Modernisation of local public services in Republic of Moldova

- Intervention area 1: Local services -

Feasibility study for an inter-municipal solid waste management center in Soldanesti

Final report

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Acronyms and abbreviations

BOD	Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
DPC	Dynamic Prime Costs
EC	Eclectic Conductivity
EU	European Union
EUR	Euro, currency
GCL	Geo-synthetic Clay Liner
GHG	Green House Gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
IMC	Inter-Municipal Cooperation
ISWMS	Integrated Solid Waste Management System
JSC	Joint Stock Company
LPA	Local Public Authority
MBT	Mechanical Biological Treatment
MDL	Moldovan Lei, currency
ME	Municipal Enterprise
MEC	Ministry of Economy
MRF	Material Recovery Facility
MSW	Municipal Solid Waste
RDF	Refuse Derived Fuel
SB	Stabilized Biomass
SEDS	Socio-Economic Development Strategy
SWM	Solid Waste Management
TOC	Total Organics

1 Introduction

1.1 Background and aim of the project

Within the program “Modernization of Local Public Services in the Republic of Moldova” GIZ is supporting the city of Soldanesti and 26 surrounding rural administrative units (municipalities/communes) in the rayons of Soldanesti and Rezina to establish an enhanced state-of-the-art Integrated Solid Waste Management System (ISWMS). The project aims on improving the overall environmental situation by means of reducing pollution and emissions in the greater area known as Ciorna river basin.

The final component of the ISWMS to be established is the inter-municipal solid waste management center consisting of a material recovery facility (MRF), a composting plant, and an enhanced landfill which will serve as a transitional waste disposal site for the service area in accordance with the regional waste management plan. After the transitional period the disposal site is expected to be replaced by a regional landfill serving four rayons (Soldanesti, Rezina, Telenesti and Orhei). The location of the future regional landfill has not been selected, yet.

1.2 Objective of this report

The aim of the feasibility study is a detailed analysis of the envisaged investment for the inter-municipal solid waste management center considering all components of the entire ISWMS as a whole (including waste collection). Based on the analysis recommendations for the lay out of the facility will be developed on the level of conceptual design as well as recommendations regarding the future implementation. In this regard the following main topics will be taken into account:

- Organizational/institutional aspects;
- Financial aspects;
- Social/gender aspects; and
- Environmental aspects.

Within the scope of the feasibility study, the ISWMS will be assessed in detail, considering the increasing waste amounts according to population and waste forecasts. Investment and operation costs will be calculated and all projected changes in the system due to the establishment of the inter-municipal solid waste management center will be compared to a baseline scenario (current situation), in which the solid waste management is limited on collection and disposal at temporary dumpsites. In order to assess the financial feasibility of the inter-municipal solid waste management center and the ISWMS the future revenues from tariffs/fees/taxes as well as additional income sources will be analyzed. Recommendations for the implementation of the upgraded ISWMS will be developed in form of an implementation plan, proposing work streams to particular task areas. Potential risks to be faced, that might hamper the implementation of the inter-municipal solid waste management center, will be examined carefully.

1.3 Methodology

Despite its title this document differs - for various good reasons - from typical feasibility studies as commonly compiled in international consulting services. Due to the character of the ongoing intervention in the project area various investments, which are part of the future SWM center, have already been placed based on previous implementation

plans and concepts. Originally, the feasibility study was initiated as supporting document for the procedure of changing the land destination for the future SWM centre. From this aspect, there was neither a need not an opportunity to develop options for the concept and the lay out of the facility as it usually happens in feasibility studies. The key criteria such as the location, the main objectives and the general functions of the facility were yet determined.

Additionally, the given precondition of some key criteria has impact on other tasks, which are usually addressed in a feasibility study, i.e. mainly the selection of the location. The site in Parcani was determined based on an earlier finalized site identification and approval process for the originally planned local landfill and composting facility. The Consultant has reviewed and checked this process in order to ensure that the process had been carried out properly and that the site decision could be accepted. Otherwise the procedure would have been to be repeated. According to the approval of the authorities (sanitation and environmental aviza) the site is suitable for this kind of facility. The site selection had been discussed with local stakeholders and residents. According to the current legal framework the previous process was carried out properly particularly in line with the Law Nr 951 from 29.05.1996 on Environmental Expertise and Environmental Impact Assessment. This refers to the frequently disputed question whether the site selection requires EIAs for various candidate sites during the selection procedure or whether it is facilitated as in the EU with environmental screening during the selection and the subsequent EIA during design. Based on the Consultant's appraisal the site is suitable and the selection process was proper. Hence, the site was taken for further planning.

1.4 Limitations

This feasibility study exclusively refers to the single investment plan for an inter-municipal solid waste management center. Scopes beyond this task had not been addressed. Particularly any tasks regarding the future set-up of the SWM system in the waste region 6 (East Centre) according to the ideas of the SWM strategy and the Regional Plan for central region were not object of his study, unless those plans were seen having a direct impact to the local level. Hence, the location of transfer stations required for the regional SWM system, the management of specific waste such as hazardous waste, WEEE etc. are not subject of this study. In all relevant regards the existing national and regional plans/strategies were taken into account.

The existing SWM systems in the service area were assessed, in particular the infrastructure of the waste collection, the institutional set-up of the operating entities and the financial aspects (waste taxes). Wherever it deemed necessary, recommendations were developed. In general, the described existing waste management systems appeared reasonable and useful, what is partly owed to the fact that the structures were implemented in parallel to the compilation of the feasibility study. Regularly, conclusions from the assessment were immediately implemented such as the routing and system of waste collection. However, the existing infrastructure is mainly the result of a recent intervention, which started not earlier than 2010. The efficiency and appropriateness of the measures still need to be analyzed in depth and over a longer period of operation. Thus, it was seen not to be the moment for significant changes of the original lay out for instance towards more or less separate source collection.

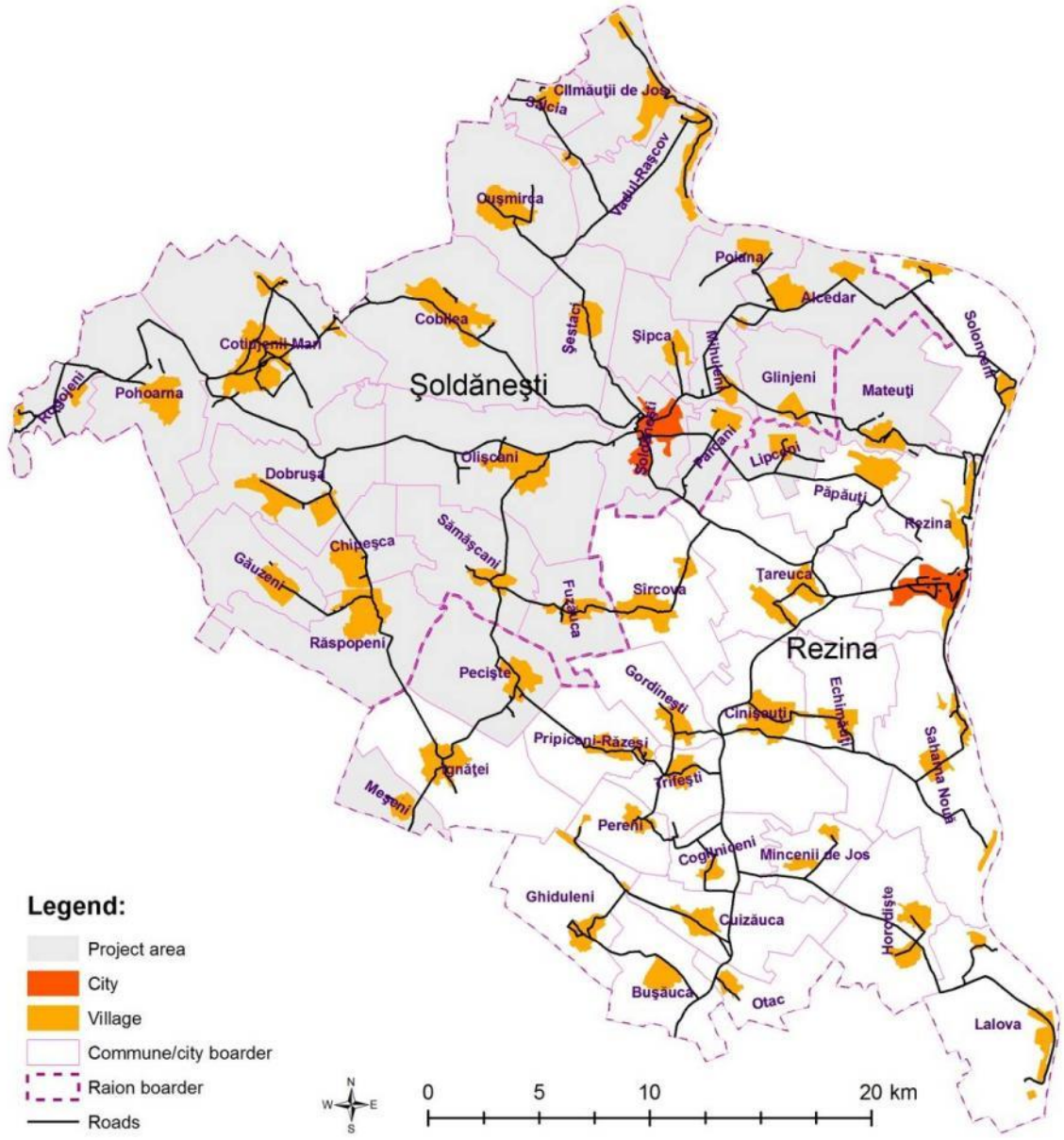
It should be understood that it was not the scope of work to discuss, to introduce or to support the implementation of regional infrastructure and organization such as IMC organization for the waste region 6. This task was left to the foreseen feasibility study for the regional SWM system.

2 Basic data

2.1 Demographics

The project area includes 27 administrative units: all 23 administrative units (one city and 22 rural municipalities) from Soldanesti rayon with an area of about 59,646 ha; and 4 administrative units (4 municipalities) from Rezina rayon with an area of 7,364 ha (see Fig. 2-1).

Figure 2-1: Project area



Data source: Institute of Ecology and Geography; Map design: GOPA, 2013

Table 2-1 describes the population of each administrative unit located in the project area. The population estimation after the year 2009 is based on Census 2004 and Ministry of Economy (MEC) 2009 data (Deprivation Index of Small Areas 2009).

Table 2-1: Population in the project area

Place name	Population (real data)		Annual population change	Population (estimation)			
	Census 2004	MEC 2009		2014	2020	2025	2030
Soldanesti rayon:	42,227	39,811	-1.14%	37,774	35,627	34,057	32,664
1. Soldanesti city	6,304	6,088	-0.69%	5,881	5,642	5,450	5,264
2. Alcedar	1,548	1,445	-1.33%	1,351	1,247	1,166	1,091
3. Chipesca	1,645	1,331	-3.82%	1,095	867	714	587
4. Climautii de Jos	1,467	1,489	0.30%	1,511	1,539	1,562	1,586
5. Cobilea	2,986	2,757	-1.53%	2,552	2,327	2,154	1,994
6. Cusmirca	2,427	2,277	-1.24%	2,139	1,985	1,865	1,752
7. Fuzauca	814	764	-1.23%	718	667	627	589
8. Gauzeni	1,404	1,490	1.23%	1,584	1,704	1,812	1,926
9. Glinjeni/Hlingeni	1,007	954	-1.05%	905	849	806	764
10. Mihuleni	618	582	-1.17%	549	511	482	455
11. Oliscani	3,025	2,690	-2.21%	2,406	2,104	1,881	1,682
12. Parcani	769	784	0.39%	799	818	834	851
13. Poiana	996	839	-3.15%	715	590	503	428
14. Raspopeni	2,775	2,770	-0.04%	2,764	2,758	2,752	2,747
15. Salcia	1,053	997	-1.06%	945	887	841	797
16. Samascani	1,502	1,378	-1.65%	1,268	1,148	1,056	972
17. Sestaci	1,184	1,128	-0.95%	1,075	1,016	968	923
18. Sipca	756	695	-1.61%	641	581	536	494
19. Vadul-Rascov	2,004	2,109	1.05%	2,222	2,366	2,493	2,626
20. Cotiujenii Mari	3,657	3,483	-0.95%	3,321	3,136	2,990	2,850
21. Pohoarna	2,002	1,811	-1.91%	1,645	1,465	1,330	1,208
22. Rogojeni	743	683	-1.62%	629	571	526	485
23. Dobrusa	1,541	1,267	-3.56%	1,057	850	709	592
Rezina rayon:	5,516	5,726	0.76%	5,994	6,381	6,764	7,212
24. Lipceni	641	590	-1.59%	545	495	457	421
25. Mateuti	2,045	2,040	-0.05%	2,035	2,029	2,024	2,019
26. Meseni	916	921	0.11%	926	932	937	943
27. Peciste	1,914	2,175	2.73%	2,489	2,925	3,347	3,829
Total:	**47,743**	**45,537**	**-0.92%**	**43,768**	**42,008**	**40,821**	**39,876**

Source: elaborated by GOPA.

The total population of Soldanesti rayon in 2014 is estimated at 37,774. Only 16% of the population live in urban area (i.e., Soldanesti city), while the majority of population (84%) live in rural area. According to statistical data (statistica.md), in Soldanesti city 52.1% of population is represented by women, while in the villages the women represent about 51% of the total population.

The population of the 4 municipalities of Rezina rayon included in the project area is 5,994, which represents 12% of the total population of the rayon. According to statistical data, about 50.6% of the rural population in Rezina rayon is represented by women.

Based on the data provided in Table 2-1, it is estimated that the population in the project area will gradually decrease at about 0.9% per year for the next 15 years.

2.2 Waste amounts

At the moment the household waste generated in the project area is estimated at about 0.71 kg/person/day in urban area and 0.51 kg/person/day in rural area (see Table 2-2). Hence, in 2013 one person from urban area generated about 259 kg of household waste, while a person from rural area generated about 186 kg. It is expected that the household waste generation per person will grow by 2% each year for the next 15 years.

Table 2-2: Household waste generation rates in the project area

Generation rates:	2013	2014	2019	2024	2029
Urban population:					
Daily generation rate (kg/person/day)	0.71	0.73	0.80	0.89	0.98
Annual generation rate (kg/person/year)	259	266	292	325	358
Rural Population:					
Daily generation rate (kg/person/day)	0.51	0.52	0.57	0.63	0.70
Annual generation rate (kg/person/year)	186	190	208	230	256

Source: elaborated by GOPA on the basis of estimation data on waste generation per capita discussed in the Waste Management Strategy and expert analysis during fieldwork.

In Soldanesti rayon the quantity of household waste generated in 2013 is estimated at about 7,543 tones, however only about 28% (≈2,140 tons) of it is collected and disposed in an organized manner. The rest of the waste is disposed individually by the citizens at the local authorized dumpsite or at unauthorized places.

At the moment, only the city of Soldanesti and 4 municipalities from the Soldanesti rayon have in place organized systems for household waste collection. Soldanesti Municipal Enterprise (ME), named “IM Regia Apa Soldanesti”, collects the waste from Soldanesti city, while the Cotiujenii Mari ME, named “IM Servicii Comunal-locative Cotiujenii Mari”, collects the waste from Cotiujenii Mari, Pohoarna, Rogojeni, and Dobrusa rural municipalities. It is estimated that about 70% (≈1,080 tons/year) of household waste generated in Soldanesti city is collected. According to estimation data, Cotiujenii Mari ME collects about 84% (≈1,060 tons/year) of household waste generated in the 4 municipalities it serves.

The 4 municipalities from Rezina rayon within the project area do not have any organized solid waste management systems. All the waste generated here (≈1,100 tons/year) is disposed individually by the citizens at the local authorized dumpsite or in unauthorized places.

The economic entities and public institutions from the project area also generate every year about 372 tons of commercial waste that are similar to household waste. About 320 tons are generated in the Soldanesti rayon, while the rest (52 tons) are generated in the 4 municipalities from Rezina rayon. It is estimated that at the moment about 40% (150 tons/year) of this waste is collected and disposed at the local dumpsites by the Soldanesti ME and Cotiujenii Mari ME.

Besides strictly household waste, a lot of agricultural waste (mainly manure) is generated in the households within the project area. The amount of manure generated is dependent on the number and type of animals present in each administrative unit. Taking into consideration the potential amount generated by different species of animals (i.e.,

cattle, swine, sheep/goats, horses/mules/donkeys, and poultry), it was calculated that about 68,622 tons (76,928 m^3) of manure is generated each year in the project area. The calculation of the amount of manure generated in each administrative unit is described in Annex 1.

As is can be seen from Annex 1, about 2,411 tons (2,669 m^3) of manure is generated each year in Soldanesti city (in the outskirts), and about 56,142 tons (63,268 m^3) - in the rural area of Soldanesti rayon. In the 4 municipalities of Rezina rayon about 10,068 tons (10,991 m^3) of manure is generated each year.

Table 2-3 below summarizes the quantity of household/commercial solid waste and agricultural waste generated and collected by the waste management services in the project area in 2013.

Table 2-3: Main solid waste streams generated and collected in the project area, year 2013

Waste stream:	Generated, tons	Collected, tons
Household/commercial waste, including:	9,020	2,290
Household waste from population	*8,650*	*2,140*
Commercial waste from economic entities/public institutions	*372*	*150*
Agricultural/manure waste	68,622	2,400

Source: elaborated by GOPA.

A part of the agricultural waste generated in the households of Soldanesti city is transported to the local dumpsite, either by citizens themselves or by the Soldanesti Municipal Enterprise as a paid service. At the same time, a lot of agricultural waste (including construction waste) is placed by the citizens near the platforms (see Fig. 2-2). In this situation Soldanesti ME is collecting this waste at its own expense; in the summer of 2013, Soldanesti ME had to collect and transport (using the tractor with the 4 m^3 trailer) to the dumpsite about 150 m^3 of this type of waste per month.

Figure 2-2: Agricultural waste placed near platforms in Soldanesti city

Source: GOPA.

The agricultural waste generated in rural areas is dumped at the local dumpsite or at unauthorized places (see Fig. 2-3). At the same time, some citizens burn it in the household. A limited number of households use the agricultural waste as fertilizer.

Another important waste type that ends up at the dumpsites is construction and demolition waste. There is no data on the amount of this type of waste generated in the pro-

ject area. Only some very general information on this type of waste exists. According to visual inspection of the wastes disposed at the authorized dumpsites (gisme-diu.gov.md), about 40% of the total waste volume disposed at the dumpsite in Soldanesti city represented the constriction/demolition waste (see Annex 11). In the rural area, this type of waste disposed at local dumpsites is around 25%.

Figure 2-3: Dumping of agricultural waste in rural area

Source: GOPA.

2.3 Waste composition

According to the household waste composition analysis carried out in Soldanesti rayon during the summer of 2013, about 18-19% of the household waste is comprised of recyclable materials. The density of household waste in the containers was 220 kg/m^3 in urban area and 230 kg/m^3 in rural area.

Table 2-4 describes the household waste composition in the urban and rural areas, which represents the data used to calculate the amounts of residual waste and recyclables generated by urban and rural population in the project area. Annex 2 represents the detailed composition of the household waste and describes the methodology for waste composition analysis. The pictures with household waste fractions in the project area are presented in Fig. 2-4 below.

Table 2-4: Household waste composition, r. Soldanesti

Waste components	Urban area	Rural
Mixed paper	5.6%	5.0%
Plastics	9.1%	8.4%
Metals	0.7%	0.6%
Glass	3.5%	3.7%
Residuals	81.1%	82.3%
Total:	**100%**	**100%**

Source: elaborated by GOPA.

Figure 2-4: The household waste fractions in the project area

Mixed paper

Plastics

Metal

Glass

Residual waste: mixed organic & inorganic

Residual waste: inert

Source: GOPA.

3 Current solid waste management system

3.1 Institutional set-up

3.1.1 Current institutional set-up

As it was mentioned earlier, the system of solid waste management in Soldanesti rayon is based on 2 Municipal Enterprises: Soldanesti ME which collects the waste from Soldanesti city with about 16% of rayon population; and Cotiujenii Mari ME which collects the waste from Cotiujenii Mari, Pohoarna, Rogojeni, and Dobrusa municipalities with about 18% of the rayon population. Soldanesti ME started the waste management service in the city in 2009, while Cotiujenii Mari ME started servicing the above mentioned 4 municipalities at the beginning of the year 2013. The rest of the municipalities within the rayon do not have any organized waste management services.

Soldanesti ME (IM Regia Apa Soldanesti) has 2 separate departments: 1) waste management department - deals with solid waste collection and disposal, including street cleaning; 2) water and sewage department - deals with drinking water supply and waste water treatment in the city. There are 23 employees at the enterprise, 15 are men and 8 are women. In the administration and selling of the services provided by both departments are involved 14 employees: management - chief manager and deputy manager (both are men); financial administration - chief accountant, accountant, and cashier (all 3 are women); billing of the services - 5 controllers/supervisors (3 women and 2 men); office security - 3 employees (all are men); legal service - a part time lower (female). In water sector are solely involved 4 employees (all of them are men): 2 locksmiths, 2 machine operators, and a driver. In the solid waste collection and disposal activities are directly involved 3 employees (all are men) who operate the compactor track, the tractors, the bulldozer, and the excavator. Additionally, Soldanesti municipality hires 14 workers (half are women and half are men) who are involved in waste collection (container handling) and street cleaning. Soldanesti municipality pays the salary of these workers jointly with the National Agency of Employment.

Cotiujenii Mari ME (IM Servicii Comunal-locative Cotiujenii Mari) employs 18 people, 13 women and 5 men. The main staff consists of: 1 director (female), 1 accountant (female), 2 truck drivers (males), and 1 tractor driver (male). Additionally, 13 workers (11 women and 2 men) are involved in platform cleaning and billing; these works receive between 50% and 75% of the salary form the enterprise, while the rest of the salary is paid by the National Agency of Employment.

From the information presented above, it can be concluded that the staff of the municipal enterprises are not gender balanced. In the case of Soldanesti ME the management is represented only by men. The women are more represented in financial, billing and legal activities of the enterprise. In contrast, Cotiujenii Mari ME is managed by women; the men are only involved in collection and disposal of waste.

The solid waste management service is provided to citizens, public institutions, and economic agents on the basis of individual contracts between municipal enterprises and the served clients.

In Soldanesti city the tariff for the citizens is 5.1 MDL/person/month, while the tariff for an economic agent or a public institution is 150 MDL/month. According to 2013 data, Soldanesti ME services 1,733 contracted households, which pay the tariff for 2,701 people. Considering the number of the people living in the city, it seems that only 46% of the city population is actually paying for the service.

At the moment, 112 economic agents are contracted by Soldanesti ME for the waste management service. It seems that about 91% of the economic agents are paying the tariff considering that 127 economic agents are registered in the city according to the Rayon Council data.

Cotiujenii Mari ME is charging the served population with a fee of 10 MDL/household/ month. The small economic agents (e.g., small shops, bars, etc.) are paying a fee of 50 MDL per month, while big economic agents and public institutions (e.g., schools, city hall) were paying a fee of 150 MDL per month.

According to the data from the beginning of the year 2013, Cotiujenii Mari ME has 1,054 contracts with the private households (573 in Cotiujenii Mari, 27 in Pohoarna, 186 in Rogojeni, and 268 in Dobrusa). In line with this information only about 45% of the total households (54% in Cotiujenii Mari, 4% in Pohoarna, 89% in Rogojeni, and 61% in Dobrusa) are contracted.

There are 37 economic agents contracted by Cotiujenii Mari ME within the service area. It seems that about 84% of the economic agents are contracted considering that 44 economic agents are registered in the area according to the Rayon Council data.

There is no waste management system set up for the 4 municipalities (i.e., Lipceni, Mateuti, Meseni, and Peciste) of Rezina rayon within the project area, which represent about 12% of the rayon population.

3.1.2 Intermediate institutional set-up

At present a new institutional set-up is being developed consisting of an Inter-municipal Joint Stock Company (JSC), which shall provide services to the participating municipalities in Soldanesti and Rezina rayons. This initiative is further described in section 5.4.

In preparation for the new set-up, platforms have been established and equipped with containers in the participating municipalities and collection trucks and other equipment have been procured as described elsewhere in this document.

The municipal enterprise in Soldanesti is now utilizing this equipment to provide collection and disposal services based on agreements with some of the rural municipalities. The waste is to be disposed of in approved and upgraded dumpsites that will be utilized until the solid waste management center has been established.

These services are provided to villages at a fee of 8 MDL/person/month, which is charged monthly to the municipalities. The municipalities have been encouraged to raise taxes to enable them to pay for the service (see section 5.4), however, the actual means of raising the necessary funding is for the individual municipalities to decide. At the same time, the waste management service in Soldanesti city is provided at an increased fee - 10 MDL/person/month.

The municipalities have selected initially to use this procedure to enable the implementation of the waste management system in parallel with the establishment of the JSC (see section 5.4).

This initial procedure is not a long term solution, since any solid waste management service provider (public or private) will have to be selected through a tendering procedure unless the municipality acquiring the service exercises management control over the service provider (meaning that that the respective municipality is a founder of the respective company) or unless the value of the contract is below a certain threshold. This means that provision of the service by the municipal enterprise of Soldanesti to other municipalities can only take place over a short period since a long term contract would exceed this threshold. If, however, a JSC, which is owned, and thereby con-

trolled, by all the municipalities, is providing the service, tendering is not required. Even if the law does not state explicitly this exception form the general rule of the tendering procedure, this conclusion can by drawn from the interpretation of sense of the current legal provisions, from the current practices and European directives and jurisprudence.

3.2 Waste collection and transport

3.2.1 The Infrastructure for household waste collection

There are two distinct types of infrastructure for household waste collection in the project area, which are determined by the two operators for waste management in the area. The infrastructure managed by the Cotiujenii Mari ME was designed during 2009-2012 to collect the household waste from 4 rural municipalities of Soldanesti rayon: Cotiujenii Mari, Pohoarna, Rogojeni, and Dobrusa. The infrastructure managed by Soldanesti ME has been recently enhanced in order to better manage the household waste within Soldanesti city and extend the service to other 18 rural municipalities from Soldanesti rayon and 4 rural municipalities from Rezina rayon.

In the area serviced by Cotiujenii Mari ME, the household waste is collected from 100 platforms, which are distributed within the 4 municipalities in the service area. Each platform has 4 containers of 0.67 m^3, and a mesh box of about 1 m^3 for recyclables (see Fig. 3-1).

Figure 3-1: Type of collection points (platforms) in the project area

A platform from Cotiujenii Mari

A platform from Soldanesti city

Source: GOPA.

The conducted spatial analysis shows that the platforms within Cotiujenii Mari service area are well distributed within the villages. About 84% of the population seems to have good access to platforms - i.e., the platforms are within a 300 m buffer distance for 84% of the residential area (see Annex 3).

The household waste serviced by Soldanesti ME is to be separately collected from a total of 288 platforms. The separate collection fractions are the following: 1) residual waste; 2) plastic, metal and tetrapak recyclables; 3) mixed paper; 4) glass bottles and jars.

Currently, there are 53 platforms in Soldanesti city. The platforms are quite well distributed and it is assessed that about 98% of the city population has good access to these platforms (see Annex 3). By adding 4 extra collection points (in accessible area of the

city not covered by platforms) the collection coverage of the city can even increase to 100%.

There are 235 platforms in the villages that are to be serviced by Soldanesti ME (until the inter-municipal waste management company is created). According to conducted spatial analysis the platforms cover about 76% of the residential area in the 18 rural municipalities of the Soldanesti rayon and 63% of the residential area in the 4 rural municipalities of Rezina rayon (see Annex 3). In this situation, it was decided to identify extra collection points (in accessible area of the villages not covered by platforms) to increase the waste collection coverage. According to spatial analysis, about 115 extra collection points (see Annex 5) are needed in the villages serviced by Soldanesti ME to reach more than 95% collection coverage. The spatial collection coverage of the residential area with the both platforms and extra collection points is represented in Annex 4.

A collection point (a platform or an extra collection point without platform) in Soldanesti city has 7 containers:

- 4 containers of 0.24 m^3 for residual waste;
- 1 container of 1.1 m^3 for plastic, metal and tetrapak recyclables;
- 1 container of 0.24 m^3 for mixed paper;
- 1 container of 0.24 m^3 for glass bottles and jars.

A collection point (a platform or an extra collection point without platform) in a village has 4 containers:

- 1 container of 1.1 m^3 for residual waste;
- 1 container of 1.1 m^3 for plastic, metal and tetrapak recyclables;
- 1 container of 0.24 m^3 for mixed paper;
- 1 container of 0.24 m^3 for glass bottles and jars.

Besides the main collection points, it was proposed to place (on the routes between the main collection points) extra containers at public places - i.e. places close to public institution, shops, parks, etc. At a public place, both in urban and rural areas, 4 containers of 0.24 m^3 are placed - one container for each of the following fractions: a) residual waste; b) plastic, metal and tetrapak recyclables; c) mixed paper; d) glass bottles and jars.

The number of platforms, extra collection points, public places, and required containers for each administrative unit serviced by Soldanesti ME is presented in Annex 5. As it can be seen from this annex, in 4 municipalities (i.e., Vadul-Rascov, Mateuti, Meseni, Peciste), which have a high population density, there is not one but 2 containers for residual waste at a collection point. This was done in order to secure enough volume for one week of residual waste storage at the collection points until the scheduled collection day.

It should be noticed that in the case of the platforms that cannot be easily accessed by the collection trucks (or those raised over the ground) in the villages, each container of 1 m^3 for residual waste should be replaced by 4 containers of 0.24 m^3 to make sure that the waste can be loaded safely into the truck.

3.2.2 Household waste collection frequency and transportation

In Cotiujenii Mari service area the residual waste is collected when the containers are full (usually once a week) by two 7.5 m^3 GAZ compactor trucks (see Fig. 3-2). At the moment, all recyclables are collected together with residual waste and disposed to the local dumpsite. From 2014 the recyclables within Cotiujenii Mari service area will be collected by the 14 m^3 MAN compactor truck when the containers are just about full.

Figure 3-2: Type of compacter trucks used to collect the waste in the project area

GAZ 7.5 m^3 truck

IVECO 8 m^3 truck

MAN 22 m^3 truck

MAN 14 M^3 Truck

Source: GOPA.

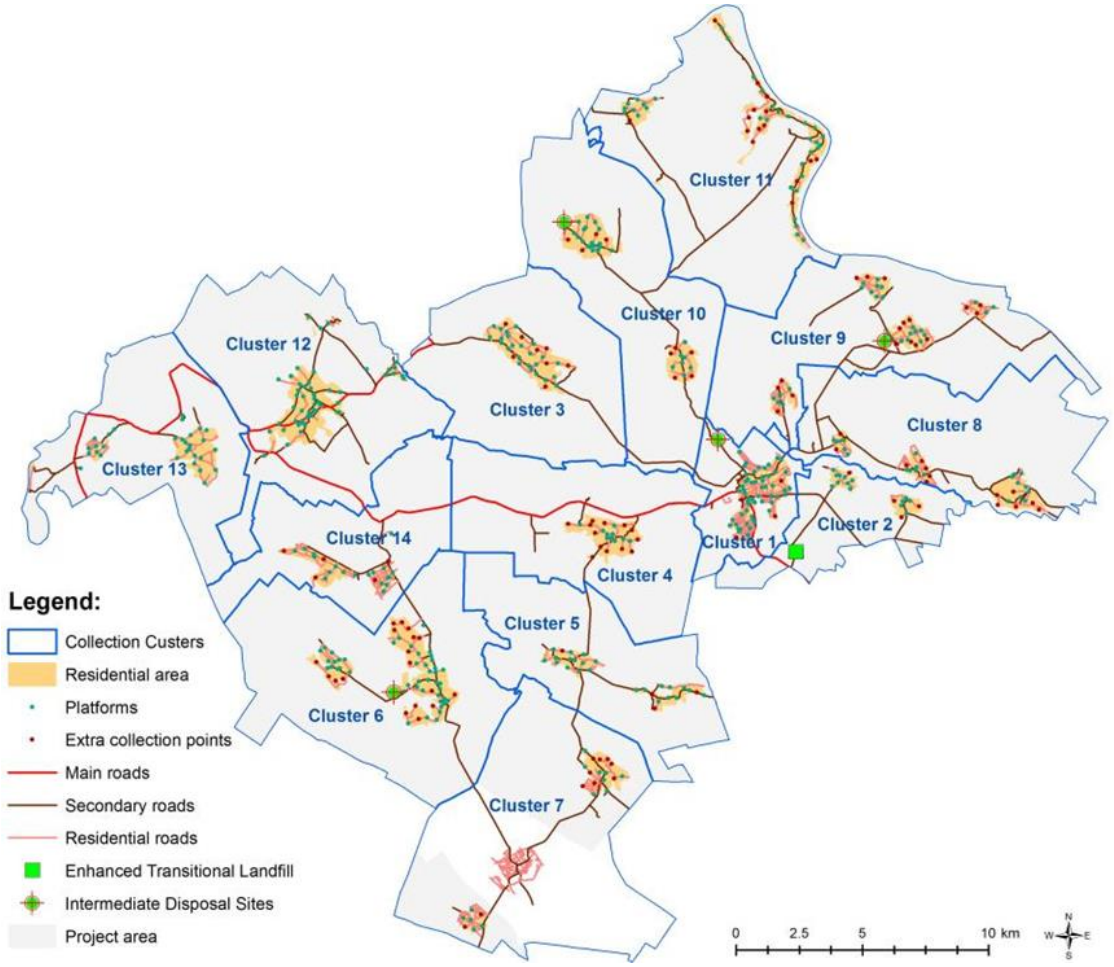
In rural areas with Soldanesti service area the residual waste will be collected once a week by the 14 and 22 m^3 MAN compactor trucks (see Fig. 3-2). The recyclables will be separately collected by the 14 m^3 MAN compactor truck when the containers are just about full.

In Soldanesti city, the residual waste will be collected 3 times per week. For the next 3 years (2014-2016) the residual waste will be collected by the 8 m^3 IVECO compactor truck, while after 2016 - by the 14 m^3 MAN compactor truck (see Fig. 3-2). The recyclables will be separately collected by the 14 m^3 MAN compactor truck when the containers are just about full.

In order to optimize the waste collection and transportation costs, it was decided to group the municipalities into clusters. The clustering insures also that the trucks are utilized efficiently during collection and transportation of waste. In the case of residual waste collection, 11 clusters were established for Soldanesti service area and other 3

clusters for Cotiujenii Mari service area (see Fig. 3-3). In the case of recyclable materials collection, 10 clusters were established for Soldanesti service area and other 2 clusters for Cotiujenii Mari service area (see Fig. 3-4). The clusters were formed depending on the proximity of municipalities to shared routes and waste disposal and treatment infrastructure. The residual waste or recyclables from one cluster is to be collected in one day during one or multiple routes.

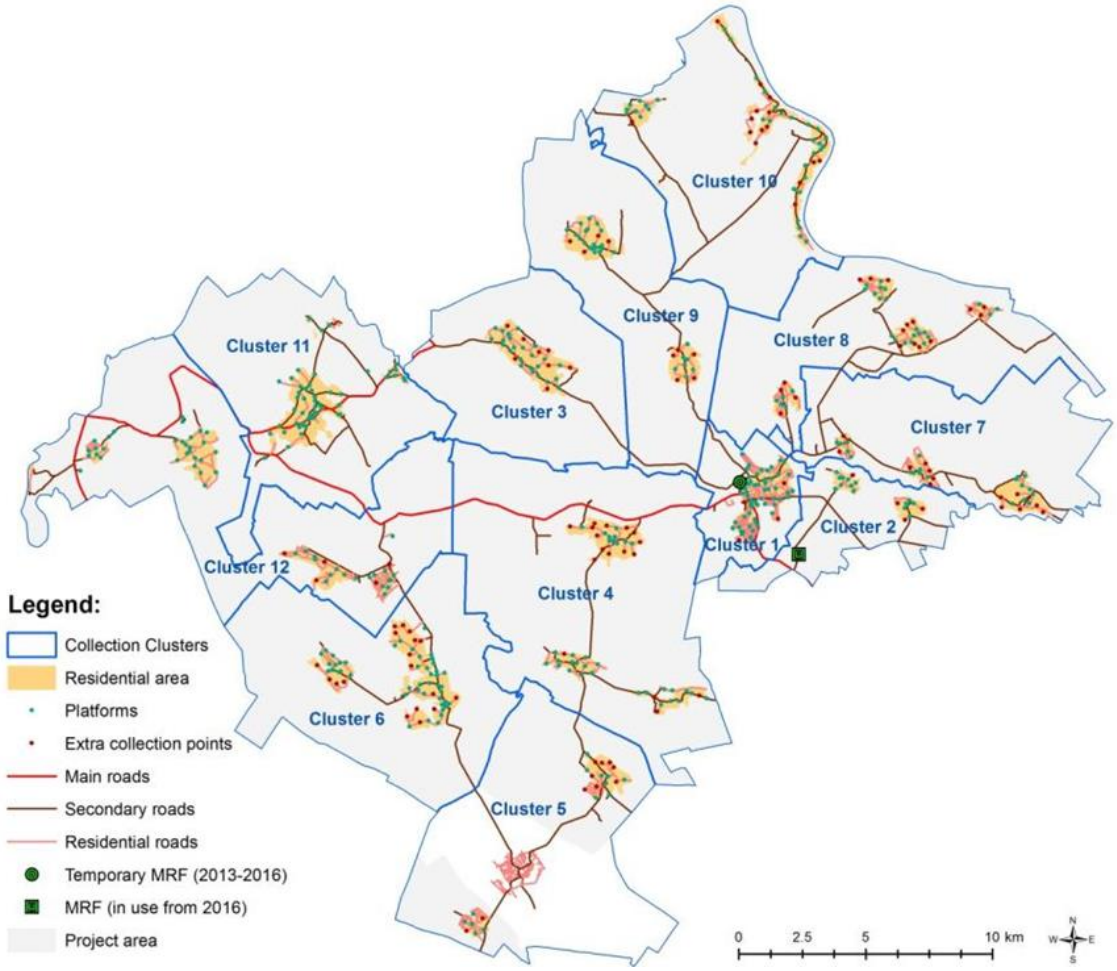
Figure 3-3: Residual waste collection clusters within the project area



Data source: Institute of Ecology and Geography, GOPA; Map design: GOPA, 2013.

Annex 6 describes the data on collection and transportation of residual waste from the collection clusters within project area for the years of 2014 and 2016. Annex 7 presents the data on collection and transportation of recyclables from the collection clusters within the project area for the years of 2014 and 2016. As it can be seen from Annex 6, in 2014 for the collection and disposal of 1,548 tons of residual waste generated in Soldanesti city, the IVECO truck will travel about 7,920 km (or 55 km per collection day). In the same year, for the collection and disposal of 5,938 tons of residual waste generated in the villages within Soldanesti service area, the MAN trucks will travel about 52,227 km (or 209 km per working day). It is important to notice that only about 25-30% of the distance is actually traveled during the collection of the waste from the collection points within the residential areas; the rest of the distance is traveled on the main roads in order to reach the residential areas and then to transport the collected waste to the disposal sites.

