Pursuant to Article 9, paragraph 4 of the Waste Act (Official Gazette No 178/2004 and 111/2006), the Government of the Republic of Croatia at its session on 19 July 2007 adopted the following

WASTE MANAGEMENT PLAN IN THE REPUBLIC OF CROATIA FOR THE PERIOD FROM 2007 TO 2015

1. BASIC GOALS OF THE WASTE MANAGEMENT PLAN 2007 – 2015

The Waste Management Plan in the Republic of Croatia (hereinafter: the Plan) represents the fundamental document on waste management in the Republic of Croatia for the period from 2007 to 2015. The framework for the preparation of the Plan includes the Waste Management Strategy of the Republic of Croatia (OG 130/05) (hereinafter: the Strategy), legislation in force and guidelines of the European Union.

The Strategy, as a constituent part of the National Environmental Strategy (OG 46/02), includes an evaluation of the present state in waste management, strategic and quantitative goals and measures for achieving those goals, guidelines, investment estimates and sources of funding.

The basic task of the Plan for the period mentioned is to organise the implementation of the main goals of the Strategy set out for the period from 2005 to 2025 in the area of waste management in Croatia which are:

a) establishment of an integrated waste management system,
b) remediation and closing of existing landfills,
c) remediation of "hot spots", locations in the environment which are highly burdened with waste,
d) development and establishment of regional and county centres for waste management, with pre-treatment of waste before final disposal or landfilling and
e) complete computerisation of the waste management system.

The Government of the Republic of Croatia adopts the Plan for the period from 2007 to 2015 which, in accordance with the Waste Act (OG 178/04, 111/06), contains the following:

(1) types, quantities and origin of waste for which management must be ensured,
(2) the requirements for managing special categories of waste,
(3) distribution of locations (networks) of facilities and devices for the recovery and disposal of waste and the deadlines for their construction,
(4) general technical requirements for waste management facilities and devices and
(5) estimate and possible sources of funding needed for implementing waste management goals.

Supervision over the implementation of the Plan shall be performed by the Ministry of Environmental Protection, Physical Planning and Construction (MEPPPC) which shall once a year submit to the Government of the Republic of Croatia a report on the fulfilment of established obligations and the efficiency of undertaken measures from the Plan.

The general and technical requirements for waste management facilities and devices are analysed in this Plan within individual chapters and not as a separate unit.

Waste management plans (of counties, The City of Zagreb, cities and municipalities) must be in line with the Strategy and the Plan. The waste management plan of a county and of The City of Zagreb shall be adopted by the county assembly and the city assembly of The City of Zagreb for a period of eight years, while the competent office of the county and the City of Zagreb shall monitor its implementation.

The waste management plan of a city or municipality shall be adopted by the city/municipal assembly for a period of eight years, while the competent office shall monitor its implementation.

TABLE 1 Timetable for the establishment of an integrated waste management system in Croatia

Period	2007	2008	2009	2010	2011	2012	2013	2014	2015
1. Adoption of waste management plans (counties, The City of Zagreb)									
2. Establishment of county and regional waste management centres									
3. Supervision over the implementation of the Plan and annual reporting (carried out by MEPPPC)									

Through the implementation of this Plan the following shall be accomplished:

1. setting up a waste management system in each county according to the regional/county concept,
2. increase of the share of separately collected waste,
3. recycling and re-use of waste,
4. pre-treatment of waste before final disposal,
5. reduction of the share of biodegradable waste in municipal waste,
6. extraction of refused derived fuel (RDF),
7. reduction of quantities of waste deposited on landfills,
8. reduction of adverse impacts of waste on the environment,
9. self-sustainable financing of the municipal waste management system.

2. CROATIAN LEGISLATION IN THE FIELD OF WASTE MANAGEMENT

Overview of legislation regulating waste management in Croatia:

- Waste Management Strategy of the Republic of Croatia, OG 130/05
- Waste Act, OG 178/04, 111/06
- Act on Ratification of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, OG – International Treaties 3/1994
- Regulation on categories, types and classification of waste with a waste catalogue and list of hazardous waste, OG 50/05

- Regulation on supervision of transboundary movement of waste, OG 69/06, 17/07
- Regulation on requirements for handling hazardous waste, OG 32/98
- Regulation on unit charges, corrective coefficients and detailed criteria and standards for determination of charges for burdening the environment with waste, OG 71/04
- Ordinance on waste management, OG 23/07
- Ordinance on landfills, in the process of adoption
- Ordinance on waste types, OG 27/96
- Ordinance on requirements for handling waste, OG 123/97 and 112/01
- Ordinance on methods and requirements for thermal treatment of waste (in the process of adoption)
- Ordinance on packaging and packaging waste, OG 97/05, 115/05
- Ordinance on the management of waste tyres, OG 40/06
- Ordinance on waste oil management, OG 124/06
- Ordinance on the management of waste batteries and accumulators, OG 133/06
- Ordinance on the management of end-of-life vehicles, OG 136/06
- Ordinance on the management of waste electrical and electronic equipment and devices (in the process of adoption)
- Ordinance on medical waste management (in the process of adoption)
- Ordinance on the form, content and method of keeping the register of parties subject to payment of the charge for burdening the environment with waste, OG 120/04
- Ordinance on the register of legal and natural persons carrying out mediation activities in organising the recovery and/or disposal of waste and legal and natural persons carrying out the activity of export of non-hazardous waste, OG 51/06
- Ordinance on standards, procedure and method of determination of the amount of the charge for real estate owners and local self-government units, OG 59/06
- Ordinance on the method and terms for calculation and payment of charges for burdening the environment with waste, OG 95/04
- Decision on packaging labelling requirements, OG 155/05, 24/06, 28/06
- Decision on the permitted quantity of waste tyres to be used for energy purposes in 2006, OG 64/06
- Decision on the permitted quantity of waste tyres to be used for energy purposes in 2007, OG 37/07

There are a number of other regulations which in some manner, that is, indirectly effect or regulate methods of waste management such as the Utilities Act (OG 26/2003 – revised text, 178/2004 and 178/2007), the Chemicals Act (OG 150/05), the Transport of Hazardous Substances Act (OG 97/93, 151/03), etc.

2.1. OBLIGATIONS UNDER EXISTING AND NEW LEGISLATION

According to waste management obligations and responsibilities which ensue from the Waste Act the State is responsible for the management of hazardous waste and for the incineration of waste; counties and The City of Zagreb are responsible for management of all types of waste with the exception of hazardous waste and incineration and cities and municipalities are responsible for municipal waste management.

The costs of waste management are calculated according to the criteria of waste quantities and waste properties, subject to the application of the "polluter pays" principle. For municipal waste from households other calculation criteria may be applied in accordance with the regulation governing utility services.

