both for households and CII sector have to be reviewed taking into account the guidelines mentioned above and in order to meet the EU requirements. Increase of tariffs for households up to a maximum of 1% of the spendable income should be introduced in a phased way. Economic instruments (e.g. environmental tax on use of non-sanitary landfills, environmental tax on use of collection trucks older than 10 years) should be introduced to enforce Cistoca to invest in more environmentally friendly WM activities (sanitary landfill, new collection trucks, waste separation).

C5.5 Operational aspects

C5.5.1 Collection and disposal

The EP Strategy proposes several possibilities to overcome the environmental problems with the current landfilling practices in Brcko. These possibilities include (i) rehabilitation of the existing site and continuation of disposal activities; (ii) construction of a new landfill at Barnjaci or Kladje. Regardless of the approach adopted to resolve the current situation, it would be good practice to consider a short-term (temporary) solution until the long-term vision is implemented. Possible short-term options are:

- i) Final closure of the existing landfill and temporary transport of waste to the regional landfill in Bijeljina
- ii) Quick remediation and upgrading of a small footprint of the existing site and continuation of disposal while a long-term solution is decided and implemented

It is understood that the opposition of the population might delay the possible solution involving continuation of disposal at the existing site, which is very close to the city center and the river. However, public awareness campaigns can explain the benefit of upgrading the site and difference between sanitary operations vs. non-sanitary landfills.

Option (i)- Final closure and (temporary) transport of waste to RL Bijeljina

The cost estimate for final closure of the existing landfill covering 12 ha is shown in Table C5-1. Please note that the suggested material, quantity, and sequence are just for cost calculation purposes and may not reflect exact technical details and requirements for the actual work.

Table C5-1: Final closure existing landfill

Works	Unit cost (BAM/m ²)
Shaping/levelling	3
Geotextile	4
Geomembrane	12
Clay (50cm)	8
Drainage gravel layer (30cm)	7
Gas wells	3
Soil and seeding	3
Total/m ²	40
Various clean up works	3
Total cost (12 ha)	5,160,000

In case the amount for closing the landfill will be a loan at 3% and repayment through tariff increase over 20 years the annual cost would be equivalent to BAM 17/t ($0,0672 \times 5,160,000 / 20,500$ tons). The average waste quantity (20,500 tons) to be landfilled annually up to 2025 is based on Table C1-16 – realistic scenario (Chapter 1) i.e. collected waste less separated dry recyclables.

Cost calculations for waste transport to Bijeljina including operational and amortization costs are presented in Annexes C4.1, C5.1 and C5.2 for (a) direct transport by the collection trucks and (b) construction of a low-cost transfer station with high capacity long haul transport to Bijeljina. The results of the cost calculations are summarized in Table C5-2. The cost difference between direct transport and via a transfer station is marginal when using a 7.5 tons truck, while direct transport is lower when using a 10 tons truck. In both cases (direct transport or via transfer station) the disposal costs in Bijeljina and the cost for closing the existing landfill in Brcko have to be added. The disposal cost in Bijeljina indicated in the table is based on a proposal submitted by Bijeljina Regional Landfill to Brcko District (BAM 55/ton including VAT). It can be concluded that there is a cost saving in using a 20m³ collection truck for direct transport to Bijeljina as compared to using a transfer station. Therefore, any procurement of new trucks by Komunalno Brcko/Cistoca should give preference to large trucks in case direct transport is envisioned to be implemented. Suitability of large trucks and their mobility throughout the collection routes in the city shall be investigated.

Table C5-2: Collection, Transport and Disposal costs to Bijeljina (BAM/t excl. VAT)

Assumed 21,500t/y	12m ³ collection truck	20m ³ collection truck
Collection and Transport to Bijeljina	60.23	55.63
Transport via Transfer Station		
Collection and transport to Transfer Station	40.81	42.41
Transfer Station	2.95	2.95
Transport Transfer Station to Bijeljina	15.44	15.44
Total (via Transfer Station)	59.20	60.80
Disposal in Bijeljina (excl. VAT) ¹	47	47
Cost of LF closing in Brcko	17	17
Grand total (BAM/ton)	123.2	119.63

¹ Based on offer from Bijeljina of BAM 55/ton incl. VAT.