Figure 3-4: Recyclables collection clusters within the project area



Data source: Institute of Ecology and Geography, GOPA; Map design: GOPA, 2013

As it can be seen from Annex 7, in 2014 for the collection of 110 tons of recyclables recovered from Soldanesti city, the 14 m^3 MAN truck will travel about 1,943 km (or 162 km per month). At the same time, for the collection of 218 tons of recyclables recovered from the villages within Soldanesti service area, the same truck will travel about 11,973 km (or about 250 km per week). About 45 tons of recyclables can be recovered in 2014 from Cotiujenii Mari service area. In this case the 14 m^3 MAN truck has to travel about 2,360 km (or 197 km per month).

Table 3-1 presents the usage of trucks for the collection of household waste during 2014 and 2016. As it can be observed from the table, with the establishment of the full SWM system in 2016, the distance traveled by the trucks increases as the residual waste need to be transported away to a common disposal site. Also, MAN trucks will be quite intensely used. Yet again, it is important to notice that only about 30% of the distance is actually travelled within the residential areas in order to collect the waste from the collection points; more than 70% of the distance is traveled on the main roads in order to reach the localities and then to transport the collected waste to disposal or treatment facilities.

Table 3-1: The usage of trucks for the collection of household waste in the project area

Truck type:	km travelled during 2014			km travelled during 2016		
	km/week	km/month	km/year	km/week	km/month	km/year
IVECO 8 m^3 truck	165	660	7,920	198	739	9,518
MAN 14 m^3 truck	571	2,284	27,408	777	3,110	37,315
MAN 22 m^3 truck	856	3,425	41,095	1,316	5,264	63,168
GAZ 7.5 m^3 truck, 1st	76	303	3,631	347	1,386	16,634
GAZ 7.5 m^3 truck , 2nd	76	303	3,631	347	1,386	16,634

Source: elaborated by GOPA.

3.2.3 Household waste amounts collected

After the project implementation, the amounts of household waste collected will grow substantially. The collection rate in Soldanesti rayon is expected to increase from 28% in 2012-2013 to more than 95% in 2014-2015. The collection rate in the 4 municipalities of Rezina rayon is going to be also above 95% in 2014-2015.

Table 3-2 presents the household waste amounts to be collected per year during 2014-2030 in each administrative unit within Soldanesti service area. Table 3-3 presents the household waste amounts to be collected per year during 2014-2030 in each administrative unit within Cotiujenii Mari service area. It is assumed that all population within the project area has access to collection points within the municipalities.

Table 3-2: Household waste collection within Soldanesti service area (2014 to 2030)

Municipality name	Household waste amounts (tons/year):								
	2014	2015	2016	2017	2018	2019	2020	2025	2030
Soldanesti rayon:	6,356	6,428	6,502	6,577	6,654	6,733	6,813	7,243	7,725
1.Soldanesti city	1,563	1,584	1,604	1,625	1,646	1,667	1,689	1,801	1,921
2.Alcedar	257	258	260	262	263	265	267	275	284
3.Chipesca	208	204	200	196	193	189	185	168	153
4.Climautii de Jos	287	294	300	307	314	322	329	369	413
5.Cobilea	485	487	489	491	493	495	498	509	520
6.Cusmirca	406	409	412	415	418	421	424	440	457
7.Fuzauca	136	137	138	139	140	142	143	148	154
8.Gauzeni	301	311	321	331	342	353	364	428	502
9.Glinjeni/Hlingeni	172	173	175	177	178	180	182	190	199
10.Mihuleni	104	105	106	107	108	108	109	114	118
11.Oliscani	457	456	454	453	452	451	450	444	439
12.Parcani	152	155	159	163	167	171	175	197	222
13.Poiana	136	134	132	131	129	128	126	119	112
14.Raspopeni	525	535	546	556	567	578	590	650	716
15.Salcia	179	181	183	184	186	188	190	198	208
16.Samascani	241	242	242	243	244	245	245	249	253
17.Sestaci	204	206	208	211	213	215	217	229	241
18.Sipca	122	122	123	123	123	124	124	127	129
19.Vadul-Rascov	422	435	448	462	476	491	506	588	685
Rezina rayon:	1,138	1,172	1,208	1,245	1,283	1,323	1,364	1,597	1,547
1.Lipceni	103	104	104	105	105	105	106	108	107
2.Mateuti	386	394	402	409	417	426	434	478	469
3.Meseni	176	180	183	187	191	195	199	221	217
4.Peciste	473	495	519	544	570	597	625	790	754
Total:	**7,494**	**7,600**	**7,709**	**7,822**	**7,937**	**8,056**	**8,177**	**8,840**	**9,271**

Source: elaborated by GOPA.

Table 3-3: Household waste collection within Cotiujenii Mari service area (2014 to 2030)

Municipality name	Household waste amounts (tons/year):								
	2014	2015	2016	2017	2018	2019	2020	2025	2030
1. Cotiujenii Mari	631	637	644	650	657	664	671	706	743
2. Pohoarna	312	312	313	313	313	313	313	314	315
3. Rogojeni	120	120	120	121	121	122	122	124	126
4. Dobrusa	201	197	194	191	188	185	182	167	154
Total:	**1,263**	**1,267**	**1,271**	**1,275**	**1,279**	**1,283**	**1,288**	**1,311**	**1,338**

Source: elaborated by GOPA.

Besides the household waste generated by population, it is estimated that about 372 tons of commercial waste (which is similar to household waste) produced by economic entities and public institutions within the project area will be collected in 2014-2015. About 320 tons will be collected from Soldanesti service area, while the rest 52 tons will be collected from by Cotiujenii Mari service area. Annex 10 presents the calculation of the commercial waste amounts to be collected per year during 2014-2030 from project area.

3.2.4 Collection and transportation of agricultural and construction wastes

An awareness campaign (that is under preparation at the moment) will be conducted in the project area to promote composting of agricultural/organic waste in the household and use the resulted compost as fertilizer and soil enhancement.

With the establishment of the composting facility in 2016, the citizens from Soldanesti city and adjacent villages (i.e., Parcani, Lipceni, Sipca, Mihuleni, Glinjeni, Sestaci, and Oliscani) who are not able to compost the agricultural waste in the household will have the possibility to request the collection of the agricultural waste (including green waste) as a separate, paid service. The agricultural waste will be transported to the inter-municipal solid waste management center for composing. It is estimated that about 690 tons of agricultural waste will be collected every month from the area.

In rural areas the agricultural waste will be composted in the household. In the future, municipal composting facilities could be set up (at the former dumping sites or other appropriate areas) for local use. The collection of the agricultural waste (with the condition that it is not mixed with other type of waste) from the households will be done as a paid, separate service.

The collection of construction materials (excluding hazardous materials) form households will be done on request as a separate paid service. The construction waste will be transported to the authorized disposal sites.

3.3 Recycling and treatment

As it can be seen from the household waste composition (Table 2-3), there are possibilities for recycling. It is important to notice though that not all recyclable materials contained in the household waste can be recovered. The first cause is determined by the fact that not all people will separately dispose the household waste; some time will be needed until more people will start to properly separate the recyclables and place them in the appropriate containers at the collection points. The second cause is determined by the fact that the contaminated recyclables are not recoverable and will end up in the residual waste.

We assume that in 2014, with the start of the separate collection of household waste, the recovery rate of recyclables will be 35% in urban area (i.e., Soldanesti city) and

20% in rural area (see Table 3-4); the recovery rate is expected to be a little bit higher in Soldanesti city since some recycles have been separately collected for some time already. It is assumed that the recovery rate will grow by 5% each year until it reaches 50%, by 2% afterwards until it reaches 60%, and by 1% onwards until it reaches 80%. We assume that 20% of recyclables contained in the household waste are contaminated and cannot be recovered.

Table 3-4: Recovery rates of recyclable materials in the project area (2014 to 2026)

Recovery rates of recyclables:	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
in urban area	35%	40%	45%	50%	52%	54%	56%	58%	60%	61%	62%	63%	64%
in rural area	20%	25%	30%	35%	40%	45%	50%	52%	54%	56%	58%	60%	61%

Source: elaborated by GOPA.

The amounts of recyclable materials recovered (i.e., the fraction of recyclables separately placed in appropriate containers at the collection points) for every administrative unit within Soldanesti service area is presented in Table 3-5. The composition of the collected household waste, including the amount and type of recovered recyclable materials, for Soldanesti service area is described in Annex 8.

As it can be seen from Table 3-5, about 103 tons of recyclable materials (i.e., 35% of the recyclables contained in the household waste) will be recovered from Soldanesti city in 2014. Taking into consideration the composition of the recyclables, the mixed paper will constitute about 31 tons, plastics - 50 tons, metals - 4 tons, and glass - 19 tons (see Annex 8).

Table 3-5: Recyclables recovery within Soldanesti service area (2014 to 2030)

Municipality name	Recovered recyclables amounts (tons/year):								
	2014	2015	2016	2017	2018	2019	2020	2025	2030
Soldanesti rayon:	273	334	396	460	516	574	632	792	915
1.Soldanesti city	103	120	136	154	162	170	179	214	247
2.Alcedar	9	11	14	16	19	21	24	29	33
3.Chipesca	7	9	11	12	14	15	16	18	18
4.Climautii de Jos	10	13	16	19	22	26	29	39	48
5.Cobilea	17	22	26	30	35	39	44	54	60
6.Cusmirca	14	18	22	26	30	34	38	47	53
7.Fuzauca	5	6	7	9	10	11	13	16	18
8.Gauzeni	11	14	17	21	24	28	32	45	58
9.Glinjeni/Hlingeni	6	8	9	11	13	14	16	20	23
10.Mihuleni	4	5	6	7	8	9	10	12	14
11.Oliscani	16	20	24	28	32	36	40	47	50
12.Parcani	5	7	8	10	12	14	15	21	26
13.Poiana	5	6	7	8	9	10	11	13	13
14.Raspopeni	19	24	29	34	40	46	52	69	82
15.Salcia	6	8	10	11	13	15	17	21	24
16.Samascani	9	11	13	15	17	19	22	26	29
17.Sestaci	7	9	11	13	15	17	19	24	28
18.Sipca	4	5	7	8	9	10	11	13	15
19.Vadul-Rascov	15	19	24	29	34	39	45	62	79
Rezina rayon:	40	52	64	77	91	105	121	170	216
1.Lipceni	4	5	6	6	7	8	9	11	13
2.Mateuti	14	17	21	25	30	34	38	51	61
3.Meseni	6	8	10	12	14	16	18	24	28
4.Peciste	17	22	28	34	40	48	55	84	115
Total:	**313**	**386**	**461**	**537**	**607**	**679**	**753**	**962**	**1,131**

Source: elaborated by GOPA.

From the villages within the Soldanesti service area about 210 tons of recyclables (i.e., 20% of the recyclables contained in the household waste) are expected to be recovered in 2014. The composition of the recovered recyclables is the following: mixed paper - 59 tons, plastics - 100 tons, metals - 7 tons, and glass - 44 tons (see Annex 8).

The amounts of recyclable materials recovered for the administrative unit within Cotiujenii Mari service area is presented in Table 3-6. The composition of the collected house-hold waste, including the amount and type of recovered recyclable materials, for Cotiujenii Mari service area is described in Annex 9.

Table 3-6: Recyclables recovery within Cotiujenii Mari service area (2014 to 2030)

Municipality name	Household waste amounts (tons/year):								
	2014	2015	2016	2017	2018	2019	2020	2025	2030
1.Cotiujenii Mari	22	28	34	40	47	53	59	75	85
2.Pohoarna	11	14	17	19	22	25	28	33	36
3.Rogojeni	4	5	6	7	9	10	11	13	15
4.Dobrusa	7	9	10	12	13	15	16	18	18
Total:	**45**	**56**	**67**	**79**	**91**	**102**	**114**	**139**	**154**

Source: elaborated by GOPA.

As it can be seen from Table 3-6, about 45 tons of recyclable materials (i.e., 20% of the disposed recyclables) could be recovered from Cotiujenii Mari service area in 2014. Taking into consideration the composition of the recyclables, the mixed paper will constitute about 13 tons, plastics - 21 tons, metals - 2 tons, and glass - 9 tons (see Annex 9).

Besides the recyclables generated by population, it is estimated that in 2014 about 16 tons of recyclable materials generated by economic entities and public institutions will be recovered within the project area (see Annex 10).

The collected recyclable materials will be transported to the sorting and bailing station (Material Recovery Facility - MRF) for further sorting and bailing of plastic, paper, and metal packaging materials. The bailed recyclables will be then sold at market price to companies which process re-cyclable materials. The collected glass will not undergo any further processing. It will be sold as mixed broken glass.

3.4 Disposal

3.4.1 Local dumping

As it was mentioned above, currently the waste generated in the administrative units is disposed at local dumpsites. According to a 2013 inventory study of the dumpsites (http://gismediu.gov.md), every administrative unit in the project area has a solid waste disposal site (see Fig. 3-5 and Annex 11). The dumpsites in the project area occupy about 21 ha; the area of a dumpsite is between 0.1 and 2.2 ha (see Annex 11).

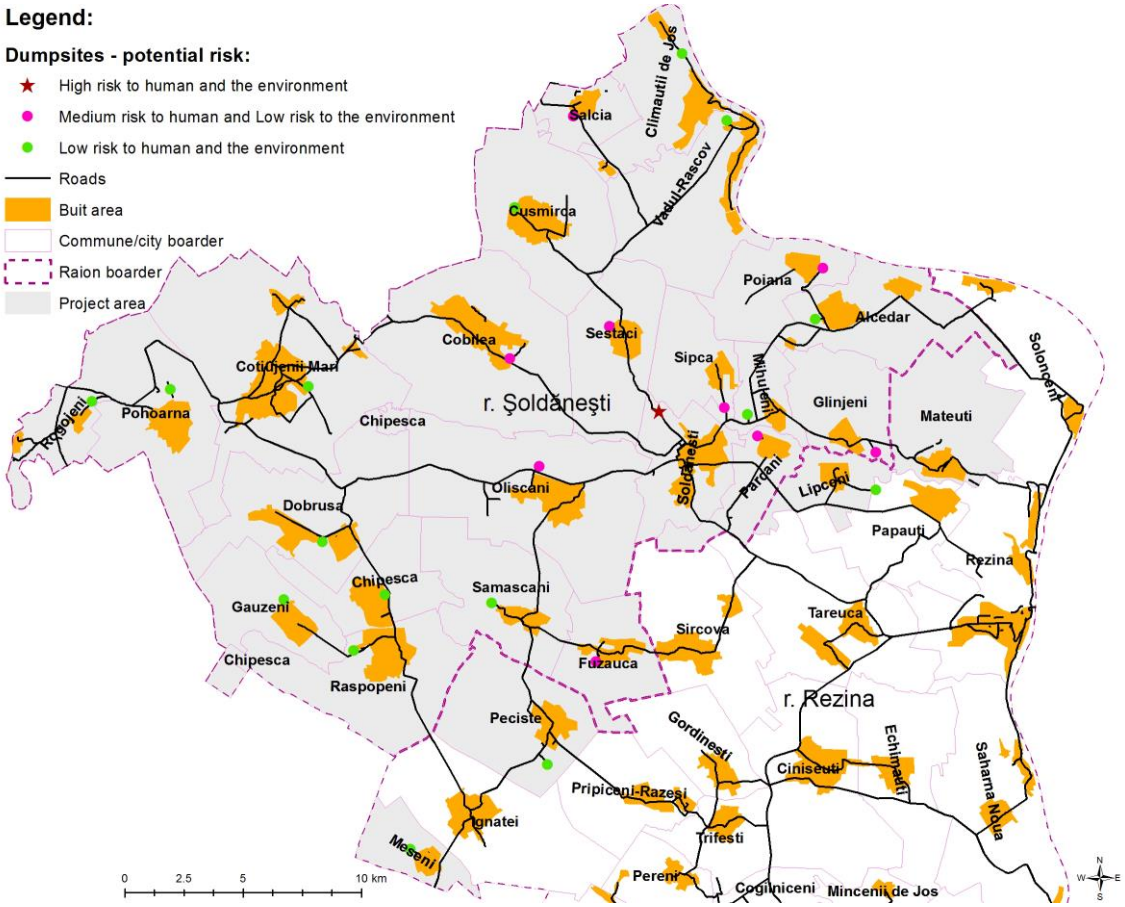
Even if the locations of the dumpsites are authorized by local authorities, the present operation activities at all waste disposal sites do not comply with local environmental standards. Usually, the waste is just disposed on a field without any facilities for waste handling. From time to time, a bulldozer is used to cover the accumulated waste with soil at the dumpsite.

The map of the project area with the solid waste disposal sites, classified according to their potential risk to human health and the environment, is presented in Fig. 3-5 above. As it can be seen from the map, the dumpsite with the highest potential risk to both human health and the environment is located in Soldanesti city. The majority of

dumpsites in the villages closed to Soldanesti city have a medium potential risk to human health and a low risk to the environment.

The city of Soldanesti has one active solid waste disposal site with an area of 0.5 ha; the site has a high priority ranking regarding the necessity for implementation of remediation actions, as it has the highest risk to human health and the environment. According to visual inspection (done within the inventory study), the structure of the wastes disposed at the site are as follows: 30% - household/municipal waste; 40% - construction/ demolition waste, 20% - agricultural waste (animal manure), and 10% - other waste (see Annex 11). It can be assumed that the majority of wastes in the "other waste" category belong to recyclable materials, since the industrial, hazardous/hospital, and animal tissue wastes were not recorded at the site.

Figure 3-5: The description of the dumpsites within the project area



Data source: Institute of Ecology and Geography, gismediu.gov.md, GOPA; Map design: GOPA, 2013

There are 22 solid waste disposal sites in the rural area (comprised by 22 municipalities) of the Soldanesti rayon, one for each rural administrative unit (see Fig. 3-5 and Annex 11). The average area of one site is about 0.8 ha; the minimum area is 0.1 ha, the maximum area is 2.2 ha. According to visual inspection of the solid waste disposal sites, the structure of the wastes disposed there were the following: 16% - household/municipal waste; 29% - construction/demolition waste, 46% - agricultural waste (animal manure), and 9% - other wastes.

According to the inventory (see Fig. 3-5 and Annex 11), all 22 solid waste disposal sites in the rural area of the Soldanesti rayon have a low potential risk to the environ-

ment. About 41% of the sites have a medium potential risk to human health, while the rest have a low risk. The solid waste disposal site in Poiana village has a high priority ranking regarding the necessity for implementation of remediation actions. Other 3 solid waste disposal sites (in Parcani, Sipca, and Sestaci villages) have a medium priority ranking regarding the need for implementation of remediation measures.

The majority of the solid waste disposal sites in the rural area of Soldanesti rayon could be extended, according to inventory data, however the land area available for extension is not specified. The solid waste disposal sites in 6 villages (i.e., Parcani, Sipca, Poiana, Sestaci, Cobilnea, and Dobrusa) cannot be extended since there is no adjacent land available for this purpose.

In two villages (i.e., Cusmirca and Dobusa), the access road to the solid waste disposal sites are covered by asphalt. In other 6 villages (i.e., Sipca, Climautii de Jos, Fuzauca, Gauzeni, Pohoarna, and Rogojeni) the solid waste disposal sites are accessed by gravel roads. The rest of the sites, located in 14 villages, are connected by soil roads. The bottom layer of the waste disposal sites in 7 villages (i.e., Glinjeni, Parcani, Mihuleni, Sipca, Poiana, Sestaci, and Cobilnea) is composed of sand or soil. The bottom layer of 4 sites (in Salcia, Samascani, Raspopeni, and Gauzeni villages) has not been assessed, while for the rest 11 solid waste disposal sites the bottom layer is composed of clay.

All 4 municipalities within Rezina rayon, which are included in the project area, have a solid waste disposal site. The total area of the 4 sites comprises about 2 ha; the area of a site varies from 0.2 ha to 1 ha, with a mean value of 0.5 ha. The sites pose low risk to human health and the environment (see Fig. 3-5 and Annex 11).

According to visual inspection, the structure of the wastes disposed at these 4 sites in Rezina rayon are as follows: 21% - household/municipal wastes; 24% - construction/ demolition wastes, 43% - agricultural waste (animal manure), and 12% - other waste. Three of these sites could be extended, according to inventory data, however the land area available for extension is not specified. The site located in Lipceni village cannot be extended since there is no adjacent land available for this purpose.

In 2 villages (i.e., Peciste and Meseni) the solid waste disposal sites are accessed by gravel roads, while in the other 2 villages (i.e., Mateuti and Lipceni) they are accessed by soil roads. The bottom layer of the waste disposal sites in 2 villages (i.e., Mateuti and Lipceni) is composed of soil, while in the other 2 villages (i.e., Mateuti and Lipceni) the bottom layer of the sites is composed of clay.

3.4.2 Intermediate disposal

Taking into consideration the fact that the building of the Enhanced Transitional Landfill in Parcani will be finished not earlier than in 2015, intermediate disposal of residual waste is necessary. Following the National Strategy on Solid Waste Management and the regional planning, Soldanesti rayon authorities proposed to use 4 authorized dumpsites in the rayon for the intermediate disposal (for the next 2 years) of the residual waste generated in the project area. These 4 temporary dumpsites are located in: Soldanesti city, Alcedar, Cusmirca, and Raspopeni (see Annex 12). All of them are uniformly distributed over the project area and have good access. According to Ministry of Environment (gismediu.gov.md) the dumpsite used by Soldanesti city poses a high risk to human health and the environment while the other 3 dumpsites pose low risks to both human health and the environment (see Fig. 3-5 above).

The intermediate disposal sites will be improved and refurbished with fences, gates and compacted subsoil in order to facilitate the storage of the waste for the next 2

years. The Soldanesti ME (or the new IMC organization) will manage these waste disposal sites so that there is good access and the waste is covered periodically with soil. When the Enhanced Transitional Landfill opens, all intermediate disposal sites will be closed and rehabilitated.

The selected intermediate disposal sites will serve from 5 to 7 nearby administrative units, and will accept from 1,184 to 3,124 tons of residual waste in one year (see Table 3-7).

Table 3-7: The intermediate waste disposal sites within the project area

Intermediate waste disposal site:	The serviced administrative units (AU):	Waste quantity* to be disposed, tons/year
Alcedar	6 AUs: Alcedar, Poiana, Sipca, Mihuleni, Glinjeni, Mateuti	1,184 (259+925)**
Cusmirca	5 AUs: Cusmirca, Sestaci, Vadul-Rascov, Climautii de Jos, and Salcia	1,498 (409+1,089)
Raspopeni	5 AUs: Raspopeni, Chipesca, Gauzeni, Peciste, and Meseni	1,682 (506+1,176)
Soldanesti	7 AUs: Soldanesti city, Cobilea, Oliscani, Samascani, Fuzauca, Parcani, and Lipceni	3,124 (1,548+1,576)

* Represents the residual waste from population, economic entities and public institutions.
**The first figure in parentheses represents the waste disposed from the AU where the disposal site is located, while the second figure represents the waste that comes from other AUs.

Source: elaborated by GOPA.

In Cotiujenii Mari service area the disposal of household waste will continue as previously for the next 2 years. After that, the residual waste will be transported for disposal at the Enhanced Transitional Landfill from Parcani. All disposal sites in the area will be closed and rehabilitated. In order to ease the transportation of the household waste to the transitional landfill, building a transfer station near Pohoarna village will be considered.

It is important to notice that setting up a transfer station only for serving 12,230 people from 6 municipalities (i.e., Cotiujenii Mari, Pohoarna, Rogojeni, Dobrusa, Chipesca, Raspopeni, and Gauzeni) of Soldanesti rayon is probably not economically feasible. At least, other nearby municipalities from Floresti rayon (e.g., Prodanesti, Domulgheni, Cunicea, Sanatauca, Napadova, Cuhurestii de Jos) should be served by this transfer station to make it economically more feasible.

4 Inter-municipal solid waste management concept

4.1 Outline

Originally, the solid waste management in the region was on a very poor level characterized by a lack of waste collection coverage which was limited to urban areas, only. In rural areas the waste management was not much more but “organized littering”. Residents had to bring their waste to a local dumpsite located at the outskirts of the village and dump it there. With the first GIZ investments in the system the waste collection was expanded to the villages introducing separate collection of residual waste and selected recyclables. A simple baling station for the recyclables, mainly the voluminous PET, completed the first stage of the new SWM system, which still was rather an end of pipe system than an ISWMS.

The next phase aims on further developing the existing infrastructure towards an ISWMS. The basic idea is to address all major waste streams (recyclables, organic/ agricultural waste, and residual waste), to introduce appropriate collection and treatment measures, and to facilitate an emission reduced waste disposal at an environmentally sound landfill. The entire system shall be organized in a sustainable, cost efficient and affordable manner with an adequate institutional set up.

The major technical components, which are required to achieve the goal of an ISWMS, are a MRF, a composting plant for organic/agricultural waste and an enhanced landfill. All the components shall be hosted at a central location, which forms an inter-municipal solid waste management center. The center services Soldanesti city, 22 rural municipalities of Soldanesti rayon and 4 villages from Rezina rayon. The facility will be operated by an inter-municipal company, where all connected administrative units participate.

Having the potential future developments in mind, the inter-municipal solid waste management center has to be designed in a flexible and modular way that allows cost efficient adjustments fitting to the regional SWM systems. According to the regional plans and developments regarding the organization of the SWM on regional level the designated ISWMS may need adequate adjustments in future. The Regional Program for Waste Management in Center Development Region aims on establishing a regional landfill serving 4 rayons (Soldanesti, Rezina, Telenesti, and Orhei). The location of the regional landfill will be selected by a site selection process in accordance with Moldovan legislation. In case that the regional disposal site is to be established on the spot of the inter-municipal solid waste management center in Soldanesti, the existing site will be extended and upgraded. In case that an alternative location is identified, the enhanced transitional landfill (within the SWM center) will be closed when it has reached capacity and turned into a waste transfer station. The establishment of the regional SWM system including the regional landfill may take another 4 to 10 years.

4.2 Recycling activities

Recyclables are collected in separate bins in both urban and rural areas. The recycling activities to be carried out at the inter-municipal solid waste management center basically aim at improving the segregation of recyclables and at preparing the goods for transportation to the processing facilities. The overall goal is to create revenues and to minimize the amount of waste for disposal.

4.3 Waste treatment

A large portion of the waste generate in the rural areas is organic waste from subsistence farming activities, gardening and management of public green areas. The average portion of organic waste materials in the household waste amount to 56% in urban and 58% in rural areas. In order to keep reasonable transportation costs in remote areas decentralized composting in small village plants or in private backyards is promoted and carried out. Separate collection of organic waste on a regular schedule is provided in a distance up to 15 km from the inter-municipal solid waste management center, which will be located in Parcani. This area includes Soldanesti city and 6 villages (Parcani, Mihuleni, Glinjeni, Sestaci, Sipca, Oliscani, Lipceni). The general design criteria for the composting facility aims at establishing a reliable, easy to manage, cost efficient and flexible treatment system, which in particular allows adapting to varying amounts of input material. That type of treatment plant would enable the extension of the collection area and to conduct seasonal or out of schedule collection of agricultural waste.

4.4 Waste disposal

A safe, cost efficient and environmental sound waste disposal will close the biggest and most urgent gap in the current waste management system, what means the uncontrolled disposal of waste at the village dumpsites. As part of the inter-municipal solid waste management center, an enhanced landfill will be constructed and all village dumpsites will be closed. The landfill will be designed providing airspace for up to 10 years for the waste of the service area. The design will further consider that other municipalities (from Rezina or Floresti) may bring their waste to the landfill in order to avoid any kind of temporary emergency situation at their own sites. Thus, the site will be designed in a way easily allowing the extension of the tipping area. This will also reduce efforts in case of turning the site into a regional landfill, if selected.

Nevertheless, the predominant design criterion is the transitional character of the facility. Hence, mobile equipment and smart treatment methods are preferred versus fixed installations. Items shall be planned which are later suitable to be utilized at the regional landfill no matter where this one will be located. The technical standard of the landfill will refer to the protection goals of EU regulations; however, technical components are not necessarily designed according to EU standards, but definitely above local technical regulations for a “polygon”.

5 Inter-municipal solid waste management center

5.1 Material recovery facility

5.1.1 Design criteria

During the transitional period prior to the implementation of the regional SWM system, the MRF will process all recyclables which are collected in the service area. Recyclables from areas which are foreseen to have their own transfer station in the future (such as Cotiujenii Mari) will be sent to the MRF facility until the transfer station is in place. The long term concept aims at baling their recyclables at the transfer station in order to minimize transportation efforts. However, it is not clear whether and when Cotiujenii Mari will have a transfer station.

Beyond the municipalities from the service area other municipalities will most likely send their recyclables to the facility within the future regional service scheme, in particular municipalities from Rezina rayon. Thus the design of the plant includes sufficient reserve capacity to later process those amounts. The reserve capacity may also be used to process selected portions of residual waste if it turns out that this waste still contains a reasonable amount of recyclables.

The detailed evaluation and prognosis of the amounts of recyclables in the service area has been presented in tables 3-5 and 3-6. Table 5-1 summarizes the numbers which have been used as design criteria for the MRF. The required reserve capacity for the recyclables to be collected from not yet connected population has been estimated based on the latest existing population numbers (i.e., Ministry of Economy - MEC, 2009).

Table 5-1: Design criteria for the MRF

Source	population [-]	Amount of recyclables [t]			
	ME 2009	2014	2020	2025	2030
Current service area:	45,537	358	867	1,101	1,285
including „Cotiujenii Mari" service area	*7,244*	*45*	*114*	*139*	*154*
Reserve capacity for Rezina rayon:					
population not yet connected	42,844	337	816	1,036	1,209
additional capacity [%]	94.1%	94.1%	94.1%	94.1%	94.1%
Total annual capacity (current + reserve)	**88,381**	**695**	**1,683**	**2,137**	**2,494**
Required daily capacity (current)		1.43	3.47	4.40	5.14
Required daily capacity (reserve)		1.35	3.26	4.14	4.84
Total required daily capacity		**2.78**	**6.73**	**8.55**	**9.98**

Source: elaborated by GOPA.

The numbers illustrate that almost half of the capacity refers to guaranteed amounts from the project area while the other half is related to non-ensured amounts of recyclables from outside the current service area. Additionally, the required capacity increases significantly over the years due to the fact of expected in-crease in waste generation and improvements in separate-source collection efficiency. The full spread between minimum capacity (2014: 1.43 t/day from current service area) and maximum capacity (2030: 9.98 t/day from entire area) makes a factor of 7. Regarding the design of the plant this fact requires a flexible, modular system which is easy to adjust to changing

amounts of input material. Flexibility can be achieved by means of shift operation and upgrading with a second line. However, the civil construction (paved/rigid area, roofs, access) must be designed in a way to allow those later adjustments. Generally, the required capacity makes the MRF in Soldanesti a rather small facility and some of the design criteria will be exceeded anyways, because the minimum size of reasonable items is larger than required.

According to the above data, the MRF shall have a design capacity of at least 1.3 ton/hour, while the start-up capacity could be of about 350 kg/hour. The capacity flexibility is to be secured by increasing or decreasing the number of employees and the operation time of the facility.

5.1.2 Process description

Basically, MRFs are waste treatment facilities where components of a mixed waste stream (so called “dirty MRFs”) or source separated collected mixed recyclables (“clean MRFs”) are segregated by means of manual picking and/or mechanical separation techniques. A number of screening and sorting techniques are used to split the waste stream into recyclables and non-recyclable residual waste for disposal or further processing. Technical levels as well as the costs of MRFs vary broadly depending on the sophistication in terms of automation, combination of processes and the corresponding equipment. Despite the different techniques all MRFs consist generally of the same process steps namely:

- Delivery and reception;
- Screening (if applicable);
- Segregating (manually or automatically);
- Baling;
- Storage.

The input material delivered to the plant is separately collected in 3 different bins/containers: one mixed bin for plastic, metal and tetrapak, another bin for paper and cardboard and a third bin for glass. The delivery area provides roofed storage space for 20 tons of input material to enable flexible operation hours when the full capacity of the plant has not been reached, yet.

Since it is not clear, yet, how clean the recyclables will arrive at the facility, in the beginning of the MRF process all material will be directed through a drum sieve in order to separate particles smaller than 40 mm from the input stream, because those small particles are difficult to be picked from the sorting belt.

The segregation of certain materials from the mixed recyclables (plastic/tetrapak, metal) as well as the segregation of undesired materials from the single material fractions is carried out on a flat belt by means of hand assorting. The flat belt offers working space for 4-6 workers.

The glass will be deposited in metal containers to be then transported to glass container factories for further processing. The rest of segregated recyclables will be directed to a hydraulic baler, where the material is compacted into blocks. The various blocks will be carried by a fork lifter to a storage area to wait for pick up for further processing at recycling companies.

Any hazardous materials discovered during the segregation process will be stored in special containers and disposed afterwards at specialized disposal facilities.

5.1.3 Layout of the MRF

The equipment for the plant has already been purchased and is in use at a temporary location in Soldanesti city. The drum sieve has dimensions of 1000 mm (diameter) by 2,000 mm (length). The full capacity is approximately 5 tons/hour. The flat belt has dimensions of 6 m (length) by 1.5 m (width). The capacity, which is controlled by the selected speed of the belt, has also a maximum of 5 tons/hour. The lowest capacity has the baler, which can process 700 kg/h. Thus, the existing equipment has a maximum combined capacity of 5.6 tons/day.

Figure 5-1 shows the drum sieve and the baler. By placing a second baler or operating the existing baler for more than 8 hours per day the capacity can be increased easily to 10-20 tons/day without any upgrades for the belt and the sieve. However, the system does not incorporate any redundancy, yet, in particular not for the belt. There is the risk that the system needs to be completely shut down in case the flat belt has an operation failure. A shut down may be not very problematic in the beginning with the small input amounts. With increasing input the reliability of the system becomes more crucial. Thus, the MRF building is designed in a way to allow setting up a second belt, which can be operated in parallel, as substitution, or as second step.

Figure 5-1: Sorting and bailing equipment (left: drum sieve, right: baler)

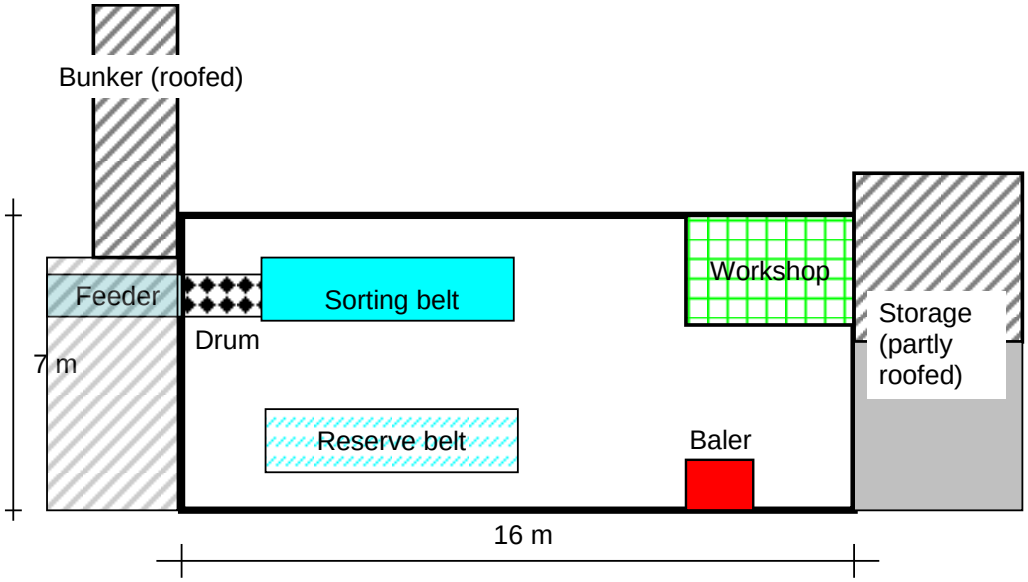
Source: GOPA.

Figure 5-2 shows a potential lay out for the MRF. The equipment for screening, assorting and baling is placed in a building 16 x 7 m (112 m^2). Additionally two roofed partly in house compounds are needed to host the flat bunker for deliveries and the storage of bales of water sensitive materials (paper/cardboard). The roofs cover a total area of minimum 28 m^2. Around the MRF building several paved or concrete areas are needed for drop off of input material, traffic areas, open air storage areas, pick up places etc. In total around 400 m^2 of constructed surface area is required.

The collected recyclables (except for glass) will be unloaded from the truck at the unloading area and temporary stored at the storage area for lose materials (bunker). From the temporary storage area the recyclables are fed into the rotating screen in order to pre-segregate the fine materials. From the rotating screen the materials will be discharged onto a conveyor belt for manual segregation by the workers. The plastic, metal, and Tetrapak recyclables will be sorted separately as: PET (Polyethylene Ter-

ephthalate), LDPE (Low Density Polyethylene), HDPE (High-Density Polyethylene), PVC (Polyvinyl Chloride), PP (Polypropylene), PS (Polystyrene), ferrous cans, aluminum cans, and tetrapak containers/cartons. The mixed paper will be segregated as cardboard and different quality classes of paper. The different sorted recyclable fractions will be baled and transferred (using the hand lifter) to the storage area for baled materials; the baled paper/cardboard is stored only indoor, while the baled plastic, metal, and tetrapak materials can be stored either in-door or out-door.

Figure 5-2: Layout for MRF



Source: elaborated by GOPA

The residuals waste from the screening and segregation process goes into a discharge container, to be disposed afterwards at the landfill.

The collected glass materials will not undergo any processing. They will be only stored in metallic containers and then sold as mixed broken glass to companies for further processing - e.g. Glass Container Factories.

5.2 Composting facility

5.2.1 Design criteria

Agricultural waste forms the largest portion of waste generated in the service area. The total amount adds up to 68,600 tons/year, almost 8 times the amount of solid waste (8,800 tons/year) in the project area (including Cotiujenii Mari service area). Additionally the solid waste contains lots of organic material, according to the waste analysis between 56 - 58%. Although the organic waste causes the main emissions of solid waste (methane and organic leachate pollution) and although organic matter can be a valuable secondary raw material the separate collection in the entire service area with centralized treatment is not affordable. In the beginning the concept foresees establishing a separate collection with treatment for a limited area only with the aim to learn more about alternative treatment and management options as well as about the marketing opportunities for the final material (compost). The collection pilot area includes all villages located close to the inter-municipal solid waste management center (up to 15 km distance). This area includes Soldanesti city (outskirts) and 7 villages (Parcani, Mihu-

leni, Glinjeni, Sestaci, Sipca, Oliscani, Lipceni). The total amount of organic waste collected in these municipalities is estimated about 6,200 tons/year. The treatment of 6,200 tons/year of organic/agricultural waste is expected to generate about 3,100 tons of compost each year.