Waste management costs shall include:

1. costs of separate collection of waste,
2. costs of transport of waste,
3. costs of other waste management measures not covered by income realised from movement of waste,
4. estimated costs of removing waste which an unidentified person discarded into the environment and
5. costs of recovery and/or disposal of waste which include costs of designing and constructing the facilities for recovery and/or disposal of waste, operating costs of facilities for recovery and/or disposal of waste and estimate of costs of closing facilities for recovery and/or disposal of waste, their aftercare and construction of new facilities which will be used after termination of operation of the existing facility.

Construction of facilities intended for treatment, storage and disposal of waste is in the interest of the state. The developer of physical planning documents is obligated to plan the locations for the construction of these facilities. Locations may also be designated in industrial zones (production zones) in accordance with the Plan, if in conformity with the provisions of the physical planning document. If units of local and regional self-government do not designate locations for the facilities in question in their physical plans, within the deadline prescribed under a special regulation, the decision on those locations shall be made by the Government of the Republic of Croatia.

The State shall ensure restoration of the environment at locations which have been highly burdened with waste by unidentified persons or persons which have ceased to exist if no legal successor is determined under this Plan.

The new Ordinance on waste management has achieved significant alignment with EU legislation, especially with the Regulation concerning the establishment of a European Pollutant Release and Transfer Register which requires that EU Member States set up the appropriate registers by the year 2009. In conformity with the Aarhus Convention, the public would thereby be ensured access to data on emissions into the air, soil and water and among other things, off-site transfer of waste. The Ordinance incorporates elements which basically ensure that the Waste Cadastre system will be a basis from which data for the Pollutant Release and Transfer Register will be filtered. Part of the obligations (related to two waste disposal operations, D2 and D3) still need to be resolved.

The new Proposal of the Environmental Protection Act, which is at present in parliamentary procedure, will regulate:

- environmental protection and sustainable development principles,
- protection of environmental components and environmental protection,
- sustainable development and environmental protection documents,
- instruments of environmental protection implementation,
- environmental monitoring,
- information system,
- liability for damage,
- financing and instruments of general environmental policy,
- supervision over the application of the Act,
- misdemeanours and misdemeanour fines.

The Act will prescribe the inclusion of the general public in resolving environmental issues which will strengthen the position of the public in environmental information access, participation of the public in procedures for adopting plans, programmes and concrete decisions relating to the environment and will fulfil the requirements of the Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (Aarhus Convention) which Croatia ratified in December 2006.

2.1.1. Environmental Impact Assessment and Waste Management

The Environmental Protection Act currently in force (OG 82/94 and 128/99) and Ordinance on environmental impact assessment (OG 59/00, 136/04 and 85/06) prescribe the implementation of the EIA procedure for waste management facilities.

Pursuant to Annex I List of Projects A of the Ordinance, the assessment procedure is mandatory for the following waste management facilities:

- facilities for final disposal of hazardous waste by incineration and/or physical and chemical processes,
- facilities for landfilling hazardous waste,
- facilities for treatment, storage and landfilling of radioactive waste,
- facilities for final disposal of municipal and non-hazardous waste by incineration and/or physical and chemical processes, with a capacity of 10,000 t/year and more,
- facilities for landfilling municipal and non-hazardous industrial waste, with a capacity of 10,000 t/year and more,
- facilities for landfilling inert waste with a capacity of 250,000 m³ of total volume or 4 ha surface area and more,
- facililities for mechanical-biological treatment of waste, with a capacity of 10,000 t/year and more.

Apart from the above mentioned, the EIA procedure is also mandatory for the following waste management facilities, from Annex B of the Ordinance, with the possibility of developing a Targeted Study:

- facilities for treatment of construction waste with an annual capacity of more than 25,000 m³,
- wells for disposal of industrial waste by well injection,
- underground disposal sites (abandoned mining shafts, and the like),
- remediation, restoration and/or closing of landfills operated by some party.

In the assessment of the environmental impact of waste management facilities, the acceptability of such facilities to the environment is evaluated, necessary environmental protection measures and environmental monitoring programme are established so as to reduce negative impacts to the least possible extent and achieve the greatest possible level of conservation of the environment. The EIA procedure is carried out in the early stage of preparation of the project, before the issuing of the location permit or some other approval in the case of projects for which the issuing of a location permit is not needed.

One of the basic preconditions for achieving sustainable waste management is the participation of the public in the preparation of waste management and in its implementation. Public participation is also a component part of the procedure for adopting physical planning documents and the EIA procedure. During public inspection which is part of the EIA procedure the public participates by providing opinions, objections and proposals which must

be reviewed during the procedure. In the past, the notice announcing the holding of a public inspection and public debate was published in a daily newspaper and put up on notice boards of counties and municipalities/cities. As of mid-May 2004 the wider public has been included in the public inspection so that notices on the holding of a public inspection and study summaries are also published on the web site of the MEPPPC. Cities and municipalities on a local level educate the public through mass media (TV, radio, newspapers) on how to handle waste. The public participated in the adoption of this Plan through public debates held in municipalities and cities and through public inspection of the Waste Management Plan for the Period from 2007 to 2015.

3. EU FRAMEWORK

The framework for the European waste management policy is contained in the Council Resolution on a Community Strategy for Waste Management (97/C76/01) based on the then in force Waste Framework Directive (75/442/EEC) and other European regulations in the field of waste management. There are three key European principles:

- prevention of waste generation,
- recycling and re-use and
- improvement of final disposal and supervision.

In the document Cohesion Policy in Support of Growth and Jobs: Community Strategic Guidelines, 2007-2013, Member States jointly attempt to maximise economic gain and reduce costs by resolving environmental polluting at the source. In the waste management sector this means that preference is given to prevention, recycling and biodegradation of waste, which is cheaper and ensures a higher level of employment than waste incineration and landfilling.

In the context of the accession of Croatia to the EU, the adoption and beginning of implementation of the Plan is one of the short-tem priorities defined in the Accession Partnership. The Accession Partnership is the main instrument of the pre-accession strategy of a candidate country and the EU, by which short-term and mid-term priorities on the path towards EU membership are jointly established. Accordingly, the adoption and beginning of implementation of the Plan is a priority for which EU financial assistance is determined for its fulfilment and the conditions connected with that financial assistance.

EU Directives in the field of waste management are organized into four “groups” of directives depending on whether they provide for:

- the waste management framework (Waste Framework Directive and Hazardous Waste Directive),
- individual waste streams (Directive on Packaging and Packaging Waste, Directive on Disposal of Waste Oil, Directive on Titanium Dioxide Industrial Waste, Directive on End-of-life Vehicles, Directive on Sewage Sludge, Directive on Waste Electrical and Electronic Equipment, Directive on Batteries and Accumulators containing Certain Hazardous Substances, Directive on Disposal of PCBs and PCTs),
- movement of waste, import and export of waste (Regulation on the supervision and control of shipments of waste within, into and out of the European Community) and
- facilities for treatment and landfill of waste (Landfill Directive, Waste Incineration Directive, IPPC Directive).