Option (ii)-Upgrading and (temporary) continued operations at existing landfill

A cost estimate is presented in Annex C5.3 including operational and amortization costs for upgrading the existing landfill and continuation of waste disposal on top. It shows a total investment of about BAM 7.5 million based on construction of bottom closure for a 5-year disposal cell of 150x150 m (BAM 3.5 million) and a temporary closure (BAM 2.85 million) of remaining area (95,000m²). The operational costs/ton for this option are indicated in Table C5- 3.

Table C5- 3: Continued landfill operations (BAM/t excl. VAT)

	12m ³ collection truck	20m ³ collection truck
Collection	40.8	42.4
Disposal	52.4	52.4
Total	93.2	94.8
Temporary closure remaining area	8.5	8.5
Grand total	101.7	103.3

C5.5.2 Separation at source

In the EP Strategy, no targets are indicated for separation of waste. However, in order to meet the requirements of the EU it will be needed to implement separation. The maximum quantity available of dry recyclables based on the realistic scenario (see chapter 1) in 2025 can be estimated at 30% x 50% x 0,9 x 25,159=3,400 tons/year (10% of packaging waste is collected from CII sector before waste is disposed in containers).

Introduction of separation at source using 240 liters containers for dry recyclables and 1,100 liters containers for mixed waste will increase the collection costs with average about BAM 25/ton (see Annex C5.4). There are various options for further handling of the pre-separated dry recyclables viz.:

Option (i): Transporting the separated materials together with the mixed waste to a sorting line at RL Bijeljina and selling it. A cost calculation for this option is given in Annex C5.6 showing a cost of BAM 141.79/ton excluding any revenues from selling the materials to the sorting line.

Option (ii): Construction of a sorting line at Brcko landfill. The costs for installation of a sorting line with an input of 3,400 t/y are presented in Annex C5.5. It shows a small revenue of BAM 0.55/ton based on the following assumptions (i) 30% separation at source by the inhabitants; (ii) current sales prices which can fluctuate strongly over time; (iii) staffing costs only 50% for sorting line; (iv) rejects at sorting line of 25%. The total cost for this option is calculated in Annex C5.6 showing a cost of BAM 119.89/ton.

Option (iii): Selling the pre-separated materials to a trader in Brcko.

It is not recommended to introduce separation at source of organic waste and composting up to 2025. The first priority is separation of dry recyclables and this will require a substantial effort in the field of PA awareness raising and logistic organization. Moreover, a market survey is needed to assess the demand for any compost.

C5.5.3 Required equipment

In Table 5.4 the required equipment is indicated in case household waste collection will be carried out using 1,100 liters containers without separation at source. The number of containers is calculated on basis of waste quantities to be collected without taking into consideration the service level i.e. walking distance by inhabitants. Also in Table C5-4 is indicated the required equipment in case the waste will be transported to a regional landfill at 40km distance.

Table C5-4: Required equipment without separation at source

	Municipal landfill (10km)		Regional landfill (40km)	
Truck capacity	12m ³	20m ³	12m ³	20m ³
Number of trucks	7	6	9	8
Number of containers-1,100 liters	850	850	850	850

Source: Annex C4-1

In case separation at source will be introduced the required number of equipment will increase as indicated in Table C5-5.

Table C5-5: Required equipment with separation at source

	Municipal landfill (10km)		Regional landfill (40km)	
Truck capacity	12m ³	20m ³	12m ³	20m ³
Number of trucks	13	12	17	14
Number of containers -1,100 liters	900	900	900	900
- 240 liters	1,195	1,195	1,195	1,195

Source: Annex C5.4

Bulky waste can be collected through so-called “bring stations” or by “door-to-door” service on request. As no reliable statistical information is available it is not recommended to construct “bring stations” but to introduce door-to-door collection. Normally most of the bulky waste (furniture, mattresses, timber, etc.) is collected with opened trucks. A number of flatbed trucks might be needed for collection of white goods and electrical appliances as it is expected that the EPR scheme for WEEE might contract the waste collection company. Any need to be established once the WEEE Scheme will contract the collection company. A rough estimate can be made based on the EU

requirement of minimum 4kg/cap/year to be collected or approximately 260 t/y or 0.8 t/day or one truck. Also, private companies could be hired by the WEEE scheme.