Since it is not clear, how effective the villages will manage their agricultural waste in future and how cost-efficient the composting facility will work, additional input material may be delivered to the plant. In case that the future regional landfill will be located far away from Soldanesti area it might become financially attractive to segregate organic components from the residual waste for composting saving costs for the expensive long distance transportation. Thus, the size of treatment area will be designed significantly bigger than needed for the 6,200 tons of the selected area. In the meantime the contingency area can be used for biological treatment of residual waste prior to landfilling, which reduces methane generation and leachate concentration. The design value for the treatment capacity is 15,000 tons/year. Assuming a treatment period of 3 months and a net treatment area demand of 1 m^2 per ton of input material, the total area for treatment will be 3,750 m^2. Including 25 % of additional working areas (for moving, driving) and 10 % for temporary storage of final product, the total area for composting will be 5,060 m^2. The calculated area does not include the surface requirement for the parking of machinery. The machinery will be parked at the multipurpose parking lot within the inter-municipal solid waste management center.

The composting facility has the following components: 1) waste receiving area; 2) windrow decomposing area (concrete pad); 3) leachate/storm-water detention basin (the same basin used by the landfill); 4) compost maturating area; 4) sieving and storage facility. An example of such a facility is presented in Fig. 5-3 bellow.

Figure 5-3: An example of a windrow composting facility

Source: http://www.bae.uky.edu/uk-arc/composting.htm.

5.2.2 Process description

Composting is an aerobe treatment process. Organic components of the input material will be decomposed by microorganisms and thus stabilized. Nutrients such as nitrogen (N), phosphate (P) and Potassium (K) remain in the final product and make the compost a valuable source of fertilizer. Various treatment techniques are available which differ in terms of required treatment time, space and costs. The overall situation in the region is characterized by the fact that space and time is available while financial resources are limited. Thus, the selected treatment concept foresees a passively aerated open windrow composting process as illustrated in figure 5-4.

Figure 5-4: Windrow composting

Source: GOPA

Figure 5-5: Windrow turner

Source: GOPA

In order to supply sufficient oxygen to the microorganisms and to cool down the heaps during intensive treatment phase the windrows will be frequently turned using a wind-

row turner as shown in figure 5-5. During the treatment certain water content in the windrows needs to be maintained. In cool and humid climate the treatment is carried out partly under roof to avoid a breakdown of the biological process due to wetting. Same applies for tropical climate with extreme heavy precipitation of 30 mm/h and more. Table 5-2 summarizes the climate data for the region according to information from the meteorological station in Balti. The climate conditions in Moldova are favorable and allow running the process open air, since larger precipitation (40+ mm) occurs in summer time (April to September), when the daily average high temperature is mostly above 20°C. During that time the evaporation is high, hence the windrows will quickly loose moisture. During that period irrigation of the windrows will be required. Irrigation water can be taken from the leachate pond, since the leachate pollution will be low and will not contaminate the final product. Excess water during wet periods are captured and directed to the leachate pond.

Table 5-2: Relevant climate data

Parameters:	Unit	Month:												Year
		01	02	03	04	05	06	07	08	09	10	11	12	
Temperature - average high	°C	-0.5	1.3	7	16	22	25	26	26	21.8	15	7.6	2.1	14.1
Temperature - average low	°C	-7.5	-5.4	-1.6	4.5	9.9	13	15	13.5	9.5	4.3	0.3	-4	4.2
Precipitation quantity	mm	31	28	28	44	55	86	79	49	43	22	34	30	529
Average days with precipitation	days	11	11	9	11	12	13	11	8	8	6	9	11	120

Data source: statistica.md.

The process of compost facility operations consist of five basic steps: (1) unloading of the agricultural/organic waste at the waste receiving area; (2) segregation of recovery material and set up of windrow heaps; (3) decomposition of the organic portion of the waste; (4) maturation; (5) sieving, packing and storage of final product (compost).

5.2.3 Layout of composting facility

The treatment area is 5,060 m^2. If affordable, the entire area shall be constructed by asphalt or concrete ground. Optionally, half of the treatment area could be constructed using mineral concrete (“savura”), a 0-15 mm limestone material which forms a rigid ground after compaction. The location of the treatment area is shown in the lay out plan for the waste management center (see Fig. 5-7 below).

5.3 Enhanced transitional landfill

5.3.1 Objective

As already mentioned, the poor waste disposal activities are responsible for the main emissions and pollution of the SWM sector in the region as well as elsewhere in the country. In 2012, the Moldovan government has adopted a waste management strategy responding to environmental problems. The strategy targets the formation of waste zones consisting of 3-4 Rayons each and the establishment of central regional landfills in those waste zones. The regional program/plan for waste management in the center development region was finalized at the end of 2013, which establishes a common waste management region for Rezina, Soldanesti, Orhei and Telenesti rayons. For the 4 rayons one central regional landfill shall be established. The site has not been selected, yet, currently two locations are under discussion (Parcani, r. Soldanesti, and Mitoc, r. Orhei). However, the final decision will be taken according to a formalized site

selection procedure, which may change all previous considerations. The regional plan envisaged finalizing the establishment of the regional landfill by the end of 2017. This schedule appears to be very ambitious. It requires smooth and unconstrained planning procedures as well as sufficient financial resources. Examples from other countries indicate that the implementation of those regionalization plans are extremely difficult and time consuming. For instance, Serbia, which is a better developed and economically stronger country than Moldova approved a similar National Strategy in 2001 and has so far (after 12 years) not succeeded to finalize all regional plans, not even to talk about institutionalizing all regional waste zones or establishing the regional landfills. Taking this dynamic into account it appears more likely that it takes up to 10 years before a regional landfill is in place.

Prior to establishing the regional landfill, the Strategy and the Regional program/plan promote restricting the waste disposal activities to 3-4 former dumpsites per rayon as transitional waste disposal sites. The other sites should be closed. This policy bears high environmental risks. Concentrating waste disposal to a small number of sites (without being enhanced accordingly) means that those sites receive significantly more waste than they are designed for. The speed of pile up the waste will increase what influences the landfill milieu negatively. Gas emissions and leachate pollution will increase massively, because the sites will most likely switch into hydrolysis (acid) phase (while they are currently either in predominant aerobic condition or in stabile methane phase). This strategy could be tolerated, if it was definitely for very limited time only. For a ten year period this procedure would be not acceptable. Moreover, most sites particularly in the rural area have limited authorized area available, only. They may quickly run out of airspace without any legal (and technical) opportunity for extension.

The local situation in Soldanesti rayon perfectly illustrates this problem. In the rayon 4 smaller rural sites are available, which could provide airspace for not more than 3-4 years (if accepting the environmental disadvantages). The dumpsite used by Soldanesti city is considered by the Ministry of Environment to be a hot spot and should be closed as soon as possible. Thus, useful transitional landfill airspace is not available. The stakeholders with support from international experts decided to go for a new transitional disposal site instead of extending the old dumpsites.

This transitional site shall be constructed in a way providing sufficient airspace for up to ten years in order to bridge the potential lack of landfill volume prior to establishing the regional landfill. The technical level shall be above the existing and valid Moldovan standards for so called “polygons” issued in 2001. The technical standard does not necessarily have to meet EU regulations for sanitary landfills, but shall respond to the general idea in terms of matching the overall protection goals for humans, soil, water, and climate. This enhanced transitional landfill (in contrast to a sanitary landfill) is not seen as a substitution of the future regional landfill, but a temporary amendment.

After establishing the regional landfill the disposal site will be closed and turned into a transfer station. (The landfill could be also used until its full capacity if such a decision is taken.) Alternatively, the design will enable the upgrade of the enhanced transitional landfill into a regional sanitary landfill, in case the political stakeholders vote in favor for the location.

5.3.2 Design criteria

Basically, the landfill shall provide sufficient airspace to receive the waste from the service area for a period of up to 10 years. The projected waste amounts for the service region (Soldanesti city plus 26 rural administrative units from Soldanesti and Rezina

rayons) are listed in table 5-3. The total amount is estimated to 90,244 tons for a 10 year period.

Table 5-3: Projected waste amounts for the service area

Year:	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total
Waste amount [tons]	8,799	8,822	8,857	8,893	8,930	9,011	9,095	9,185	9,278	9,373	90,244

Source: elaborated by GOPA.

This waste amount is considered to be the minimum, because the waste collection has been established in the service area only. Other municipalities, which are situated not far away from the transitional site, are not connected to the service system and hence their waste is not considered in table 5-3. Same applies for municipalities, which already have advanced waste collection in place, but do not have transitional landfill volume available. This applies in particular for the municipality of Floresti, which has established collection service in Floresti city and 12 surrounding municipalities.

Other than shown in table 5-3 alternative scenarios for solid waste amounts to be delivered to the enhanced transitional landfill can be expected. On a mid-term, the site will be the only reasonable and environmental sound landfill in a larger area stretching from the North-West (Floresti) to the East (Rezina). Even some villages from Telenesti rayon could be attracted by the idea to intermediately and temporarily deliver waste to the site. Table 5-4 illustrates the expected waste amounts for various scenarios.

Table 5-4 illustrates that the total amount of waste delivered to the enhanced transitional landfill may easily triple over the operation period adding up to 276,000 tons of waste. This number does not even reflect the maximum amount to be reasonably expected with more municipalities from Floresti rayon delivering waste (using existing/planed transportation infrastructure in Floresti municipality) or from Telenesti rayon (relatively small distances). Anyhow, the uncertainty about the waste amounts is high since it depends on factors hardly to forecast such as the speed of implementation of regional plans and the political willingness to ban local dumping (which is the cheaper option compared to delivering to the enhanced transitional landfill). For the conceptual design a required landfill volume of 250,000 m^3 (corresponding to approximately 200,000 tons of waste) has been selected.

Table 5-4: Scenarios for waste delivered to the enhanced landfill

Scenario:	Connected Population [-], Census 2004	Total waste amount [tons in 10 years]
1: Minimum (table 5-3) Soldanesti rayon (incl. Cotuijenii Mari service area) + 4 villages from Rezina rayon	42,227	90,244
2: Medium Soldanesti rayon (incl. Cotuijenii Mari service area) + 4 villages from Rezina rayon + 13 municipalities from Floresti rayon	86,607	185,088
3: Upper Soldanesti rayon (incl. Cotuijenii Mari service area) + all (25) municipalities from Rezina rayon + 13 municipalities from Floresti rayon	129,186	276,084

Source: elaborated by GOPA.

Regarding the technical features of the facility the main design criteria were:

- Application of adequate technical standards to match the overall protection goals of modern landfilling, in particular redundant (combined) barrier system, minimization of emissions from gas and leachate by appropriate treatment systems;
- Minimization of installation efforts corresponding to the transitional character of the site, in particular avoidance of immobile installations which could not be reutilized at the later regional site;
- Design in a way that allows potential further upgrade to regional site, if selected;
- Stepwise development and construction of tipping fields in order to allow adjustment to waste amounts.

Principally, the enhanced transitional landfill is needed for the disposal of the household waste (residuals) generated within Soldanesti and Cotiujenii Mari service areas. However, other waste management operators from adjacent areas (e.g., Floresti, Rezina) could also dispose the waste to the landfill after paying a gate fee.

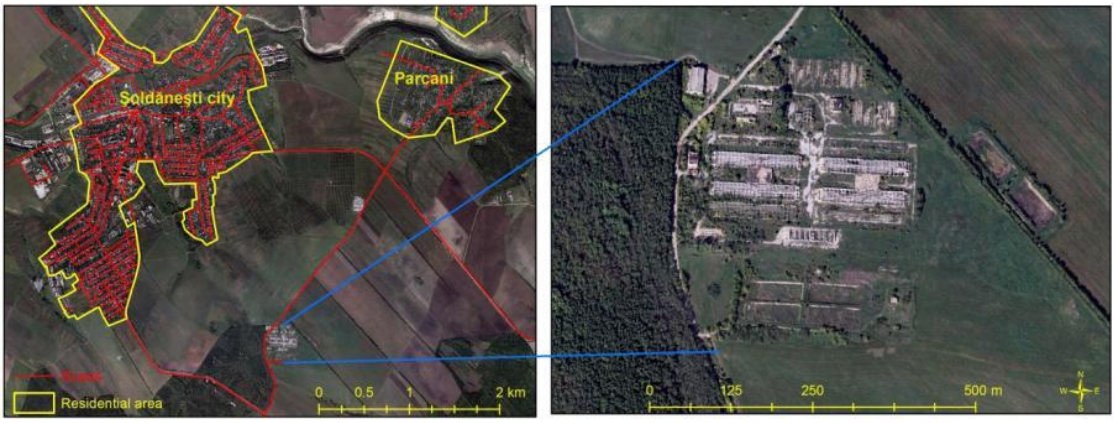
It is estimated that in the year of 2016 about 7,547 tons of residual waste (coming from population, economic entities, and public institutions) will be collected from Soldanesti service area and 1,251 tons from Cotiujenii Mari service area. At the same time, Floresti service area might deliver around 8,262 tons of residual waste to the landfill (see Annex 13).

Annex 13 presents the calculations regarding lifespan of the 250,000 m^3 of the available landfill volume depending on the quantity of household waste (residuals) disposed from Soldanesti, Cotiujenii Mari, and Floresti service areas. It can be noticed that the 250,000 m^3 landfill volume is sufficient to dispose all household waste collected from Soldanesti and Cotiujenii Mari service areas for more than 25 years. If the landfill is to also accept the household waste collected from Floresti service area, the landfill volume will be enough for about 15 years.

5.3.3 Location

The enhanced transitional landfill shall be part of the inter-municipal solid waste management center. An appropriate location for the center including the landfill has been identified earlier by local stakeholders in the vicinity of Parcani (8 km South of Sodanesti city center) on an abandoned area of a former livestock confinement complex (latitude: 47.79 longitude: 28.81; altitude: 258 m) with an area of 14.8 ha (see Fig. 5-6). The land is public property of Parcani municipality and has already been secured for the construction of the center. Recently, the land destination has been changed from “agricultural land” to “industrial land” according to Government Decision Nr 1123 from 20.12.2013.

Figure 5-6: Location of enhanced transitional landfill



Data source: gismediu.gov.md; Map design: GOPA, 2013.

5.3.4 General design idea

The landfill acts as a temporary disposal site for household solid waste till the regional landfill has been established. It replaces the intermediate dumpsites which do not have the capacity and the technical standard to ensure a safe and environmental sound waste disposal for more than 2 years. The enhanced transitional landfill still has a temporary character, although it may later become the regional landfill. Hence, the design aims on providing landfill airspace in an adequate technical standard with limited long term investments (which would become obsolete, in case the site will be closed). In order to match the EU protection goals for the environment (atmosphere, ground water) and humans, a three component barrier system will be constructed. The barriers are formed by pretreated, stabilized waste (barrier 1) and a two component liner system (barrier 2 and 3) which is leaner than required by EU landfill directive. The reduced liner system is compensated by the reduction of emission potential from the waste, which will be achieved by mechanical biological treatment (MBT).

MBT expresses a group of various treatment methods which range from simple systems operated at the landfill (aiming on reducing waste emissions) via composting all the way to high end treatment systems like biological drying (aiming on producing refused derived fuel RDF for incineration). The applied system for the SWM center in Soldanesti is one of the very simple treatment methods. The treatment method was very popular in Western Europe in the past, the method is easy to apply, reliable and cost efficient.

The anticipated MBT method will be maintained by passively providing air to the waste sustaining aerobe decomposition processes in open windrows. After finalizing the treatment the windrows will be finally compacted on site. The detailed operational process as well as the expected output is described in chapter 5.3.6. For further information see Münnich et al, Pilot project of mechanical-biological treatment of waste, Waste Management 26 (2006), pp.150-157.

5.3.5 Conceptual design

According to the selected design criteria a landfill volume of 250,000 m^3 is projected. The lined tipping area will be approximately 25,000 m^2 stretching 140 m (W-E) x 180 m (N-S). The landfill base has a longitudinal slope of 1.5 % in West-East direction with the highest point on the West side. Figure 5-7 illustrates the site map according to the con-

ceptual design. The arrangement of landfill components may be changed during detailed engineering considering site specific factors.

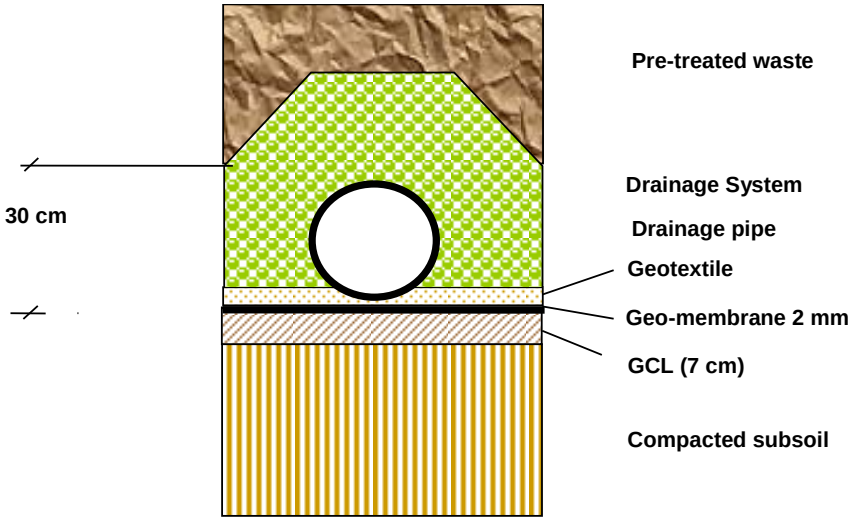
Figure 5-7: Conceptual design of enhanced transitional landfill – site map

Data source: gismediu.gov.md; Map design: GOPA, 2013.

On the western border of the tipping area sufficient space is available to construct an extension area of the same size. The extension area will have the slope in the opposite direction creating a roof profile for the entire landfill base. The entire landfill zone 1 will be constructed as one measure. For operational reasons the landfill area is divided into three tipping zones (1.A to 1.C) with an area of approximately 8,000 m^2 each. That allows opening the tipping areas step by step minimizing the amount of leachate generated.

The base liner system consists of two combined sealing components (see Fig. 5-8). The lower layer will be a geo-synthetic clay liner (GCL), the upper layer a PE-HD geo-membrane with a thickness of 2 mm. The geo-membrane is protected from punctuation by means of a geotextile (1,200 g/m^2). On top of the geotextile a drainage layer of gravel (min 8/16, preferred 16/32 mm) is placed.

Figure 5-8: Cross section landfill base line system



Source: elaborated by GOPA

Three lines of PE-HD drainage pipes will capture the leachate percolating through the waste. The leachate runs through the drainage pipes to shafts located at the Eastern end, where the pipes are connected to a transportation pipe. Through this pipe the leachate is directed to a leachate basin which provides a storage capacity of 4,500 m^3. The basin has a sealed area of 2,000 m^2 and will be constructed in the former manure pits. The existing structure may be refurbished.

The design of the lined area and the leachate collection system allows extending the tipping zones to the West, if necessary. The extension zone 2 will show an opposite slope, thus the fully expanded tipping area would have a “roof” profile. Additional extension areas can be made available to the North and to the Southwest.

The auxiliary facilities (entrance area, workshop, social rooms), and the MRF is situated North of the tipping area on the western border of the premise. The composting area is located on the North-Eastern side of the tipping area.

5.3.6 Operation concept

The technical standard of the liner system does not match EU standards, since the mineral component is simply a GCL instead of three layers of clay with total thickness of 90 cm. In order to achieve the overall protection goals of state of the art waste disposal the waste will be biologically treated prior to final compaction at the tipping area. Thus, the organic content and biochemical reactions in the landfill will be minimized.

The biological treatment process is characterized by a degradation of organic waste components through activity of microorganisms. With the anticipated treatment technology the degradation runs under aerobe conditions. Aerobe processes require sufficient supply of oxygen, nutrients (nitrogen, phosphorous) and moisture. The degradation process is endothermic; hence the process site is heating up. Optimum process

temperature ranges from 40°C to 60° C. The appropriate extraction of energy is essential. Sewage sludge may be added to the input waste stream of the MBT with no problems to be expected up to a portion of 10 %. The figure 5-9 illustrates the obvious effects of mechanical biological treatment on municipal solid waste. The effect on leachate concentration is illustrated in Table 5-5.

Figure 5-9: MSW prior (left side) and after (right side) biological treatment


Source: GOPA.

Table 5-5: Leachate concentration from MBT landfill

Parameter:	Basis leachate				
	12 days	69 days	90 days	161 days	208 days
pH - value [-]	7.1	7.4	7.1	6.8	7.5
EC [µS/cm]	16,600	8,420	7,840	5,030	3,710
TOC [mg/l]	1,812	354	299	180	98
COD [mg/l]	4,670	1,061	961	644	452
BOD5 [mg/l]	244	290	119	18	15
NH4-N [mg/l]	392	16	76	< 5	< 5

Source: Münnich et al, Pilot project of mechanical-biological treatment of waste, *Waste Management 26* (2006), 150-157.

The major benefits of biological pre-treatment are:

- Reducing the waste mass by about 15% due to degradation of organic components;
- Improving the leachate quality (COD to about 500 mg/l, BOD5 < 20 mg/l);
- Increasing the waste density from 0.8 t/m^3 up to 1.2 t/m^3.

Several positive side effects are also regularly observed:

- Birds are not attracted to the pretreated waste;
- The compaction requires less effort due to homogenization and reduction of particle size and change in material properties;

- The pretreated waste is less vulnerable versus self-ignition, thus landfill fires are avoided;
- Daily coverage of pre-treated waste using soil is not necessary, since the fine fraction has properties similar to soil and matches the main requirements for daily cover material, such as minimal odor and non-susceptibility to wind;
- Landfill gas generation is reduced substantially by 95 %, what maintains climate mitigation, since methane gas is recognized to be an important Green House Gas (GHG) and contributes 21 times more than carbon dioxide to global warming;
- The biochemical and geotechnical properties of the finer fraction are quite similar to soil. After biological treatment the fine fraction may be segregated from the waste to be used as soil amendment or even as fertilizer under certain limitations;
- Settlements of landfills are significantly reduced;
- The landfill becomes less permeable, what results in a reduction of the amount of leachate.

Table 5-6 provides an overview on waste properties after comprehensive biological treatment in comparison to the properties of untreated waste.

Table 5-6: Properties of stabilized biomass compared to untreated waste

Parameter:	Bio-treatment (chimney-effect) 12 - 16 months	MSW untreated
Solids (mechanical):		
Wet density [Mg / m³]	1.2	0.85 - 1.0
Solids (chemical):		
Ignition loss [mass %]	33 - 40	75 - 85
Total Organics (TOC) [mass %]	7 - 12	27 - 32
Leachate:		
TOC [mg/ l]	95	1,000 - 3,000
COD [mg/ l]	210	3,000 - 6,000
BOD5 [mg/ l]	17	800 - 2,000
NH4-N [mg/ l]	16	20 - 200
Gas:		
Respiration activity (aerobe) per 4 days [g O2/kg]	<5	>50
Gas production (anaerobe) [l/kg]	1 - 1.8	15 - 200

Source: Münnich et al, Pilot project of mechanical-biological treatment of waste, Waste Management 26 (2006), 150-157.

The output material of the MBT, the so called SB (stabilized biomass), consists mainly of stabilized organic materials, inert particles and synthetics. Valuable waste fractions can be recovered from the stabilized biomass prior to final disposal. Simple means like screening in a drum sieve (see Fig. 5-10) is useful to segregate RDF (refuse derived fuel for incineration) and fine fraction. For instance, the fine material could be used as so-called methane oxidation layer, a methane reducing landfill cap. Other applications as soil amendment are also possible. Utilization in agriculture is not recommended as it needs strict and continuing monitoring.

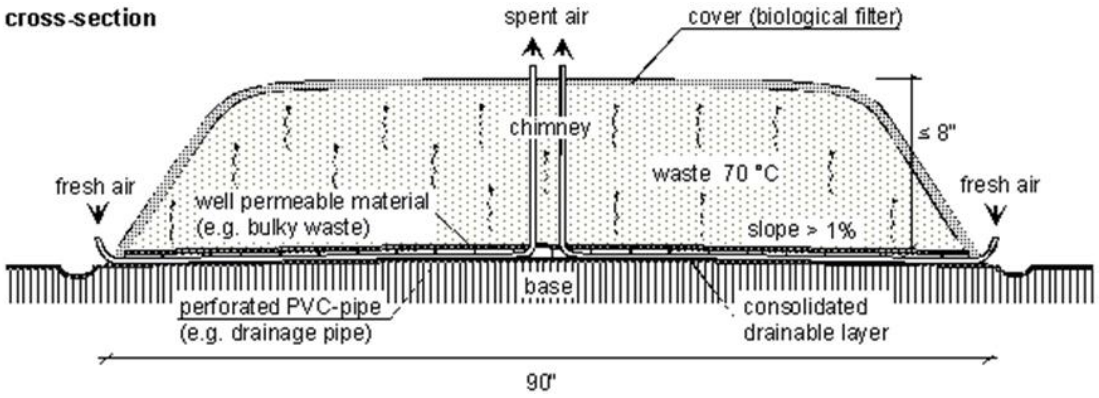
With regard to local conditions, legal frameworks and waste management targets, a broad spectrum of MBT processes and combinations are currently established and available in Europe. The treatment systems significantly vary in terms of technical standards, costs, and operation parameters. For financial reasons a passively aerated, open air system has been selected.

Figure 5-10: Screening of SB (left) & segregation of methane oxidation layer material (right)

Source: GOPA.

The most popular passively aerated treatment method is called chimney effect procedure. The waste is placed on a ventilation layer (coarse material, bulky waste) and ventilation pipes are installed in the trapezoid windrows. Oxygen supply results from passive aeration due to thermal dynamic effects and is not controlled. The heaps are piled with a height of 2 to 2.5 m. The trapezoid windrows may be covered with bio filter material for insulation and avoidance of odor emissions. As the entire process is not encapsulated, possibilities of emission control are limited. If the process is not performing properly, particularly when passive aeration is insufficient or completely inhibited in parts of the wind-row or the entire windrow, anaerobic conditions will occur. This may effect odor and me-thane gas emissions and require a rebuild of the pile. Figure 5-11 shows a typical scheme of an open static passively aerated windrow according to chimney effect procedure.

Figure 5-11: Chimney effect bio-treatment procedure – scheme



Source: Turk, 1998. The impact of waste size on the airflow in chimney-effect stockpiles.

In general, static systems can be operated directly on a landfill and do not need any specific ground construction. After finalizing the bioprocess, the SB will be compacted and next piles will be placed on top. The treatment area for the chimney effect windrows amounts to approximately 1 m^2/t, thus the available landfill area allows a treatment period of approximately 12 months. Figures 5-12 (set up of piles) and 5-13 (German landfill with treatment) illustrate the process.

Figure 5-12: Chimney effect - set up of piles

Source: GOPA

Figure 5-13: Wilhelmshaven landfill operating chimney effect piles

Source: GOPA

Till 2005 several open MBT plants were in operation in Germany for example in Wilhelmshaven, Meisenheim and Kirchberg. A change in landfill regulation, which banned any open air treatment, enforced the operators to establish indoor treatment facilities. Thus, none of the former reference plants exist anymore. Similar plants have been established in developing countries for example in Sao Sebastiao (Brazil), Phitsanulok (Thailand), Teheran (Iran). Detailed investigation on some of the projects has been conducted in a GIZ sector project (see http://www2.gtz.de/dokumente/bib/04-5731.pdf). Most of the plants operate for a limited period only, being regularly replaced by more comprehensive and better equipped facilities (roofed, indoor etc.). Thus, currently no open MBT site is in operation.

5.4 Institutional set-up

5.4.1 General

According to legislation (the law on local self-government, the law on decentralization, the law on public communal services) the municipalities are responsible for providing waste management services to the public within the municipal borders. The municipality can do this through its own municipal organization (e.g., department, municipal enterprise, commercial society owned by the municipality, etc.) or through hiring an external contractor (private or public) to provide the service. This latter possibility requires that the service is tendered. The tendering procedures are regulated by the law on concessions no. 534-XIII of 13.07.95, which unfortunately is quite outdated and partly contradicts some newer laws - i.e. law on Public Private Partnership (PPP) and law on local public administration. It is expected that the law will soon be revised and partly replaced by a new chapter in the law on public tendering no. 96 of 13.04.2007.

Since most of the municipalities are small and some have not even established a waste management service, it is clearly beneficial for the municipalities to cooperate within an Inter-Municipal Cooperation (IMC) organization to provide this service. In order to allow the direct delegation of the service, it is important that municipalities participating in such an IMC have control of the organization (operator) and that there is a majority public ownership. This obviously limits the choices of acceptable institutional set-ups and although these conditions are not clearly regulated by national legislation, this is the conclusion made by legal experts from interpretation of Moldovan and European laws and regulations. The newly adopted water sector law nr 303 from 13/12/2013 supports this interpretation as in article 13, paragraph (12), it states that in the case of operators with majority public capital, the service can be delegated directly to them by the respective LPAs. This rule can be applied by analogy to the SWM sector.

Recently the State Chancellery with the support of UNDP-Moldova proposed an amendment to the GD 387 from 0.6.06.1994 on model regulation of ME that will make possible the establishment of a ME by several municipalities. Now, a ME can be established only by one municipality and it is not possible that several LPAs establish a common ME. Therefore, after the respective changes are passed, a ME may be considered as one of the potential institutional set-ups for IMC initiatives.

Taking in consideration the arguments presented above, the central point of the proposed new waste management system is the establishment of an IMC company.

5.4.2 Establishment of the inter-municipal cooperation company

The central point of the proposed new waste management system is the establishment of an IMC company in the form of a Joint Stock Company as described below.

Early in 2012, a number of local governments decided to consider the establishment of an inter-municipal solid waste management company. Later in the process it was decided to establish a joint stock company covering the municipalities within Soldanesti rayon, and other 4 adjacent municipalities within Rezina rayon. Soldanesti rayon is also participating. The steps in the decision making process regarding the establishment of an IMC company are presented in Annex 14.

The legal situation regarding the establishment of an IMC company was studied and discussed, which led to the following conclusions:

- It is not legally possible to delegate the service to an existing public cleansing company (i.e., municipal enterprise) from one municipality to work in another municipality unless a public tender has been performed first. This requires supple-

mentary administrative effort from LPAs, and any other company (private or public) could bid for, and possibly win.

- An “Association” of ALPs as being considered in other parts of Moldova could serve only as an optional/additional element of the institutional model, since municipalities cannot delegate specific functions to the association (e.g., tariff approval, policy approval, etc.). This means that the “Association” could only work on attracting investments/funds and/or taking some role in monitoring the operator. In the case of association models based on a private operator (which is not the case of Soldanesti rayon where the intention is to have a publically owned operator), the “Association” could also, on behalf of a group of municipalities, tender for the services after which every municipality would have to enter into an agreement with the selected company. An association may be considered in addition to a regional JSC, but is not a stand-alone solution. The Association and the operator (e.g, JSC) have different roles in the institutional model and they do not exclude each other. Most of the potential functions of the “Association” can be performed by the Shareholder Assembly or the Board of Directors of the company. One of the reasons (in Romania for instance) for creating associations as independent structures (from the operator) is to demonstrate a control of the municipalities over the operator via the respective associations of inter-community development - so called “*control similar*”. It is a rather expensive additional organisation, which should be avoided if the municipalities establish an operating entity anyway.
- Although legal requirements are not entirely clear, the legal advice is that establishment of a joint stock company or a limited liability company will be an acceptable solution that will allow the involved municipalities to authorize the new company to provide waste management services to the municipalities without tendering. The background for this is that each single municipality will exercise control of the new company through their place in the Shareholder Assembly and the Board. This control and the public ownership are the key factors when deciding whether or not public tendering is required.
- There are certain limitations regarding the limited liability company, e.g. the number of shareholders allowed, which leads to the conclusion that a joint stock company is the preferred and therefore selected option, although it does entail some additional formalities and costs (registers, registering of shares, etc.).

Creating a JSC owned by local governments may also have the advantage that such a public company can attract outside support from donors and other funding agencies, which a private organization cannot or alternatively, that the shareholders (the municipalities and/or the rayon) can obtain such support and consequently transfer the support as share capital to the JSC. In this specific case a large amount of equipment has already been donated to one municipality (Soldanesti city) with the purpose to service the surrounding municipalities. The equipment donated is listed in Annex 15.

Furthermore, the organization of the JSC according to the laws also governing private business will in the longer term allow for the payment of competitive salaries and will support innovation and the development of market strategies in order to increase the performance of the services.

One of the goals of a JSC is by law to generate a profit. However, this profit should only to a limited extent, if at all, be used to pay dividends to the shareholders. Rather, the levied waste fees shall be used to cover the costs of waste management and any sur-

plus should be reinvested or turned into reserves which eventually can be applied to landfill aftercare and new waste management infrastructure.

Withdrawing from the JSC must be strictly limited to the extent permitted by law, especially during the first years after the start of landfill operation. Leaving the JSC must be precisely regulated and must consider the financial and institutional sustainability of the JSC. The detailed internal rules of the JSC are to be set out in the Statutes.

Financial relationship between the JSC and its shareholders

After establishment, the JSC will enter into a service agreement with each municipality. The total payment from the shareholders for the service provided by the JSC shall be sufficient to cover the entire cost of solid waste management system.

The municipalities shall be invoiced monthly in advance by the JSC and pay accordingly. The municipalities shall pay according to the number of officially registered inhabitants in each of the municipalities. The payment per inhabitant for a particular service shall be the same for all municipalities, independent of the distances from the landfill.

The municipalities are responsible for the collection of waste management taxes from the households. If the collection rate is below 100%, the shareholder will have to cover the difference out of their municipal budget, unless additional funding (e.g. from central or rayon government) is available.

If the municipalities are not paying their bills as required the JSC has the right to cease servicing that specific municipality after giving ample warning. Obviously, payment in the longer term is very important to make the JSC financially sustainable. Otherwise the JCS will have to cease operation altogether and file for bankruptcy.

Share capital

The JSC will have the municipalities and the Soldanesti rayon as shareholders. The share capital will encompass a cash part and an “in kind” part. The cash part shall be equivalent to EUR 28,000 of which the rayon will contribute 35.7% (EUR 10,000) and the municipalities the balance, i.e. 64.3% (EUR 18,000). The municipal contribution will be in accordance with the number of inhabitants in each municipality. The distribution of the required cash payment, as well as value of equipment, is shown in Annex 16.

The “in kind” part will be composed of the equipment that has been donated to the Soldanesti municipality. To ensure equality the ownership of this equipment will be distributed to the municipalities in accordance with the number of inhabitants. The combined cash and “in kind” share capital input will result in the distribution of shares as presented in Annex 16. This rather complicated procedure was required since all equipment had been donated to Soldanesti municipality only, although the intention clearly was to benefit all the municipalities participating in setting up the JSC. Since the donated equipment is new it can be contributed at cost price.

Also part of the donation was 259 platforms (with the value of 1,949,882 MDL or 114,670 EUR), which represent collection points for placement of the containers. These platforms are constructed at suitable locations at the municipalities and ownership was originally transferred to the municipalities and shall remain as such.

Equipment that is not part of the donation as well as office facilities will be leased by the new JSC at a nominal fee. It was considered to also include these items in the “in kind” contribution, but that would require a cumbersome and expensive valuation procedure, which is the reason for selecting the leasing option. The facilities and equipment to be leased cannot be financially depreciated since it is still owned by the munic-

ipalities directly, however, compared to the value of the new equipment this has minor influence on the result of the JSC.

Organization of the JSC

The element of the JSC is presented in Annex 17. The Shareholder Assembly has the responsibility to select the Board of Directors. The Board of Directors may be elected among the members of the Shareholder Assembly, but may also be chosen from outside if, for example, it is deemed beneficial to add a special expertise to the Board. Normally, the Shareholder Assembly will meet once a year to execute their duties. It may, however, be necessary to have extraordinary meetings in cases where the Board of Directors does not have the authority to make some decisions.

The Board of directors shall define broad policies and objectives for the JSC. The Board elects a Chairman among its member. Also, as indicated above, the Board selects and appoints the General Manager and supervises and supports his performance. It is the Board's responsibility to ensure that adequate financial resources are available and the Board is accountable to the shareholders for the performance of the JSC. The Board approves the annual budget and is in charge of developing and negotiation the compensation package for the General Manager.

The Chairman of the board's duties normally includes:

- Chairing the meetings of the board;
- Organizing and coordinating the board's activities;
- Having regular meetings with the JSC management;
- Reviewing and evaluating the performance of the General Manager and the other board members.

The General Manager directs the operation of the JSC on a daily basis. The main responsibilities include:

- Reporting to the Board of Directors on a regular basis;
- Cooperating with the Chairman of the Board regarding important decisions and issues;
- Making decisions about the implementation of the JSC's duties as required;
- Ensuring the employees are developed and motivated;
- Communicating with the press and other external stakeholders as required.

It is envisioned that the JSC shall be responsible for:

- Calculation of waste management fees;
- Household waste collection, transfer, transport and disposal;
- Collection, sorting and selling of recyclables;
- Collection, treatment and selling of compostables;
- Public relations, information and waste advisory;
- Extension of the service area within the present shareholder's area, with prior coordination with respective affected municipality/municipalities;
- Incorporation of additional municipalities in the system.

It is envisioned that the municipalities will be responsible for:

- Approving the fees and tariffs;
- Paying for the services to the JSC;
- Collection of waste taxes from citizens to pay for the service or raise the necessary funding in other ways;
- Maintenance of collection points/platforms and ensuring access to them;
- Waste avoidance measures;
- Control and monitoring of the operator (JSC).

The organization of the JSC, including its management and administrative structure and task descriptions, is outlined in detail in the Statutes of the JSC. The administrative structure and the organizational chart of the JSC are presented in Annex 18.

Inclusion of the waste management system of „Cotiujenii Mari" service area

Cotujenii Mari municipality, together with three other municipalities (i.e, Dobrusa, Rogojeni, and Pohoarna), presently operates their own solid waste management system; this system is quite different from the one in Soldanesti service area. These municipalities do not have access to a landfill and are therefore interested in participating in the ownership of the JSC or at least have access to the planned landfill in Parcani.

In order for the municipalities within the Cotujenii Mari service area to participate in the ownership of the JSC from the beginning the four municipalities will obtain the same benefits and have the same obligations. This is described above, but basically it means:

- The municipalities will obtain ownership of the new equipment according to the number of inhabitants. This ownership shall then be transferred to the JSC as share capital;
- The municipalities shall pay in their share of the cash share capital;
- The municipalities shall enter into a service agreement with the JSC for the provision of the solid waste management service;
- The municipalities shall raise the necessary funds to pay for the service through waste taxes or other means;
- Existing equipment shall be made available to the JSC at a nominal lease fee;
- The JSC will employ relevant staff from the four municipalities to operate this equipment.