The obligation of waste management planning, in the form of development of waste management plans on the part of competent authorities, is directly stipulated by three directives: the Waste Framework Directive, the Hazardous Waste Directive and the Directive on Packaging and Packaging Waste. However other European legislation, that is, directives relating to individual waste streams and to waste treatment and landfill facilities must also be taken into consideration when developing waste management plans.

The most significant European directives governing the waste management sector are:

- Waste Framework Directive 2006/12/EC,
- Landfill Directive 1999/31/EC,
- Hazardous Waste Directive 91/689/EEC with Amendments 94/31/EC, 166/2006,
- Sewage Sludge Directive 86/278/EEC,
- Waste Incineration Directive 2000/76/EC,
- Directive on Packaging and Packaging Waste 94/62/EC with Amendments 2005/20/EC, 2004/12/EC, 1882/2003.

The Sixth Environment Action Programme of the European Community: Environment 2010: Our Future, Our Choice, adopted in 2001, defines prevention and waste management as one of the four main priorities with the primary goal of separating the generation of waste from economic activities.

4. STATUS ANALYSIS OF WASTE MANAGEMENT IN CROATIA

In Croatia at the present cities and counties organise the collection and landfilling of waste in a way which cannot be called an integrated waste management system. In the past few years activities on setting up the system have been carried out (in Zagreb, Šibenik, Rijeka, Sisak, Osijek and other cities) which have been intensified by the adoption of the Strategy. The following status analysis, which constitutes a precondition for planning future activities, provides an overview of the present organisation of activities, types and quantities of waste in Croatia.

4.1. SEPARATE WASTE COLLECTION

The Waste Act prescribes the obligation of separate collection and storage of waste whose valuable properties can be used. In addition, when collecting municipal waste, hazardous waste must be separated from it.

Primary recycling and separate waste collection is carried out for those waste substances whose return into the cycle is technically and financially feasible. The main task of separate waste collection is to reduce the potentials of municipal waste which is intended for landfilling, that is, to treat and use the municipal waste for energy purposes prior to landfilling.

Separate waste collection is carried out through integrated expert planning and competition in which the private and public sectors take part. Since the 90's, systems of separate collection of paper, cardboard, packaging waste (glass, PET and metal), green waste, spent batteries, medicinal products, oils, vehicle tyres, metal bulk waste and construction waste have been gradually developing in Croatia and recycling yards and «green islands» have been established.

Separate collection of individual waste materials is organised and is being carried out to a greater or lesser degree in almost all counties. According to data for the year 2005, in the territory of Croatia, the system of separate collection operated through a total of 39,030 containers for reception of various waste types. For the reception of mixed municipal waste, 158,191 containers have been registered in Croatia.

Average shares of separately collected components in 2005, including PET packaging, are shown in Figure 1.

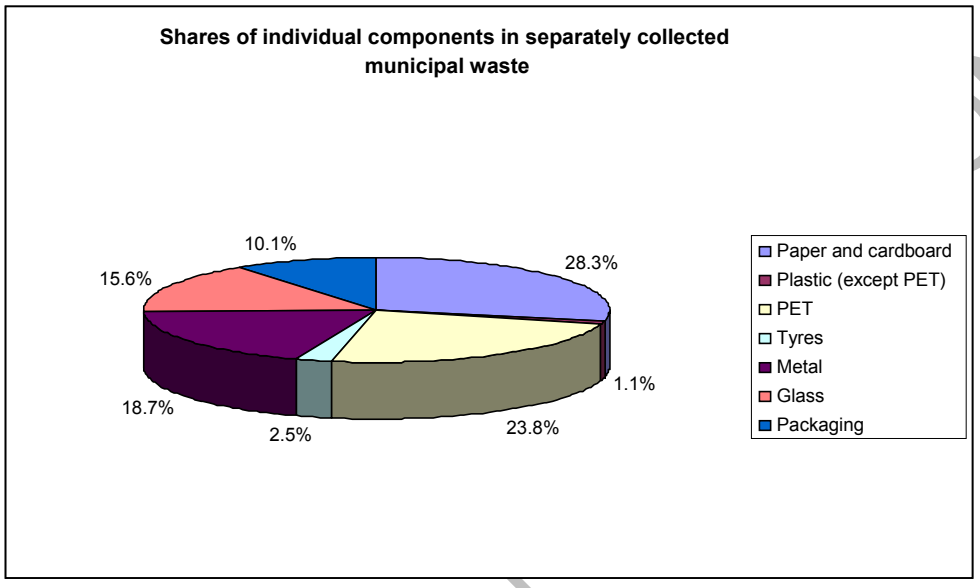


FIGURE 1 Shares of individual components in separately collected municipal waste

During 2005 and 2006, systems for the management of individual waste categories have been established (packaging and packaging waste, waste tyres, end-of-life vehicles, waste oils, waste batteries and accumulators) which have achieved excellent results, both in environmental protection and in economic development. Significant progress has been made in the separate collection of packaging and packaging waste by the establishment of a new "deposit" system of collecting packaging and packaging waste, based on the new Ordinance on packaging and packaging waste (OG 97/05 and 101/05). The success of the system of packaging waste management and its acceptance by the majority of the public is also evidenced by 910 million collected items, that is, 78,000 t of packaging waste, the amount which has been returned in one year.

Waste tyres (15,000 t), waste oils, batteries and accumulators are also collected and citizens have also shown great interest in returning old vehicles. In the period of one month, 1015 end-of-life vehicles have been turned over to collectors.

4.2. WASTE FLOW MONITORING AND REPORTING

Waste Management Information System (WMIS) is in the implementation phase in those counties in which organised waste management has begun. However the level of participation of the information system in the waste management system is low.

WMIS is an integrated part of the environmental information system whose contents, procedures for data submission and data keeping, deadlines and forms on which data are submitted are defined under the Waste Act and subordinate regulations[1]. The maintenance of the WMIS is entrusted to the Croatian Environment Agency (CEA), while supervision over the operating of WMIS is under the competence of the MEPPPC.