For the collection of industrial waste, it is proposed to use large containers (5-7m³). The number of containers and the number of skip trucks will depend on the number of contracts.

C6 INVESTMENTS

The expected investments (BAM excl. VAT) are indicated in Table C6-1 for the following options:

Option (i): Waste collection without separation at source and disposal at the upgraded municipal landfill (at 10km distance) or direct transport to a regional landfill (40 km to Bijeljina) with final closure of the landfill in Brcko.

Option (ii): Same as Option (i) with separation at source and construction of a separation line at the ML in Brcko.

Option (iii): Final closure of the existing landfill (12 ha) in case a new landfill site has been selected.

Table C6-1: Required investments (BAM)

Description	Municipal landfill	Bijeljina RL
Equipment and infrastructure		
(i) Collection without separation:		
Trucks	1,670,000	2,190,000
Containers	510,000	510,000
ML Brcko upgrading		
-New cell with supporting facilities	4,140,000	
-Temporary closing remaining part	2,850,000	
-Equipment	500,000	
Final Closure existing ML in Brcko		5,160,000
(ii) Collection with separation:		
Trucks	3,230,000	3,970,000
Containers	720,000	720,000
Sorting line at ML	2,400,000	
ML Brcko upgrading	7,490,000	
Final closure existing ML in Brcko		5,160,000
(iii) New site/regional landfill:		
-Final closure existing landfill	5,160,000	
-Trucks (incl. separation at source)	3,230,000	
-Containers (incl. separation at source)	720,000	
-Sorting line	2,400,000	
Cost for new landfill- ESIA	150,000	
- Construction	To be investigated	
Institutional support		
Department of Public Utilities		500,000
Komunalno Brcko/Cistoca		500,000

ANNEXES

Annex C4.1: Collection and transport in 2015-BD

Distance to landfill	10km to MLF		40km to RL	
Collection system				
Container system	1100.00		1100.00	
inhabitants Census 2013	83516.00		83516.00	
living abroad	19500.00			
population	64016.00			
Generation (kg/cap/day)	0.80		0.80	
waste quantity (tons/year)	24386.67		24386.67	
collected	20484.80		20484.80	
Collection truck-airvolume (m ³)	12.00	20.00	12.00	20.00
compaction	3.00	3.00	3.00	3.00
volume/truckx90%(m ³)	32.40	54.00	32.40	54.00
load/truck(550kg/m ³ x0.9)	5.94	9.90	5.94	9.90
Price truck (KM)	220000.00	300000.00	220000.00	300000.00
Price container -1100 litre (KM)	600.00	600.00	600.00	600.00
Working days/year	300.00	300.00	300.00	300.00
Calculation trucks/containers				
Time/shift (minutes)	480.00	480.00	480.00	480.00
Fueling	20.00	20.00	20.00	20.00
Garage to collection area	20.00	20.00	20.00	20.00
Lunch break	30.00	30.00	30.00	30.00
Landfill to garage				
Available for collection and transport	410.00	410.00	410.00	410.00
Cycle time truck				
Collection/container (minutes)	5.00	5.00	5.00	5.00
containers/truck	29.45	49.09	29.45	49.09
collection time (minutes)	147.27	245.45	147.27	245.45
transport to landfill	15.00	15.00	50.00	50.00
Unloading at landfill	15.00	15.00	15.00	15.00
transport to collection area	15.00	15.00	50.00	50.00
total(minutes)	192.27	290.45	262.27	360.45
trips/shift/truck	2.13	1.41	1.56	1.14
Weight/shift/truck (tons)	12.67	13.97	9.29	11.26
shifts/day (8-10 hrs./day)	1.00	1.00	1.00	1.00
Capacity/year/truck	3799.91	4192.39	2785.73	3378.23
Number/trucks	5.39	4.89	7.35	6.06
truck availability	0.80	0.80	0.80	0.80
actual truck number	6.74	6.11	9.19	7.58
containers/day (collection 2xweek)	677.18	677.18	677.18	677.18
filling degree 80%	846.48	846.48	846.48	846.48