Alternatively, the four municipalities can join later, e.g. at the opening of the landfill. The conditions for participation will be detailed at that point in time, but it is envisaged that the following provisions would apply:

- Shares can be paid for as cash and "in kind".
- The cash payment per inhabitant shall be at least the same as that paid by other shareholders.
- "In kind" payment can be for equipment that has a value to the JSC. Such equipment will have to be evaluated and the cost for the valuation borne by the four municipalities.

- The four municipalities shall accept all conditions applying to all other shareholders of the JSC.

If the four municipalities decide not to participate in the ownership of the JSC, they can decide to continue their present operation and in the future, when the landfill is operational, deliver their waste to the landfill and pay the required gate fee. The gate fee will be fixed on normal commercial terms.

The enhanced transitional landfill

It is anticipated that the investment in the enhanced transitional landfill will be in the form of a grant but the operation as well as the long term aftercare also requires significant resources. The ownership of the landfill can be distributed in the same way as the ownership of the equipment, i.e. according to the number of inhabitants in each single municipality. The final decision of the ownership of the landfill may be taken later, since the landfill is unlikely to be built until 2015.

The Municipality of Parcani has through a council decision accepted that the landfill be established at the designated land, but obviously some kind of fee will have to be paid to the municipality for the use of the land

The landfill will be operated by staff from the technical department of JSC, which will be paid from the fees/taxes/tariffs paid by population and juridical persons and by the extra funds accumulated from the gate fee paid by external entities that bring the waste to the landfill. The fees/taxes/tariffs and the landfill gate fee shall be sufficient to cover costs related to the operation as well as depreciation of the landfill infrastructure and equipment.

Environmental control of the JSC

The entity responsible for supervision and controlling that the waste management activities of the municipalities, and therefore by the JSC, are executed in an environmentally sound manner and in accordance with rules and regulations is the Environmental Inspection Soldanesti which is a unit of the State Environmental Inspectorate.

The work of the Environmental Inspection also includes enforcement related to the generators of waste and it is subsequently very important for the sustainability of the JSC ensuring that the generators are utilizing the proper management method for solid waste, i.e. the services of the JSC.

The Environmental Inspection Soldanesti lacks resources and experience and would benefit from a capacity building program.

6 Financial feasibility

6.1 Funding schemes

The calculation of the financial feasibility is based on the assumption that all initial investments for the waste management center will be financed by grant money as a follow up measure to the already allocated investments for the waste collection system development. The main reason to expect additional grant funds is that the service area has a status as a pilot project demonstrating an enhanced modern integrated solid waste management system. The inter-municipal solid waste management center in Parcani, r. Soldanesti will complete and finalize the integrated system. Based on this assumption costs of financing (for loans) have not been considered when calculating the operational costs of the SWM system and the tariffs/fees/taxes needed to sustain this system. After the waste management system has been entirely established, it is expected that the reinvestments required for the replacement of infrastructure, installations, and equipment, as well as investments for expanding the system will be raised from the collected fees/taxes/tariffs and from bank loans. The grant money may be available through international donor funds (German Investment Funds) or through the National Fund for Regional Development and/or the National Environmental Fund.

6.2 Investment and replacement schedule

The total investment costs for the inter-municipal solid waste management center (excluding the equipment used for collection and transportation of wastes) amount to 47.98 million MDL (2.82 million EUR). Table 6-1 displays a cost breakdown with the major budget headings regarding investments in construction works and infrastructure for the SWM center. Table 6-2 represents the costs related to equipment and installations needed for all facilities of the system; the table shows also the equipment procured for the collection and transportation of wastes. It should be noted that a significant part of equipment and installations have been procured already. Only 1.62 million MDL (95,000 EUR) are needed to procure the remaining equipment. Thus, the remaining investment costs needed for the inter-municipal solid waste management center amount to 31.77 million MDL (1.87 million EUR), which are comprised mainly of the costs related to construction works and infrastructure presented in Table 6-1.

Table 6-1: Breakdown of investment in construction and infrastructure

	Cost, MDL	Cost, EUR
1. General works	3,901,500	229,500
2. Earth works	769,250	45,250
3. Base liner system	9,987,500	587,500
4. Leachate collection and storage	697,000	41,000
5. Surface water management	238,000	14,000
6. Surface cover	0	0
7. Gas Collection and treatment	0	0
8. Infrastructure	4,751,500	279,500
9. Buildings and roofed areas	4,488,000	264,000
10. Waste treatment (concrete paved areas)	2,580,600	151,800
11. Hazardous waste cell	0	0
Subtotal	27,413,350	1,612,550
Contingencies, 10%	2,741,335	161,255
Total	**30,154,685**	**1,773,805**

1 EUR = 17 MDL

Source: elaborated by GOPA.

Table 6-2: Breakdown of investment in equipment and installations

	Status:	Price MDL	Price EUR
1. Landfill facility			
Bulldozer (15t, 130 kW)	procured	2,160,993	127,117
Wheel loader (3t, 120 kW, shovel 2.5m³)	procured	1,330,000	78,235
Leachate trailer (with pump attachment)	not procured	510,000	30,000
Car (4wd,ac, 70 kW)	procured	364,085	21,417
Workshop equipment	not procured	255,000	15,000
Office furniture including interiors	not procured	340,000	20,000
Laboratory equipment	not procured	510,000	30,000
Total:		**5,470,078**	**321,769**
2. Material Recovery Facility (MRF)			
Drum sieve	procured	1,108,547	65,209
Sorting belt	procured	321,318	18,901
Baler	procured	160,659	9,451
Hand Lift	procured	158,186	9,305
Total:		**1,748,710**	**102,865**
3. Composting facility			
Drum sieve	procured	1,609,648	94,685
Windrover	procured	1,729,771	101,751
Wood shredder	procured	4,644,756	273,221
Tractors (3 units)	procured	1,706,000	100,353
Trailers (7 units)	procured	917,600	53,976
Total:		**10,607,775**	**623,987**
4. Collection and Transportation			
Compactor Trucks (2 units)	procured	3,742,965	220,174
Containers	90% procured	2,889,992	170,000
Welding equipment	procured	4,330	255
Cleaning equipment	procured	39,990	2,352
Total:		**6,677,277**	**392,781**
Grand Total:	-	**24,503,840**	**1,441,402**

1 EUR = 17 MDL

Note: 252 containers (58 of 1.1 m^3 and 194 of 0.24 m^3) still need to be procured to complete the waste collection infrastructure; the cost of the containers needed amounts to ≈ 0.237 million MDL (13,940 EUR).

Source: elaborated by GOPA.

The detailed cost breakdown related to construction works and infrastructure is shown in Annex 19. The costs do not include the surface cover after the landfill closure. This will be covered by accruals and savings over years from the waste fees/taxes. The major single budget lines related to construction works and infrastructure are site mobilization (200K EUR), liner system (300K EUR for GCL and geo-membrane), drainage layer (225K EUR), office buildings (180K EUR), and concrete paved areas (152K EUR), which make together about 66% of this type of costs.

There is a special season that the cost breakdown does not include a landfill cover. The design of the landfill cap depends on the condition of the landfill at closure date (gas emissions, expected settlements). For MBT landfills emissions and settlements are small, thus the landfill cover may become very simple. It is even possible to derive the cover material from the pretreated waste. However, this application requires additional investigations during the design of the landfill closure construction. Whether and to which extent additional constructions for the landfill cap will be necessary depends mainly on how proper the MBT process had been operated. Thus, a correct and reliable estimation of landfill closure measures is not possible in advance. Therefore, the costs have not been included in the calculation.

The detailed cost breakdown related to equipment and installations is shown in Annex 20. The major budget lines related to equipment and installations (excluding the equipment used for collection and transportation of wastes) are composting equipment (470K EUR) and bulldozer (127K EUR), which make together about 41% of all costs of equipment and installations.

The lifetime of the most constructions/infrastructure is about 25 years. The leachate basin and the fences need major repairs (or replacement) after 15 years. Also, the scale, which is part of the weighing bridge infrastructure, has an expected lifetime of 10 years. The major part of equipment needs replacement after 10 years. Annex 21 presents the lifetime and replacement schedule of the major constructions/infrastructure, installations, and equipment of the waste management system.

6.3 Operation costs

The operation costs for the entire waste management system established in the project area consist of selling, general & administration costs and the costs necessary to operate the following activities of the system: a) collection and transportation of residual waste and recyclables; b) sorting and bailing of recyclable materials; c) disposing of the residual wastes; d) composting of organic/agricultural wastes (see Table 6-3). The operation costs have two distinct levels of intensity determined by the initial and fully established phases of the waste management system. The initial phase of the waste management system (status quo) includes the period of 2014-2015, while the fully established phase of the waste management system, which includes the investment in the inter-municipal solid waste management center, follows after 2015.

As it can be seen from Table 6-3, the total operation costs (including depreciation of equipment and infrastructure) amount to about 4.4 million MDL for the initial phase of the waste management system (years 2014-2015). However, after the establishment of the inter-municipal solid waste management center in 2016, the operational costs of the waste management system increase to more than 8.8 million MDL. The net increase in the operational costs between 2015 and 2016 is 4.4 million MDL, which mainly represents the extra costs needed to run the established inter-municipal solid waste management center.

It is important to notice that the costs of workforce increase every year since the real increase of salary of personnel is about 4% per year; the increase of the selling, general & administration costs each year is determined by the same reason. The annual increase in expenditures for fuel used for waste collection and transportation is due to growth of waste quantities (including recyclables) that need to be collected every year. All operation costs are calculated according to present prices (2013-2014).

The detailed calculations regarding operation costs of the components of the inter-municipal solid waste management center are presented separately in Annex 22 (Material Recovery Facility), Annex 23 (Composting Facility), and Annex 24 (Enhanced Transitional Landfill). Also, the operation cost for Collection & Transportation of wastes and Selling, General & Administration are presented in Annex 25 and Annex 26 respectively.

Excluding depreciation of equipment and infrastructure, the highest operation costs are incurred by collection & transportation of waste and final disposal of residual waste at the landfill, followed by composting of organic/agricultural waste (see Table 6-3, and annexes 22-26).

Table 6-3: Operation costs of the waste management activities, 1000 MDL (2014 to 2020)

Activities and cost lines:	2014	2015	2016	2017	2018	2019	2020
Selling, general & administration costs:	371	384	398	413	428	444	460
Collection and transportation:	2,840	2,887	3,105	3,160	3,210	3,260	3,312
Cost of workforce	760	790	822	848	875	903	932
Cost of fuel	559	577	763	792	814	837	859
Equipment maintenance costs	386	386	386	386	386	386	386
Infrastructure maintenance costs	94	94	94	94	94	94	94
Other costs: consumables	49	49	49	49	49	49	49
Depreciation of equipment	803	803	803	803	803	803	803
Depreciation of infrastructure	189	189	189	189	189	189	189
Sorting & Baling of recyclable materials:	662	672	561	567	574	581	589
Cost of workforce	232	241	208	215	222	229	236
Cost of electricity	6	6	6	6	6	6	6
Equipment maintenance costs	52	52	52	52	52	52	52
Facility maintenance costs	0	0	29	29	29	29	29
Other costs: consumables, rental	70	70	34	34	34	34	34
Depreciation of equipment	175	175	175	175	175	175	175
Depreciation of infrastructure	128	128	57	57	57	57	57
Disposing of the residual wastes:	504	505	2,894	2,900	2,906	2,912	2,918
Cost of workforce	30	31	180	186	192	198	204
Cost of fuel	120	120	313	313	313	313	313
Cost of electricity	0	0	5	5	5	5	5
Equipment maintenance costs	108	108	231	231	231	231	231
Facility maintenance costs			188	188	188	188	188
Consumables and monitoring costs			160	160	160	160	160
Accruals			180	180	180	180	180
Other costs: rental	66	66					
Depreciation of equipment	180	180	545	545	545	545	545
Depreciation of infrastructure			1,093	1,093	1,093	1,093	1,093
Composting of organic/agri. wastes:			1,897	1,900	1,903	1,907	1,910
Cost of workforce			96	99	102	106	109
Cost of fuel			180	180	180	180	180
Cost of electricity			1	1	1	1	1
Equipment maintenance costs			371	371	371	371	371
Facility maintenance costs			52	52	52	52	52
Other costs: consumables			34	34	34	34	34
Depreciation of equipment			1,061	1,061	1,061	1,061	1,061
Depreciation of infrastructure			103	103	103	103	103
Total costs (thousand MDL):	**4,376**	**4,448**	**8,855**	**8,940**	**9,021**	**9,104**	**9,189**

Source: elaborated by GOPA

The operation costs can be also represented by major type of expenditures incurred by the entire waste management system (see Table 6-4). As it can be seen from Table 6-4, the expenses on fuel, workforce, and maintenance of equipment comprise the major part of the operational costs of the waste management system, if we do not account for the depreciation of equipment and infrastructure.

Based on the data described in Table 6-4, Figure 6-1 below shows the percentage structure of operation costs when the waste management system is initiated in 2014 and when all components of the system are established in 2016.

As it can be seen from Figure 6-1, for the initial waste management system the expenditures on workforce, fuel, and maintenance of equipment account for 51%, while for the fully established system - 41%. This shift is mainly determined by increase of

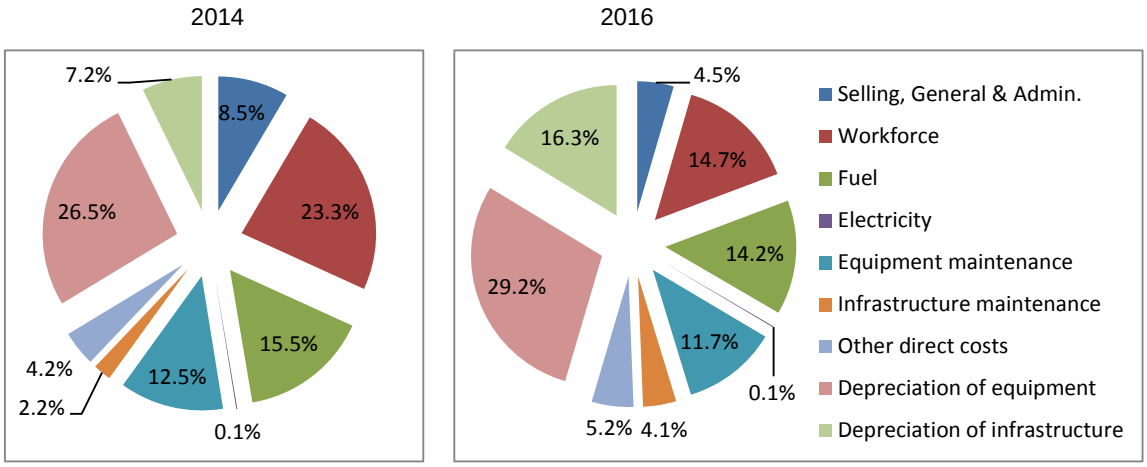
costs related to maintenance and depreciation of infrastructure and equipment after the establishment of the inter-municipal solid waste management center (see Table 6-4).

Table 6-4: The structure of operation costs, 1000 MDL (2014 to 2020)

Cost type:	2014	2015	2016	2017	2018	2019	2020
Selling, general & administration costs	371	384	398	413	428	444	460
Cost of workforce	1,021	1,062	1,306	1,347	1,390	1,435	1,481
Fuel cost	680	697	1,256	1,285	1,307	1,330	1,352
Electricity cost	6	6	11	11	11	11	11
Equipment maintenance costs	547	547	1,040	1,040	1,040	1,040	1,040
Infrastructure maintenance costs	94	94	362	362	362	362	362
Other costs	185	185	456	456	456	456	456
Depreciation of equipment	1,158	1,158	2,583	2,583	2,583	2,583	2,583
Depreciation of infrastructure	316	316	1,442	1,442	1,442	1,442	1,442
Total costs (thousand MDL):	**4,376**	**4,448**	**8,855**	**8,940**	**9,021**	**9,104**	**9,189**

Source: elaborated by GOPA.

Figure 6-1: The structure of operation costs in 2014 (initial phase) and 2016 (final phase)



Source: elaborated by GOPA.

6.4 Operating revenues

The operating revenues of the waste management system in the project area can be divided into two major groups: 1) revenues from tax, tariffs, and charges; 2) revenues from selling the recovered materials (such as recyclables and compost). Table 6-5 below presents all operational revenues. All revenues discussed in the document do not include VAT.

Table 6-5: The structure of operating revenues, 1000 MDL (2014 to 2020)

Revenue lines:	2014	2015	2016	2017	2018	2019	2020
Waste Tax for population	3,490	3,654	5,155	5,426	5,712	6,013	6,332
Tariff for Economic Entities	293	308	324	339	354	361	368
Tariff for Public Institutions	322	329	335	342	349	356	363
Charges for organic/agri. waste collection	0	0	310	310	310	310	310
Revenues from compost sold	0	0	263	263	263	263	263
Revenues from recovered recyclables	803	990	1,182	1,378	1,558	1,742	1,932
Total:	**4,908**	**5,281**	**7,568**	**8,057**	**8,545**	**9,045**	**9,567**

Source: elaborated by GOPA

As can be noticed from Table 6-5, for a period of 7 years the revenues coming from the waste collection tax, paid by serviced residents, are between 66% and 71% of the total. The revenues accumulated from tariffs paid by public institutions and economic entities fluctuate between 8% and 13%. An important revenue line represents the funds gained from the selling of the recovered materials - between 16% and 20% are the revenues attributed to the recovered recyclable materials.

6.4.1 Revenues from tax, tariffs, and charges

The revenues incurred from the tax on waste management for population, tariffs for public institutions and economic entities, and the charges (for on demand extra service) for the organic/agricultural waste collections are presented in Table 6-6 bellow. The tax, tariffs, and charges used to calculate the revenues are discussed in Chapter 6.7 Financial capability (required tax/fees/tariffs). For the period of 2014-2020, the share of the revenues coming from the waste tax levied on residents is between 84 and 86 per-cent of this type of revenues. The tariff paid by economic entities brings between 5 and 7%, while the tariff paid by public institutions - 5 to 8%. In addition, it is expected that 4 - 5% of this type of revenues will come from the charges paid by residents who request on demand collection of organic/agricultural waste from the household.

Table 6-6: Revenues from tax, tariffs, and charges, 1000 MDL (2014 to 2020)

Revenue lines:	2014	2015	2016	2017	2018	2019	2020
Waste Tax for population:	3,490	3,654	5,155	5,426	5,712	6,013	6,332
Soldanesti Service Area - Soldanesti city	353	405	585	660	742	829	922
Soldanesti Service Area - Rural area	2,586	2,684	3,783	3,952	4,130	4,317	4,514
Cotiujenii Mari Service Area - Rural area	551	565	787	813	840	867	896
Tariff for Economic Entities:	293	308	324	339	354	361	368
Soldanesti Service Area:	270	283	297	310	323	329	336
Soldanesti city - Big firms (SA, SRL, IM, IS)	*24*	*25*	*26*	*26*	*27*	*27*	*28*
Soldanesti city - Smal firms (indiv. enterpr.)	*146*	*150*	*155*	*158*	*161*	*165*	*168*
Rural area - Big firms (SA, SRL, IM, IS)	*44*	*47*	*51*	*55*	*59*	*60*	*62*
Rural area - Smal firms (individ. enterpr.)	*56*	*60*	*65*	*70*	*75*	*77*	*78*
Cotiujenii Mari Service Area:	23	25	27	29	31	32	32
Rural area - Big firms (SA, SRL, IM, IS)	*9*	*10*	*11*	*12*	*12*	*13*	*13*
Rural area - Smal firms (individ. enterpr.)	*14*	*15*	*16*	*17*	*19*	*19*	*19*
Tariff for Public Institutions:	322	329	335	342	349	356	363
Soldanesti Service Area - Soldanesti city	31	31	32	32	33	34	34
Soldanesti Service Area - Rural area	243	248	253	258	263	268	274
Cotiujenii Mari Service Area - Rural area	49	50	51	52	53	54	55
Charges for organic/agri. waste collection:	0	0	310	310	310	310	310
Soldanesti city	0	0	84	84	84	84	84
Rural area	0	0	225	225	225	225	225
Total:	**4,104**	**4,291**	**6,123**	**6,416**	**6,724**	**7,040**	**7,372**

Source: elaborated by GOPA.

The following assumptions were used to calculate the revenues from Table 6-6:

- The service will retain 85% of the local waste tax;
- Tariff payment rate of Public Institutions is 100%;
- Tariff payment rate of Economic Entities from urban area is 93% in 2014, 94% in 2015, and 95% from 2016 onwards;
- Tariff payment rate of Economic Entities from villages is 80% in 2014, 85% in 2015, 90% in 2016, 95% in 2017, and 100% from 2018.

It is important to notice that the revenue from waste tax assumes that the municipalities will pay 85% of waste tax collected from population. We think that this assumption is quite realistic since the taxes can be better enforced, unlike tariffs charged on the basis of contracts. (As it was discussed in section 3.1.1 above, the calculations show that at the moment only about 50% of the population connected to waste management services in the project area pay the contract based tariffs). However, if we assume that only 50% of the population will pay the tax, the revenues from the waste tax will decrease by 45-48%. As a result, the total revenues described in Table 6-6 will decrease by about 38-41%, from 2014 to 2020. This information is important in the context of cost recovery of the waste management system.

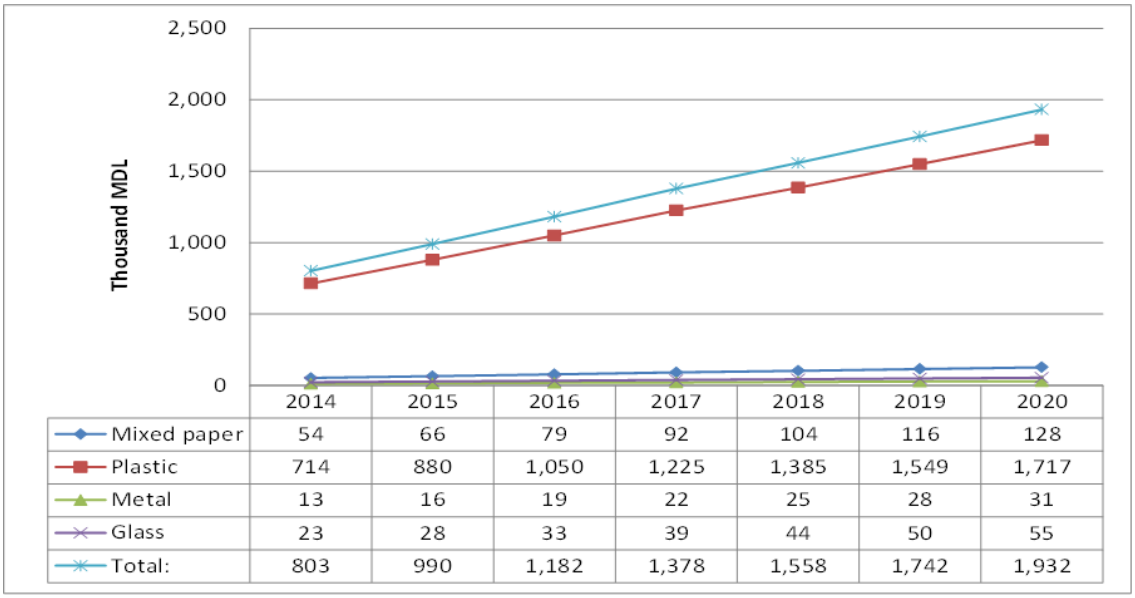
6.4.2 Revenues from recovered materials

There are two types of materials to be recovered within the project area: recyclables materials (mainly packaging materials) recuperated at the Sorting and Baling Station (starting from 2014) and compost produced at the Composting Facility (starting from 2016).

In 2014, the expected revenues from recyclable materials recovered (from population, public institutions and economic entities) within the project area is going to be about 0.8 million MDL (see Fig. 6-2). It is expected that for the next 7 years the revenues will grow significantly every year as the recovery rate of recyclables increases. Almost 90% of the total revenues are attributed to plastic recyclables.

The prices used to calculate the revenues from recovered materials sold are the following: mixed paper - 500 MDL/ton (29 EUR/ton); plastic - 4,000 MDL/ton (235 EUR/ton); metal - 1,000 MDL/ton (59 EUR/ton); glass - 300 MDL/ton (18 EUR/ton); compost - 85 MDL/ton (5 EUR/ton). These are local average prices; the prices do not include VAT.

Figure 6-2: The expected revenues from recyclables within the project area, 2014-2020



	2014	2015	2016	2017	2018	2019	2020
Mixed paper	54	66	79	92	104	116	128
Plastic	714	880	1,050	1,225	1,385	1,549	1,717
Metal	13	16	19	22	25	28	31
Glass	23	28	33	39	44	50	55
Total:	803	990	1,182	1,378	1,558	1,742	1,932

Source: elaborated by GOPA.

It is important to mention that in 2014 about 30% of these revenues are due to the recovered recyclables from Soldanesti city. After some 10 years, about 80% of the reve-

nues will come from the recovered recyclable materials from rural area, the rest 20% - from Soldanesti city.

From 2016, with the building of the Composting Facility at the Waste Management Center in Parcani, about 3,100 tons of compost will be produced every year generating approximately 263 thousand MDL per year. About 27% of this revenue is attributed to the compost produced from the organic/agricultural waste collected from Soldanesti city (outskirts) and 73% from the organic/agricultural waste collected from 7 villages (i.e., Parcani, Lipceni, Sipca, Mihuleni, Glinjeni, Sestaci, and Oliscani) located within 10-15 km distance from the Composting Facility.

6.5 Dynamic prime costs

The dynamic prime costs (DPC) represent the average service/production costs per unit of quantity (e.g., ton of processed solid waste). These costs are computed by using either the annual cost or cost present values and the quantities. Both approaches produce the same results. For the calculation of DPC the following formula was used:

DPC = Annual Costs (AC)/Annual Output (AO)

The DPC is measured in MDL/unit of quantity (MDL/ton of processed waste in our case).

For this study the annual costs can be grouped in two major sets: Depreciation Costs (DC) and Operation Costs (OC), which are described in Table 6-3 above. Taking into consideration the fact that this project is financed by grant money (real interest rate for the financing = 0%), the Investment Costs (IC) are equal to DC. Table 6-7 below shows the calculated DPC of each component of the household waste management system in the project area. Table 6-8 shows the DPC of the composting activity (including collection of organic wastes) carried out in the project area.

As it can be seen from Table 6-7, for the year of 2014, the DPC of the Collection and Transportation of household wastes (including Selling, General & Administration of the process) is about 352 MDL (21 EUR) per ton of waste collected. The DPC increases slightly every year because of two main reasons: 1) the annual growth in the quantity of residual wastes and recyclables generated; 2) the annual rise in cost of workforce (real salary increase = 4% per year).

The DPC of Sorting and Baling one ton of recyclables is about 1,770 MDL (104 EUR) in 2014. Following 2014, the DPC decreases every year as a result of intensification of recovery of recyclables. This means that the quantity of recyclables placed separately in appropriate containers increases every year as people become more aware of the benefits of recycling (as a result of a continuous wornness rising about recycling and environment). It should be noticed that the revenues incurred while processing one ton of recyclables amount to about 2,460 MDL (145 EUR) per year. This means that in 2016 the MRF will earn (without taking into consideration the collection costs) a net amount of 1,300 MDL (76 EUR) while processing one ton of collected recyclables.

In 2014, the DPC of disposing one ton of residual waste at the temporary dumpsites is about 67 MDL (4 EUR). This is a quite low cost as the disposal infrastructure is not complete. With the establishment of the enhanced transitional landfill in 2016, the DPC increases to 329 MDL (19 EUR) per one ton of disposed waste. The calculation assumes that from 2016 the waste generated within Cotiujenii Mari service area will be also disposed at the newly constructed landfill. The disposal of wastes from Floresti rayon or other municipalities outside the project area are not part of the calculations.

Table 6-7: Dynamic prime costs of household waste management activities, MDL/ton

	Units	2014	2015	2016	2017	2018	2019	2020
Collection and Transportation of household wastes, including Selling, General & Administration:								
Depreciation Costs (DC):	1000 MDL/y.	991	991	991	991	991	991	991
Constructions	*1000 MDL/y.*	*189*	*189*	*189*	*189*	*189*	*189*	*189*
Equipment	*1000 MDL/y.*	*803*	*803*	*803*	*803*	*803*	*803*	*803*
Operation Costs (OC)	1000 MDL/y.	2,219	2,280	2,512	2,582	2,646	2,713	2,780
Waste Collected	tons/y.	9,128	9,238	9,350	9,466	9,584	9,706	9,832
Dynamic Prime Costs:	MDL/ton	352	354	375	377	380	382	384
amount of DC	*MDL/ton*	*109*	*107*	*106*	*105*	*103*	*102*	*101*
amount of OC	*MDL/ton*	*243*	*247*	*269*	*273*	*276*	*279*	*283*
Sorting & Baling of recyclables:								
Depreciation Costs (DC):	1000 MDL/y.	302	302	232	232	232	232	232
Constructions	*1000 MDL/y.*	*128*	*128*	*57*	*57*	*57*	*57*	*57*
Equipment	*1000 MDL/y.*	*175*	*175*	*175*	*175*	*175*	*175*	*175*
Operation Costs (OC)	1000 MDL/y.	360	369	329	335	342	349	357
Recyclables Processed	tons/y.	374	403	481	560	632	706	783
Dynamic Prime Costs:	MDL/ton	1,770	1,666	1,167	1,013	908	823	752
amount of DC	*MDL/ton*	*808*	*750*	*483*	*414*	*367*	*328*	*296*
amount of OC	*MDL/ton*	*962*	*916*	*684*	*599*	*541*	*495*	*456*
Disposing of the residual wastes:								
Depreciation Costs (DC):	1000 MDL/y.	180	180	1,638	1,638	1,638	1,638	1,638
Constructions	*1000 MDL/y.*	*0*	*0*	*1,093*	*1,093*	*1,093*	*1,093*	*1,093*
Equipment	*1000 MDL/y.*	*180*	*180*	*545*	*545*	*545*	*545*	*545*
Operation Costs (OC)	1000 MDL/y.	324	325	1,256	1,262	1,268	1,274	1,281
Waste Disposed	tons/y.	7,486	7,516	8,799	8,822	8,857	8,893	8,930
Dynamic Prime Costs:	MDL/ton	67	67	329	329	328	327	327
amount of DC	*MDL/ton*	*24*	*24*	*186*	*186*	*185*	*184*	*183*
amount of OC	*MDL/ton*	*43*	*43*	*143*	*143*	*143*	*143*	*143*
DPC of the system, MDL	MDL/ton	479	482	744	744	743	741	740
DPC of the system, EUR	EUR/ton	28	28	44	44	44	44	44

1 EUR = 17 MDL
Note: During 2014-2015, the residual waste from Cotiujenii Mari Area is disposed at local dumpsites within the municipalities at no cost for the waste management company.
Source: elaborated by GOPA.

Table 6-8: Dynamic prime costs of organic wastes composting, MDL/ton

	Units	2014	2015	2016	2017	2018	2019	2020
Depreciation Costs (DC):	1000 MDL/y.			1,164	1,164	1,164	1,164	1,164
Constructions	*1000 MDL/y.*			*103*	*103*	*103*	*103*	*103*
Equipment:	*1000 MDL/y.*			*1,061*	*1,061*	*1,061*	*1,061*	*1,061*
Operation Costs (OC)	1000 MDL/y.			733	736	739	743	746
Org. Waste Processed	tons/y.			6,191	6,191	6,191	6,191	6,191
Dynamic Prime Costs:	MDL/ton	-	-	306	307	307	308	309
amount of DC	*MDL/ton*			*188*	*188*	*188*	*188*	*188*
amount of OC	*MDL/ton*			*118*	*119*	*119*	*120*	*121*
DPC, EUR	EUR/ton	-	-	18	18	18	18	18

1 EUR = 17 MDL
Source: elaborated by GOPA.

Besides the DPC calculated separately for the various activities within solid waste management system, Table 6-7 also summarizes the general PDC for the entire system. This DPC was calculated by dividing all annual costs needed to sustain the system by the quantity of household waste handled in the system each year. In 2014, the DPC of

the initial household waste management system amounts to 479 MDL/ton (28 EUR/ton) of collected household waste. In 2016, the DPC of the improved system (since the establishment of the inter-municipal solid waste management center) increases to around 744 MDL/ton (44 EUR/ton) of collected household waste, which represents a 55% upsurge comparing to initial incomplete system.

As it can be seen from Table 6-8, with the establishment of the composting facility in 2016, the DPC of composting one ton of organic/agricultural waste (which includes also the collection of these wastes from nearby 8 municipalities) is about 306 MDL (18 EUR). It should be noticed that the revenues incurred while selling the produced compost amount to only 43 MDL (2.5 EUR) per ton of processed agricultural/organic waste. This means that the net cost for collection and composting of one ton of organic/agricultural waste is about 263 MDL (15.5 EUR). Normally, this final cost has to be covered by the households which additionally request this service at a supplementary fee/charge (calculated per ton of organic/agricultural waste to be collected from the household). Realistically, at this moment, it is not possible to charge more than 50 MDL (including VAT) per ton (200 MDL per one trailer of 4 tons) for the collection of this type of waste from the households. If it is admitted that 40 MDL per ton (excluding VAT) of organic waste will be raised from the additional fee, than there is about 223 MDL (13.1 EUR) per ton that has to be covered from somewhere. It seems that this amount of money can be only covered by all population in the project area, as the market value of compost is very low and it does not seem to increase in the future.

For waste management projects, it seems wise to calculate the DPC not only on quantity of collected and processed wastes but also on the number of people served by the system. This approach is presented in Annex 27. In this specific case, the DPC for composting activities is not calculated based on just the people served since at this moment the exact number of people that will use this particular service is not known. In this situation it was decided to separately present an option where the cost of composting activity is distributed to all people from the project area.

As it can be seen from Annex 27, in 2014 the DPC for the basic 3 activities of the household waste management system (Collection & Transportation of Household Wastes, Sorting & Baling of Recyclables, and Disposal of Residual Wastes) amounts to 8.3 MDL/person/month (0.49 EUR/person/month). In 2016, the DPC for the improved 3 activities of the system (within the inter-municipal solid waste management center) increases to around 13.4 MDL/person/month (0.79 EUR/person/month), which represents a 58% upsurge comparing to initial incomplete system. The DPC for the composting activities (including collection of organic/agricultural wastes) is nearly 3.6 MDL/person/ month (0.21 EUR/person/month) if the annual costs are distributed to all people in the project area (even if not all of them have access to this particular service). Finally, in 2016 the DPC of the entire waste management system adds up to 17.0 MDL/person /month (1.0 EUR/person/ month).

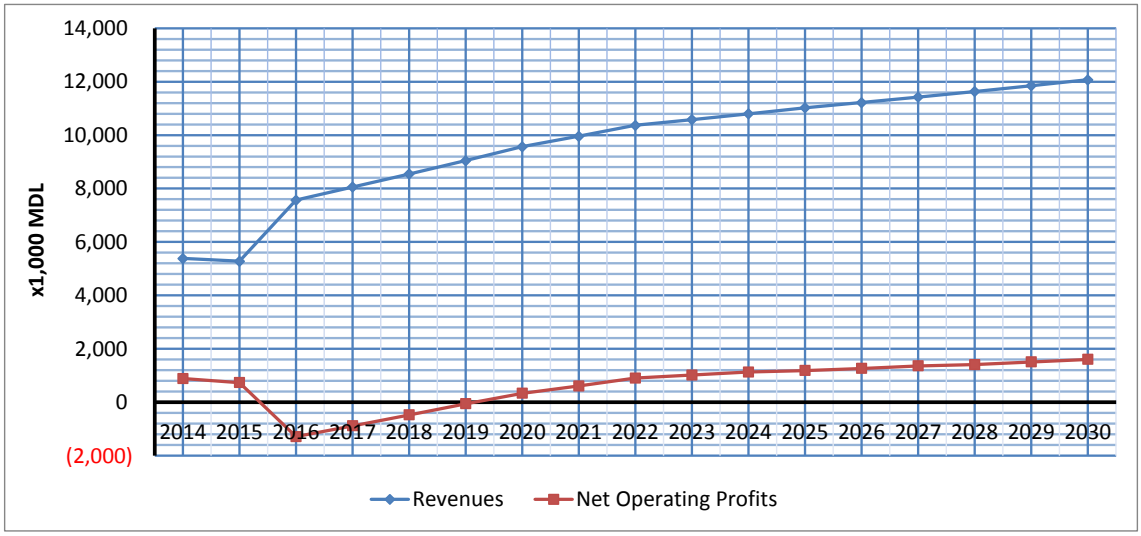
6.6 Cash flow analysis

The operation cash flow of the solid waste management service for the project area is presented in Annex 28. There are two different options of the cash flow described in the annex: 1) includes all investments made in the waste management system - the initial investment made as grant and future investments (to be made from collected fees/taxes) necessary to sustain the system; 2) excludes initial investment made as grant, but includes all future investments necessary for the replacement of the equipment and installations.

As it can be seen from Annex 28, the operating profits are positive for the period of 2014-2015, meaning that the waste fees collected cover all costs of the system. After the establishment of the inter-municipal solid waste management center in 2016, the operating profits are negative for the next 4 years. This happens because it was not possible to set, from the beginning, the waste tax/fee at the necessary level in order to fully cover all the costs of the solid waste management system (including depreciation costs of equipment and infrastructure). As described in *Chapter 6.7 Financial capability*, the waste tax will be increased gradually. Nevertheless, this fact will not create serious crash shortages in running the service. Actually, the shortfall represents a part of the funds necessary to cover the depreciation costs of equipment and infrastructure. The full collection of these funds will be delayed for some years. Normally, the available cash will be enough for the day-to-day operation of the service.

Figure 6-3 presents the Revenues versus Net Operating Profits of the waste management system according to the Cash Flow described in Annex 28. After 2016, with the establishment of the solid waste management center, the brake-even point (i.e., net operating profits = 0) of the waste management system will occur between the years of 2019 and 2020. As it can be seen from the Fig. 6-3, the revenues needed to sustain the system during this period (i.e., revenues at the break-even point) have to be at about 9.3 million MDL per year.

Figure 6-3: Revenues versus net operating profits of the SWM system



Source: elaborated by GOPA.

It is important to notice that the established solid waste management system is not in fact a commercial project but rather a social one, which intends to resolve an environmental problem in the area. At the same time, the system seems to be sustainable if implemented according to concept described in this feasibility study.