4.2.1. Contents of the information system and present situation

a) *Waste Cadastre (EEC[2]/Waste)* – part of the future Environmental Pollution Register and basis for international reporting
b) Data on annual generated/collected/treated waste quantities, registered by types on the registration forms are gathered at the county level in state administration offices, where data input is carried out and delivered in electronic form to the CEA to be combined.
c) Register of waste management permits and certificates of entry into the registers (an on-line database is currently in preparation)
d) Landfill Cadastre – on-line GIS database on existing locations of landfills which will need to be brought in line with the requirements of the new Ordinance on landfilling
e) Data on transboundary movement of waste – data is kept on the basis of permits, certificates and annual reports on the transboundary movement of waste
f) Databases on special waste categories – competence is divided between the Environmental Protection and Energy Efficiency Fund (EPEEF) and the CEA
g) Accompanying forms for hazardous waste
h) Waste management plans of producers
i) Monitoring the implementation of waste management plans of counties, cities and municipalities
j) Data on laboratories, regulations and other information relevant for the field of waste

[1] Ordinance on waste types (OG 27/96), Ordinance on the Environmental Emission Cadastre (OG 36/96), Regulation on supervision of transboundary movement of waste (OG 69/06), Ordinance on packaging and packaging waste (OG 97/05), Ordinance on the management of waste tyres (OG 40/06)
[2] EEC- Environmental Emission Cadastre

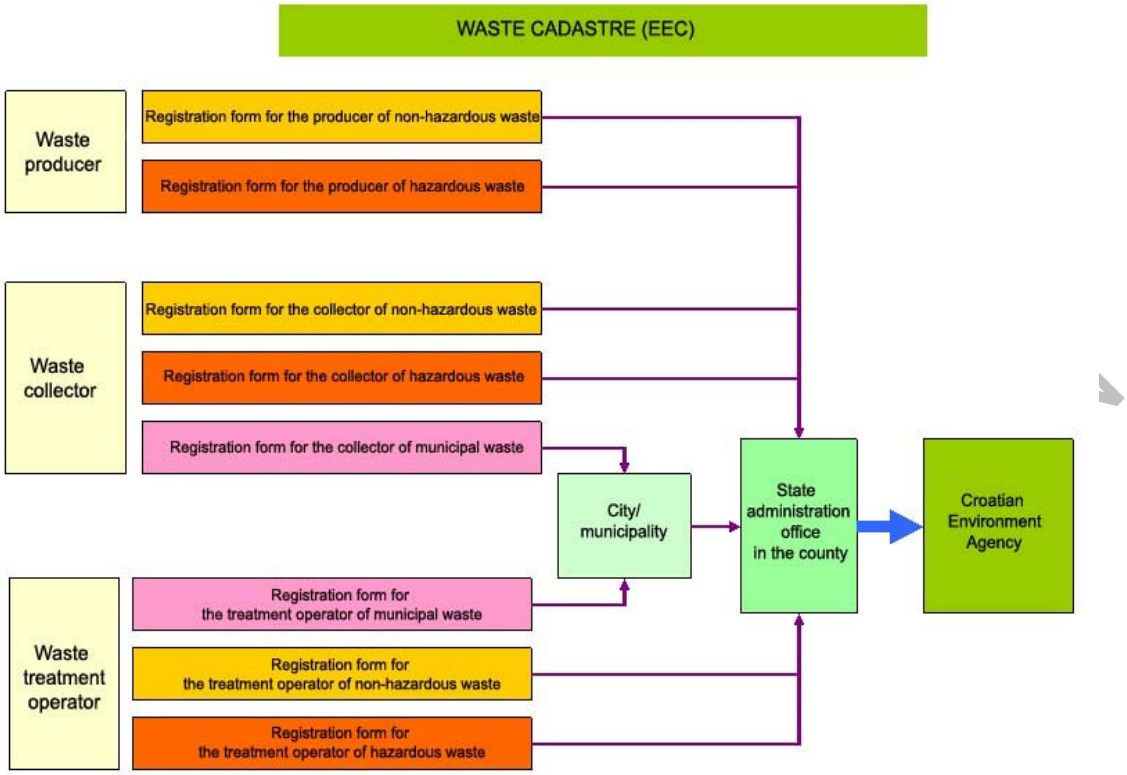


FIGURE 2 Diagram of the data flow in the Waste Cadastre (EEC/Waste)

Even though the present system for monitoring waste flows regulates the collection of all data needed for a quality evaluation of the current situation in the field of waste at the national level and for fulfilling international obligations, the existing data are deficient and the quality of part of the data is questionable.

The overlapping of requests for data based on obligations from different regulations in the field of waste and the functioning of parallel systems of collecting almost the same data (statistical research of the Central Bureau of Statistics) causes problems in establishing uniform official data. By the time of accession to the European Union that problem should be resolved by establishing a uniform data collection system (such as joint forms), by ensuring data quality control and using such computer solutions which would enable the necessary data processing to be carried out by different competent authorities, while at the same time establishing clear competences and obligations in relation to reporting to different EU bodies.

Quality assurance, broadening of the scope of registration and timely registration of data are closely connected to the present inadequate situation in the competent bodies at the regional and local level for which necessary staff and technical equipment need to be secured. There is a need for continuous cooperation among all parties obligated to apply the system, for education and training programmes and providing user assistance services.

In parallel with the increase in the number of new regulations in the waste sector, the number of reporting obligations has also increased which, on one hand, presents a strain on legal entities but also on institutions entrusted with the implementation of the data collection system, with its establishment or with supervision.

4.3. MUNICIPAL WASTE

By definition, municipal waste is waste from households, waste from production activities and/or services when the waste is by its properties and composition similar to waste from households.

The Waste Act stipulates that the county or city ensure the implementation of measures for municipal waste management.

Organised collection of municipal waste covers an average of 92.8% of the population of Croatia.

An overview of municipal waste collection coverage by counties is shown in Figure 3.

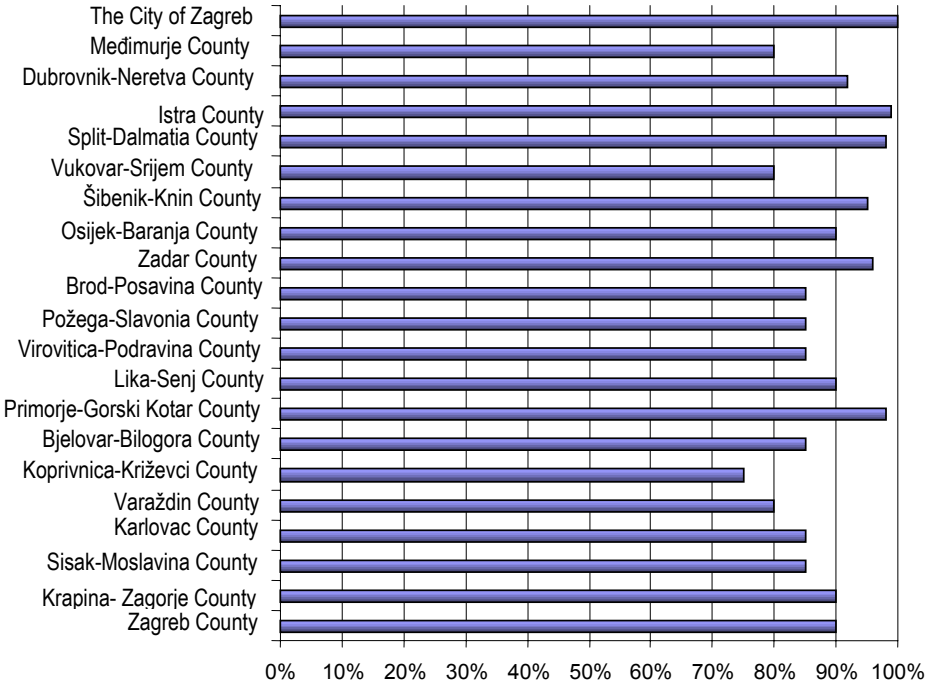


FIGURE 3 Share of population covered by the organised system of municipal waste collection according to counties for the year 2005.