Investments (KM)				
Collection trucks	1482486.16	1832318.48	2022209.25	2273910.10
Containers	507887.71	507887.71	507887.71	507887.71
Operational costs				
<i>Wages</i>				
1 Driver+2 loadersx1,15=3.45/truck	18.60	16.86	25.37	20.92
Average costs (KM/year)	12000.00	12000.00	12000.00	12000.00
Costs/year (KM)	223181.55	202287.96	304434.41	251039.68
Total Including management (25%)	278976.94	252859.95	380543.01	313799.59
<i>Fuel</i>				
km/cycle				
garage to collection area	5.00	5.00	5.00	5.00
collection route	15.00	25.00	15.00	25.00
To landfill	10.00	10.00	40.00	40.00
to collection area	10.00	10.00	40.00	40.00
Total km/day	429.29	334.81	1128.83	754.53
Total km/year	128788.00	100442.02	338649.16	226358.72
Litre (0,3 litre/km)	38636.40	30132.61	101594.75	67907.62
costs/year (KM1,9/litre)	73409.16	57251.95	193030.02	129024.47
lubricants (1.5ltr/100km)	7727.28	6026.52	20318.95	13581.52
<i>Tyres</i>				
4-6/truck;30,000km	17.17	20.09	45.15	45.27
Cost (600KM/tyre)	10303.04	12053.04	27091.93	27163.05
<i>M+R</i>				
Truck (5%)	74124.31	91615.92	101110.46	113695.51
Containers (2%)	10157.75	10157.75	10157.75	10157.75
Total	84282.06	101773.68	111268.22	123853.26
<i>Insurance</i>				
Trucks (1,0%)	14824.86	18323.18	20222.09	22739.10
Sub-total OPEX	469523.34	448288.33	752474.23	630160.99
Miscellaneous (10%)	46952.33	44828.83	75247.42	63016.10
Total OPEX	516475.68	493117.16	827721.65	693177.09
<i>Amortization</i>				
Trucks (7 years, 3%)	237939.03	294087.12	324564.58	364962.57
Containers (7 years, 3%)	81515.98	81515.98	81515.98	81515.98
subtotal CAPEX	319455.01	375603.09	406080.56	446478.55
Grand total	835930.68	868720.26	1233802.21	1139655.64
Cost/ton(KM)	40.81	42.41	60.23	55.63
Average KM/ton	41.61		57.93	

Annex C4.2: Landfill operations-2015 BD

Assumptions				
Quantity (tons/year)	20484			
Annual increase: 1%				
1st cell (tons/5 years)	104980.5			
Average /year (tons)	20996.1			
Storage density (t/m ³)				0.7
Storage height (m)				20
Storage volume 1st cell (m ³)	172467.96			
Storage area: 150x150m ²		22500		
service area 150 x30m ²		4500		
Civil works				
Description	unit	total units	cost/unit	total(KM)
Service area	m ²	4500	35	157500
Garage/ repair shop incl. tools	m ²	125	750	93750
Gas flare				250000
Electricity network				75000
Water supply system				100000
Fence	m	660	100	66000
Gatehouse area	m ²	250	600	150000
Portacabin offices				100000
Surface water ditch	m	510	350	178500
Leachate ponds	l.s.	2	75000	150000
Subtotal civil works (20 years depreciation)				1320750
Storage cell	m ²	22500	70	1575000
Closing after 5 years	m ²	22500	50	1125000
Subtotal civil works (5 years depreciation)				2700000
Grand total civil works				4020750
Equipment				
Compactor/bulldozer	l.s.	1	400000	400000
Excavator	l.s.	1	235000	235000
Weighbridge	l.s.	1	80000	80000
Aerators leachate ponds		2	30000	60000
Wheels washing		1	70000	70000
Various tools		1	20000	20000
Total equipment				865000
Amortization costs/year				
<i>Civil works</i>				
Cell (5 years,3%)			589410	