The above information assumes that 85% of the population will pay the waste tax. However, if we assume that that only 50% of the population will pay the waste tax, then the cost recovery of the waste management system will be problematic. In this situation, only the operation and maintenance cost will be covered in full by the decreased revenues. The depreciation costs will not be fully covered; from 2014 until 2030 about 41% of the depreciation costs will not be actually covered. At the same time, we think that this scenario is less probable to occur. We still think that the 85% recovery rate of

the waste tax is a quite realistic assumption since unlike the contact based fees the taxes can be better enforced.

6.7 Financial capability - required tax/fees/tariffs

6.7.1 Required waste tax for population

Taking into consideration the operation costs of the service and extra revenues that can be obtained (from selling the recovered materials and collecting extra funds through tariffs/charges levied on Public Institution and Economic Entities for solid waste generation), in 2014 a minimum of 6.5 MDL/person/month needs to be raised from the population serviced in order to deliver and sustain the waste management service in the project area. After the full establishment of the inter-municipal solid waste management center in 2016, the minimum amount that needs to be raised from the population is 13.1 MDL/person/month. The calculations for these 2 figures are presented in Table 6-9 below. It is important to notice that these calculations are based on the condition that all population in the service area will pay the required tax. However, it is unlikely to reach a tax collection rate of 100%. Probably, the collection rate of this tax will not reach more than 80-85%. Hence, adjustment of the calculated figures might be needed. If it is assumed that 80% of the population will pay the tax, then the minimum monthly amount per person that needs to be raised would be 8.1 MDL in 2014 and 16.3 MDL in 2016 (see table 6-9).

Table 6-9: Calculation of the waste management service cost for population, 2014 & 2016

	2014	2016
Service Costs, MDL/y:	4,376,341	8,855,223
Cost of workforce	*1,021,235*	1,306,107
Fuel cost	*679,513*	*1,255,667*
Equipment maintenance costs	*546,556*	*1,040,334*
Infrastructure maintenance costs	*94,260*	*362,452*
Other costs	*190,600*	*467,640*
Selling, General & Administration Costs	*370,520*	*398,013*
Depreciation of equipment	*1,157,638*	*2,583,324*
Depreciation of Infrastructure	*316,019*	*1,441,686*
Extra Revenues, MDL/y:	1,417,891	2,413,672
Recyclables sold	*803,117*	*1,181,702*
Compost sold	*0*	*263,097*
Tariffs paid by Public Institutions	*322,200*	*335,217*
Tariffs paid by Economic Entities	*292,574*	*324,130*
On demand charges paid for organic waste collection service	*0*	*309,526*
Service Costs - Extra Revenues, MDL/y:	2,958,450	6,441,551
Contingencies: 15% in 2014 and 5% in 2016, MDL/y	443,768	322,078
Total Service Costs per year, MDL/y	3,402,218	6,763,629
Total Service Costs per month, MDL/m	283,518	563,636
Total Service Costs per month per person served - 100% payment rate, MDL/pers/m	6.5	13.1
Total Service Costs per month per person served - 80% payment rate, MDL/pers/m	8.1	16.3

Note: population served in 2014 - 43,774; population served in 2016 - 43,148.

Source: elaborated by GOPA.

As it can be seen from Table 6-9, in 2016 the tax that has to be collected from population serviced has to increase by a factor of 2 to sustain the enhanced solid waste management system. Such a drastic increase in the tax will be problematic for local population. Therefore, it was proposed to increase the tax gradually over time. Also, it was

decided to differentiate the tax between people leaving in urban and rural areas. Since the range of services needed in the cities is higher than in the villages (e.g., collection of waste from landscaping activities is done only in the city), the tax for solid waste management will be also a little bit higher for urban population. Also, the average per capita income is somewhat higher in urban area.

For the year of 2014 it is proposed to have a tax of 10 MDL/person/month in urban area and 8 MDL/person/month in rural area, and increase it to 10.5 and 8.5 respectively in 2015. From 2016 it is reasonable to start with a tax of 14 MDL/person/month in urban area and 12 MDL/person/month in rural area, and increase it each year by 8% for the next 6 years and by 2% afterwards to sustain the service. The 2% increase of the tax after 6 years is necessary to cover for the real annual increase in the cost of workforce.

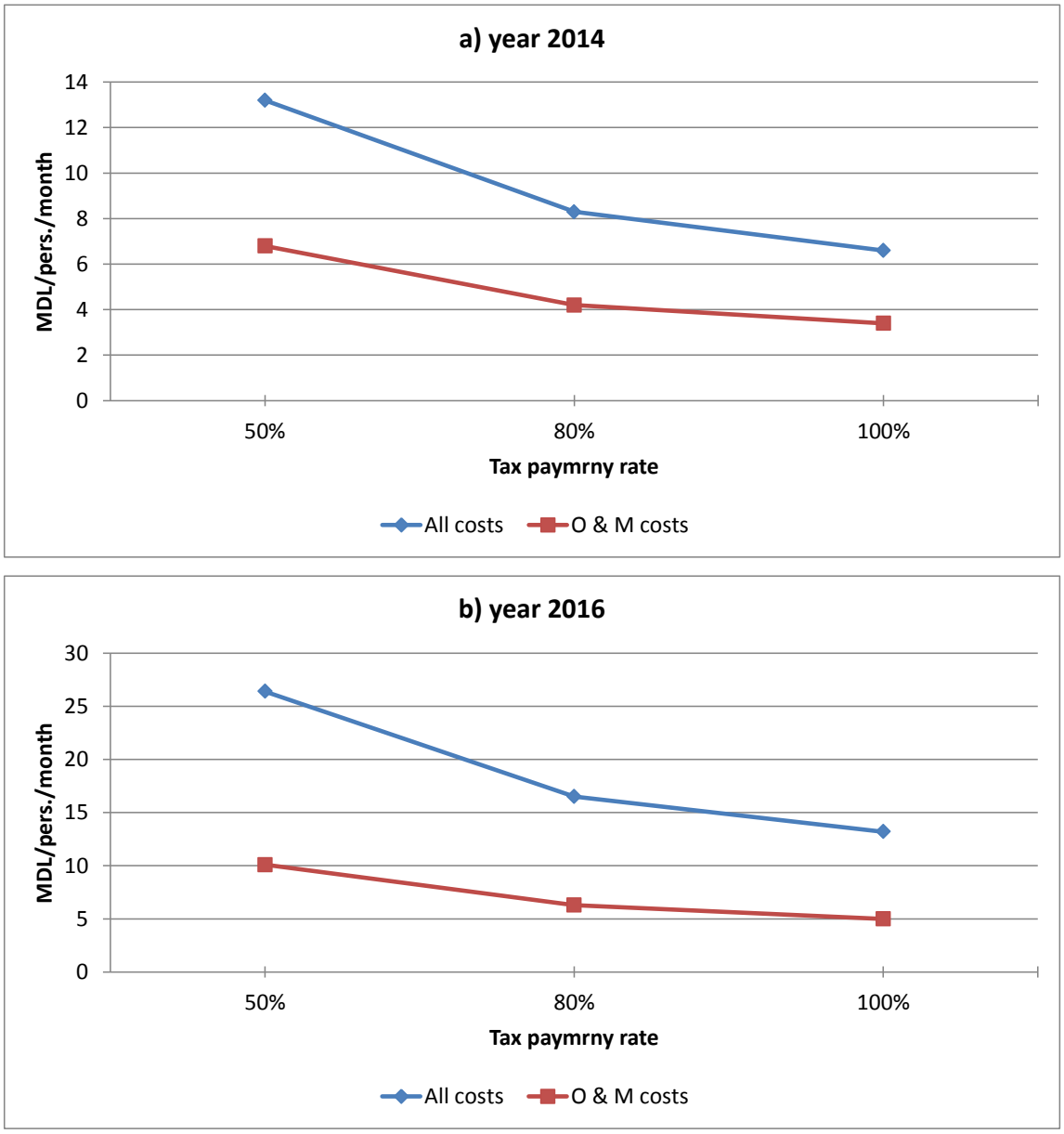
The proposed approach will bring negative operating profits between 2016 and 2019 (see Chapter 6.6 Cash flow analysis). However, this will not create serious crash shortages in running the service, since only the funds necessary to cover the depreciation costs of equipment and infrastructure will not be entirely collected from the beginning. The full collection of these funds will have to be delayed for some years.

Annex 29 presents a sensitivity analysis in calculating the waste tax assuming different scenarios regarding included costs of the waste management system and tax payment rates for the years of 2014 and 2016. Figure 6-4 presents the results of this analysis in a graphical form.

As can be seen from Annex 29 and Figure 6-4, in the case that all costs (i.e., operation, maintenance, and depreciation of equipment and infrastructure) of the waste management system are included, for the year of 2014 the waste tax has to be set at 8.1 or 13.0 MDL/pers./month if it is assumed that the tax payment rate is 80% or 50% respectively. However, in the case that only the operation and maintenance cost of equipment and infrastructure are to be covered, for the same year the waste tax can to be set at only 4.1 or 6.5 MDL/pers./month when the tax payment rate is 80% or 50% respectively.

For the year of 2016, when the complete waste management system is established, the tax per person has to be set at 16.3 or 26.1 MDL/pers./month if it is assumed that the tax payment rate is 80% or 50% respectively and when all costs of the waste management system are to be covered. On the other hand, in the case that only the operation and maintenance cost of the equipment and infrastructure are to be covered, for the same year the tax could to be set at 6.1 or 9.8 MDL/pers./month when the tax payment rate is 80% or 50% respectively.

Figure 6-4: Waste tax level depending on the costs and payment rate, yeas 2014 and 2016



Source: elaborated by GOPA.

6.7.2 Other required fees/tariffs for waste management

Since the public institutions and economic entries within the project area are placing the household type waste (not industrial waste!) at the collection points, they will be charged a tariff for using the waste management infrastructure. The tariffs will be paid to the waste management entity in the project area on the basis of a service contract. Every public institution, from both urban and rural areas, will have to pay a tariff of 150 MDL/month. Each economic entity from urban area will pay a tariff of 150 MDL/month. The small economic entities (which are classified as *individual enterprises*) from rural area will pay a tariff of 50 MDL/month, while the rest of economic entities from the villages will pay 150 MDL/month. These tariffs include VAT. The tariffs will be increased each year by 2% to account for real annual rise in workforce costs. These tariffs are the

ones used at the moment by the waste management municipal enterprises from Soldanesti city and Cotiujenii Mari. It seems that both public institutions and economic entireties within the project area are financially capable to pay these tariffs.

The on demand collection of organic/agricultural waste from households will be paid separately by the residents requesting the service. The charge/fee for this extra service is 50 MDL per ton (200 MDL per one trailer of 4 tons) of organic wastes. This fee is not enough to cover the full cost for collection and composting this type of waste (which is about 306 MDL per ton); however the residents do not seem financially capable to pay more. This charge will be also increased by 2% each year to account for real annual rise in workforce costs.

With the establishment of the transitional enhanced landfill, a waste disposal gate fee has to be charged to any entity (outside of the inter-municipal waste management system) that brings household/municipal waste to the landfill. The gate fee has to be set at about 230 MDL/ton (13.5 EUR/ton) of waste disposed in order to cover the operational costs of landfilling and 30% of the costs related to depreciation of equipment and infrastructure used at the landfill.

The above mentioned gate fee is valid for occasional delivery of waste. For organized delivery of household/municipal waste from big areas, the gate fee has to be recalculated depending on the quantity of waste delivered. Hence, if the household waste collected within Floresti project area (which includes 12 municipalities within Floresti rayon with a population of about 37,000) is to be also disposed of at the new landfill in Parcani, the gate fee would be 170 MDL/ton of waste disposed. In this particular case, the gate fee includes both the operational and depreciation costs of landfilling. If this fee is to be transferred in full to served population, than each person form this area has to be charged about 3 MDL per month in order to cover the waste disposal costs.

7 Socio economic impact

7.1 Affordability analysis

According to official statistics data (www.statistica.md), the total monthly available income per capita in the project area (i.e., Center Region) was 1,869 MDL in urban areas and 1,243 MDL in rural areas in the year of 2012. From 2011 to 2012, the total available income increased by 4.25% in urban areas and by 4.75% rural areas. On the basis of this information it was estimated that in 2014 the monthly available income per capita in the project area was 2,031 MDL in Soldanesti city and 1,364 MDL in the villages (see Annex 30). The available information is not gender desegregated; hence it is not possible to differentiate between incomes available in female and male headed households.

For the assessment of affordability, internationally accepted affordability levels for SWM fees are considered. The World Bank states that a range of 0.7 - 2.5 % of the income of a household is affordable for SWM fees. However, in industrial states a common value is 0.6-1.2 % (mainly due to the relatively high income of the households). The affordability analysis shows that the proposed tax for solid waste management, which has to be levied on population in the project area, is reasonable for the majority of residents. With the data available, the differentiation of affordability between men and women cannot be made at this moment. The affordability ratio of the tax for the year of 2014 is about 0.5% and 0.6% of per capita income in urban and rural areas respectively (see Annex 30). In 2016 the affordability ratio of the tax is around 0.6% and 0.8% of per capita income in Soldanesti city and rural area respectively. After 2016, the affordability level of the tax will increase gradually reaching in the year of 2022 the maximum of 0.8% and 1.0% of per capita income respectively in Soldanesti city and in the villages within the project area.

Nevertheless, it should be noted that particularly in the rural area a significant number of poor households exist (represented usually by the families with many children, families with only one parent, and families with retirees and disabled persons), which are not able to pay any waste fees at all. (Up-to-date data on these households is not available for the area.) The local government is responsible to foster the livelihood of the poor. Thus, it may be necessary to facilitate special arrangements for the poorest.

7.2 Economic impact

The waste management investments made in the project area brings benefits to local economy. At initial phase, local economic agents had already benefited by carrying out works related to waste collection infrastructure. The total cost of the works carried out by local economic entities amounts to 2.92 million MDL (172,000 EUR); the completed works include the construction of collection points (platforms), renovation of Soldanesti ME office, and technical supervisions of these works. For the next phase (2014-2015), about 23.36 million MDL (1.38 million EUR) will be invested in the building of the waste management center in Parcani. Yet again, local and national economic agents will have the possibility to benefit from executing the construction works.

A new inter-municipal waste management company is being development at the moment in the project area. As shareholders of the new company, the municipalities have received already waste management equipment with a total cost of about 22.87 million MDL (1.35 million EUR). The activity of the company will contribute to local economy development and to the developing of the waste management sector in the project ar-

ea. Simply the returning of the valuable recyclables into the economic circle will generate revenues of about 9.6 million MDL (0.56 million EUR) by 2020.

Indirect economic development effects are expected for agricultural sector, in particular for the subsistence farmers with their small strips of land. The compost produced at the SWM center can become an affordable alternative to mineral fertilizer and can improve the profitability of the micro farming, which suffers from low yields due to a lack of fertilizer and machinery.

In the opposite, the new system will put a small economic burden to residents and businesses by introducing or increasing waste fees. Currently, only the economic entities and public institutions from 5 municipalities of Soldanesti rayon (i.e., Soldanesti city, Cotiujenii Mari, Dobrusa, Rogojeni and Pohoarna) are connected to waste management services and are charged for the services. With the implementation of the waste management system for the entire project area in 2014, all economic entities and public institutions in the project area will have to pay for the use of waste management infrastructure. In this situation, the economic entities from rural area, especially the smaller ones, seem to be more affected by the need to pay for waste management. To reduce this stress it was decided to differentiate the tariffs levied on economic entities located in rural areas. As a result, the small businesses (i.e., individual enterprises) from villages will have to pay a lower tariff than the other firms.

7.3 Social and gender impact

The provision of waste management service to population within the project area is a social and environmental project rather than a commercial one. With the project implementation, the access of population in the area to organized waste management services will increase from about 28-33% in 2013 to more than 95% in 2014. Taking into consideration that women and children are usually more involved in household activities, including the activities related to waste disposal, the increase of access of population to organized waste management services will mostly benefit these groups of citizens.

In contrast to the waste collection, the effects of the SWM activities carried out at the SWM center are rather invisible and indirect to the residents. However even the indirect effects may improve the living conditions particularly of women. The improved hygiene due to clean up of waste accumulations and closure of dumpsites can reduce diseases and injuries in children, what takes away a burden from the mothers. Additional indirect positive effects are expected from the economic development. The improvement of living conditions for the poor farmers will positively influence particularly the women, because they are the backbone of family workforce in the fields.

It should be noticed that from social point of view the access to waste management services is not equal for every household in the project area. As it was already mentioned in the affordability analysis section above, the low income households (which usually include the families with many children, families with only one parent, families with retirees and disabled persons) will have difficulties in paying the required waste management taxes/fees. In this situation the local government should take actions in order to foster the livelihood of the poorest. Subventions could be given to poor families in order to cover the public services provided in the municipalities, including waste management services.

During 2012-2013, the municipalities within the project area have received as grant waste collection infrastructure and equipment in the mount of 25.79 million MDL (1.52 million EUR) for the establishment of an inter-municipal waste management company. Along with the provision of organized waste management services in the project area,

the new company will contribute to local economy development and lessening of social problems by employing local citizens and by paying fees and taxes on its economic activities.

Besides the existing workers at the municipal enterprises in Soldanesti city and Cotiujenii Mari, the new inter-municipal waste management company plans to hire about 40 new workers (37 in 2014 and another 4 in 2016). The majority of these new workers will be hired from the unemployed population with assistance from the National Agency for Employment.

As described in section 3.1 Institutional set-up, the personnel of the municipal enterprises in the project area is not gender equilibrated at the moment. This fact should be considered and addressed during the hiring of the new personnel for the future inter-municipal waste management company. It is imperative that both women and men are equally represented in the management/administration positions of the company.

The total workforce of the inter-municipal waste management company is expected to reach about 68 employees in 2016. For the year of 2014, the company is expected to pay about 196,000 MDL (12,000 EUR) in social and medical contributions on the workforce. These annual contributions will be about 254,000 MDL (15,000 EUR) in 2016.

The VAT paid by the company on sales of services to business and recovered materials is expected to be about 220,000 MDL (13,000 EUR) in 2014 and 350,000 MDL (21,000 EUR) in 2016. For the following 5 years after 2016, the VAT paid by the company is expected to increase by about 8-9% per year as a result of revenue growth.

The elaboration of the studies and the preparation of the project have been carried out in a gender sensitive approach. Gender distinguished data has been used wherever available. The implementation process will be assisted in order to follow up the goal of gender equality in the project.

8 Environmental impact

8.1 Environmental impact of the current SWM system

A collection system for municipal solid waste and recyclables is being established in the project area. Although the organic and agricultural waste will not be separately collected at this stage, none of the collected household waste is being either dumped at irregular former dumpsites, buried in the backyards, or burned. In certain seasons (especially in fall) the air pollution is extremely high (mainly due to burning of waste) in the region. With the introduction of waste collection in the rural areas the negative effects from littered waste (hygiene, soil and water pollution) are reduced. However, a significant amount of the waste is still not collected and poses environmental hazards.

The collected waste is to be disposed during the next 1.5-2 years at improved intermediate dumpsites. Due to the small amount and the comparably large area of the dumpsites, the growth of the waste piles is slow which allows the waste to aerobically decompose. Thus, the generation of methane and organic leachate is comparably small. However, emissions from the waste accumulations exist and cause pollution of soil and water and pose a threat for human and animal life. The inadequate waste disposal is a major contributor to environmental problems in the region. Furthermore, the free access to most of the dumpsites poses danger of injuries and health risks for unauthorized persons on the dump sites.

Table 8-1 summarizes the environmental shortfalls of the present SWM system.

Table 8-1: Environmental shortfalls of the present SWM system

Subject of environmental protection	Environmental Shortfalls
Human beings	• Scattered waste negatively affects the hygienic situation in living areas; • Due to missing waste facility management the dumpsite operations are inadequate and there is the potential for pollution over adjacent areas; • Waste blown from the dumpsites by the wind to the neighboring yards; • Water from the dumpsites infiltrating the streets and gardens of neighboring living areas; • Unhygienic conditions on dumpsites are a threat to all persons entering the area; • Rodent and insect nuisances can spread disease.
Soil	• Indiscriminate disposal pollutes soil.
Water	• Indiscriminate disposal pollutes groundwater; • Disposal of waste without any protective measures pollutes soil and groundwater; • Leachate generation from dumpsites may pollute the groundwater; • No stormwater management and potential for runoff of leachate into stormwater drains.
Climate and air	• Bad smell from the landfills in neighboring living areas; • Smoke from burning waste; • Uncaptured methane gas emission from the dumpsites.
Landscape	• Due to missing waste facility management the disposed waste pollutes large areas; • Waste from the landfills blown by the wind to neighboring yards; • High consumption of dumpsite space due to unorganized operation.

Source: elaborated by GOPA.

8.2 Expected environmental impact of the inter-municipal SWM center

With the planned inter municipal SWM center in Parcani the major gaps of the existing system will be closed, at least partly. The project aims at improving the collection and treatment of agricultural waste and at establishing an environmental sound waste disposal. In consequence, the environmental impacts of the new SWM system will be significant lower than the current impact. Although, the construction and operation of the SWM center and the landfill will create new impacts, they will be lower and less dispersed. Additionally, advanced technical measures will mitigate potential negative environmental impact to the highest extent. The enhanced transitional landfill features 3 separate barriers which shall block leachate from penetrating the subsoil: biological treatment to minimize the reactivity of the waste; a composite landfill liner system consisting of 2 separate barriers, a geo-membrane and a GCL. Further, the biological treatment will reduce odors and gas emissions from the site.

Providing appropriate landfill volume will allow the authorities to impose the laws and regulations regarding waste disposal more strictly towards the citizens and the commercial waste generators. Problems like littering and irregular disposal outside of designated areas will become easier to prosecute, since nobody can claim a lack of disposal options.

Table 8-2 summarizes the expected environmental advantages/impacts of the planned center including MBT and landfill in comparison to the current SWM in the region.

Table 8-2: Expected environmental advantages/impacts of the IM SWM center

Subject of environmental protection	Environmental advantages/impacts
Human beings	• Enhancement of hygienic situation in living areas, because the amount of scattered waste will be reduced significantly due to extended collection services.
Water	• Significant minimization of leachate generation, that may pollute surface and/or groundwater; • Significant minimization of odor generated from deposited waste.
Climate and Air	• Significant minimization of methane gas and CO_2 emission potential of deposited waste; • Substitution of primary resources by secondary raw materials.
Landscape	• Minimization of required landfill volume and closure of dumpsites.

Source: elaborated by GOPA

Besides the direct revenues gained by selling the recycling materials recovered at the MRF (described in the financial chapter above), the recycling activity brings also environmental benefits. The environmental benefits of recycling can be analyzed on the basis of the following key environmental indicators: (1) reduction of GHG emissions; (2) energy savings; and (3) landfill space/volume savings. The first 2 indicators measure the environmental benefits of reducing the energy use (in joules) and GHG emissions (in tons CO_2 equivalent), achieved usually at global level, when in the process of production of new goods (e.g., recycling packaging products) are used recovered recycling materials inserted of virgin ones. The third indicator measures the environmental benefits achieved at local level, which represent the space saved (in m^3) at the landfill when the recyclables are recovered from the waste stream, reducing in this way the volume of waste that has to be landfilled. Since packaging materials (the main part of recyclables present in the household waste) have low densities, they turn to occupy important space in the landfills if not recovered. The calculation of these environmental benefits is presented in Annex 31.

As it can be seen from Annex 31, in 2016 the recovery of about 551 tons of recyclable materials will bring the following environmental benefits: (1) reducing the GHG emissions by 654 tons CO_2 eq.; (2) saving 18.21 MJ (or 5,058 MWh) of energy; and (3) saving 2,164 m^3 of landfill space. These benefits can be also represented in monetary units. Hence, in 2016 the monetary values of reduced GHG emissions, saved energy, and saved landfill volume are equal to about 53,000 MDL (3,000 EUR), 2.25 million MDL (133,000 EUR), and 0.22 million MDL (13,000 EUR) respectively. The total value of all these environmental benefits achieved in 2016 adds up to 2.53 million MDL (149,000 EUR). The monetary value of environmental benefits of recycling accumulated between 2016 and 2025 will constitute about 40.6 million MDL (2.4 million EUR). The assumptions in the calculating the environmental benefits, including their monetary values, are presented in Annex 31.

9 Risk assessment

There are a number of financial, political/institutional and technical risks, which the project may encounter. The following risk analysis focuses on major issues which have the potential to seriously harm the successful implementation of the inter-municipal SWM center. Major risks occur in the financial and in the political/institutional aspects of the project, while technical risks are rather small.

Major financial risks are triggered from a shortfall of expected financial funds (lack of grants for investments) and revenues from marketing of recovered materials and a lack of fee/tax collection. The main political risks are related to a lack of commitment of political stakeholders in support and in time appropriate decision making, particularly on higher administrative level (regions and national government). That may result in severe delays regarding the implementation of the project and the required institutional set-up. Conflicts may arise from the fact that the regional planning follows a different direction and supports a strategy of operating existing dumpsite (inadequate from environmental point of view) than spending money on environmental sound transitional landfills. The institutional problems must be considered to be very sensitive. The current legal framework handed the responsibility for the waste management to the LPA 1 level. However, operating an inter-municipal SWM facility requires an inter-municipal cooperation, which cannot be enforced, but requires voluntary participation of all LPA1 governments. Technical risks are limited and related to time constraints rather than technical obstacles. The proposed components of the system are based on well experienced technologies, more or less easy to establish, reliable in operation and manageable with limited education efforts.

The data base for the planning seems to be reliable. However, long term projections are often subject to unexpected changes. Some developments are difficult to forecast such as the waste generation in poor areas, changes in the social structure, economic development of the region and the country and other related factors. However, all elements of the system are designed to offer a maximum of flexibility to allow adapting to even significant shifts in waste amounts and composition. Time delays may occur due to the permitting process for the new inter-municipal transitional landfill.

Table 9-1 summarizes the possible risks for project implementation, focusing on the landfill as the key element of the SWM center. Each identified risk is evaluated according to its probability and impact and classified in this manner:

- No or low risk (1);
- Medium risk (2);
- High risk (3);
- Very high risk (4).

In addition, the influence of the project developer (i.e., IMC) on mitigating the risk is evaluated as follows: no/little influence (“no”), medium influence (“eventual”) and high influence (“yes”). Respective suggestions of mitigation measures are mentioned in the last column. The risks indicated in red must be regarded as “killing factors”, unless avoided. Red and orange field marks indicate the critical risks (level 3: high risk or above). The critical issues are the grant financing, the landfill permit procedure, establishment of the IMC, and collecting the taxes/fees. The most sensitive issue is the grant funding for the investment due to its high risk, its killing impact and the lack of mitigation measures.

Table 9-1: Project risks and mitigation measures

Project Risks	Risk level	IMC influence	Possible Mitigation Measures
Political/administrative risks:			
Higher government levels do not support the project	3	eventual	• Lobbying
Site not available (e.g. due to improper land destination)	2	yes	• Legal procedure for waving compensation fees • Payment of compensation
Landfill site and design will not be permitted/permission will be delayed by regulatory agencies	2	yes	• Adjustment of detailed engineering
Lack of support from LPA 1 decision makers regarding institutional set-up, provision of means, financial arrangements (taxes)	3	yes	• Capacity building and provision of information on local level
SWM system is not accepted by the citizens, especially due to higher costs	3	yes	• Political directives • Awareness campaign, information, promotion • Incentives
Institutional risks:			
JSC establishment will be delayed or fails	2	yes	• Assistance from national (CALM) and international experts (GIZ) • Implementation of alternative institutional set-up, that also secures efficient SWM
Insufficient staff qualification for carrying out the required duties	2	yes	• Training and guidance by TA • Capacity building measures • Contracting of experienced private companies
Financial Risks:			
Grant money not available	3	no	• Utilization of alternative financing possibilities (commercial loans, provision of goods) • Cost reduction measures (private sector participation)
Fee/tax collection from residents is insufficient	2	yes	• Improvement of billing system • Enforcement measures • Utilization of alternative financing possibilities • Cost cutting measures (e.g. increased private sector participation)
Revenues from recycling and composting activities not achieved	2	eventual	• Cost reduction measures • Cooperation with industry • Increased private sector participation
Technical risks:			
Projected waste quantities differ from the generated amount	1	no	• Adjustment of planning
Proposed technical infrastructure for composting and MBT is inappropriate	1	no	• Revision during the detailed engineering
Shutdown of treatment facilities due to technical problems, lack of maintenance etc.	1	yes	• Long-term warranties of suppliers included in the contract • Solving of problems under guidance through TA
Leachate amount and concentration is higher than expected	2	no	• Installation of leachate treatment plant
Qualification and excellence of personal is insufficient	2	yes	• Education measures

Source: elaborated by GOPA.

10 Way forward

The work program for the implementation of the inter-municipal SWM center is shown in Annex 32. As it can be seen from the annex, it should take about 7.5 months in order to finalize and approve the technical drawings of the center. Another 5 month will take to tender the works and contract the company to construct the center.

According to the Article 6 (2, c) of the Law Nr 951 from 29.05.1996 on Environmental Expertise and Environmental Impact Assessment, the project documentation (technical drawings) of SWM center must undergo a State Environmental Expertise. Thus, just before the beginning of the works on the detailed technical drawings, the elaboration of necessary document of the Environmental Expertise (EE) should also start. The specialist or company needed for the EE documentation elaboration should be mobilized well in advance. The preparation work and tendering of the EE specialist should take about 3 months. Other 5 months will take to develop, consult, and officially approve the EE documents. It is important to notice that for this type of project comprehensive public discussions are not required by the law. However, it is recommended to consult the project plans with the nearby population to make sure that there is no strong opposition towards the project when the construction works on the inter-municipal SWM center need to begin.

The construction of the landfill and other facilities of the center have to start in February-March 2015 to be able to carry out the main construction works during the warm period of the year. According to planning, the construction of the center will take about 8 moths. It is expected that the inter-municipal SWM center will start operating in November 2015.

The project implementation time schedule contains some uncertainties, the permitting and EE procedures for the landfill and the auxiliary facilities of the center may take more time than expected. The landfill design will be carried out in cooperation between national and international experts in the area. Since the project is the first of its kind it can be a problem finding experienced local design engineers. The authorities may face similar problems in evaluating and permitting the design due to a lack of experience with such type of facilities.

The consultant considers the establishment of the JSC a mandatory requirement for a successful implementation of the project. The current structure with lots of LPA 1 units in charge for SWM is inefficient. The JSC establishment process contains a lot of risks since it requires support from each single local council.

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Annex 1

The generation of manure waste in the administrative units within the project area

Annex 1

The generation of manure waste in the administrative units within the project area

Place name	Number of animals:					Manure amout (m3/year) generated from:					Total manure:	
	cattle	swine	sheep/ goats	horses/ donkeys	poultry	cattle	swine	sheep/ goats	horses/ donkeys	poultry	m3/year	tons/year
Soldanesti raion:	**4,069**	**4,406**	**8,688**	**1,564**	**94,514**	**42,725**	**7,050**	**4,344**	**8,133**	**3,686**	**65,937**	**58,553**
1. Soldanesti city	184	150	503	25	2,965	1,932	240	252	130	116	**2,669**	**2,411**
2. Alcedar	120	195	280	45	5,890	1,260	312	140	234	230	**2,176**	**1,887**
3. Chipesca	203	280	868	67	7,823	2,132	448	434	348	305	**3,667**	**3,160**
4. Climautii de Jos	320	512	277	106	4,868	3,360	819	139	551	190	**5,059**	**4,641**
5. Cobilea	211	390	710	121	6,700	2,216	624	355	629	261	**4,085**	**3,551**
6. Cusmirca	253	145	264	135	5,469	2,657	232	132	702	213	**3,936**	**3,484**
7. Fuzauca	239	109	59	55	2,812	2,510	174	30	286	110	**3,109**	**2,881**
8. Gauzeni	151	162	387	112	3,075	1,586	259	194	582	120	**2,741**	**2,382**
9. Glinjeni (Hlingeni)	47	50	30	29	1,500	494	80	15	151	59	**798**	**701**
10. Mihuleni	65	125	95	13	2,486	683	200	48	68	97	**1,095**	**982**
11. Oliscani	113	98	274	65	3,042	1,187	157	137	338	119	**1,937**	**1,684**
12. Parcani	40	46	81	7	1,311	420	74	41	36	51	**622**	**554**
13. Poiana	81	39	63	59	1,900	851	62	32	307	74	**1,325**	**1,158**
14. Raspopeni	450	685	793	100	7,950	4,725	1,096	397	520	310	**7,048**	**6,429**
15. Salcia	110	95	17	36	2,108	1,155	152	9	187	82	**1,585**	**1,448**
16. Samascani	160	120	216	64	2,500	1,680	192	108	333	98	**2,410**	**2,168**
17. Sestaci	162	150	920	64	2,790	1,701	240	460	333	109	**2,843**	**2,453**
18. Sipca	102	180	260	18	2,300	1,071	288	130	94	90	**1,672**	**1,512**
19. Vadul-Rascov	312	322	614	174	10,500	3,276	515	307	905	410	**5,413**	**4,704**
20. Cotiujenii Mari	336	144	977	100	5,500	3,528	230	489	520	215	**4,981**	**4,414**
21. Pohoarna	145	163	155	92	4,673	1,523	261	78	478	182	**2,521**	**2,206**
22. Rogojeni	87	45	208	15	2,135	914	72	104	78	83	**1,251**	**1,114**
23. Dobrusa	178	201	637	62	4,217	1,869	322	319	322	164	**2,996**	**2,629**
Rezina raion:	**688**	**1,135**	**732**	**226**	**10,517**	**7,224**	**1,816**	**366**	**1,175**	**410**	**10,991**	**10,068**
1. Lipceni	90	60	80	20	500	945	96	40	104	20	**1,205**	**1,121**
2. Mateuti	250	350	390	60	5,090	2,625	560	195	312	199	**3,891**	**3,536**
3. Meseni	116	380	60	19	4,800	1,218	608	30	99	187	**2,142**	**1,961**
4. Peciste	232	345	202	127	127	2,436	552	101	660	5	**3,754**	**3,451**
Total:	**4,757**	**5,541**	**9,420**	**1,790**	**105,031**	**49,949**	**8,866**	**4,710**	**9,308**	**4,096**	**76,928**	**68,622**

Notes:

1) Data on number of animals - MEC, 2009 and Stat. Soldanesti, 2012-2013.
2) Assumptions used to calculate the manure generation:
   cattle - 10.5 m^3/year/1 animal, 1 anm. weight (dairy) = 454 kg, days confined = 275, no bedding;
   swine - 1.6 m^3/year/1 animal, 1 anm. weight = 68 kg, days confined = 365; no bedding;
   sheep/goats - 0.5 m^3/year/1 animal, 1 anm. weight = 45 kg, days confined = 185; no bedding;
   horses/mules/donkeys - 5.2 m^3/year/1 animal, 1 anm. weight = 454 kg, days confined = 183; no bedding;
   poultry - 3.9 m^3/year/100 units of poultry, 1 anm. weight (hen) = 0.9 kg, days confined = 275; no bedding.
   Reference used for the calculations - Manure Management for Small and Hobby Farms, 2008.

Source: elaborated by GOPA.

Annex 2

The detailed household waste composition in the project area and the description of the waste composition analysis methodology

Annex 2

The detailed household waste composition in the project area and the description of the waste composition analysis methodology

Waste components	Urban area	Rural
Mixed paper	5.5%	5.0%
TetraPak cartons/boxes	0.1%	0.0%
Plastics	9.1%	8.4%
Metals	0.7%	0.6%
Glass	3.5%	3.7%
Hygiene/diapers	8.4%	9.1%
Medical	0.1%	0.1%
Textiles	4.0%	3.7%
Inert (stones, ceramic, etc.)	2.2%	1.9%
Organic	20.2%	21.9%
Screening < 25 mm	46.2%	45.7%
Total:	**100%**	**100%**
Recyclables	18.9%	17.7%
Organic total	56.2%	58.4%
Useless	24.9%	23.9%
Household density in the container:	**220 kg/m^3**	**230 kg/m^3**

Notes:
1. The samples for analysis represented full containers at collection points.
2. The organic content of the screening for urban area is 78% and for rural area - 80%.

Source: elaborated by GOPA.

Waste composition analysis - methodology

The evaluation of the feasibility of a MRF requires comprehensive data on waste composition, waste types and waste amounts. Waste types and amounts are investigated during weighing campaigns, if weighbridges are available; waste composition is studied during a waste analysis. Waste composition analyses are carried out to take account of different levels of affluence with different residential areas (high/low income, urban/rural, single house/apartment blocks). The sampling methodology takes account of variations between and within residential areas. The areas are selected to give a good geographical spread across the city/region in order to ensure a statistically significant sampling methodology.

Sampling for the waste composition analyses is carried out from three different sources:

- Samples are collected from each household (Kerbside) randomly from the selected areas;
- Samples are collected from the open collection trucks or from central collection points;
- Samples are collected from the municipal compaction trucks (at the disposal site).

In order to ensure that collected samples are representative at each sampling point, selected sample quantities exceed 150 kg.

For the waste composition analyses an iron mesh with a size of approximately 2 x 2 m is taken with a pore size between 25-40 mm (whatever is available). The mesh is placed at a height of 75 cm above ground by using for example old tyres as columns. The height of the mesh is ar-

ranged reaching the waist of the personnel assorting the waste in order to minimise bending over. Assorted waste materials are collected in bags and sorted into 13 different waste fractions. A foil was placed below the mesh during sorting of the different waste fractions to collect the screenings, i.e. that fraction that has passed through the mesh/sieve and that cannot be allocated to any of the sub categories. The collected samples were placed and sorted on the iron screen. To safeguard the health and safety of the personnel involved all workers were given synthetic gloves.

Kerbside Collection of Samples
(Picture: South Africa)

Sample Delivery at the Landfill
(Picture: South Africa)

Once all the samples have been collected, bags are opened and the waste is sorted into the different categories using the sorting methodology described above. Each category of the waste is placed in a separate bag and weighed using a hanging scale. The waste that is unsortable, for various reasons is collected and weighed separately. The scale used is accurate to 0.1 kilograms. The weight of the waste collected in each category is recorded.

The following waste fractions are regularly assorted:

- Mixed Paper, White Paper, Cardboard;
- PET bottles;
- Polystyrene;
- Mixed plastic foils;
- Other plastics;
- Glass;
- Metals;
- Organic (food, vegetables);
- Green waste (garden waste, leaves);
- Nappies;
- Unsorted waste (clusters, lump);
- Screening/fine fraction (< 25 mm) - see figures below.

To extract maximal information from the data, it is important to understand what the organic portion of those fractions is. Thus, the organic content is determined by means of measuring the loss of ignition (LoI) and/or organic dry substance (oDS) in the laboratory. If laboratory testing is not available, the organic content can be taken from literature.