Disposal of municipal waste in Croatia is carried out by 199 utility companies and concession holders registered for the collection and landfill of municipal waste and Table 2 provides the total number of municipal waste collectors by counties[3].

[3] Guidelines Development for Starting Implementation of the Waste Management Plan in the Republic of Croatia, Ekonerg, Zagreb 2006.

TABLE 2 Overview of municipal waste collectors by counties

COUNTY	MUNICIPAL WASTE COLLECTORS
Bjelovar-Bilogora	9
Brod-Posavina	9
Dubrovnik-Neretva	7
The City of Zagreb	8
Istra	7
Karlovac	10
Koprivnica-Križevci	7
Krapina-Zagorje	4
Lika-Senj	9
Međimurje	3
Osijek-Baranja	10
Požega-Slavonia	3
Primorje-Gorski Kotar	13
Sisak-Moslavina	10
Split-Dalmatia	22
Šibenik-Knin	12
Varaždin	6
Virovitica-Podravina	7
Vukovar-Srijem	17
Zadar	18
Zagreb	8
TOTAL	**199**

Collection of waste in most communities is organised once a week (and in larger communities two to three times a week) according to a set schedule. In certain counties which are active in the tourism industry, during tourist season waste is collected on a daily basis.

Apart from the general population, municipal waste is also collected from economic entities, from the hospitality and catering industry and similar activities, depending on the need for collection. Waste is collected in plastic bags, receptacles, containers, mobile balers or compactors.

Costs of waste management are calculated in numerous ways, depending on the factors in the waste treatment cycle. In Croatia two methods of calculation of costs and earnings are used. One is based on real waste quantities generated by the waste producer and the other on derived waste quantities according to the surface area used by the waste producer (area of business premises, apartment, house). At the moment, in the majority of the counties, only the expenses of the collection system are included in the price of municipal waste disposal, except in the City of Zagreb and in a few other cities where expenses of waste landfilling are also included in the price.

For the most part waste is deposited at the nearest landfill in the same county in which it was generated. A small percentage of waste (about 2.2 %) is deposited at a landfill in another county in relation to the point of generation. The largest inter-county waste transport is carried out from Krapina - Zagorje County to Karlovac County (around 24%), from Brod - Posavina to Vukovar County (21%) and from Međimurje County to Karlovac County (12% of

collected waste). The largest quantity of waste from other counties is landfilled in Karlovac County (14,291 tons per year) and in Vukovar - Srijem County (14,188 tons per year).

4.3.1. Estimate of municipal waste quantities

Inspection of the existing situation in waste management and of present and future quantities and the composition of waste is necessary for developing a proposal for a solution within the framework of an integrated waste management system as well as a precise definition of such municipal waste, from the point of generation to the point of final disposal. Awareness of municipal waste quantities from the lowest to the highest organisational level constitutes the basis for defining municipal waste flows and developing balance sheets. Due to years-long neglect in monitoring the situation in the waste management sector, as well as, among other things, monitoring the movement of its quantities, until the development of this Plan, the exact quantities of waste still have not been precisely determined for the county levels which, according to the Strategy, should become the smallest organisational units and should be the implementing parties of the waste management system.

As fundamental data for this Plan, the data estimates from the project LIFE 04 TCY/CRO/000028 Guidelines Development for Starting Implementation of the Waste Management Plan in the Republic of Croatia, Ekonerg, Zagreb 2006, for the year 2005 were used. The total estimated quantity of produced municipal waste in the territory of Croatia for the year 2005 amounts to 1.5 million tons and is shown in Table 3.

TABLE 3 Quantity of produced municipal waste in 2005 by counties[4]

COUNTY	Population (Central Bureau of Statistics, census 2001)	Produced municipal waste in 2005 in tons
1. Zagreb	309,696	81,181
2. Krapina-Zagorje	142,432	30,640
3. Sisak-Moslavina	185,387	62,332
4. Karlovac	141,787	37,174
5. Varaždin	184,769	40,206
6. Koprivnica-Križevci	124,467	26,249
7. Bjelovar-Bilogora	133,084	36,740
8. Primorje-Gorski Kotar	305,505	114,984
9. Lika-Senj	53,677	17,766
10. Virovitica-Podravina	93,389	26,391
11. Požega-Slavonia	85,831	27,658
12. Brod-Posavina	176,765	54,818
13. Zadar	162,045	69,659
14. Osijek-Baranja	330,506	126,456
15. Šibenik-Knin	112,891	35,367
16. Vukovar-Srijem	204,768	42,245
17. Split-Dalmatia	463,676	142,423

[4] Guidelines Development for Starting Implementation of the Waste Management Plan in the Republic of Croatia, Ekonerg, Zagreb 2006.

18. Istra	206,344	96,400
19. Dubrovnik-Neretva	122,870	44,410
20. Međimurje	118,426	24,533
21. The City of Zagreb	779,145	311,749
TOTAL	4,437,460	1,449,381

The quantity of produced municipal waste per capita amounts to an average of 0.90 kg/per capita/per day (327 kg/per capita/per year), ranging between 0.56 to 1.28 kg/ per capita/per day (206 to 467 kg per capita/per year).

4.3.1.1. Tourism waste

The above mentioned data also includes waste from the tourism industry. The share of this waste in individual counties greatly varies. For the purposes of this Plan, the total estimated quantity of tourism waste in each county is linked to the number of over-night-stays by tourists and according to that estimate, it amounts to 97,700 tons per year.

The total tourism waste yield in most counties is not particularly significant in a quantitative sense but its share may be relatively large if a tourist municipality or even county is looked at separately. Apart from that, it is also significant that that quantity of waste is generated only in one particular period of the year, so in planning the system of disposal and management that fact also has to be taken into account.

4.3.2. Composition of municipal waste

The composition of municipal waste changes depending on the environment in which it is generated and depends on a great number of factors such as: living standard of the population, type of inhabited area, the existing level of utility infrastructure and the like.