<i>Remaining works (20 years,3%)</i>			88754.4	
<i>Equipment (10 years,3%)</i>			101378	
Total amortization			779542.4	
OPEX/year				
<i>Wages</i>			month	
Landfill manager		1	3000	36000
Assistant manager		1	2000	24000
Gatehouse weighbridge operator		2	1500	36000
Site controller		2	1500	36000
Drivers		2	1500	36000
Guard		2	1200	28800
Technician workshop		1	1500	18000
Engineers		1	2000	24000
Administrator		2	1500	36000
Secretary		1	1500	18000
Sub-total				292800
Overhead				336720
<i>Energy</i>				
Bulldozer/Compactor (6hrs x 300 days x 250kW)		1 ltr=10.6kwh	360000	64528.30
Excavator (3 hours x 300 days x 150kw)			108000	19358.49
Site: 50kW x 10hrs x 300days			120000	14040
Leachate aerators (8hrs x 15Kw x 2 = 240kwh/day)			87600	10249.2
Sub-Total				97926.79
<i>M+R</i>				
Civil works (0.5%)				6603.75
Equipment (5%)				43250
Sub Total M+R				49853.75
<i>Waste covering</i>				
15% of tonnage x KM 5/ton				22500
<i>Insurance equipment</i>				865
<i>Environmental monitoring</i>				30000
<i>Office</i>	Consumables			15000
	Phone, utilities			5000
	Audit			5000
<i>Total</i>				25000
<i>Total OPEX</i>	26.81			562865.54
<i>Total CAPEX</i>	37.13			779542.4
<i>Grand total</i>				1342407.94
<i>Cost/ton (excl. VAT)</i>				63.94
<i>Cost/ton incl. VAT</i>				74.81

Annex C5.1 Transfer Station-BD

	Ramp	
Cost estimate		
Civil works		
Ramp		75000
Pavements (m ²)		75000
Utility connections		20000
Total	ramp	170000
<i>Amortization costs</i>		
Civil works (20 yrs/3%)		27285
Operational costs		
<i>Wages</i>		
Coordinator	1	17820
Holidays, sickness (15%)		20493
Overhead (25%)		25616.25
<i>Energy</i>		
Site (25kW;300days;10hrs/day)	60000	7020
<i>M+R</i>		
Civil works (2%)		3400
OPEX		36036.25
CAPEX		37111
Grand total (BAM)		63321.25
Cost/ton (BAM excl. VAT)	21500	2.95



Annex C5.2 Transport costs to Bijeljina (40km)

	Trailer with compression	Collection truck 10 t	Collection truck 6,0 t
Quantity (t/y)	21500	21500	21500
Days/year	300	300	300
Distance (km)	40	40	40
Truck (tons)	20	10	6
Time available	480	480	480
Lunch break	30	30	30
Fueling etc.	20	20	20
Available/day	430	430	430
Trips/day			
Loading	90	0	0
To RL (40km/hr)	60	60	60
Back from RL	60	60	60
Unloading at RL	20	20	20
Total/trip (min)	230.00	140	140
Trips/day	1.87	3.07	3.07
Km/day/truck	149.57	245.71	245.71
Cap/day (tons)	37.39	30.71	18.43
Cap/year(tons)	11217.39	9214.29	5528.57
Trucks	1.92	2.33	3.89
Trucks Availability (80%)	2.40	2.92	4.86
Cost/truck	400000.00	300000.00	260000.00
Investment (BAM)	958333.33	875000.00	1263888.89
Amortization (7 yrs., 3%)	153812.50	140437.50	202854.17
<i>Operational costs</i>			
Wages			
Driver (x 1,15 x 1,25)	49593.75	44275.00	73791.67
M+R (5%)	47916.67	43750.00	63194.44
<i>Fuel</i>			
Km/year	86000	172000.00	286666.67
Liters/year	25800	51600.00	86000.00
Cost (BAM 1,9/liter)	49020	98040.00	163400.00
Lubricants	5160	10320.00	17200.00
Total	54180	108360.00	180600.00
Tyres	28.67	34.40	38.22
Cost	17200.00	20640.00	22933.33
Insurance (1%)	9583.33	8750.00	12638.89
OPEX	178473.75	225775.00	353158.33
Cost/ton	8.30	10.50	16.43
CAPEX	153812.50	140437.50	202854.17

<i>Cost/ton</i>	7.15	6.53	9.44
Total cost/ton	15.46	17.03	25.86
Truck trip (excl. VAT)	309.10	170.33	155.17
Cost/km	3.86	2.13	1.94
Cost/ton km	0.19	0.21	0.26