Screen (South Africa)

Waste Assorting (Moldova)

Scale (South Africa)

Fine Fraction (Moldova)

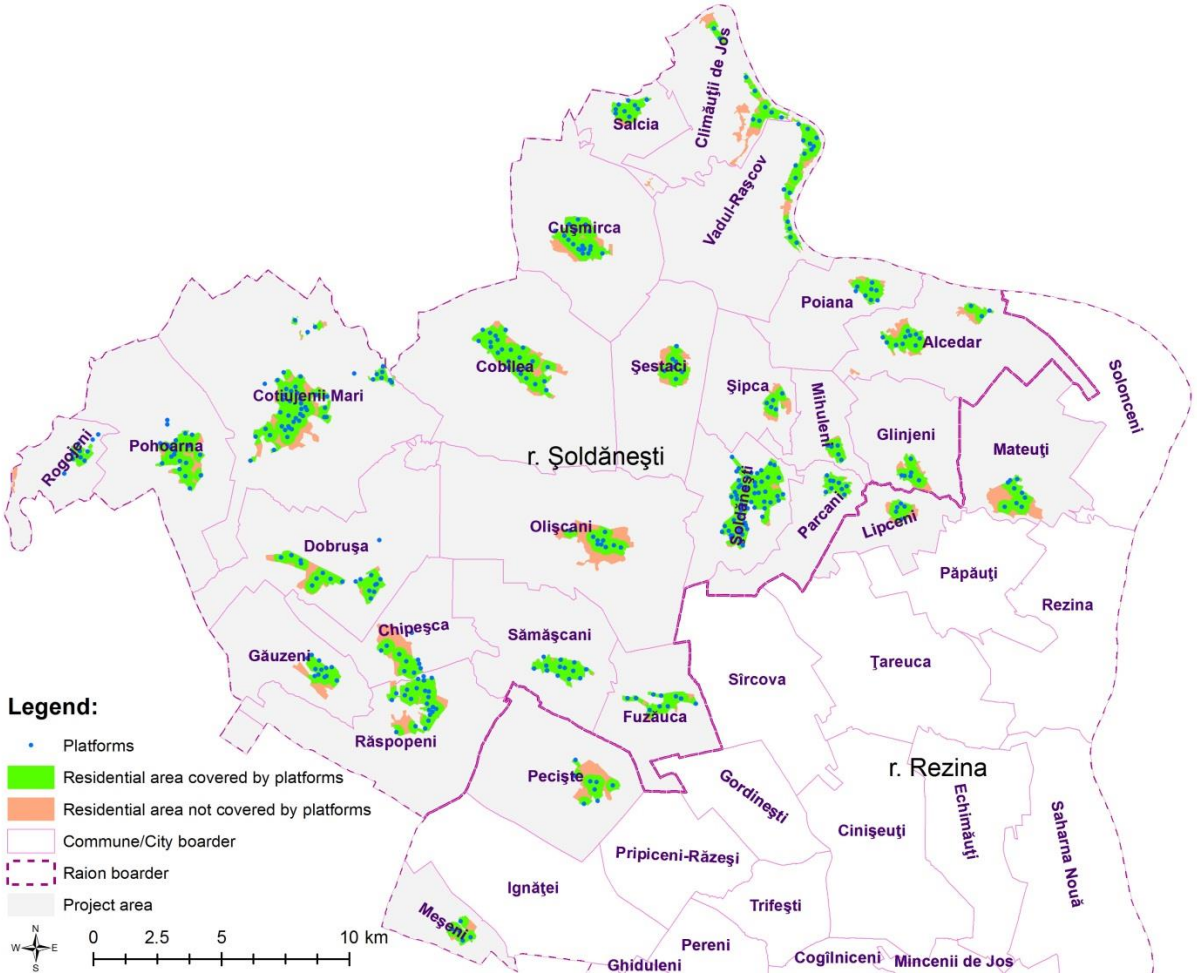
Analysed sample (China)

Annex 3

The map of the platform coverage of the residential areas within the project area

Annex 3

The map of the platform coverage of the residential areas within the project area



Data source: Institute of Ecology and Geography, GOPA; Map design: GOPA, 2013.

Notes:

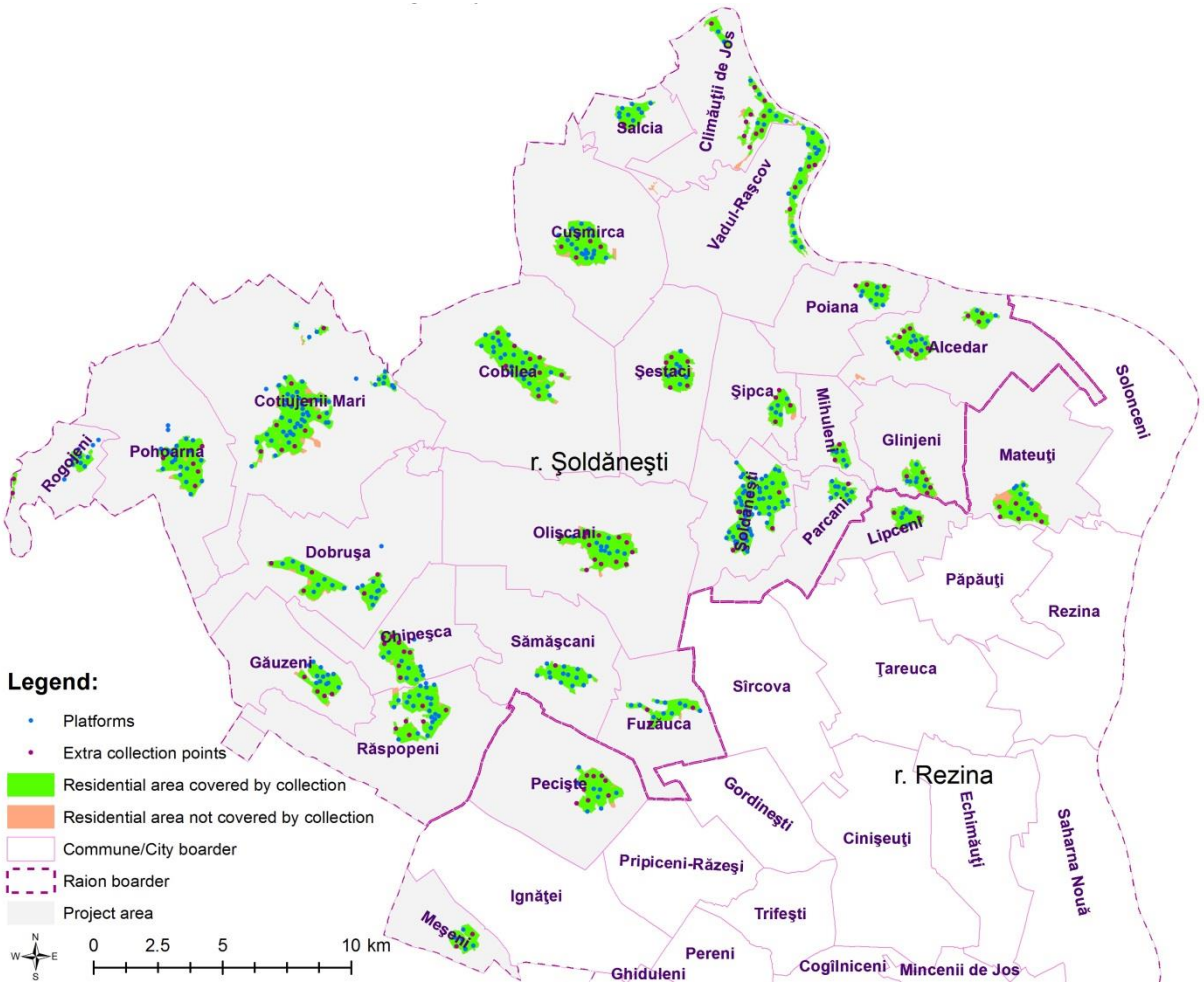
1. The area covered by platforms represents the residential area within a 300 m buffer distance from the platforms.
2. The area not covered by platforms represents the residential area outside a 300 m buffer distance from the platforms.
3. The analysis assumes that the area with easy access to the platforms is equally proportional to the population covered by collection.

Annex 4

The map of the coverage of the residential areas with platforms and extra collection points

Annex 4

The map of the coverage of the residential areas with platforms and extra collection points



Data source: Institute of Ecology and Geography, GOPA; Map design: GOPA, 2013.

Notes:

1. The area covered by collection represents the residential area within a 300 m buffer distance from the platforms and extra collection points.
2. The area not covered by collection represents the residential area outside a 300 m buffer distance from the platforms and extra collection points.
3. The analysis assumes that the area with easy access to the platforms and extra collection points is equally proportional to the population covered by collection.

Annex 5

The number of platforms, extra collection points, public places and required containers in the municipalities within Soldanesti service area

Annex 5

The number of platforms, extra collection points, public places and required containers in the municipalities within Soldanesti service area

Municipality name	Nr. of platforms	Estimated collection coverage of platforms	Containers at platforms:				Nr. of extra collection points	Containers at extra collection points:				Nr. of public places	Containers at bublic places:		Total containers:	
			for res. waste:		fro reciclables:			for res. waste:		for reciclables:			for res. waste:	for reciclables:		
			0.24 m3	1.1 m3	0.24 m3	1.1 m3		0.24 m3	1.1 m3	0.24 m3	1.1 m3		0.24 m3	0.24 m3	0.24 m3	1.1 m3
Soldanesti raion:	**261**		**212**	**225**	**522**	**261**	**96**	**16**	**96**	**192**	**96**	**160**	**160**	**480**	**1,582**	**678**
1. Soldanesti city	53	98%	212		106	53	4	16		8	4	20	20	60	422	57
2. Alcedar	13	73%		13	26	13	10		10	20	10	10	10	30	86	46
3. Chipesca	10	59%		10	20	10	8		8	16	8	10	10	30	76	36
4. Climautii de Jos	9	53%		9	18	9	10		10	20	10	7	7	21	66	38
5. Cobilea	24	85%		24	48	24	8		8	16	8	10	10	30	104	64
6. Cusmirca	20	81%		20	40	20	4		4	8	4	7	7	21	76	48
7. Fuzauca	7	90%		7	14	7	3		3	6	3	7	7	21	48	20
8. Gauzeni	12	69%		12	24	12	4		4	8	4	10	10	30	72	32
9. Glinjeni (Hlingeni)	6	78%		6	12	6	5		5	10	5	5	5	15	42	22
10. Mihuleni	5	94%		5	10	5	2		2	4	2	5	5	15	34	14
11. Oliscani	11	46%		11	22	11	13		13	26	13	10	10	30	88	48
12. Parcani	9	99%		9	18	9	1		1	2	1	5	5	15	40	20
13. Poiana	8	87%		8	16	8	3		3	6	3	10	10	30	62	22
14. Raspopeni	23	80%		23	46	23	6		6	12	6	10	10	30	98	58
15. Salcia	9	91%		9	18	9	1		1	2	1	5	5	15	40	20
16. Samascani	13	98%		13	26	13	1		1	2	1	7	7	21	56	28
17. Sestaci	7	74%		7	14	7	5		5	10	5	5	5	15	44	24
18. Sipca	5	65%		5	10	5	4		4	8	4	10	10	30	58	18
19. Vadul-Rascov	17	86%		34	34	17	4		8	8	4	7	7	21	70	63
Rezina raion:	**27**		**0**	**49**	**54**	**27**	**19**	**0**	**35**	**38**	**19**	**35**	**35**	**105**	**232**	**130**
1. Lipceni	5	71%		5	10	5	3		3	6	3	5	5	15	36	16
2. Mateuti	9	58%		18	18	9	6		12	12	6	10	10	30	70	45
3. Meseni	5	84%		10	10	5	2		4	4	2	10	10	30	54	21
4. Peciste	8	58%		16	16	8	8		16	16	8	10	10	30	72	48
Total:	**288**		**212**	**274**	**576**	**288**	**115**	**16**	**131**	**230**	**115**	**195**	**195**	**585**	**1,814**	**808**

Source: elaborated by GOPA.

Annex 6

Collection and transportation of residual waste from the collection clusters within project area, years 2014 and 2016

Annex 6

Collection and transportation of residual waste[1] from the collection clusters within the project area, years 2014 and 2016

Year 2014

Cluster	Nr of municipalities within the cluster	Nr of collection points:		Truck used to collect the waste	Nr of routes per week	Distance travelled per route (km):		Distance travelled per year (km/y):	Fuel consumption per year* (litters/y):	Location of the intermediate disposal site	Waste collected and disposed per year:	
		platforms	extra collection points			during collection	during transportation				tons/y	m^3/y
Soldanesti Service Area												
Cluster 1	1 (Soldanesti city)	53	4	IVECO - 8m^3	9	9	9	7,920	6,744	Soldanesti city	1,548	3,871
Cluster 2	2 (Parcani, Lipceni)	14	4	MAN - 14m^3	1	12	24	1,714	772	Soldanesti city	257	620
Cluster 3	1 (Cobilea)	24	8	MAN - 22m^3	1	18	26	2,122	876	Soldanesti city	483	1,164
Cluster 4	1 (Oliscani)	11	13	MAN - 14m^3	1	17	17	1,642	697	Soldanesti city	457	1,101
Cluster 5	2 (Samascani, Fuzauca)	20	4	MAN - 14m^3	2	9	32	3,984	1,313	Soldanesti city	378	912
Cluster 6	3 (Chipesca, Raspopeni, Gauzeni)	45	18	MAN - 22m^3	3	14	64	11,146	3,555	Raspopeni	1,035	2,493
Cluster 7	2 (Peciste, Meseni)	13	10	MAN - 22m^3	2	10	94	9,970	3,015	Raspopeni	648	1,560
Cluster 8	3 (Mihuleni, Glinjeni, Mateuti)	20	13	MAN - 22m^3	2	10	33	4,133	1,570	Alcedar	663	1,598
Cluster 9	3 (Alcedar, Poiana, Sipca)	26	17	MAN - 22m^3	1	28	38	3,154	1,381	Alecedar	519	1,250
Cluster 10	2 (Cusmirca, Sestaci)	27	9	MAN - 14m^3	2	10	29	3,792	1,343	Cusmirca	612	1,474
Cluster 11	3 (Vadul-Rascov, Climautii de Jos, Salcia)	35	15	MAN - 22m^3	2	21	89	10,570	3,392	Cusmirca	886	2,135
Total:	**23**	**288**	**115**	**3**	**26**	**158**	**455**	**60,147**	**24,658**	**-**	**7,486**	**18,178**

Cotiujenii Mari Service Area												
Cluster 12	1 (Cotiujenii mari)	50	-	GAZ - 7.5m^3	4	8	3	2,126	1,836	Cotiujenii Mari	632	1,523
Cluster 13	2 (Pohoarna, Rogojeni)	30	-	GAZ - 7.5m^3	3	9	12	3,048	1,388	Pohoarna, Rogojeni	432	1,040
Cluster 14	1 (Dobrusa)	19	-	GAZ - 7.5m^3	2	8	14	2,088	899	Dobrusa	205	493
Total:	**3**	**99**	**-**	**2**	**9**	**25**	**29**	**7,262**	**4,123**	**-**	**1,269**	**3,056**

Year 2016

Cluster	Nr of municipalities within the cluster	Nr of collection points:		Truck used to collect the waste	Nr of routes per week	Distance travelled per route (km):		Distance travelled per year (km/y):	Fuel consumption per year* (litters/y):	Location of the disposal site	Waste collected and disposed per year:	
		platforms	extra collection points			during collection	during transportation				tons/y	m^3/y
Soldanesti Service Area												
Cluster 1	1 (Soldanesti city)	53	4	IVECO - 8m^3	9	9	13	9,518	6,984	Parcani	1,554	3,885
Cluster 2	2 (Parcani, Lipceni)	14	4	MAN - 14m^3	1	12	16	1,315	559	Parcani	260	627
Cluster 3	1 (Cobilea)	24	8	MAN - 22m^3	1	18	31	2,352	954	Parcani	478	1,152
Cluster 4	1 (Oliscani)	11	13	MAN - 14m^3	1	17	17	1,642	697	Parcani	430	1,075
Cluster 5	2 (Samascani, Fuzauca)	20	4	MAN - 14m^3	2	9	34	4,157	1,356	Parcani	375	903
Cluster 6	3 (Chipesca, Raspopeni, Gauzeni)	45	18	MAN - 22m^3	3	14	164	25,574	7,163	Parcani	1,047	2,522
Cluster 7	2 (Peciste, Meseni)	13	10	MAN - 22m^3	2	10	110	11,506	3,339	Parcani	687	1,655
Cluster 8	3 (Mihuleni, Glinjeni, Mateuti)	20	13	MAN - 22m^3	2	10	35	4,325	1,618	Parcani	670	1,615
Cluster 9	3 (Alcedar, Poiana, Sipca)	26	17	MAN - 22m^3	1	28	57	4,061	1,608	Parcani	510	1,228

Cluster 10	2 (Cusmirca, Sestaci)	27	9	MAN - 14m^3	2	10	34	4,272	1,463	Parcani	610	1,470
Cluster 11	3 (Vadul-Rascov, Climautii de Jos, Salcia)	35	15	MAN - 22m^3	2	21	139	15,350	4,587	Parcani	911	2,195
Total:	**23**	**288**	**115**	**3**	**26**	**158**	**650**	**84,072**	**30,328**	**-**	**7,532**	**18,327**
Cotiujenii Mari Service Area												
Cluster 12	1 (Cotiujenii mari)	50	-	GAZ - 7.5m^3	4	8	58	12,614	3,409	Parcani	633	1,524
Cluster 13	2 (Pohoarna, Rogojeni)	30	-	GAZ - 7.5m^3	3	9	91	14,510	3,108	Parcani	425	1,024
Cluster 14	1 (Dobrusa)	19	-	GAZ - 7.5m^3	2	8	56	6,144	1,507	Parcani	195	469
Total:	**3**	**99**	**-**	**2**	**9**	**25**	**205**	**33,268**	**8,024**	**-**	**1,253**	**3,017**

*Fuel consumption calculation assumptions: IVECO truck - during collection within residential areas = 25 l/100; during transportation on main roads = 20 l/100. MAN truck - during collection within residential areas = 30 l/100; during transportation on main roads = 25 l/100. GAZ truck - during collection within residential areas = 20 l/100; during transportation on main roads = 15 l/100. Loading the waste into the truck = 0.15 l per container.
[1]Residual waste generated from population, economic entities and public institutions.

Source: elaborated by GOPA.

Annex 7

Collection and transportation of recyclables from the collection clusters within the project area, years 2014 and 2016

Annex 7

Collection and transportation of recyclables[1] from the collection clusters within the project area, years 2014 and 2016

Year 2014

Cluster	Nr of municipalities within the cluster	Nr of collection points:		Truck used to collect the waste	Nr of routes per year	Distance travelled per route (km):		Distance travelled per year (km/y):	Fuel consumption per year* (litters/y):	Recyclables recovered per year (tons/y):
		platforms	extra collection points			during collection	during transportation			
Soldanesti service area										
Cluster 1	1 (Soldanesti city)	53	4	MAN - 14m^3	56	28	7	1,943	598	110
Cluster 2	2 (Parcani, Lipceni)	14	4	MAN - 14m^3	16	12	22	546	158	9
Cluster 3	1 (Cobilea)	24	8	MAN - 14m^3	16	18	24	674	202	18
Cluster 4	3 (Oliscani, Samascani, Fuzauca)	31	17	MAN - 14m^3	20	36	27	1,256	382	31
Cluster 5	2 (Peciste, Meseni)	13	10	MAN - 14m^3	31	20	55	2,316	629	24
Cluster 6	3 (Chipesca, Raspopeni, Gauzeni)	45	18	MAN - 14m^3	20	41	50	1,824	537	38
Cluster 7	3 (Mihuleni, Glinjeni, Mateuti)	20	13	MAN - 14m^3	26	20	28	1,251	362	24
Cluster 8	3 (Alcedar, Poiana, Sipca)	26	17	MAN - 14m^3	14	28	50	1,089	325	19
Cluster 9	2 (Cusmirca, Sestaci)	27	9	MAN - 14m^3	17	21	27	816	243	22
Cluster 10	3 (Vadul-Rascov, Climautii de Jos, Salcia)	35	15	MAN - 14m^3	21	42	63	2,201	626	33
Total:	**23**	**288**	**115**	**1**	**237**	**266**	**353**	**13,916**	**4,062**	**328**
Cotiujenii Mari service area										
Cluster 11	1 (Cotiujenii Mari)	50	-	MAN - 14m^3	10	32	60	924	255	23
Cluster 12	3 (Pohoarna, Rogojeni, Dobrusa)	49	-	MAN - 14m^3	12	44	76	1,436	393	22
Total:	**4**	**99**	**-**	**1**	**22**	**76**	**136**	**2,360**	**648**	**45**

Year 2016

Cluster	Nr of municipalities within the cluster	Nr of collection points:		Truck used to collect the waste	Nr of routes per year	Distance travelled per route (km):		Distance travelled per year (km/y):	Fuel consumption per year* (litters/y):	Recyclables recovered per year (tons/y):
		platforms	extra collection points			during collection	during transportation			
Soldanesti service area										
Cluster 1	1 (Soldanesti city)	53	4	MAN - 14m^3	73	28	11	2,811	838	144
Cluster 2	2 (Parcani, Lipceni)	14	4	MAN - 14m^3	24	12	16	658	191	15
Cluster 3	1 (Cobilea)	24	8	MAN - 14m^3	24	18	31	1,176	335	27
Cluster 4	3 (Oliscani, Samascani, Fuzauca)	31	17	MAN - 14m^3	28	36	25	1,702	508	46
Cluster 5	2 (Peciste, Meseni)	13	10	MAN - 14m^3	49	20	56	3,729	1,000	39
Cluster 6	3 (Chipesca, Raspopeni, Gauzeni)	45	18	MAN - 14m^3	31	41	55	2,976	847	59
Cluster 7	3 (Mihuleni, Glinjeni, Mateuti)	20	13	MAN - 14m^3	40	20	35	2,196	612	38
Cluster 8	3 (Alcedar, Poiana, Sipca)	26	17	MAN - 14m^3	21	28	57	1,777	506	29
Cluster 9	2 (Cusmirca, Sestaci)	27	9	MAN - 14m^3	26	21	34	1,425	405	34
Cluster 10	3 (Vadul-Rascov, Climautii de Jos, Salcia)	35	15	MAN - 14m^3	33	42	69	3,683	1,021	51
Total:	**23**	**288**	**115**	**1**	**349**	**266**	**389**	**22,133**	**6,263**	**482**
Cotiujenii Mari service area										
Cluster 11	1 (Cotiujenii Mari)	50	-	MAN - 14m^3	16	32	65	1,555	422	35
Cluster 12	3 (Pohoarna, Rogojeni, Dobrusa)	49	-	MAN - 14m^3	18	44	81	2,241	607	35
Total:	**4**	**99**	**-**	**1**	**34**	**76**	**146**	**3,796**	**1,029**	**70**

*Fuel consumption calculation assumptions: MAN truck - during collection within residential areas = 30 l/100; during transportation on main roads = 25 l/100. Loading the waste into the truck = 0.15 l per container.
[1]Recyclables generated from population, economic entities and public institutions.

Source: elaborated by GOPA.

Annex 8

The quantity (tons/year) of the collected fractions of household waste in the administrative units within Soldanesti service area, 2014-2030

Annex 8

The quantity (tons/year) of the collected fractions of household waste in the administrative units within Soldanesti service area, 2014-2030

Place name	2014						2020						2025						2030					
	HW:	Res	MP	P	M	G	**HW:**	Res	MP	P	M	G	**HW:**	Res	MP	P	M	G	**HW:**	Res	MP	P	M	G
Soldanesti raion:	**6,356**	**6,083**	**79**	**130**	**10**	**55**	**6,813**	**6,181**	**181**	**301**	**22**	**128**	**7,243**	**6,451**	**227**	**378**	**28**	**161**	**7,725**	**6,810**	**262**	**436**	**32**	**185**
1. Soldanesti city	**1,563**	1,460	31	50	3.8	19	**1,689**	1,510	53	86	6.6	33	**1,801**	1,587	64	103	7.9	40	**1,921**	1,674	73	119	9.1	46
2. Alcedar	**257**	248	3	4	0.3	2	**267**	243	7	11	0.8	5	**275**	246	8	14	1.0	6	**284**	252	9	16	1.1	7
3. Chipesca	**208**	201	2	3	0.2	2	**185**	169	5	8	0.6	3	**168**	151	5	8	0.6	4	**153**	136	5	8	0.6	4
4. Climautii de Jos	**287**	277	3	5	0.3	2	**329**	300	8	14	1.0	6	**369**	330	11	19	1.3	8	**413**	366	13	23	1.6	10
5. Cobilea	**485**	467	5	8	0.6	4	**498**	454	12	21	1.5	9	**509**	455	15	26	1.8	11	**520**	460	17	28	2.0	13
6. Cusmirca	**406**	392	4	7	0.5	3	**424**	387	11	18	1.3	8	**440**	394	13	22	1.6	10	**457**	404	15	25	1.8	11
7. Fuzauca	**136**	132	1	2	0.2	1	**143**	130	4	6	0.4	3	**148**	132	4	7	0.5	3	**154**	136	5	8	0.6	4
8. Gauzeni	**301**	290	3	5	0.4	2	**364**	332	9	15	1.1	7	**428**	382	13	22	1.5	9	**502**	444	16	27	2.0	12
9. Glinjeni (Hlingeni)	**172**	166	2	3	0.2	1	**182**	166	5	8	0.5	3	**190**	170	6	10	0.7	4	**199**	176	6	11	0.8	5
10. Mihuleni	**104**	101	1	2	0.1	1	**109**	100	3	5	0.3	2	**114**	102	3	6	0.4	3	**118**	105	4	6	0.5	3
11. Oliscani	**457**	441	5	8	0.5	3	**450**	410	11	19	1.3	8	**444**	397	13	22	1.6	10	**439**	388	14	24	1.7	11
12. Parcani	**152**	146	2	3	0.2	1	**175**	159	4	7	0.5	3	**197**	176	6	10	0.7	4	**222**	196	7	12	0.9	5
13. Poiana	**136**	131	1	2	0.2	1	**126**	115	3	5	0.4	2	**119**	106	4	6	0.4	3	**112**	99	4	6	0.4	3
14. Raspopeni	**525**	506	5	9	0.6	4	**590**	538	15	25	1.8	11	**650**	581	19	33	2.3	14	**716**	634	23	39	2.8	17
15. Salcia	**179**	173	2	3	0.2	1	**190**	173	5	8	0.6	4	**198**	177	6	10	0.7	4	**208**	184	7	11	0.8	5
16. Samascani	**241**	232	2	4	0.3	2	**245**	224	6	10	0.7	5	**249**	223	7	13	0.9	6	**253**	224	8	14	1.0	6
17. Sestaci	**204**	197	2	3	0.2	2	**217**	198	5	9	0.7	4	**229**	204	7	12	0.8	5	**241**	213	8	13	0.9	6
18. Sipca	**122**	117	1	2	0.1	1	**124**	113	3	5	0.4	2	**127**	113	4	6	0.5	3	**129**	114	4	7	0.5	3
19. Vadul-Rascov	**422**	407	4	7	0.5	3	**506**	461	13	21	1.5	9	**588**	526	18	30	2.1	13	**685**	606	22	37	2.7	16
Rezina raion:	**1,138**	**1,098**	**11**	**19**	**1**	**8**	**1,336**	**1,218**	**33**	**56**	**4**	**25**	**1,547**	**1,383**	**46**	**78**	**6**	**34**	**1,880**	**1,664**	**61**	**103**	**7**	**45**
1. Lipceni	**103**	100	1	2	0.1	1	**106**	96	3	4	0.3	2	**108**	96	3	5	0.4	2	**110**	97	4	6	0.4	3
2. Mateuti	**386**	373	4	6	0.5	3	**434**	395	11	18	1.3	8	**469**	419	14	24	1.7	10	**526**	466	17	29	2.1	13
3. Meseni	**176**	170	2	3	0.2	1	**199**	182	5	8	0.6	4	**217**	194	7	11	0.8	5	**246**	217	8	13	1.0	6
4. Peciste	**473**	456	5	8	0.6	3	**597**	544	15	25	1.8	11	**754**	674	23	38	2.7	17	**998**	883	32	54	3.9	24
Total:	**7,494**	**7,181**	**90**	**149**	**11**	**63**	**8,149**	**7,398**	**214**	**357**	**26**	**153**	**8,791**	**7,834**	**273**	**456**	**33**	**195**	**9,604**	**8,473**	**323**	**538**	**39**	**231**

HW - total household waste; Res - residual waste; MP - mixed paper; P - plastics; M - metal; G - glass. Source: elaborated by GOPA.

Annex 9

The quantity (tons/year) of the collected fractions of household waste in the administrative units within Cotiujenii Mari service area, 2014-2030

Annex 9

The quantity (tons/year) of the collected fractions of household waste in the administrative units within Cotiujenii Mari service area, 2014-2030

Place name	2014						2020						2025						2030					
	HW:	Res	MP	P	M	G	**HW:**	Res	MP	P	M	G	**HW:**	Res	MP	P	M	G	**HW:**	Res	MP	P	M	G
1. Cotiujenii Mari	**631**	608	6	11	0.8	5	**671**	611	17	28	2.0	12	**706**	631	21	36	2.5	16	**743**	657	24	41	2.9	18
2. Pohoarna	**312**	301	3	5	0.4	2	**313**	286	8	13	0.9	6	**314**	281	9	16	1.1	7	**315**	279	10	17	1.2	8
3. Rogojeni	**120**	115	1	2	0.1	1	**122**	111	3	5	0.4	2	**124**	111	4	6	0.4	3	**126**	112	4	7	0.5	3
4. Dobrusa	**201**	194	2	3	0.2	1	**182**	166	5	8	0.5	3	**167**	150	5	8	0.6	4	**154**	137	5	8	0.6	4
Total:	**1,263**	**1,218**	**13**	**21**	**2**	**9**	**1,288**	**1,174**	**32**	**54**	**4**	**24**	**1,311**	**1,172**	**39**	**66**	**5**	**29**	**1,338**	**1,184**	**43**	**73**	**5**	**32**

HW - total household waste; Res - residual waste; MP - mixed paper; P - plastics; M - metal; G - glass.

Source: elaborated by GOPA.

Annex 10

Commercial waste (similar to household waste) generated from Economic Entities and Public Institutions, 2014-2030

Annex 10

Commercial waste (similar to household waste) generated from Economic Entities and Public Institutions within project area, 2014-2030

Varibale	Units	2014	2015	2016	2017	2018	2019	2020	2025	2030
Residual waste (RW) generated:										
RW in Soldanesti Service Area:	**tons/year**	**306**	**302**	**299**	**295**	**293**	**290**	**287**	**280**	**275**
Urban area (Soldanesti city):	*tons/year*	*88*	*87*	*86*	*85*	*85*	*84*	*84*	*82*	*81*
Rural area:	*tons/year*	*217*	*215*	*212*	*210*	*208*	*205*	*203*	*198*	*195*
RW in Cotiujenii Mari Service Area:	**tons/year**	**50**	**49**	**48**	**47**	**47**	**46**	**45**	**43**	**42**
Recyclables generated:										
Recyclables in Soldanesti Service Area:	**tons/year**	**14**	**17**	**20**	**23**	**25**	**27**	**30**	**35**	**37**
Recyclables from urban area:	*tons/year*	*6*	*7*	*8*	*9*	*9*	*10*	*10*	*11*	*12*
Recyclables from rural area:	*tons/year*	*8*	*10*	*12*	*14*	*16*	*18*	*20*	*23*	*25*
Recyclables in Cotiujenii Mari Service Area:	**tons/year**	**2**	**2**	**3**	**3**	**4**	**4**	**4**	**5**	**5**
Public Institutions (PI) Data:										
Nr. of PI in Soldanesti Service Area:	#	**152**	**152**	**152**	**152**	**152**	**152**	**152**	**152**	**152**
Number of Public Institutions in Soldanesti city:	#	*17*	*17*	*17*	*17*	*17*	*17*	*17*	*17*	*17*
Number of Public Institutions in rural area:	#	*135*	*135*	*135*	*135*	*135*	*135*	*135*	*135*	*135*
Nr. of PI in Cotiujenii Mari Service Area:	#	**27**	**27**	**27**	**27**	**27**	**27**	**27**	**27**	**27**
Schools Data:										
Soldanesti Service Area:										
Nr. of schools and kindergartens in Soldanesti city:	#	4	4	4	4	4	4	4	4	4
Total students in schools	#	*1,054*	*1,047*	*1,039*	*1,032*	*1,025*	*1,018*	*1,011*	*977*	*943*
Total children in the kindergartens	#	*243*	*242*	*240*	*238*	*237*	*235*	*234*	*226*	*218*
Total number of teachers in the schools	#	*86*	*86*	*86*	*86*	*86*	*86*	*86*	*86*	*86*
Total number of teachers in the kindergartens	#	*23*	*23*	*23*	*23*	*23*	*23*	*23*	*23*	*23*
Nr. of schools and kindergartens in rural area:	#	47	47	47	47	47	47	47	47	47
Total students in schools	#	*3,559*	*3,536*	*3,513*	*3,492*	*3,471*	*3,452*	*3,434*	*3,359*	*3,310*
Total children in the kindergartens	#	*1,013*	*1,007*	*1,002*	*997*	*992*	*988*	*984*	*966*	*954*
Total number of teachers in the schools	#	*369*	*369*	*369*	*369*	*369*	*369*	*369*	*369*	*369*
Total number of teachers in the kindergartens	#	*126*	*126*	*126*	*126*	*126*	*126*	*126*	*126*	*126*
Cotiujenii Mari Service Area:										
Nr. of schools and kindergartens:	#	11	11	11	11	11	11	11	11	11
Total students in schools	#	*816*	*800*	*784*	*768*	*753*	*738*	*723*	*655*	*594*
Total children in the kindergarten	#	*278*	*273*	*268*	*263*	*258*	*254*	*250*	*229*	*210*
Total number of teachers in the schools	#	*76*	*76*	*76*	*76*	*76*	*76*	*76*	*76*	*76*
Total number of teachers in thekindergarten	#	*39*	*39*	*39*	*39*	*39*	*39*	*39*	*39*	*39*
Economic Entities (EE) Data:										
Nr. of EE in Soldanesti Service Area:	#	**310**	**310**	**310**	**310**	**310**	**310**	**310**	**310**	**310**
Number of Economic Entities in Soldanesti city:	#	127	127	127	127	127	127	127	127	127
Small econ. entit. (i.e., individual enterprises):	#	*109*	*109*	*109*	*109*	*109*	*109*	*109*	*109*	*109*
Large econ. entit. (i.e., JSC, LC - SA, SRL, IM, IS, etc.):	#	*18*	*18*	*18*	*18*	*18*	*18*	*18*	*18*	*18*
Number of Economic Entities in rural area:	#	183	183	183	183	183	183	183	183	183
Small econ. entit. (i.e., individual enterprises):	#	*145*	*145*	*145*	*145*	*145*	*145*	*145*	*145*	*145*
Large econ. entit. (i.e., JSC, LC - SA, SRL, IM, IS, etc.):	#	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*
Nr. of EE Cotiujenii Mari Service Area:	#	**44**	**44**	**44**	**44**	**44**	**44**	**44**	**44**	**44**
Small econ. entit. (i.e., individual enterprises):	#	*36*	*36*	*36*	*36*	*36*	*36*	*36*	*36*	*36*
Large econ. entit. (i.e., JSC, LC - SA, SRL, IM, IS, etc.):	#	*8*	*8*	*8*	*8*	*8*	*8*	*8*	*8*	*8*

Notes:

1) Data sources: data on economic entities - Rayon Councils, 2013; data on public institutions: Municipalities, 2013; data on schools - Ministry of Education (ME), 2013; data on kindergartens – Ministry of Economy (MEC), 2009.
2) Assumptions used to calculate the waste generation:
   2.0 kg/econ. entity/w.day; 2.0 kg/publ. inst./w.day.
   0.1 kg/student/school day; 0.05 kg/child in the kindergarten/w.day.
   0.15 kg/teacher in the school/school day; 0.15 kg/teacher in the kindergarten/w.day.
   School days per year = 176; working days per year = 250.
   Waste composition = waste composition of household waste.
   Recovery rate of recyclables = recovery rate of recyclables from household waste.