Biodegradable waste means any waste that is capable of undergoing anaerobic or aerobic decomposition, such as garden waste, kitchen waste and paper and cardboard while biodegradable municipal waste means waste from households, as well as other biodegradable waste, which because of its nature and composition is similar to biodegradable waste from households.[5]

In Croatia monitoring of the municipal waste system has not been systematically carried out. Results obtained from individual testing exist for some areas. The sorting and analysis of waste carried out in the period from 1992 to 2000, with most of the testing carried out in 1997 in the towns of Velika Gorica, Bjelovar, Osijek, Zagreb, Koprivnica, Sisak, Samobor, Orahovica, Split, Crikvenica, Novi Vinodolski, Novalja, Pag and their suburbs and rural municipalities which within organised municipal waste collection deposit their waste on existing landfills. Tests were carried out in different periods for each season.
Table 4 shows the obtained results of testing for the continental area and coastal area of Croatia and the mean value for the areas mentioned.[6]

[5] M. Crowe, K. Nolan, C. Collins, G. Carty, B. Donlon, M. Kristoffersen, European Topic Centre on Waste, Biodegradable municipal waste management in Europe, EEA 2002.
[6] T. Domanovac, R. Orašanin: Composition of municipal waste of the continental and coastal areas of the Republic of Croatia, VII International waste management symposium Zagreb, 2002.

TABLE 4 Overview of the average annual composition of municipal waste

Waste component	mass %, continental area	mass %, coastal area	mass %, mean value	mass %, biodegradable share
Kitchen and bio waste	43.1	41.0	42.1	**74.5**
Paper and cardboard	19.6	20.3	20.0	
Skin and bones	3.0	3.1	3.1	
Wood	1.3	1.2	1.3	
Textile	7.8	8.2	8.0	
Glass	6.6	7.0	6.8	
Metals	4.1	4.0	4.1	
Inert	1.5	2.2	1.9	
Plastic	11.6	12.3	12.0	
Rubber	0.9	0.5	0.7	
Special	0.4	0.2	0.3	

Taking into account the above mentioned, the reference year for monitoring the fulfilment of set targets for reducing the share of biodegradable waste in municipal waste is the year 1997, for which it has been estimated that 1,015,000 tons[7] of municipal waste was produced in Croatia. Based on the data shown in Table 4, 74.5% of waste constitutes biodegradable waste, that is, it is estimated that 756,175 tons of biodegradable waste was produced in 1997.

4.4. NON-HAZARDOUS INDUSTRIAL WASTE

Industrial waste is waste resulting from production processes in industries, crafts and other processes which differs in its composition and properties from municipal waste. Also, pursuant to the Waste Act, leftovers from the production process when used in the production process of the same producer are not considered to be industrial waste.

Non-hazardous waste is waste which does not have any of the properties established under Annex II of the Regulation on categories, types and classification of waste with a waste catalogue and list of hazardous waste.

4.4.1. Registered and landfilled quantities and types of non-hazardous industrial waste

Producers, collectors, waste treatment operators and all other persons performing waste management are obligated to, once a year, submit data on the types, quantities and waste streams to the competent state administration office in the county, while data for all the counties is combined in the CEA.

[7] IPZ Uniprojekt MCF, 2005.

For various reasons, some types of waste are often not registered in the system, the data on them is incomplete or of poor quality. That is why EEC – WASTE still cannot ensure complete and coherent data on industrial waste quantities, types and streams.

According to the data from EEC – WASTE in the year 2004 1,514,363 tons of non-hazardous industrial (technological) waste was produced. The greatest percentage of the total produced quantity of non-hazardous waste constitutes waste registered under the categories:

- 02 00 00 - Wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing, food preparation and processing (23.28 %)

  In this group 62,494 tons of animal faeces, urine and manure (KB 02 01 06), 81,804 tons of soil from cleaning and washing beet (KB 02 04 01 and 02 04 99), and 65,965 tons of off-specification calcium carbonate (KB 02 04 02) have been registered.

  The mentioned waste types are generally, with the adequate pre-treatment, used at the very point of generation, and part of the calcium carbonate is also taken over by farmers which use it for correcting PH values of agricultural soil.

- 06 00 00 – Wastes from inorganic chemical processes (21.83%)

  In this group Petrokemija d.d. has registered 302,400 tons of phosphogypsum (KB 06 09 01) and 25,750 tons of other waste from phosphorus chemical processes (KB 06 09 99).

  This waste is deposited on a controlled landfill for Category I technological waste, owned by Petrokemije d.d. which holds all the necessary documentation required by law.

Figure 4 shows the quantities of registered non-hazardous industrial waste by counties in the year 2004.

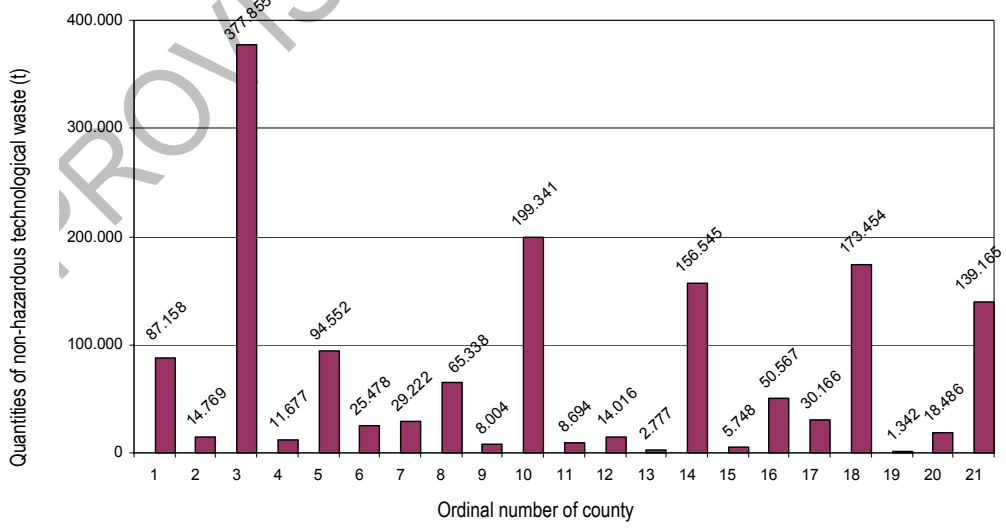


FIGURE 4 Quantities of produced non-hazardous waste by counties (2004)

ORDINAL NUMBERS OF COUNTIES:

1. Zagreb County,	2. Krapina – Zagorje County,
3. Sisak – Moslavina County,	4. Karlovac County,
5. Varaždin County,	6. Koprivnica – Križevci County,
7. Bjelovar – Bilogora Conty,	8. Primorje – Gorski Kotar County,
9. Lika – Senj County,	10. Virovitica – Podravina County,
11. Požega – Slavonia County,	12. Brod – Posavina County,
13. Zadar County,	14. Osijek – Baranja County,
15. Šibenik – Knin County,	16. Vukovar – Srijem County,
17. Split – Dalmatia County,	18. Istra County,
19. Dubrovnik – Naretva County,	20. Međimurje County,
21. The City of Zagreb	

During the analyses of data from the EEC which relate to the management of produced waste at the point of generation several business entities wrote in their registration forms that they landfill the waste produced at the point of generation, meaning, in their own surroundings, for which it is to be supposed that they do not always have all the necessary accompanying documentation and necessary permits.