Annex C5.3: Closing existing landfill with waste disposal on top BD

Annual waste quantity (tons)	22500			
Construction costs				
Item	units	unit cost		Total(BAM)
Waste shaping, leveling, compaction	25000	7		175000
Gas relief zone with pipes (30cm)	25000	6		150000
Geotextile	25000	4		100000
Sand, bentonite layer	25000	35		875000
Geotextile	25000	4		100000
Clay for embankments (6m ³ xlength)	450	16		43200
Drainage gravel with leachate pipes	25000	12		300000
Subtotal (first cell of 150x150m)	25000	69.728		1743200
Civil works				
Fencing (m)	450	100		45000
Weighbridge				80000
Leachate treatment				700000
gas wells, piping and flare				400000
Roads and ditches	450	700		315000
Fire fighting				100000
Monitoring				30000
Wheels washing				70000
Various tools				20000
Subtotal works				1760000
Total				3503200
Temporary closing remaining area (110000-2500)	95000	30		2850000
Grand total				6353200
Equipment				
Compactor				300000
Dozer				200000
Total				500000
Engineering /design (10%)				635320
				7488520
Amortization costs				
First cell (5 years)		1743200		380540.56
Civil works (20 years)		1760000		118272
Temporary closing (20 years)		2850000		191520
Equipment (12 years)		500000		50000
Design (20 years)		635320		42693.50
Total				783026.06
				34.80
Operational costs				

Wages				
Landfill manager	1	3000		36000
Assistant LF manager	1	2000		24000
Weighbridge operator	2	1500		36000
Site controller	2	1500		36000
Drivers	2	1500		36000
Guards	1	1200		18000
Engineer workshop	1	1500		18000
Administrator	2	1500		36000
Secretary	1	1500		18000
				258000
Overhead (25%)				322500
Energy				
Site (50kW, 300 days, 8hrs/day)	96000	0.117		11232
Compactor (250 kW x 6hrs, 300 days)	360000	1ltr=10,6kW		64528.30
Dozer (200 kW, 6 hrs, 300 days)	288000			51622.64
Leachate treatment	365	100		36500
total				163882.943
M+R				
civil works (0,5%)		1760000		8800
Equipment (5%)		500000		25000
Total				33800
Waste covering				
15% x tons x 5km	22500	0.15		16875
Insurance equipment	500000	0.01		5000
Environmental monitoring				30000
Office				15000
Total OPEX				587057.94
				26.09
Total cost/ton				60.89

Annex C5.4: Cost estimate mixed containers collection-BD

			10 km to LF				40 km to RL			
COLLECTION			Large truck (20m ³)		Small truck (12m ³)		20m ³		12m ³	
Assumptions			Mixed containers		Mixed containers		Mixed containers		Mixed containers	
Container system (liters)			1100	240	1100	240	1100	240	1100	240
Waste volume/year(ton)			25160		25160		25160		25160	
Recyclables:30% \times 50,56% in 240 ltr			21725.36	3434.64	21725.36	3434.64	21725.36	3434.64	21725.36	3434.64
Collection truck-air volume			20	20	12	10	20	20	12	10
	compaction		3	3	3	3	3	3	3	3
	volume/truck \times 90%(m ³)		54	54	32.4	27	54	54	32.4	27
Load (550kg/m ³ /300kg/m ³)			9.9	5.4	5.94	2.7	9.9	5.4	5.94	2.7
Price truck (KM)			300000	300000	220000	220000	300000	300000	220000	220000
Price container -1100 litre(KM)			600	150	600	150	600	150	600	150
Working days/year			300	300	300	300	300	300	300	300
Waste density (kg/m ³)			185	80	185	80	185	80	185	80
Calculation number trucks and containers										
Time/shift (minutes)			480	480	480	480	480	480	480	480
Fueling.			20	20	20	20	20	20	20	20
Garage to collection area (10km-20km)			20	20	20	20	20	20	20	20
Lunch break			30	30	30	30	30	30	30	30
Landfill to garage										
Available for collection and transport			410	410	410	410	410	410	410	410
Cycle time truck										
Collection/container (minutes)			5	4	5	4.00	5	4	5	4
Containers/truck			49.09	225	29.45	112.50	49.09	225	29.45	112.5