Annex 11

The inventory data on solid waste disposal sites in the project area

Annex 11

The inventory data on solid waste disposal sites in the project area

Administrative unit of the site location	Potential Risk to Human Health	Potential Risk to the Environment	Ranking for Remediation Action	Total Risk Rank	Potential to Extend the Site	Access road	Bottom layer	Area, ha	Municipal Waste, %	Construction/ Demolition Waste, %	Animal Manure, %	Other, %
r. Soldanesti												
Soldanesti city	High	High	Urgent	1	No	gravel		0.5	30	40	20	10
Raspopeni	Low	Low	Low	4	Yes	soil		0.1	0	0	0	0
Rogojeni	Low	Low	Low	4	Yes	gravel	clay, sand/soil	0.2	5	80	10	5
Poiana	Medium	Low	High	2	No	soil	sand/soil	0.2	20	20	50	10
Climautii de Jos	Low	Low	Low	4	Yes	gravel	clay	0.3	10	40	40	10
Glinjeni	Medium	Low	Low	4	Yes	soil	sand/soil	0.4	15	40	40	5
Parcani	Medium	Low	Medium	3	No	soil	sand/soil	0.4	20	15	60	5
Alcedar	Low	Low	Low	4	Yes	soil	clay, sand/soil	0.4	18	18	55	9
Cobilea	Medium	Low	Low	4	No	soil	sand/soil	0.4	15	10	65	10
Sipca	Medium	Low	Medium	3	No	gravel	sand/soil	0.5	10	15	65	10
Mihuleni	Low	Low	Low	4	Yes	soil	sand/soil	0.6	20	15	60	5
Oliscani	Medium	Low	Low	4	Yes	soil	clay, sand/soil	0.6	20	20	40	20
Sestaci	Medium	Low	Medium	3	No	soil	sand/soil	0.6	10	15	70	5
Vadul-Rascov	Low	Low	Low	4	Yes	soil	clay, sand/soil	0.8	0	0	0	0
Salcia	Medium	Low	Low	4	Yes	soil		0.9	20	40	30	10
Fuzauca	Medium	Low	Low	4	Yes	gravel	clay, sand/soil	0.9	10	80	5	5
Pohoarna	Low	Low	Low	4	Yes	gravel	clay, sand/soil	1	20	10	60	10
Chipesca	Low	Low	Low	4	Yes	soil	clay, sand/soil	1.1	20	20	50	10
Gauzeni	Low	Low	Low	4	Yes	gravel		1.6	21	16	58	5
Cotiujenii Mari	Low	Low	Low	4	Yes	soil	clay, sand/soil	1.6	9	55	27	9
Samascani	Low	Low	Low	4	Yes	soil		1.7	15	20	60	5
Cusmirca	Low	Low	Low	4	Yes	asphalt	clay, sand/soil	1.9	15	20	45	20
Dobrusa	Low	Low	Low	4	No	asphalt	clay, sand/soil	2.2	20	20	50	10
r. Rezina:												
Meseni	Low	Low	Low	4	Yes	gravel	clay, sand/soil	0.2	0	0	0	0
Lipceni	Low	Low	Low	4	No	soil	sand/soil	0.4	20	30	40	10
Peciste	Low	Low	Low	4	Yes	gravel	clay, sand/soil	0.4	22	17	50	11
Mateuti	Low	Low	Low	4	Yes	soil	sand/soil	1	20	25	40	15

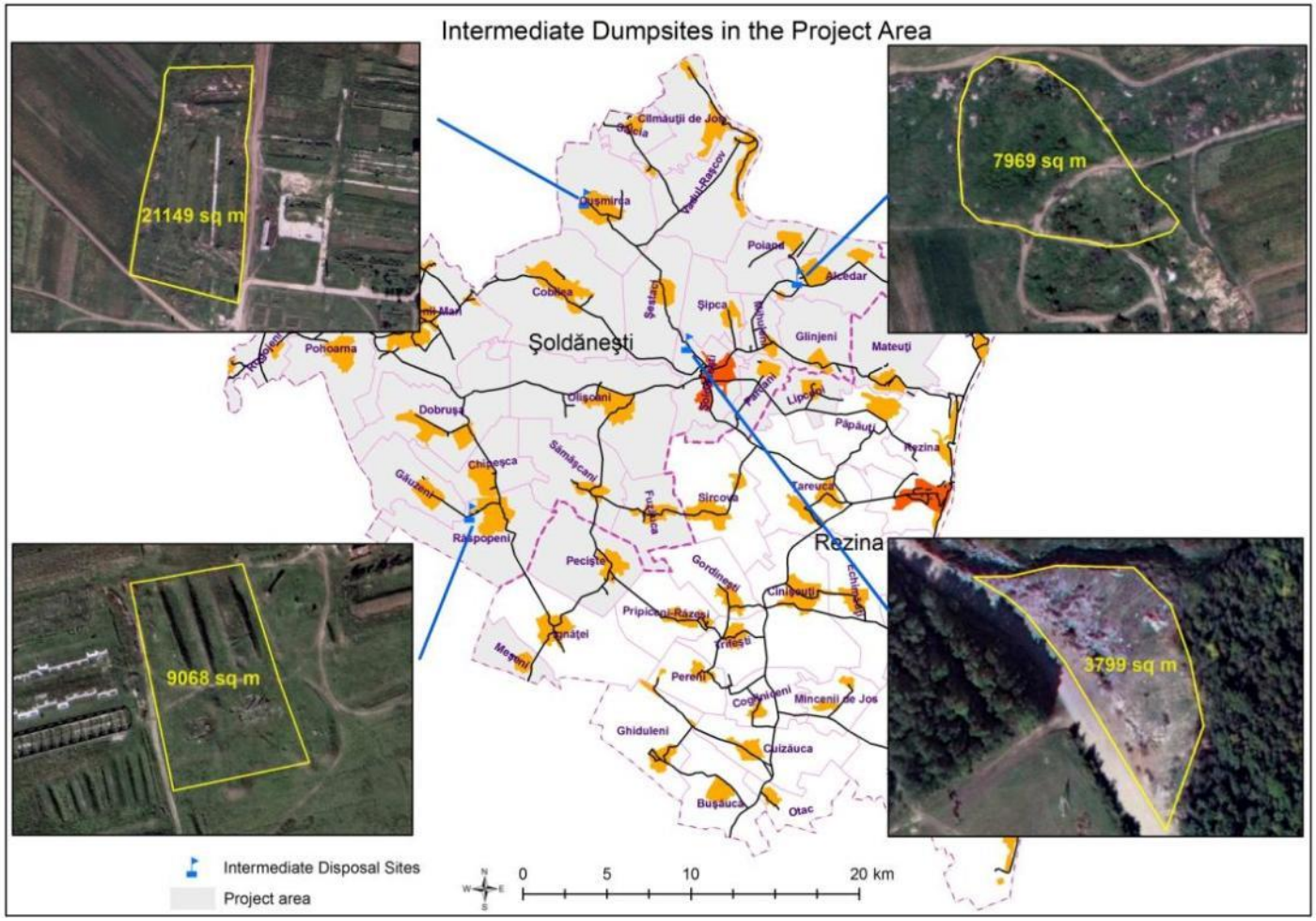
Data source: http://gismediu.gov.md. Note: the percentage of waste types at the disposal sites is based on visual inspection made at the moment of filed inventory.

Annex 12

The map of the intermediate waste disposal sites within the project area

Annex 12

The map of the intermediate waste disposal sites within the project area



Data source: Institute of Ecology and Geography, gismediu.gov.md, GOPA; Map design: GOPA, 2013.

Annex 13

The lifespan of the Enhanced Transitional Landfill depending on quantity of household waste disposed each year

Annex 13

The lifespan of the Enhanced Transitional Landfill depending on quantity of household waste disposed each year

Varibale	Units	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Landfill lifespan:																
Scenario 1 - Serving 27 municipalities from Soldanesti and Cotiujenii Mari Service Areas:																
Landfill available volume at the beginning of the year:	**m3**	**250,000**	**242,001**	**233,981**	**225,929**	**217,845**	**209,727**	**201,535**	**193,266**	**184,916**	**176,481**	**167,960**	**159,336**	**150,606**	**141,766**	**132,814**
New landfill volume added during the year:	m3		0	0	0	0	0	0	0	0	0	0	0	0	0	0
Remaining landfill volume at the end of the year:	m3	242,001	233,981	225,929	217,845	209,727	201,535	193,266	184,916	176,481	167,960	159,336	150,606	141,766	132,814	123,746
Scenario 2 - Serving 39 municipalities from Soldanesti , Rezina and Floresti raions:																
Landfill available volume at the beginning of the year:	**m3**	**250,000**	**234,491**	**218,910**	**203,224**	**187,431**	**171,529**	**155,455**	**139,207**	**122,767**	**106,134**	**89,301**	**72,245**	**54,959**	**37,440**	**19,681**
New landfill volume added during the year:	m3		0	0	0	0	0	0	0	0	0	0	0	0	0	0
Remaining landfill volume at the end of the year:	m3	234,491	218,910	203,224	187,431	171,529	155,455	139,207	122,767	106,134	89,301	72,245	54,959	37,440	19,681	1,678
Household Waste (HW) to be disposed:																
Scenario 1 - Serving 27 municipalities from Soldanesti and Cotiujenii Mari Service Areas:																
HW to be disposed every working day:	**tons/day**	**35**	**35**	**35**	**36**	**36**	**36**	**36**	**37**	**37**	**37**	**38**	**38**	**39**	**39**	**40**
HW to be disposed every year:	**tons/year**	**8,799**	**8,822**	**8,857**	**8,893**	**8,930**	**9,011**	**9,095**	**9,185**	**9,278**	**9,373**	**9,487**	**9,604**	**9,724**	**9,847**	**9,975**
Vol. of HW desposed (compaction of MBT - 1.1 tons/m3):	**m3/year**	**7,999**	**8,020**	**8,052**	**8,084**	**8,118**	**8,192**	**8,269**	**8,350**	**8,434**	**8,521**	**8,624**	**8,730**	**8,840**	**8,952**	**9,068**
Scenario 2 - Serving 39 municipalities from Soldanesti , Rezina and Floresti raions:																
HW to be disposed every working day:	**tons/day**	**68**	**69**	**69**	**69**	**70**	**71**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**
HW to be disposed every year:	**m3/year**	**17,060**	**17,138**	**17,255**	**17,373**	**17,492**	**17,681**	**17,873**	**18,083**	**18,297**	**18,515**	**18,762**	**19,014**	**19,272**	**19,535**	**19,803**
Vol. of HW desposed (compaction of MBT - 1.1 tons/m3):	**m3/year**	**15,509**	**15,580**	**15,686**	**15,793**	**15,902**	**16,074**	**16,249**	**16,439**	**16,634**	**16,832**	**17,057**	**17,286**	**17,520**	**17,759**	**18,003**
HW (residuals fraction) to be collected:																
Soldanesti ME Service Area:	tons/year	7,547	7,579	7,622	7,666	7,711	7,793	7,878	7,969	8,062	8,158	8,269	8,384	8,502	8,623	8,748
Cotiujenii Mari ME Service Area:	tons/year	1,251	1,243	1,235	1,227	1,219	1,218	1,217	1,217	1,216	1,216	1,218	1,220	1,222	1,224	1,227
Floresti ME Service Area:	tons/year	8,262	8,316	8,398	8,480	8,563	8,670	8,778	8,898	9,019	9,142	9,275	9,411	9,548	9,687	9,828

Source: elaborated by GOPA.

Annex 14

The steps of decision making process for the establishment of an Inter-municipal Co-operation (IMC) organization to provide the solid waste management service

Annex 14

The steps of decision making process for the establishment of an Inter-municipal Co-operation (IMC) organization to provide the solid waste management service

The decision to establish an IMC was developed over an extended period of time, involving a number of meetings and several steps:

- July to September 2012 - a number of municipalities signed a declaration of intent to cooperate regarding management of solid waste;
- July 30, 2013 - it was agreed to establish an inter-municipal company among municipalities from Soldanesti and Rezina rayons;
- September 17, 2013 - the recommended approach regarding IMC was presented and discussed during the meeting with the presence of authorities from Soldanesti rayon, local municipalities, Ministry of Environment, Ministry of Regional Development and Construction, and Regional Development Agency Center;
- September 23, 2013 - the share capital was discussed with Soldanesti rayon president;
- October 16, 2013 - the proposed fees were presented to the authorities from Soldanesti rayon and the municipalities from Soldanesti and Rezina;
- October 23, 2013 - share capital, start-up assistance, and ownership of future landfill were discussed with the president of Soldanesti rayon;
- In addition to the key events described above numerous other meetings and events took place prior to this to develop the cooperation.

Annex 15

The equipment donated to the municipality of Soldanesti

Annex 15

The equipment donated to the municipality of Soldanesti city

Nr.	Name of equipment	Quant.	Unit cost, MDL	Total cost, MDL	Total, EUR
1	Bulldozer Shantui SD22CPV 43211000	1	1,945,024.62	1,945,024.62	114,413
2	Blade for Bulldozer Shantui SD22CPV	1	215,968.16	215,968.16	12,704
3	Wheel loader (3t, 120 kW, shovel 2.5m³)	1	1,330,000.00	1,330,000.00	78,235
4	Car - Renault Master	1	364,084.92	364,084.92	21,417
5	Drum sieve, for recyclables sorting	1	1,108,547.10	1,108,547.10	65,209
6	Sorting belt, for recyclables sorting	1	321,318.00	321,318.00	18,901
7	Baler, for recyclables	1	160,659.00	160,659.00	9,451
8	Hand Lift	1	158,186.00	158,186.00	9,305
9	Drum sieve, for composting facility	1	1,609,648.00	1,609,648.00	94,685
10	Windrover - 1st unit	1	1,262,732.98	1,262,732.98	74,278
11	Windrover, 2nd unit	1	467,038.22	467,038.22	27,473
12	Wood shredder	1	4,644,756.00	4,644,756.00	273,221
13	Tractor Xuzhou KAT 1304	1	530,000.00	530,000.00	31,176
14	Tractor MTZ 1221.2	2	588,000.00	1,176,000.00	69,176
15	Trailer Shandong Juwel 7	3	84,000.00	252,000.00	14,824
16	Trailer Beck ZN120	4	166,400.00	665,600.00	39,153
17	MAN Truck 14 m^3 KAOSSIS CRV 200	1	1,800,413.40	1,800,413.40	105,907
18	MAN Truck 22 m^3 KAOSSIS CRV 200	1	1,942,551.30	1,942,551.30	114,268
19	Containers - 1.1 m^3	750	2,544.00	1,908,000.00	112,235
20	Containers (+cover) - 0.24 m^3	1,620	383.00	620,460.00	36,498
21	Cover for 0.24 m^3 containers, grey color	100	69.00	6,900.00	406
22	Cover for 0.24 m^3 containers, blue color	480	71.00	34,080.00	2,005
23	Cover for 0.24 m^3 containers, green color	480	77.00	36,960.00	2,174
24	Cover for 0.24 m^3 containers - red color	480	77.00	36,960.00	2,174
25	Cover for 0.24 m^3 containers - grey color	100	77.00	7,700.00	453
26	UN containers - 220 l	20	789.00	15,780.00	928
27	Welding equipment	1	4,330.00	4,330.00	255
28	Cleaning equipment	3	13,330.00	39,990.00	2,352
29	Grass cutter	8	4,500.00	36,000.00	2,118
30	Grass mower PRONAR PDK 210	1	71,273.77	71,273.77	4,193
31	Truck tires 315/80 R22,5DSR 266	8	3,420.00	27,360.00	1,609
32	Truck tires 315/80 R22,5DSR 08A	8	3,590.00	28,720.00	1,689
33	Truck tires 315/80 R22,5DSR 266	4	3,350.00	13,400.00	788
34	Truck tires 315/80 R22,5DSR 165	8	4,000.00	32,000.00	1,882
	Total:			**22,874,441.47**	**1,345,555**

1 EUR = 17 MDL

Source: GOPA.

Annex 16

The distribution of cash contributions and value of equipment between the shareholders of the JSC

Annex 16

The distribution of cash contributions and value of equipment between the shareholders of the JSC

Nr.	Shareholders:	Population, Census 2004	Value share of equipment, MDL	Cash contribution, MDL	Shares, %
1	or. Şoldăneşti	6,304	3,020,348.12	40,404.33	13.108%
2	Alcedar	1,548	741,671.78	9,921.62	3.219%
3	Chipeşca	1,645	788,146.04	10,543.33	3.420%
4	Climăuţii de Jos	1,467	702,863.37	9,402.47	3.050%
5	Cobîlea	2,986	1,430,640.78	19,138.22	6.209%
6	Cuşmirca	2,427	1,162,814.86	15,555.41	5.046%
7	Fuzăuca	814	390,000.53	5,217.18	1.693%
8	Găuzeni	1,404	672,679.05	8,998.68	2.919%
9	Hligeni (Glinjeni)	1,007	482,469.95	6,454.18	2.094%
10	Mihuleni	618	296,093.77	3,960.96	1.285%
11	Olişcani	3,025	1,449,326.31	19,388.18	6.290%
12	Parcani	769	368,440.31	4,928.76	1.599%
13	Poiana	996	477,199.67	6,383.68	2.071%
14	Răspopeni	2,775	1,329,547.28	17,785.85	5.770%
15	Salcia	1,053	504,509.29	6,749.01	2.190%
16	Sămăşcani	1,502	719,632.44	9,626.79	3.123%
17	Şestaci	1,184	567,273.50	7,588.63	2.462%
18	Şipca	756	362,211.80	4,845.44	1.572%
19	Vadul-Raşcov	2,004	960,148.74	12,844.27	4.167%
20	Lipceni	641	307,113.44	4,108.37	1.333%
21	Mateuti	2,045	979,792.50	13,107.05	4.252%
22	Meseni	916	438,870.38	5,870.93	1.905%
23	Peciste	1,914	917,028.28	12,267.43	3.980%
24	Cotiujenii Mari	3,657	1,752,127.71	23,438.87	7.604%
25	Dobruşa	1,541	738,317.97	9,876.76	3.204%
26	Pohoarna	2,002	959,190.50	12,831.45	4.163%
27	Rogojeni	743	355,983.29	4,762.12	1.545%
28	Cons. r. Soldanesti		0.00	170,000.00	0.728%
	Total	**47,743**	**22,874,441.67**	**476,000.00**	**100.000%**

Source: elaborated by GOPA.

Annex 17

The elements of the Joint Stock Company

Annex 17

The elements of the Joint Stock Company

Shareholder Assembly	The Shareholder Assembly consists of all the owners of the JSC, i.e. the 23 municipalities and Soldanesti Rayon Council. Members, one from each owner, are appointed by the individual municipalities and the rayon council. Each member has voting rights according to the number of shares held by the respective owner.
Board of Directors	The Shareholder Assembly elects the Board of Directors. The Board shall consist of six members. The Board elects a Chairman among its members. Each Board Member has one vote. In case of parity of votes regarding a Board decision the vote of the Chairman will be deciding.
General Manager	A General Manager shall be appointed by the Board of Directors.
Administration	An administration that will be in charge of the day to day management and administration of the company under the direction of the General Manager shall be appointed/organized by the General Manager with support from board.
Operating Units	Under the direction and supervision of the General Manager and the Administration the Operating Units shall carry out the daily work in the field.

Source: elaborated by GOPA.

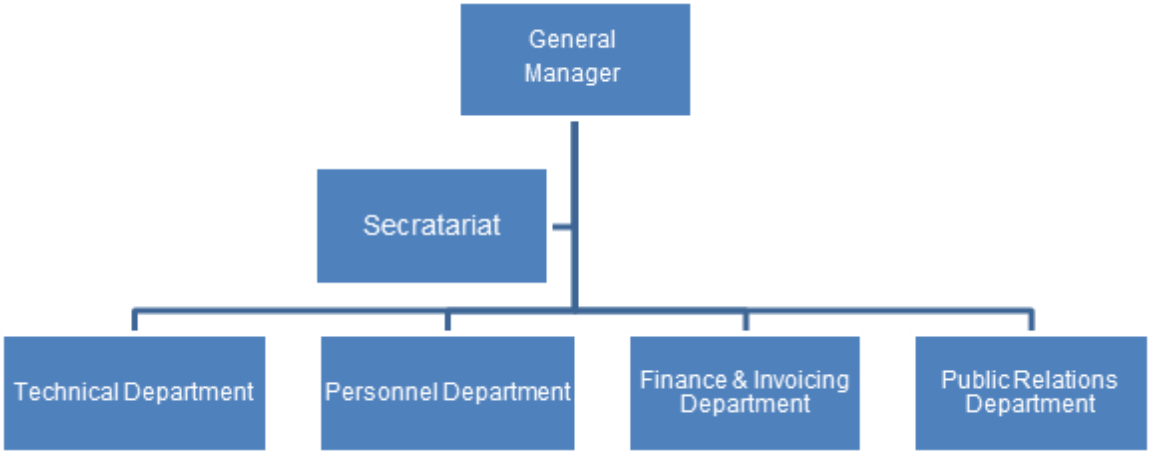
Annex 18

Organizational structure and chart of the Joint Stock Company (JSC)

Annex 18

Organizational structure and chart of the Joint Stock Company (JSC)

Organizational chart of the JSC



The administrative structure shall consist of a:

Technical Department which is in charge of:

- Waste management planning;
- Operational planning;
- Collection, transfer and transport;
- Maintenance of equipment including containers;
- Monitoring of the operation;
- Collection and sorting of recyclables;
- Collection and treatment of compostables;
- Operation of the landfill.

Personnel Department which is in charge of:

- Human resources management;
- Hiring of staff;
- Contracts with staff;
- Training of staff.

Public Relations Department which is in charge of:

- Dissemination of information material on waste management to the public and other stakeholders;
- Complaints management: respond to and take appropriate action regarding complaints from clients (the public, municipalities, commercial entities, etc.).

Finance & Invoicing Department which is in charge of:

- Financial management;
- Budget planning;
- Tariff calculation;
- Financial controlling and monitoring;
- Contracting;
- Commercial activities including selling of recyclables and compost.

Annex 19

The investment costs related to construction works and infrastructure for the inter-municipal solid waste management center

Annex 19

The investment costs related to construction works and infrastructure for the inter-municipal solid waste management center

Investment 1st Construction Stage	Unit	Quanti-ty	Unit cost, MDL	Total cost, MDL	Unit cost, EUR	Total cost, EUR
1. General works						
Site mobilization	l. sum	1	3,400,000	3,400,000	200,000.00	200,000
Site clearance	m²	40,000	5	204,000	0.30	12,000
Test field (Prototype landfill)	l. sum	1	136,000	136,000	8,000.00	8,000
Geotechnical survey	l. sum	1	85,000	85,000	5,000.00	5,000
Green belt	m²	0	34	0	2.00	0
Monitoring wells	No	3	25,500	76,500	1,500.00	4,500
Total:				3,901,500		229,500
2. Earthworks						
Bulk excavation landfill	m³	12,000	43	510,000	2.50	30,000
Bulk excavation Leachate Pond (cuts)	m³	2,000	43	85,000	2.50	5,000
Bulk excavation - Stormwater pond (cuts)	m³	0	43	0	2.50	0
Bulk excavation infrastructure	m³	600	43	25,500	2.50	1,500
0thers	m³	1,000	43	42,500	2.50	2,500
Levelling of planum	m²	25,000	4	106,250	0.25	6,250
Total:				769,250		45,250
3. Base liner system (combined liner system)						
Compaction and improvement of subsoil (45kn/m²) 150mm	m²	25,000	9	212,500	0.50	12,500
GCL	m²	25,000	102	2,550,000	6.00	150,000
2mm HDPE geomembrane	m²	25,000	102	2,550,000	6.00	150,000
Woven geotextile	m²	25,000	34	850,000	2.00	50,000
Drainage layer, 300mm gravel	m²	25,000	153	3,825,000	9.00	225,000
Total:				9,987,500		587,500
4. Leachate collection and storage						
PE-HD main leachate pipe (DN 250)	m	600	510	306,000	30.00	18,000
Leachate pipe support (sand)	m	600	85	51,000	5.00	3,000
Shafts	No	4	34,000	136,000	2,000.00	8,000
Geotextile layer A4	m²	2,000	34	68,000	2.00	4,000
1,5mm HDPE geo-membrane	m²	2,000	68	136,000	4.00	8,000
Total:				697,000		41,000
5. Surface water						
Surface water drainage along road (Concrete)	m	700	340	238,000	20.00	14,000
Total:				238,000		14,000
7. Gas Collection and Treatment						
				0		0
Total:				0		0
8. Infrastructure						
Access road (width = 6,5 m);only Asphalt layer	m	700	1,105	773,500	65.00	45,500
Internal landfill roads (width 7,5m)	m	200	2,550	510,000	150.00	30,000
Bituminous paved areas (en-trance area)	m²	2,000	340	680,000	20.00	40,000
Concrete paved areas	m²	0	510	0	30.00	0
Weighing bridge	l. sum	1	510,000	510,000	30,000.00	30,000

Vehicle cleaning unit	l. sum	1	119,000	119,000	7,000.00	7,000
Watertank	l. sum	1	51,000	51,000	3,000.00	3,000
Fence	m	1,600	850	1,360,000	50.00	80,000
Pumping accessories	No	0	153,000	0	9,000.00	0
Energy supply / Trafo	No	1	221,000	221,000	13,000.00	13,000
Water supply	l. sum	1	119,000	119,000	7,000.00	7,000
Stormwater	l. sum	1	204,000	204,000	12,000.00	12,000
Sewage and Treatment	l. sum	1	85,000	85,000	5,000.00	5,000
Telecommunication and fire alarm supply	l. sum	1	119,000	119,000	7,000.00	7,000
Total:				4,751,500		279,500
9. Buildings and roofed areas						
Office buildings	m²	200	15,300	3,060,000	900.00	180,000
Roofed areas	m²	400	3,570	1,428,000	210.00	84,000
Total:				4,488,000		264,000
10. Waste treatment						
Concrete paved areas	m²	5,060	510	2,580,600	30.00	151,800
Total:				2,580,600		151,800
11. Hazardous waste cell						
				0		0
Total:				0		0
Contingencies 10%				**2,741,335**		**161,255**
Grand Total:				**30,154,685**		**1,773,805**

1 EUR = 17 MDL

Source: elaborated by GOPA.

Annex 20

The investment costs related to equipment and installations for the inter-municipal solid waste management center (including the equipment for collection and transportation of waste)

Annex 20

The investment costs related to equipment and installations for the inter-municipal solid waste management center (including the equipment for collection and transportation of waste)

	Unit	Quantity	Unit cost, MDL	Total cost, MDL	Unit cost, EUR	Total cost, EUR
1. Landfill facility						
Bulldozer (15t, 130 kW)	No	1	2,160,993	2,160,993	127,117	127,117
Wheel loader (3t, 120 kW, shovel 2.5m³)	No	1	1,330,000	1,330,000	78,235	78,235
Tanker trailer (with pump attachment)	No	1	510,000	510,000	30,000	30,000
Car (4wd,ac, 70 kW)	No	1	364,085	364,085	21,417	21,417
Workshop equipment	l. sum	1	255,000	255,000	15,000	15,000
Office furniture including interiors	l. sum	1	340,000	340,000	20,000	20,000
Laboratory equipment	l. sum	1	510,000	510,000	30,000	30,000
Total:				5,470,078		321,769
2. Material Recovery Facility (MRF)						
Drum sieve	No	1	1,108,547	1,108,547	65,209	65,209
Sorting belt	No	1	321,318	321,318	18,901	18,901
Baler	No	1	160,659	160,659	9,451	9,451
Hand Lift	No	1	158,186	158,186	9,305	9,305
Total:				1,748,710		102,865
3. Composting facility						
Drum sieve	No	1	1,609,648	1,609,648	94,685	94,685
Windrover, 1st unit	No	1	1,262,733	1,262,733	74,278	74,278
Windrover, 2nd unit	No	1	467,038	467,038	27,473	27,473
Wood shredder	No	1	4,644,756	4,644,756	273,221	273,221
Tractor Xuzhou KAT 1304	No	1	530,000	530,000	31,176	31,176
Tractor MTZ	No	2	588,000	1,176,000	34,588	69,176
Trailer Shandong Juwel 7	No	3	84,000	252,000	4,941	14,824
Trailer Beck	No	4	166,400	665,600	9,788	39,153
Total:				10,607,775		623,987
4. Collection and Transportation						
MAN Comp. Truck - 14 m^3	No	1	1,800,413	1,800,413	105,907	105,907
MAN Comp. Truck - 22 m^3	No	1	1,942,551	1,942,551	114,268	114,268
Containers - 1.1 m^3	No	808	2,544	2,055,552	150	120,915
Containers (+cover) - 0.24 m^3	No	1,814	460	834,440	27	49,085
Welding equipment	No	1	4,330	4,330	255	255
Cleaning equipment	No	3	13,330	39,990	784	2,352
Total:				6,677,277		392,781
Grand Total:				**24,503,840**		**1,441,402**

1 EUR = 17 MDL

Source: elaborated by GOPA.

Annex 21

The lifetime and replacement schedule of the constructions/infrastructure, installations, and equipment of the waste management system in the project area

Annex 21

The lifetime and replacement schedule of the constructions/infrastructure, installations, and equipment of the waste management system in the project area

	Lifetime	Used from year	Scheduled year of replacement
Constructions and infrastructure:			
General constructions/ office buildings	25 years	2016	2041
Roofed areas	25 years	2016	2041
Paved/concrete areas	25 years	2016	2041
Base sealing system	25 years	2016	2041
Monitoring wells	25 years	2016	2041
Leachate basin	15 years	2016	2031
Pipes	25 years	2016	2041
Surface water system	25 years	2016	2041
Shafts	25 years	2016	2041
Roads	25 years	2016	2041
Scale at the weighing bridge	10 years	2016	2026
Watertank	25 years	2016	2041
Fences	15 years	2016	2031
Trenches	25 years	2016	2041
Public Utility provision infrastructure	25 years	2016	2041
Collection points - platforms	25 years	2014	2039
Equipment:			
Equipment at the landfill			
Bulldozer (15t, 130 kW)	12 years	2013	2026
Wheel loader (3t, 120 kW, shovel 2.5m³)	10 years	2016	2026
Tanker trailer (with pump attachment)	10 years	2016	2026
Car (4wd,ac, 70 kW)	10 years	2014	2024
Workshop equipment	10 years	2016	2026
Office furniture including interiors	5 years	2016	2021
Laboratory equipment	10 years	2016	2026
Equipment at the MRF			
Drum sieve for recyclables	10 years	2014	2024
Sorting belt for recyclables	10 years	2014	2024
Baler for recyclables	10 years	2014	2024
Hand Lift for recyclables	10 years	2014	2024
Equipment at the Composting site			
Drum sieve for composting	10 years	2016	2026
Windrover for composting	10 years	2016	2026
Wood shredder for composting	10 years	2016	2026
Tractor Xuzhou KAT 1304	10 years	2013	2023
Tractor MTZ	10 years	2014	2024
Trailer Shandong Juwel 7	10 years	2013	2023
Trailer Beck	10 years	2014	2024
Collect. Equipment at Soldanesti Serv. Area			
MAN Comp. Truck - 14 m^3	10 years	2014	2024
MAN Comp. Truck - 22 m^3	10 years	2014	2024
Containers - 1.1 m^3	15 years	2014	2029
Containers (+cover) - 0.24 m^3	15 years	2014	2029
Welding equipment	10 years	2014	2024
Cleaning equipment	5 years	2014	2019
Collect. Equipment at Cotiujenii Mari Serv. Area			
GAZ Comp. Truck - 7.5 m^3	10 years	2013	2023
Tractor JM b54	10 years	2013	2023

Trailer 2PTS 4.5-1	10 years	2013	2023
Excavator PE-82 Belarus 92	10 years	2013	2023
Containers - 0.67 m^3	15 years	2013	2023
Containers - 0.24 m^3	15 years	2013	2023
Office equipment	5 years	2013	2018

Source: elaborated by GOPA.

Annex 22

The calculation of the operation costs related to Material Recovery Facility, year 2016

Annex 22

The calculation of the operation costs related to Material Recovery Facility, year 2016

Material Recovery Facility (MRF)	Calculation assumptions for the year of 2016	MDL	EUR
Cost of workforce:		**208,107**	**12,242**
Salaries of workers:	Real salary increase = 4%/year	164,511	9,677
workers, 6 units	Monthly salary = 6*2,109 MDL	151,857	8,933
technician, 0.5 units	Monthly salary = 0.5*2,109 MDL	12,655	744
security, 0 units	Monthly salary = 0*1,406 MDL	0	0
Social and medical contributions on workers:		43,596	2,564
social contributions (CAS)	23% of the salary	37,838	2,226
medical insurance (CAMO)	3.5% of the salary	5,758	339
Electricity consumption costs:	1 kWh = 1.6 MDL	**5,600**	**329**
Electricity consumption of recycling equipment	Electricity use per year 3,500 kWh (12 kWh/w.day, w.days = 250)	5,600	329
Equipment maintenance costs:		**52,461**	**3,086**
Drum sieve	3% of the unit cost	33,256	1,956
Sorting belt	3% of the unit cost	9,640	567
Baler	3% of the unit cost	4,820	284
Hand Lift	3% of the unit cost	4,746	279
Facility maintenance costs:		**28,560**	**1,680**
Roofed areas	2% of the unit cost	28,560	1,680
Other costs:		**34,000**	**2,000**
Consumables	Flat rate - 34,000 MDL/year	34,000	2,000
Rental costs for the temporary MRF area	3000 MDL/month during 2014-2015	0	0
Depreciation costs:		**231,991**	**13,647**
Depreciation of equipment:		174,871	10,287
Drum sieve	Unit cost/10 years lifetime	110,855	6,521
Sorting belt	Unit cost/10 years lifetime	32,132	1,890
Baler	Unit cost/10 years lifetime	16,066	945
Hand Lift	Unit cost/10 years lifetime	15,819	931
Constructions and infrastructure:		57,120	3,360
Roofed areas	Unit cost/25 years lifetime	57,120	3,360
Total costs:		**560,719**	**32,983**

1 EUR = 17 MDL

Source: elaborated by GOPA.

Annex 23

The calculation of the operation costs related to Composting Facility (including organic waste collection), year 2016

Annex 23

The calculation of the operation costs related to Composting Facility (including organic waste collection), year 2016

Composting Facility	Calculation assumptions for the year of 2016	MDL	EUR
Cost of workforce:		**96,049**	**5,650**
Salaries of workers:	Real salary increase = 4%/year	75,928	4,466
tractor drivers, 3 units	Monthly salary = 3*2,109 MDL	75,928	4,466
Social and medical contributions on workers:		20,121	1,184
social contributions (CAS)	23% of the salary	17,464	1,027
medical insurance (CAMO)	3.5% of the salary	2,657	156
Fuel consumption costs:	1 liter of diesel fuel = 16.7 MDL	**180,044**	**10,591**
Tractor, collection of organic wastes	Fuel usage per year = 7,031 liters (tractor fuel cons. = 25 l/100 km; dist. traveled per year = 28,124; waste transp. per year = 6,191 t)	117,419	6,907
Tractor, on site work	Fuel usage per year = 3,730 liters (15 l/w.day, w.days = 250)	62,625	3,684
Electricity consumption costs:	1 kWh = 1.6 MDL	**720**	**42**
Electricity consumption of composting equipment	Electricity usage per year 450 kWh (1.8 kWh/w.day, w.days = 250);	720	42
Equipment maintenance costs:		**370,705**	**21,806**
Composting equip. - drum sieve	3% of the unit cost	48,289	2,841
Composting equip. - 1st unit windrower	3% of the unit cost	37,882	2,228
Composting equip. - 2nd unit windrower	3% of the unit cost	14,011	824
Composting equip. - wood shredder	3% of the unit cost	139,343	8,197
Tractor Xuzhou KAT 1304, 1 unit	5% of the unit cost	26,500	1,559
Tractor MTZ, 2 units	5% of the unit cost	58,800	3,459
Trailer Shandong Juwel 7, 3 units	5% of the unit cost	12,600	741
Trailer Beck, 4 units	5% of the unit cost	33,280	1,958
Facility maintenance costs:		**51,612**	**3,036**
Concrete areas	2% of the unit cost	51,612	3,036
Other costs:		**34,000**	**2,000**
Consumables	Flat rate - 34,000 MDL/year	34,000	2,000
Depreciation costs:		**1,164,002**	**68,471**
Depreciation of equipment:		1,060,778	62,399
Composting equip. - drum sieve	Unit cost/10 years lifetime	160,965	9,469
Composting equip. - 1st unit windrower	Unit cost/10 years lifetime	126,273	7,428
Composting equip. - 2nd unit windrower	Unit cost/10 years lifetime	46,704	2,747
Composting equip. - wood shredder	Unit cost/10 years lifetime	464,476	27,322
Tractor Xuzhou KAT 1304, 1 unit	Unit cost/10 years lifetime	53,000	3,118
Tractor MTZ, 2 units	Unit cost/10 years lifetime	117,600	6,918
Trailer Shandong Juwel 7, 3 units	Unit cost/10 years lifetime	25,200	1,482
Trailer Beck, 4 units	Unit cost/10 years lifetime	66,560	3,915
Constructions and infrastructure:		103,224	6,072
Concrete areas	Unit cost/25 years lifetime	103,224	6,072
Total costs:		**1,897,132**	**111,596**

1 EUR = 17 MDL

Source: elaborated by GOPA.

Annex 24

The calculation of the operation costs related to Enhanced Transitional Landfill, year 2016

Annex 24

The calculation of the operation costs related to Enhanced Transitional Landfill, year 2016

Enhanced Transitional Landfill	Calculation assumptions for the year of 2016	MDL	EUR
Cost of workforce:		**180,195**	**10,600**
Salaries of workers:	Real salary increase = 4%/year	142,447	8,379
landfill manager, 1 unit	Monthly salary = 1*3,785 MDL	45,427	2,672
driver (loader/bulldozer), 1 unit	Monthly salary = 1*2,109 MDL	25,309	1,489
worker (weighbridge), 1 unit	Monthly salary = 1*2,109 MDL	25,309	1,489
technician, 0.5 unit	Monthly salary = 0.5*2,109 MDL	12,655	744
security, 2 units	Monthly salary = 2*1,406 MDL	33,746	1,985
Social and medical contributions on workers:		37,748	2,220
social contributions (CAS)	23% of the salary	32,763	1,927
medical insurance (CAMO)	3.5% of the salary	4,986	293
Fuel consumption costs:	1 liter of diesel fuel = 16.7 MDL	**312,708**	**18,395**
Wheel loader	Fuel usage per year = 6,500 liters (26 l/w.day, w.days = 250)	108,550	6,385
Bulldozer	Fuel usage per year = 4,725 liters (18.9 l/w.day, w.days = 250)	78,908	4,642
Leachate trailer	Fuel usage per year = 3,750 liters (15 l/w.day, w.days = 250)	62,625	3,684
Car (4wd,ac, 70 kW)	Fuel usage per year = 3,750 liters (15 l/w.day, w.days = 250)	62,625	3,684
Electricity consumption costs:	1 kWh = 1.6 MDL	**5,000**	**294**
Electricity consumption of laboratory equipment	Electricity usage per year 1,125 kWh (8 kWh/w.day, w.days = 250)	3,200	188
Electricity consumption of office equipment	Electricity usage per year 2,000 kWh (4.5 kWh/w.day, w.days = 250)	1,800	106
Equipment maintenance costs:		**231,122**	**13,595**
Wheel loader	3% of the unit cost	39,900	2,347
Bulldozer	5% of the unit cost	108,050	6,356
Leachate trailer	3% of the unit cost	15,300	900
Car (4wd,ac, 70 kW)	3% of the unit cost	10,923	643
Workshop equipment	3% of the unit cost	7,650	450
Laboratory equipment	3% of the unit cost	15,300	900
Office equipment	10% of the unit cost	34,000	2,000
Facility maintenance costs:		**188,020**	**11,060**
Paved/concrete areas	2% of the unit cost	13,600	800
Office buildings	2% of the unit cost	61,200	3,600
Leachate basin	3% of the unit cost - 408,000 MDL	12,240	720
Pipes	5% of the unit cost	15,300	900
Shafts	5% of the unit cost	6,800	400
Fence	3% of the unit cost	40,800	2,400
Scale	5% of the unit cost - 340,000 MDL	17,000	1,000
Trenches	5% of the unit cost - 238,000 MDL	11,900	700
Public utility provision infrastructure	2% of the unit cost	9,180	540
Consumables and monitoring costs:		**159,800**	**9,400**
Office consumables	Flat rate - 17,000 MDL/year	17,000	1,000
MBT consumables [MDL/t]	8.5 MDL per ton of waste x 8,800 t/year = 74,800 MDL/year	74,800	4,400
Laboratory consumables	Flat rate - 17,000 MDL/year	17,000	1,000
Monitoring costs	Flat rate - 51,000 MDL/year	51,000	3,000
Accruals:		**179,520**	**10,560**
Landfill cap	17 MDL per ton of waste x 8,800	149,600	8,800

	t/year = 149,600 MDL/year		
Landfill aftercare	3.4 MDL per ton of waste x 8,800 t/year = 29,920 MDL/year	29,920	1,760
Depreciation costs:		**1,637,814**	**96,342**
Depreciation of equipment:		544,991	32,058
Wheel loader	Unit cost/10 years lifetime	133,000	7,824
Bulldozer	Unit cost/12 years lifetime	180,083	10,593
Leachate trailer	Unit cost/10 years lifetime	51,000	3,000
Car (4wd,ac, 70 kW)	Unit cost/10 years lifetime	36,408	2,142
Workshop equipment	Unit cost/10 years lifetime	25,500	1,500
Laboratory equipment	Unit cost/10 years lifetime	51,000	3,000
Office equipment	Unit cost/5 years lifetime	68,000	4,000
Constructions and infrastructure:		1,092,822	64,284
General works	Unit cost/25 years lifetime	156,060	9,180
Earth works	Unit cost/25 years lifetime	30,770	1,810
Base sealing system	Unit cost/25 years lifetime	399,500	23,500
Leachate collection and storage	Unit cost/25 years lifetime	46,467	2,733
Surface water	Unit cost/25 years lifetime	9,520	560
Infrastructure	Unit cost/25 years lifetime (exceptions: Fences - 15 yeas lifetime, Scale - 10 yeas lifetime)	234,487	13,793
Office buildings	Unit cost/25 years lifetime	122,400	7,200
Contingencies - constructions/infrastructure	10% of for construction works, infrastructure, utilities	93,619	5,507
Total costs:		**2,894,178**	**170,246**

1 EUR = 17 MDL

Source: elaborated by GOPA.