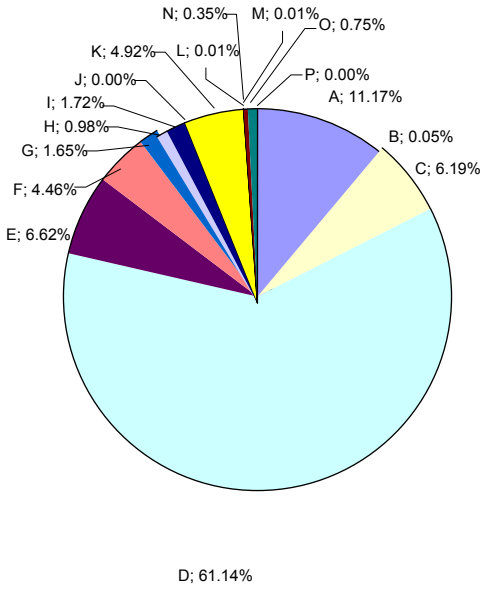
As part of the project Guidelines Development for Starting Implementation of the Waste Management Plan in the Republic of Croatia, Ekonerg, 2006, an estimate was made of the quantities of non-hazardous industrial waste deposited on municipal waste landfills in 2004 as shown in Table 5.

TABLE 5 Estimate of quantities of non-hazardous industrial (technological) waste deposited on municipal waste landfills in 2004.

County	Estimate (tons/year)
1. Zagreb	18,000
2. Krapina-Zagorje	3,000
3. Sisak-Moslavina	7,000
4. Karlovac	5,700
5. Varaždin	1,500
6. Koprivnica-Križevci	15,000
7. Bjelovar-Bilogora	3,500
8. Primorje-Gorski Kotar	30,000
9. Lika-Senj	3,500
10. Virovitica-Podravina	7,000
11. Požega-Slavonia	4,000
12. Brod-Posavina	2,000
13. Zadar	2,000
14. Osijek-Baranja	27,000
15. Šibenik-Knin	4,000
16. Vukovar-Srijem	4,000
17. Split-Dalmatia	15,000
18. Istra	15,000
19. Dubrovnik-Neretva	3,000
20. Međimurje	16,000
21. The City of Zagreb	26,000
Total	**212,200**

4.4.1.1. Composition of non-hazardous industrial waste

Figure 5 shows registered non-hazardous industrial waste by groups of activities (National Classification of Economic Activities):



A: Agriculture, hunting and forestry
B: Fishing
C: Mining and quarrying
D: Manufacturing
E: Electricity, gas and water supply
F: Construction
G: Retail and wholesale trade; repair of motor vehicles, motorcycles and personal and household goods
H: Hotels and restaurants
I: Transport, storage and communication
J: Financial intermediation
K: Real estate, renting and business activities
M: Education
N: Health and social work
O: Other community, social and personal service activities

FIGURE 5 Produced waste by groups of economic activities

4.5. HAZARDOUS WASTE

Hazardous waste is any waste that is according to its composition and properties defined as hazardous waste pursuant to the Waste Act, that is, hazardous waste is determined by categories (generic types) and composition, and it must contain one or more properties determined in the List of hazardous waste which is a constituent part of the Regulation on categories, types and classification of waste with a waste catalogue and list of hazardous waste.

Properties of waste which render it hazardous are:

H1	Explosive
H2	Oxidizing
H3 A	Highly flammable
H3 B	Flammable
H4	Irritant
H5	Harmful
H6	Toxic
H7	Carcinogenic
H8	Corrosive
H9	Infectious
H10	Toxic for reproduction (Teratogenic)
H11	Mutagenic

H12 Substances and preparations which release toxic or very toxic gases in contact with water, air or an acid

H13 Substances and preparations capable by any means, after disposal, of yielding another substance, e.g. a leachate, which possesses any of the characteristics listed above (H1-H12)

H14 Ecotoxic.

The Waste Act explicitly bans the import of hazardous waste.

4.5.1. Registered quantities and types of hazardous waste

The trend in registered quantities of hazardous waste in the period from 2001 to 2005, according to data from the EEC maintained by the CEA, is shown in Figure 6.

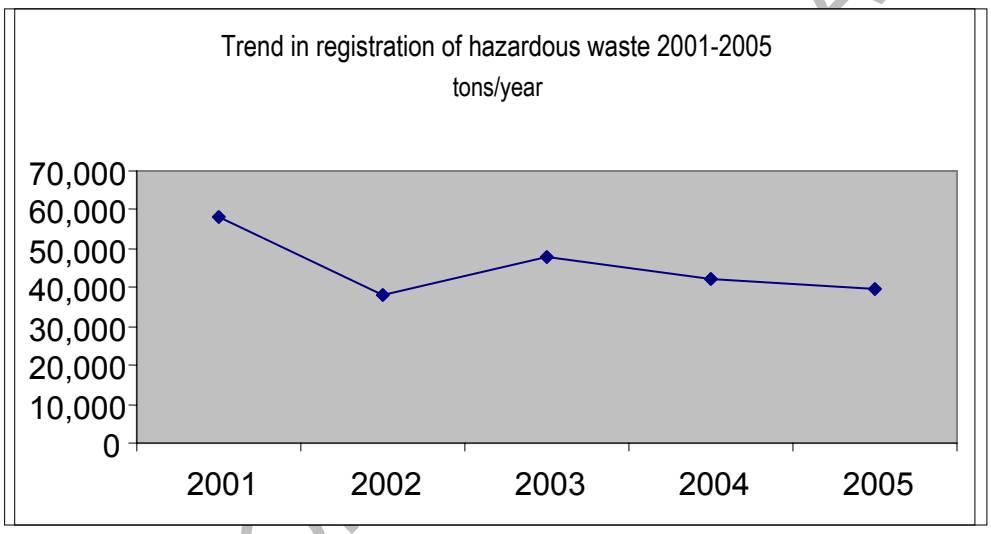


FIGURE 6 Trend in registration of hazardous waste quantities (tons/year) in the period from 2001 to 2005

To be able to define the potential locations for construction and upgrading of the necessary infrastructure for setting up a hazardous waste management system, it is necessary to identify the points of generation of hazardous waste. For the needs of the Plan an analysis of registered quantities and types of hazardous waste has been carried out by counties for each year in the period from 2002 to 2005, and Figure 7 shows the registered hazardous waste by each individual county for 2005.