Collection time (minutes)		245.45	900	147.27	450.00	245.45	900.00	147.27	450.00
Transport to landfill		15	15	15	15.00	50	50	50	50
Unloading at landfill/sorting line		15	15	15	15.00	15	15	15	15
Transport to collection area		15	15	15	15.00	50	50	50	50
Total (minutes)		290.45	945	192.27	495.00	360.45	1015.00	262.27	565.00
Trips/shift/truck		1.41	0.43	2.13	0.83	1.14	0.40	1.56	0.73
Weight/shift/truck (tons)		13.97	2.34	12.67	2.24	11.26	2.18	9.29	1.96
Shifts/day		1	1	1	1.00	1	1	1	1
Capacity/year/truck		4192.39	702.86	3799.91	670.91	3378.23	654.38	2785.73	587.79
Number/trucks		5.18	4.89	5.72	5.12	6.43	5.25	7.80	5.84
Truck availability		0.8	0.8	0.8	0.80	0.8	0.8	0.8	0.8
Actual truck number		6.48	6.11	7.15	6.40	8.04	6.56	9.75	7.30
Containers/day (collection 2 x week)		718.19	954.07	718.19	954.07	718.19	954.07	718.19	477.03
Filling degree 80%		897.74	1192.58	897.74	1192.58	897.74	1192.58	897.74	596.29
Investments (KM)									
Collection trucks		1943283.14	1832507.12	1572265.07	1407830.87	2411617.42	1968248.39	2144673.64	1606918.06
Containers		538645.24	178887.60	538645.24	178887.60	538645.242	178887.60	538645.24	89443.80
Operational costs									
<i>Wages</i>									
1 Driver + 2 loadersx1,15=3.45/truck		17.88	16.86	19.72	17.66	22.19	18.11	26.91	20.16
Average costs (KM/year)		12000.00	12000	12000.00	12000.00	12000.00	12000	12000	12000.00
Costs/year (KM)		214538.46	202308.79	236697.36	211942.54	266242.56	217294.62	322870.87	241914.21
Total Including management (25%)		268173.07	252885.98	295871.70	264928.17	332803.20	271618.28	403588.58	302392.76
<i>Fuel</i>									
km/cycle									

Garage to collection area		5	5	5	5.00	5	5	5	5
Collection route		255.00	90	15.00	45.00	25.00	90	15.00	45
To landfill		10	10	10	10.00	40	40	40	40
to collection area		10	10	10	10.00	40	40	40	40
Total km/day/all trucks		355.08	257.65	455.29	301.22	800.22	386.67	1197.19	559.25
Total km/year		106524.76	77294.96	136587.36	90364.90	240066.93	116000.61	359157.65	167776.21
Litre (0,3 litre/km)		31957.43	23188.49	40976.21	27109.47	72020.08	34800.18	107747.30	50332.86
Costs/year (KM1,9/litre)		60719.11	44058.13	77854.80	51507.99	136838.15	66120.35	204719.86	95632.44
Lubricants (1.5ltr/100km)		6391.49	4637.70	8195.24	5421.89	14404.02	6960.04	21549.46	10066.57
<i>Tyres</i>									
4-6/truck; 30,000km		21.30	15.46	18.21	12.05	48.0133868	23.20	47.89	22.37
Cost (600KM/tyre)		12782.97	9275.39	10926.99	7229.19	28808.03	13920.07	28732.61	13422.10
<i>M+R</i>									
Truck (5%)		97164.1569	91625.36	78613.25	70391.54	120580.871	98412.4195	107233.68	80345.90
Containers (2%)		10772.9048	3577.75	10772.90	3577.75	10772.9048	3577.752	10772.90	1788.876
Total		107937.06	95203.11	89386.16	73969.30	131353.78	101990.17	118006.59	82134.78
<i>Insurance</i>									
Trucks (1,0%)		19432.83	18325.07	15722.65	14078.31	24116.1742	19682.4839	21446.74	16069.1806
Sub-total OPEX		475436.54	424385.38	497957.54	417134.86	668323.35	480291.39	798043.84	519717.83
Miscellaneous (10%)		47543.65	42438.538	49795.75	41713.49	66832.3354	48029.14	79804.38	51971.78
Total OPEX		522980.19	466823.92	547753.29	431213.17	735155.69	528320.53	877848.22	571689.61
<i>Amortization</i>									
Trucks (5-7 years, 3%)		311896.94	294117.39	252348.54	225956.85	387064.60	315903.87	344220.12	257910.35
Containers (7 years, 3%)		86452.56	28711.46	86452.56	28711.46	86452.56	28711.46	86452.56	14355.73
Total CAPEX		398349.50	322828.85	338801.11	254668.31	473517.16	344615.33	430672.68	272266.08
Grand total		921329.69	789652.77	886554.39	685881.48	1208672.85	872935.86	1308520.90	843955.69
Cost/ton (KM)		42.41	229.91	40.81	199.70	55.63	254.16	60.23	245.72