Annex 25

The calculation of the operation costs related to collection and transportation of wastes, year 2016

Annex 25

The calculation of the operation costs related to collection and transportation of wastes, year 2016

Collection & Transportation	Calculation assumptions for the year of 2016	MDL	EUR
Cost of workforce:		**821,755**	**48,339**
Soldanesti Service Area		**586,968**	**34,528**
Salaries of workers:	Real salary increase = 4%/year	464,006	27,294
truck drivers, 4 units	Monthly salary = 4*2,109 MDL	101,238	5,955
container handlers, 7 units	Monthly salary = 7*2,109 MDL	177,166	10,422
local workers in villages, 22 units	Monthly salary = 22*0.5*1,406 MDL (half of the salary paid by National Agency for Employment)	185,603	10,918
Social and medical contributions on workers:		122,962	7,233
social contributions (CAS)	23% of the salary	106,721	6,278
medical insurance (CAMO)	3.5% of the salary	16,240	955
Cotiujenii Mari Service Area		**234,787**	**13,811**
Salaries of workers:	Real salary increase = 4%/year	185,603	10,918
truck drivers, 2 units	Monthly salary = 2*2,109 MDL	50,619	2,978
container handlers, 4 units	Monthly salary = 4*2,109 MDL	101,238	5,955
local workers in villages, 4 units	Monthly salary = 4*0.5*1,406 MDL (half of the salary paid by National Agency for Employment)	33,746	1,985
Social and medical contributions on workers:		49,185	2,893
social contributions (CAS)	23% of the salary	42,689	2,511
medical insurance (CAMO)	3.5% of the salary	6,496	382
Fuel consumption costs:	1 liter of diesel fuel = 16.7 MDL	**762,916**	**44,877**
Soldanesti Service Area		**611,736**	**35,984**
Collection & transportation of residual waste	Fuel usage per year = 30,367 liters	507,132	29,831
Collection & transportation of recyclables	Fuel usage per year = 6,264 liters	104,603	6,153
Cotiujenii Mari Service Area		**151,180**	**8,893**
Collection & transportation of residual waste	Fuel usage per year = 7,311 liters	133,995	7,882
Collection & transportation of recyclables	Fuel usage per year = 1,029 liters	17,184	1,011
Equipment maintenance costs:		**386,045**	**22,709**
Soldanesti Service Area		**276,064**	**16,239**
MAN Comp. Truck - 14 m^3	5% of the unit cost	90,021	5,295
MAN Comp. Truck - 22 m^3	5% of the unit cost	97,128	5,713
Containers - 1.1 m^3	3% of the unit cost	61,667	3,627
Containers (+cover) - 0.24 m^3	3% of the unit cost	25,033	1,473
Welding equipment	5% of the unit cost	217	13
Cleaning equipment	5% of the unit cost	2,000	118
Cotiujenii Mari Service Area		**109,981**	**6,469**
2 GAZ Comp. Trucks - 7.5 m^3	5% of the unit cost	43,800	2,576
Tractor JM b54 & Trailer 2PTS 4.5-1	5% of the unit cost	17,250	1,015
Excavator PE-82 Belarus 92	5% of the unit cost	24,000	1,412
Containers - 0.67 m^3	3% of the unit cost	22,651	1,332
Containers - 0.24 m^3	3% of the unit cost	1,877	110
Office equipment	3% of the unit cost	402	24
Infrastructure maintenance costs:		**94,260**	**5,545**

Soldanesti Service Area		**58,433**	**3,437**
Collection points - 259 platforms	2% of the unit cost	39,365	2,316
Administrative Office	2% of office renovation costs	19,067	1,122
Cotiujenii Mari Service Area		**35,827**	**2,107**
Collection points - 100 platforms	2% of the unit cost	35,827	2,107
Administrative Office	2% of office renovation costs	0	0
Other costs:		**49,000**	**2,882**
Consumables - Soldanesti Service Area	Flat rate - 34,000 MDL/year	34,000	2,000
Consumables - Cotiujenii Mari Service Area	Flat rate - 15,000 MDL/year	15,000	882
Depreciation costs:		**991,204**	**58,306**
Soldanesti Service Area		**692,259**	**40,721**
Depreciation of equipment:		575,394	33,847
MAN Comp. Truck - 14 m^3	Unit cost/10 years lifetime	180,041	10,591
MAN Comp. Truck - 22 m^3	Unit cost/10 years lifetime	194,255	11,427
Containers - 1.1 m^3	Unit cost/15 years lifetime	137,037	8,061
Containers (+cover) - 0.24 m^3	Unit cost/15 years lifetime	55,629	3,272
Welding equipment	Unit cost/10 years lifetime	433	25
Cleaning equipment	Unit cost/5 years lifetime	7,998	470
Constructions and infrastructure:		116,865	6,874
Collection points - 259 platforms	Unit cost/25 years lifetime	78,731	4,631
Administrative Office	Office renov cost/25 years life-time	38,135	2,243
Cotiujenii Mari Service Area		**298,945**	**17,585**
Depreciation of equipment:		227,291	13,370
2 GAZ Comp. Trucks - 7.5 m^3	Unit cost/10 years lifetime	87,600	5,153
Tractor JM b54 & Trailer 2PTS 4.5-1	Unit cost/10 years lifetime	34,500	2,029
Excavator PE-82 Belarus 92	Unit cost/10 years lifetime	48,000	2,824
Containers - 0.67 m^3	Unit cost/15 years lifetime	50,336	2,961
Containers - 0.24 m^3	Unit cost/15 years lifetime	4,172	245
Office equipment	Unit cost/5 years lifetime	2,683	158
Constructions and infrastructure:		71,654	4,215
Collection points - 100 platforms	Unit cost/25 years lifetime	71,654	4,215
Administrative Office	Office renov cost/25 years life-time	0	0
Total costs:		**3,105,179**	**182,658**

1 € = 17 MDL

Source: elaborated by GOPA.

Annex 26

The calculation of the operation costs related to selling, general & administration, year 2016

Annex 26

The calculation of the operation costs related to Selling, General & Administration Costs, year 2016

Selling, General & Administration	Calculation assumptions for the year of 2016	MDL	EUR
Cost of staff:		**364,413**	**21,436**
Soldanesti Service Area		**258,512**	**15,207**
Salaries of staff:	Real salary increase = 4%/year	204,358	12,021
General Manager, 1 unit	Monthly salary = 1*3,786 MDL	45,427	2,672
Accountant, 1 unit	Monthly salary = 1*3,191 MDL	38,289	2,252
Cashier, 1 unit	Monthly salary = 1*2,109 MDL	25,309	1,489
Supervisor, 2 units	Monthly salary = 2*1,687 MDL	40,495	2,382
Security, 1.5 units	Monthly salary = 1.5*1,406 MDL	25,309	1,489
Management car driver, 0.5 units	Monthly salary = 0.5*2,109 MDL	12,655	744
Legal advisor, 0.5 units	Monthly salary = 0.5*2,812 MDL	16,873	993
Social and medical contributions on staff:		54,155	3,186
social contributions (CAS)	23% of the salary	47,002	2,765
medical insurance (CAMO)	3.5% of the salary	7,153	421
Cotiujenii Mari Service Area		**105,901**	**6,229**
Salaries of staff:	Real salary increase = 4%/year	83,716	4,924
Local Manager, 1 unit	Monthly salary = 1*3,786 MDL	45,427	2,672
Accountant, 1 unit	Monthly salary = 1*3,191 MDL	38,289	2,252
Social and medical contributions on staff:		22,185	1,305
social contributions (CAS)	23% of the salary	19,255	1,133
medical insurance (CAMO)	3.5% of the salary	2,930	172
Electricity consumption costs:	1 kWh = 1.6 MDL	**3,600**	**212**
Electricity - admin. office in Soldanesti city	Electricity usage per year 1,125 kWh (4.5 kWh/w.day, w.days = 250)	1,800	106
Electricity - local office in Cotiujenii Mari	Electricity usage per year 1,125 kWh (4.5 kWh/w.day, w.days = 250)	1,800	106
Other costs:		**30,000**	**1,765**
Banking services	Flat rate - 1,500 MDL/month	18,000	1,059
Telephone services	Flat rate - 1000 MDL/month	12,000	706
Total costs:		**398,013**	**23,413**

1 € = 17 MDL

Source: elaborated by GOPA.

Annex 27

Dynamic prime costs (DPC) of solid waste management activities, calculated based on the number of people served in the project area, (2014 to 2020)

Annex 27

Dynamic Prime Costs (DPC) of solid waste management activities, calculated based on the number of people served in the project area, (2014 to 2020)

a) Household waste management system: Collection & Transportation of Household Wastes, Sorting & Baling of Recyclables, and Disposal of Residual Wastes.

	Units	2014	2015	2016	2017	2018	2019	2020
Collection and Transportation of household wastes, including Selling, General & Administration:								
Depreciation Costs (DC):	1000 MDL/year	991	991	991	991	991	991	991
Constructions	*1000 MDL/year*	*189*	*189*	*189*	*189*	*189*	*189*	*189*
Equipment	*1000 MDL/year*	*803*	*803*	*803*	*803*	*803*	*803*	*803*
Operation Costs (OC)	1000 MDL/year	2,219	2,280	2,512	2,582	2,646	2,713	2,780
Total Population served	1000 persons	44	43	43	43	43	42	42
Dynamic Prime Costs:	MDL/pers./y	73	75	81	83	85	88	90
amount of DC	*MDL/pers./y*	*23*	*23*	*23*	*23*	*23*	*23*	*24*
amount of OC	*MDL/pers./y*	*51*	*52*	*58*	*60*	*62*	*64*	*66*
Sorting & Baling of recyclables:								
Depreciation Costs (DC):	1000 MDL/year	302	302	232	232	232	232	232
Constructions	*1000 MDL/year*	*128*	*128*	*57*	*57*	*57*	*57*	*57*
Equipment	*1000 MDL/year*	*175*	*175*	*175*	*175*	*175*	*175*	*175*
Operation Costs (OC)	1000 MDL/year	360	369	329	335	342	349	357
Total Population served	1000 persons	44	43	43	43	43	42	42
Dynamic Prime Costs:	MDL/pers./y	15	15	13	13	13	14	14
amount of DC	*MDL/pers./y*	*7*	*7*	*5*	*5*	*5*	*5*	*6*
amount of OC	*MDL/pers./y*	*8*	*8*	*8*	*8*	*8*	*8*	*8*
Disposing of the residual wastes:								
Depreciation Costs (DC):	1000 MDL/year	180	180	1,638	1,638	1,638	1,638	1,638
Constructions	*1000 MDL/year*	*0*	*0*	*1,093*	*1,093*	*1,093*	*1,093*	*1,093*
Equipment	*1000 MDL/year*	*180*	*180*	*545*	*545*	*545*	*545*	*545*
Operation Costs (OC)	1000 MDL/year	324	325	1,256	1,262	1,268	1,274	1,281
Total Population served	1000 persons	37	37	43	43	43	42	42
Dynamic Prime Costs:	MDL/pers./y	14	14	67	68	68	69	69
amount of DC	*MDL/pers./y*	*5*	*5*	*38*	*38*	*38*	*39*	*39*
amount of OC	*MDL/pers./y*	*9*	*9*	*29*	*29*	*30*	*30*	*30*
Total DPC per year	**MDL/pers./y**	**100**	**102**	**161**	**164**	**167**	**170**	**173**
Tot. DPC per month, MDL	**MDL/pers./m**	**8.3**	**8.5**	**13.4**	**13.7**	**13.9**	**14.2**	**14.4**
Tot. DPC per month, EUR	**EUR/pers./m**	**0.49**	**0.50**	**0.79**	**0.81**	**0.82**	**0.83**	**0.85**

Note: During 2014-2015, the residual waste from Cotiujenii Mari Area is disposed at local dumpsites within the municipalities at no cost for the waste management company.
1 EUR = 17 MDL

b) Composting activity component of the solid waste management system.

	Units	2014	2015	2016	2017	2018	2019	2020
Composting of organic/agricultural wastes (including collection):								
Depreciation Costs (DC):	1000 MDL/year	-	-	1,164	1,164	1,164	1,164	1,164
Constructions	*1000 MDL/year*			*103*	*103*	*103*	*103*	*103*
Equipment	*1000 MDL/year*			*1,061*	*1,061*	*1,061*	*1,061*	*1,061*
Operation Costs (OC)	1000 MDL/year	-	-	733	736	739	743	746
Total Population served	1000 persons	-	-	44	44	44	43	43
Dynamic Prime Costs:	MDL/pers./y	-	-	43	43	43	44	44
amount of DC	*MDL/pers./y*			*26*	*26*	*27*	*27*	*27*
amount of OC	*MDL/pers./y*			*16*	*17*	*17*	*17*	*17*
Total DPC per year	**MDL/pers./y**			**43**	**43**	**43**	**44**	**44**
Tot. DPC per month, MDL	**MDL/pers./m**			**3.6**	**3.6**	**3.6**	**3.7**	**3.7**
Tot. DPC per month, EUR	**EUR/pers./m**			**0.21**	**0.21**	**0.21**	**0.22**	**0.22**

1 EUR = 17 MDL

Source: elaborated by GOPA.

Annex 28

Operational Cash Flow of the waste management service in the in the project area, 2013 to 2030

Annex 28

Operational Cash Flow of the waste management service in the project area, 2013 to 2030

Option 1. Including initial investments (grant).

Item	Units	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Revenue	1000 MDL		5,384	5,281	7,568	8,057	8,545	9,045	9,567	9,959	10,368	10,581	10,799	11,024	11,222	11,425	11,635	11,850	12,072
Costs of Goods/Service Sold (COGS)	1000 MDL		(2,532)	(2,590)	(4,432)	(4,502)	(4,568)	(4,635)	(4,704)	(4,766)	(4,823)	(4,889)	(4,958)	(5,098)	(5,167)	(5,240)	(5,370)	(5,449)	(5,536)
Selling, General & Administration Costs (SG&A	1000 MDL		(371)	(384)	(398)	(413)	(428)	(444)	(460)	(477)	(495)	(513)	(532)	(552)	(573)	(595)	(617)	(640)	(665)
Minus Depreciation	1000 MDL		(1,474)	(1,474)	(4,025)	(4,025)	(4,025)	(4,025)	(4,025)	(4,025)	(4,025)	(4,025)	(4,025)	(4,025)	(4,045)	(4,045)	(4,045)	(4,045)	(4,045)
Operating Profits	1000 MDL		1,007	833	(1,287)	(883)	(476)	(59)	378	692	1,025	1,153	1,284	1,348	1,436	1,545	1,602	1,715	1,825
Cash Taxes on Operating Profits (tax = 12%)	1000 MDL		(121)	(100)	0	0	0	0	(45)	(83)	(123)	(138)	(154)	(162)	(172)	(185)	(192)	(206)	(219)
Net Operating Profists After Tax (NOPAT)	1000 MDL		886	733	(1,287)	(883)	(476)	(59)	333	609	902	1,015	1,130	1,187	1,264	1,360	1,410	1,510	1,606
Plus Depreciation	1000 MDL		1,474	1,474	4,025	4,025	4,025	4,025	4,025	4,025	4,025	4,025	4,025	4,025	4,045	4,045	4,045	4,045	4,045
Capital Expenditures (CapEx)	1000 MDL	(15,963)	(40,549)	(1,428)	0	0	0	(53)	0	(340)	(1,749)	0	(7,250)	0	(16,452)	0	0	(3,761)	0
Free Cash Flow (FCF)	1000 MDL	(15,963)	(38,189)	778	2,738	3,142	3,549	3,913	4,358	4,294	3,178	5,040	(2,096)	5,212	(11,143)	5,405	5,455	1,794	5,651
Present Value of FCF (Intrest Rare = 12%)	1000 MDL	(15,963)	(34,097)	621	1,949	1,997	2,014	1,982	1,971	1,734	1,146	1,623	(603)	1,338	(2,554)	1,106	997	293	823

Option 2. Excluding initial investments (grant).

Item	Units	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Revenue	1000 MDL		5,384	5,281	7,568	8,057	8,545	9,045	9,567	9,959	10,368	10,581	10,799	11,024	11,222	11,425	11,635	11,850	12,072
Costs of Goods/Service Sold (COGS)	1000 MDL		(2,532)	(2,590)	(4,432)	(4,502)	(4,568)	(4,635)	(4,704)	(4,766)	(4,823)	(4,889)	(4,958)	(5,098)	(5,167)	(5,240)	(5,370)	(5,449)	(5,536)
Selling, General & Administration Costs (SG&A	1000 MDL		(371)	(384)	(398)	(413)	(428)	(444)	(460)	(477)	(495)	(513)	(532)	(552)	(573)	(595)	(617)	(640)	(665)
Minus Depreciation	1000 MDL		(1,474)	(1,474)	(4,025)	(4,025)	(4,025)	(4,025)	(4,025)	(4,025)	(4,025)	(4,025)	(4,025)	(4,025)	(4,045)	(4,045)	(4,045)	(4,045)	(4,045)
Operating Profits	1000 MDL		1,007	833	(1,287)	(883)	(476)	(59)	378	692	1,025	1,153	1,284	1,348	1,436	1,545	1,602	1,715	1,825
Cash Taxes on Operating Profits (tax = 12%)	1000 MDL		(121)	(100)	0	0	0	0	(45)	(83)	(123)	(138)	(154)	(162)	(172)	(185)	(192)	(206)	(219)
Net Operating Profists After Tax (NOPAT)	1000 MDL		886	733	(1,287)	(883)	(476)	(59)	333	609	902	1,015	1,130	1,187	1,264	1,360	1,410	1,510	1,606
Plus Depreciation	1000 MDL		1,474	1,474	4,025	4,025	4,025	4,025	4,025	4,025	4,025	4,025	4,025	4,025	4,045	4,045	4,045	4,045	4,045
Capital Expenditures (CapEx)	1000 MDL	0	0	(1,428)	0	0	0	(53)	0	(340)	(1,749)	0	(7,250)	0	(16,452)	0	0	(3,761)	0
Free Cash Flow (FCF)	1000 MDL	0	2,360	778	2,738	3,142	3,549	3,913	4,358	4,294	3,178	5,040	(2,096)	5,212	(11,143)	5,405	5,455	1,794	5,651
Present Value of FCF (Intrest Rare = 12%)	1000 MDL	0	2,107	621	1,949	1,997	2,014	1,982	1,971	1,734	1,146	1,623	(603)	1,338	(2,554)	1,106	997	293	823

Note: The revenue for the year of 2014 includes also the initial cash contribution (476,000 MDL) made by the municipalities and Rayon Council Soldanesti at the registration of the Joint Stock Company.

Source: elaborated by GOPA.

Annex 29

Sensitivity analysis in calculating the waste tax for population assuming different scenarios regarding included costs and tax payment rates, years 2014 and 2016

Annex 29

Sensitivity analysis in calculating the waste tax for population assuming different scenarios regarding included costs and tax payment rates, years 2014 and 2016

Scenario 1:
Included costs: Operation, Maintenance, and Depreciation of equipment and infrastructure;
Tax payment rate: 100%.

	2014	2016
Service Costs, MDL/y:	4,376,341	8,855,223
Cost of workforce	*1,021,235*	1,306,107
Fuel cost	*679,513*	*1,255,667*
Equipment maintenance costs	*546,556*	*1,040,334*
Infrastructure maintenance costs	*94,260*	*362,452*
Other costs	*190,600*	*467,640*
Selling, General & Administration Costs	*370,520*	*398,013*
Depreciation of equipment	*1,157,638*	*2,583,324*
Depreciation of Infrastructure	*316,019*	*1,441,686*
Extra Revenues, MDL/y:	1,417,891	2,413,672
Recyclables sold	*803,117*	*1,181,702*
Compost sold	*0*	*263,097*
Tariffs paid by Public Institutions	*322,200*	*335,217*
Tariffs paid by Economic Entities	*292,574*	*324,130*
On demand charges paid for organic waste collection service	*0*	*309,526*
Service Costs - Extra Revenues, MDL/y:	2,958,450	6,441,551
Contingencies: 15% in 2014 and 5% in 2016, MDL/y	443,768	322,078
Total Service Costs per year, MDL/y	3,402,218	6,763,629
Total Service Costs per month, MDL/m	283,518	563,636
Total Service Costs per month per person served, MDL/pers/m	6.5	13.1

Scenario 2:
Included costs: Operation, Maintenance, and Depreciation of equipment and infrastructure;
Tax payment rate: 80%.

	2014	2016
Service Costs, MDL/y:	4,376,341	8,855,223
Cost of workforce	*1,021,235*	1,306,107
Fuel cost	*679,513*	*1,255,667*
Equipment maintenance costs	*546,556*	*1,040,334*
Infrastructure maintenance costs	*94,260*	*362,452*
Other costs	*190,600*	*467,640*
Selling, General & Administration Costs	*370,520*	*398,013*
Depreciation of equipment	*1,157,638*	*2,583,324*
Depreciation of Infrastructure	*316,019*	*1,441,686*
Extra Revenues, MDL/y:	1,417,891	2,413,672
Recyclables sold	*803,117*	*1,181,702*
Compost sold	*0*	*263,097*
Tariffs paid by Public Institutions	*322,200*	*335,217*
Tariffs paid by Economic Entities	*292,574*	*324,130*
On demand charges paid for organic waste collection service	*0*	*309,526*
Service Costs - Extra Revenues, MDL/y:	2,958,450	6,441,551
Contingencies: 15% in 2014 and 5% in 2016, MDL/y	443,768	322,078
Total Service Costs per year, MDL/y	3,402,218	6,763,629
Total Service Costs per month, MDL/m	283,518	563,636
Total Service Costs per month per person served, MDL/pers/m	8.1	16.3

Scenario 3:
Included costs: Operation, Maintenance, and Depreciation of equipment and infrastructure;
Tax payment rate: 50%.

	2014	2016
Service Costs, MDL/y:	4,376,341	8,855,223
Cost of workforce	*1,021,235*	1,306,107
Fuel cost	*679,513*	*1,255,667*
Equipment maintenance costs	*546,556*	*1,040,334*
Infrastructure maintenance costs	*94,260*	*362,452*
Other costs	*190,600*	*467,640*
Selling, General & Administration Costs	*370,520*	*398,013*
Depreciation of equipment	*1,157,638*	*2,583,324*
Depreciation of Infrastructure	*316,019*	*1,441,686*
Extra Revenues, MDL/y:	1,417,891	2,413,672
Recyclables sold	*803,117*	*1,181,702*
Compost sold	*0*	*263,097*
Tariffs paid by Public Institutions	*322,200*	*335,217*
Tariffs paid by Economic Entities	*292,574*	*324,130*
On demand charges paid for organic waste collection service	*0*	*309,526*
Service Costs - Extra Revenues, MDL/y:	2,958,450	6,441,551
Contingencies: 15% in 2014 and 5% in 2016, MDL/y	443,768	322,078
Total Service Costs per year, MDL/y	3,402,218	6,763,629
Total Service Costs per month, MDL/m	283,518	563,636
Total Service Costs per month per person served, MDL/pers/m	13.0	26.1

Scenario 4:
Included costs: Operation and Maintenance of equipment and infrastructure;
Tax payment rate: 100%.

	2014	2016
Service Costs, MDL/y:	2,902,684	4,830,213
Cost of workforce	*1,021,235*	1,306,107
Fuel cost	*679,513*	*1,255,667*
Equipment maintenance costs	*546,556*	*1,040,334*
Infrastructure maintenance costs	*94,260*	*362,452*
Other costs	*190,600*	*467,640*
Selling, General & Administration Costs	*370,520*	*398,013*
Depreciation of equipment	*0*	*0*
Depreciation of Infrastructure	*0*	*0*
Extra Revenues, MDL/y:	1,417,891	2,413,672
Recyclables sold	*803,117*	*1,181,702*
Compost sold	*0*	*263,097*
Tariffs paid by Public Institutions	*322,200*	*335,217*
Tariffs paid by Economic Entities	*292,574*	*324,130*
On demand charges paid for organic waste collection service	*0*	*309,526*
Service Costs - Extra Revenues, MDL/y:	1,484,793	2,416,541
Contingencies: 15% in 2014 and 5% in 2016, MDL/y	222,719	120,827
Total Service Costs per year, MDL/y	1,707,512	2,537,368
Total Service Costs per month, MDL/m	142,293	211,447
Total Service Costs per month per person served, MDL/pers/m	3.3	4.9

Scenario 5:
Included costs: Operation and Maintenance of equipment and infrastructure;
Tax payment rate: 80%.

	2014	2016
Service Costs, MDL/y:	2,902,684	4,830,213
Cost of workforce	*1,021,235*	1,306,107
Fuel cost	*679,513*	*1,255,667*
Equipment maintenance costs	*546,556*	*1,040,334*
Infrastructure maintenance costs	*94,260*	*362,452*
Other costs	*190,600*	*467,640*
Selling, General & Administration Costs	*370,520*	*398,013*
Depreciation of equipment	*0*	*0*
Depreciation of Infrastructure	*0*	*0*
Extra Revenues, MDL/y:	1,417,891	2,413,672
Recyclables sold	*803,117*	*1,181,702*
Compost sold	*0*	*263,097*
Tariffs paid by Public Institutions	*322,200*	*335,217*
Tariffs paid by Economic Entities	*292,574*	*324,130*
On demand charges paid for organic waste collection service	*0*	*309,526*
Service Costs - Extra Revenues, MDL/y:	1,484,793	2,416,541
Contingencies: 15% in 2014 and 5% in 2016, MDL/y	222,719	120,827
Total Service Costs per year, MDL/y	1,707,512	2,537,368
Total Service Costs per month, MDL/m	142,293	211,447
Total Service Costs per month per person served, MDL/pers/m	3.3	4.9

Scenario 6:
Included costs: Operation and Maintenance of equipment and infrastructure;
Tax payment rate: 50%.

	2014	2016
Service Costs, MDL/y:	2,902,684	4,830,213
Cost of workforce	*1,021,235*	1,306,107
Fuel cost	*679,513*	*1,255,667*
Equipment maintenance costs	*546,556*	*1,040,334*
Infrastructure maintenance costs	*94,260*	*362,452*
Other costs	*190,600*	*467,640*
Selling, General & Administration Costs	*370,520*	*398,013*
Depreciation of equipment	*0*	*0*
Depreciation of Infrastructure	*0*	*0*
Extra Revenues, MDL/y:	1,417,891	2,413,672
Recyclables sold	*803,117*	*1,181,702*
Compost sold	*0*	*263,097*
Tariffs paid by Public Institutions	*322,200*	*335,217*
Tariffs paid by Economic Entities	*292,574*	*324,130*
On demand charges paid for organic waste collection service	*0*	*309,526*
Service Costs - Extra Revenues, MDL/y:	1,484,793	2,416,541
Contingencies: 15% in 2014 and 5% in 2016, MDL/y	222,719	120,827
Total Service Costs per year, MDL/y	1,707,512	2,537,368
Total Service Costs per month, MDL/m	142,293	211,447
Total Service Costs per month per person served, MDL/pers/m	4.1	6.1

Note: total population in the service area: in 2014 - 43,774; in 2016 - 43,148; population change: -1%/year.

Source: elaborated by GOPA

Annex 30

Tax/fee affordability of the waste management service in the in the project area, 2014 to 2025

Annex 30

Tax/fee affordability of the waste management service in the project area, 2014 to 2025

Variable	Units	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Urban area													
Total available income per capita per month:	MDL/capita /month	**2,031**	**2,118**	**2,208**	**2,301**	**2,399**	**2,501**	**2,607**	**2,718**	**2,834**	**2,954**	**3,080**	**3,211**
salaries:	*%*	*55%*	*55%*	*55%*	*55%*	*55%*	*55%*	*55%*	*55%*	*55%*	*55%*	*55%*	*55%*
pensions:	*%*	*14%*	*14%*	*14%*	*14%*	*14%*	*14%*	*14%*	*14%*	*14%*	*14%*	*14%*	*14%*
remittances:	*%*	*12%*	*12%*	*12%*	*12%*	*12%*	*12%*	*12%*	*12%*	*12%*	*12%*	*12%*	*12%*
individual agricultural activity:	*%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*
other:	*%*	*18%*	*18%*	*18%*	*18%*	*18%*	*18%*	*18%*	*18%*	*18%*	*18%*	*18%*	*18%*
Real Income increase:	%	4.25%	4.25%	4.25%	4.25%	4.25%	4.25%	4.25%	4.25%	4.25%	4.25%	4.25%	4.25%
Tax/fee evolution:	MDL/capita /month	**10.0**	**10.5**	**14.0**	**15.1**	**16.3**	**17.6**	**19.0**	**20.6**	**22.2**	**22.7**	**23.1**	**23.6**
Affordability ratio:	%	**0.49%**	**0.50%**	**0.63%**	**0.66%**	**0.68%**	**0.71%**	**0.73%**	**0.76%**	**0.78%**	**0.77%**	**0.75%**	**0.73%**
Rural area													
Total available income per capita per month:	MDL/capita /month	**1,364**	**1,428**	**1,496**	**1,567**	**1,642**	**1,720**	**1,801**	**1,887**	**1,977**	**2,071**	**2,169**	**2,272**
salaries:	*%*	*29%*	*29%*	*29%*	*29%*	*29%*	*29%*	*29%*	*29%*	*29%*	*29%*	*29%*	*29%*
pensions:	*%*	*18%*	*18%*	*18%*	*18%*	*18%*	*18%*	*18%*	*18%*	*18%*	*18%*	*18%*	*18%*
remittances:	*%*	*21%*	*21%*	*21%*	*21%*	*21%*	*21%*	*21%*	*21%*	*21%*	*21%*	*21%*	*21%*
individual agricultural activity:	*%*	*19%*	*19%*	*19%*	*19%*	*19%*	*19%*	*19%*	*19%*	*19%*	*19%*	*19%*	*19%*
other:	*%*	*14%*	*14%*	*14%*	*14%*	*14%*	*14%*	*14%*	*14%*	*14%*	*14%*	*14%*	*14%*
Real Income increase:	%	4.75%	4.75%	4.75%	4.75%	4.75%	4.75%	4.75%	4.75%	4.75%	4.75%	4.75%	4.75%
Tax/fee evolution:	MDL/capita /month	**8.0**	**8.5**	**12.0**	**13.0**	**14.0**	**15.1**	**16.3**	**17.6**	**19.0**	**19.4**	**19.8**	**20.2**
Affordability ratio:	%	**0.59%**	**0.60%**	**0.80%**	**0.83%**	**0.85%**	**0.88%**	**0.91%**	**0.93%**	**0.96%**	**0.94%**	**0.91%**	**0.89%**

Note: In 2012, according to official data (www.statistica.md), total monthly available income per capita in Center Region was 1,869 MDL in urban areas and 1,243 MDL in rural areas. From 2011 to 2012, the total available income increased by 4.25% in urban areas and by 4.75% rural areas.
Source: elaborated by GOPA.

Annex 31

Calculation of the environmental benefits of recycling activities within the project area, 2014 to 2025

Annex 31

Calculation of the environmental benefits of recycling activities within the project area, 2014 to 2025

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Recovered recyclable maeirials, tons	**374**	**461**	**551**	**642**	**726**	**812**	**901**	**948**	**997**	**1,044**	**1,092**	**1,141**
Paper and cardboard	107	132	157	183	207	232	257	270	284	297	311	325
Plastic	178	220	263	306	346	387	429	452	475	497	520	544
Metal	13	16	19	22	25	28	31	33	35	36	38	39
Glass	76	93	112	130	148	165	184	193	203	213	223	233
The cost of recyclables, 1000 MDL	***803***	***990***	***1,182***	***1,378***	***1,558***	***1,742***	***1,932***	***2,034***	***2,138***	***2,238***	***2,341***	***2,446***
The cost of recyclables, 1000 EUR	***47***	***58***	***70***	***81***	***92***	***102***	***114***	***120***	***126***	***132***	***138***	***144***
Reducing GHG, tons CO2 eq.	**445**	**548**	**654**	**763**	**862**	**964**	**1,069**	**1,125**	**1,183**	**1,238**	**1,295**	**1,353**
Paper and cardboard	43	53	63	73	83	93	103	108	114	119	124	130
Plastic	271	334	399	465	526	589	652	687	722	756	791	826
Metal (50% steel, 50% aluminum)	104	129	153	179	202	225	250	263	276	289	302	316
Glass	26	33	39	46	52	58	64	68	71	75	78	82
The cost - reduced CO2, 1000 MDL	***36***	***45***	***53***	***62***	***70***	***79***	***87***	***92***	***97***	***101***	***106***	***110***
The cost - reduced CO2, 1000 EUR	***2***	***3***	***3***	***4***	***4***	***5***	***5***	***5***	***6***	***6***	***6***	***6***
Energy savings, GJ	**12,378**	**15,258**	**18,208**	**21,231**	**23,998**	**26,836**	**29,748**	**31,316**	**32,925**	**34,461**	**36,040**	**37,664**
Paper and cardboard	1,927	2,374	2,832	3,301	3,730	4,170	4,621	4,864	5,114	5,352	5,597	5,848
Plastic	8,834	10,891	12,999	15,158	17,137	19,166	21,249	22,368	23,518	24,616	25,745	26,906
Metal (50% steel, 50% aluminum)	1,330	1,638	1,953	2,276	2,570	2,871	3,181	3,348	3,520	3,683	3,851	4,024
Glass	287	355	424	495	561	629	698	735	773	810	847	886
The cost - energy savings, 1000 MDL	***1,532***	***1,888***	***2,253***	***2,627***	***2,969***	***3,320***	***3,681***	***3,875***	***4,074***	***4,264***	***4,459***	***4,660***
The cost - energy savings, 1000 EUR	***90***	***111***	***133***	***155***	***175***	***195***	***217***	***228***	***240***	***251***	***262***	***274***
Saved landfill volume, m3:	**1,471**	**1,813**	**2,164**	**2,524**	**2,853**	**3,191**	**3,538**	**3,724**	**3,916**	**4,099**	**4,287**	**4,480**
Paper and cardboard	301	370	442	515	582	651	721	759	798	835	873	913
Plastic	1,010	1,245	1,486	1,733	1,959	2,191	2,429	2,557	2,688	2,814	2,943	3,075
Metal (50% steel, 50% aluminum)	40	50	59	69	78	87	97	102	107	112	117	122
Glass	120	148	177	207	234	262	291	307	323	338	354	370
The cost - saved lanfill vol, 1000 MDL	***151***	***187***	***223***	***260***	***294***	***329***	***364***	***384***	***403***	***422***	***442***	***461***
The cost - saved lanfill vol, 1000 EUR	***9***	***11***	***13***	***15***	***17***	***19***	***21***	***23***	***24***	***25***	***26***	***27***
Total cost of env benefits, 1000 MDL	**1,719**	**2,119**	**2,529**	**2,949**	**3,333**	**3,728**	**4,132**	**4,350**	**4,574**	**4,787**	**5,006**	**5,232**
Total cost of env benefits, 1000 EUR	**101**	**125**	**149**	**173**	**196**	**219**	**243**	**256**	**269**	**282**	**294**	**308**

Source: elaborated by GOPA. (http://www.epa.nsw.gov.au/resources/warr/1058BenefitsOfRecycling.pdf)

Notes:

A. Calculation assumptions of environmental benefits of recycling:

1. The level of GHG emissions reduction (kg CO2 eq.) with recovery of 1 ton of recyclables: paper and cardboard - 400; plastic - 1,520; metal-steel - 800; metal-aluminum - 15,200; glass - 350.
2. The level of energy saved (GJ) with recovery of 1 ton of recyclables: paper and cardboard - 11; plastic - 49.5; metal-steel - 32.9; metal-aluminum - 171; glass - 3.8.
3. The volume of landfill saved (m^3) with recovery of 1 ton of recyclables: paper and cardboard - 2.81; plastic - 5.66; metal-steel - 1.98; metal-aluminum - 4.21; glass - 1.59.

B. Calculation assumptions for monetary valuation of environmental benefits:

1. The cost of 1 ton of CO2 = 4.8 EUR (81.6 MDL), EU Emissions Allowances (www.eex.com).
2. The cost of 1 GJ of natural gas in EU = 7.3 EUR (123.7 MDL); industry price of 1 kWh of natural gas in EU = 0.026 EUR (0.45 MDL), EU Natural Gas Reference Price (www.eex.com).
3. The cost of 1 m^3 of landfill volume = 103 MDL (6 EUR); calculated based on the investment needed for the landfill works in Parcani (construction costs / landfill volume = 25,745,225 MDL / 250,000 m^3 = 103 MDL/m^3).

C. Local market value of recyclables (MDL/kg): mixed paper - 0.5; plastic - 4; metal - 1; glass - 0.3.

Annex 32

The road map for the implementation of the Inter-Municipal Solid Waste Management Center

Annex 32

The road map for the implementation of the Inter-Municipal Solid Waste Management Center

ID	Task name:	2014												2015											
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
1	Establish the Center (Landfill, Sorting Station, Composting area, etc.)																								
1.1	Mobilize the international engineer																								
1.2	Develop specifications for local engineering company																								
1.3	Tender for local engineering company																								
1.4	Tender evaluation																								
1.5	Engineering of the Center																								
1.6	Technical & Environmental approval of Drawings																								
1.7	Develop tender docs for the construction of the Center																								
1.8	Tender period																								
1.9	Tender evaluation																								
1.10	Contract negotiations																								
1.11	Construction works																								
1.12	Commissioning																								
1.13	Training of operators																								
2	Conduct the Environmental Expertise (EE) of the Center																								
2.1	Mobilize EE specialist																								
2.2	Develop specifications for EE consultant																								
2.3	Tender for EE consultant																								
2.4	Tender evaluation																								
2.5	Develop EE																								
2.6	Public consultations																								
2.7	Approval of EE																								

Source: elaborated by GOPA.