Combined KM/ton		68.00	62.50	82.73	85.55
Average			65.25		84.14
Annex C4.1 (only 1,100 litres containers)		40.81	42.41	55.63	60.23
Average			41.61		57.93
Difference			23.64		26.21

Annex C5.5: Sorting line BD

Sorting line calculation		Separation at source			
Quantities (2025)		5 tph			
Input quantities (tons)		3400.00			
Composition	Paper/Cardboard (%)	53	1351.50		
	Plastics (%)	27	688.50		
	Glass (%)	13	331.50		
	Cans (%)	7	178.50		
Saleable recyclables		2550.00			
Sorting line (5tph installed capacity)					
Annual capacity-300 days (tons)		9600			
Input (tons/year)		3400.00			
Rejects (impurities in pre- sorted materials)		850 25% to landfill			
Output of saleable materials (tons/year)		2550			
Cost calculation					
Investments					
Item	Costs (KM)	Total			
M/E works	1500000				
Civil works	900000				
Total	2400000				
Costs/year					
Amortization		210480	61.91		
M/E works (12 years, 3%)	150000				
Civil works (20 years, 3%)	60480				
Operations					
<i>Transport landfill rejects</i>		4250.00			
<i>M+R</i>		54000			
M/E (%)	3	45000			
Civil (%)	1	9000			
<i>Labour (one shift)</i>		76176.00			
Manager	1	2000	24000		
Engineer	1	1500	18000		
Baler	1	1300	15600		
Drivers	1	1300	15600		
Sorters	6	1000	12000		
Guards	1	1000	12000		
Administration	1	1500	18000		
			115200		

<i>Working time 50%</i>	66240.00		
<i>Overhead (15%)</i>	76176.00		
<i>Energy</i>	70246.4		
Site (10kW, 8 hrs/day, 300 days)	19200	2246.4	
20 kWh/ton	0.117	68000	7956
<i>Office</i>	5000		
Total (excl. VAT)	420152.40		123.57
<i>Cost/ton</i>	123.57		
Revenues (assumption: operator =collector)			
<i>Savings on landfill</i>	51000.00		
Quantity (tons)	850		
Disposal: KM/ton (excl. VAT)	60		
<i>Sales ex sorting line</i>	422025.00		
Paper/cardboard	140	1351.50	189210.00
Plastics (mixed)	300	688.50	206550.00
Glass	20	331.50	6630.00
Cans	110	178.50	19635.00
Sub total	2550.00		422025.00
Total	422025.00		
Price KM/ton	124.13		
Net result (KM/ton)	0.55		

Annex C5.6: Cost/ton for various options-2025

	Without waste separation at source						With waste separation at source					
	ML Brcko			RL Bijeljina			ML Brcko			RL at Bijeljina		
	tons/year	unit rate	cost/year	tons/year	unit rate	cost/year	tons/year	unit rate	cost/year	tons/year	unit rate	cost/year
Collection and transport	25160	41.61	1046908	25160	57.93	1457518.8	25160	41.61	1046907.6	25160	57.93	1457518.8
Disposal	25160	60.89	1531992	25160	47	1182520	22610	60.89	1376722.9	21760	47	1022720
Final Closure ML Brcko				25160	17	427720				25160	17	427720
Subtotal (BAM/ton excl. VAT)		102.5	2578900		121.93	3067758.8						
Separation at source												
Collection							25160	23.64	594782.4	25160	26.21	659443.6
Sorting							3400	-0.55	-1870	3400	TBD	
Total (BAM/ton excl. VAT)								119.89	3016542.9		141.79	3567402.4

Note: Disposal cost in Bijeljina based on offer of BAM 55/ton incl. VAT.

TBD = to be discussed (selling rate of dry recyclables)