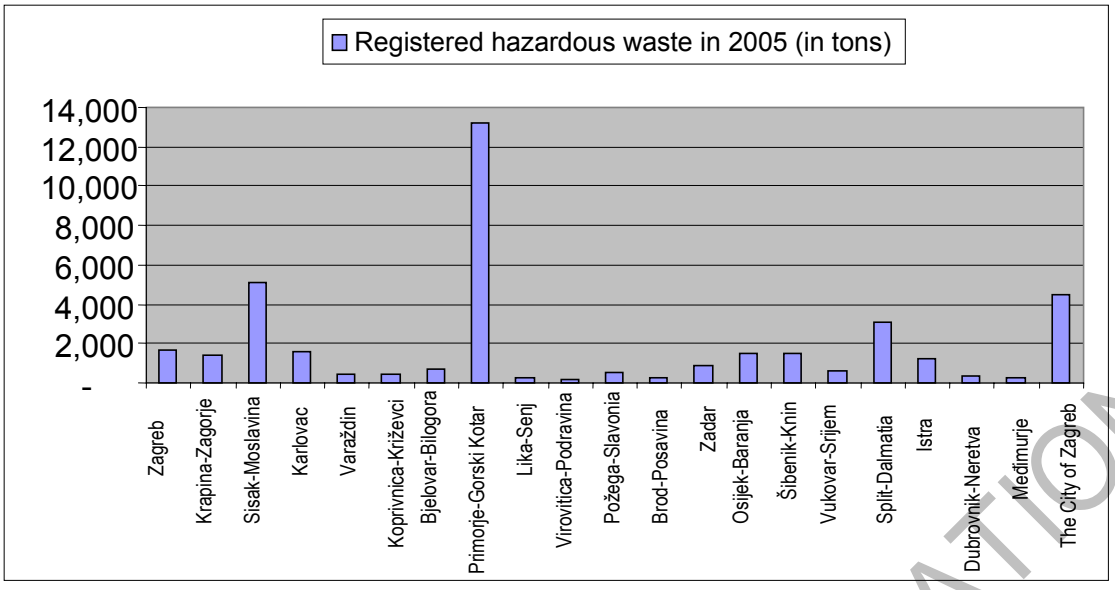


FIGURE 7 Registered hazardous waste by counties for 2005

Analysis of data on quantities and types of hazardous waste which is generated and registered in the EEC in an individual county shows that:

- the largest quantities of produced hazardous waste are registered in the Primorje – Gorski Kotar County and in the City of Zagreb;
- there is no continuity in the registering of hazardous waste in certain counties in relation to registered hazardous waste quantities (for example in Požega – Slavonia County for 2002 hazardous waste was not registered);
- about 60% of total hazardous waste produced is registered in counties in the central and northern part of the territory of Croatia.

4.5.2. Estimate of hazardous waste quantities

In view of the facts established and the lack of official data on the quantities of hazardous waste which is registered or produced in Croatia, a preliminary expert estimate of quantities of hazardous waste generated in Croatia has been made. According to the preliminary estimate, about 213,000 tons of hazardous waste is generated in Croatia per year which is three times more than the hazardous waste quantities registered in the EEC.

4.5.3. Existing infrastructure for hazardous waste management

In Croatia, technical and technological capacities for collecting, storing and treating hazardous waste are being developed in accordance with market principles. Certain economic entities have been issued permits for collecting, transporting and temporary storage of hazardous waste. In addition, there are several smaller specialised facilities in Croatia built for the purpose of recovery/treatment of hazardous waste and there are available capacities within individual industrial installations which are used for recovery/treatment of some type of hazardous waste.

For carrying out activities of collection and temporary storage of hazardous waste it is necessary to obtain a permit in accordance with Article 41 of the Waste Act. Currently in

Croatia there are 47 companies in possession of the permit for the activities of collection and temporary storage of hazardous waste in accordance with the new Waste Act and its Amendments and the old Waste Act (OG 151/03).

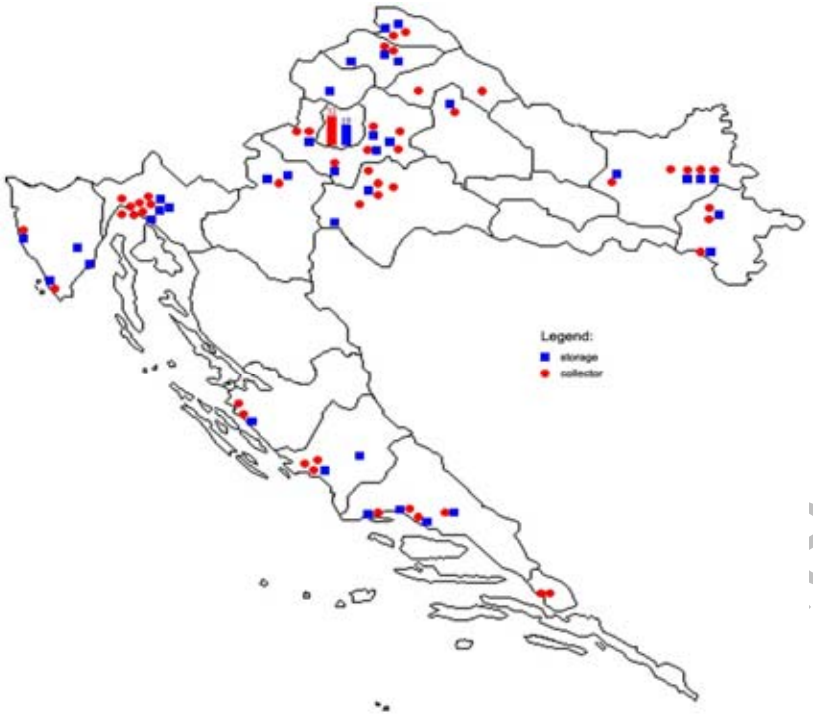


FIGURE 8 Territorial distribution of companies authorised for collection and storage of hazardous waste

For the activities of disposal/recovery of hazardous waste it is necessary to, just as for the activities of collection and storage of hazardous waste, obtain a permit in conformity with Article 41 of the Waste Act. In Croatia there are currently 43 companies holding permits for the activities of waste disposal/treatment.

The method of disposal/treatment of hazardous waste in Croatia is determined on the basis of the permits issued and is carried out in one of the following ways:

a) thermal treatment,
b) conditioning by incorporation into brick products,
c) solvent regeneration, neutralisation of acids and bases,
d) solidification and stabilisation,
e) sterilisation/disinfection,
f) electrolysis and dilution,

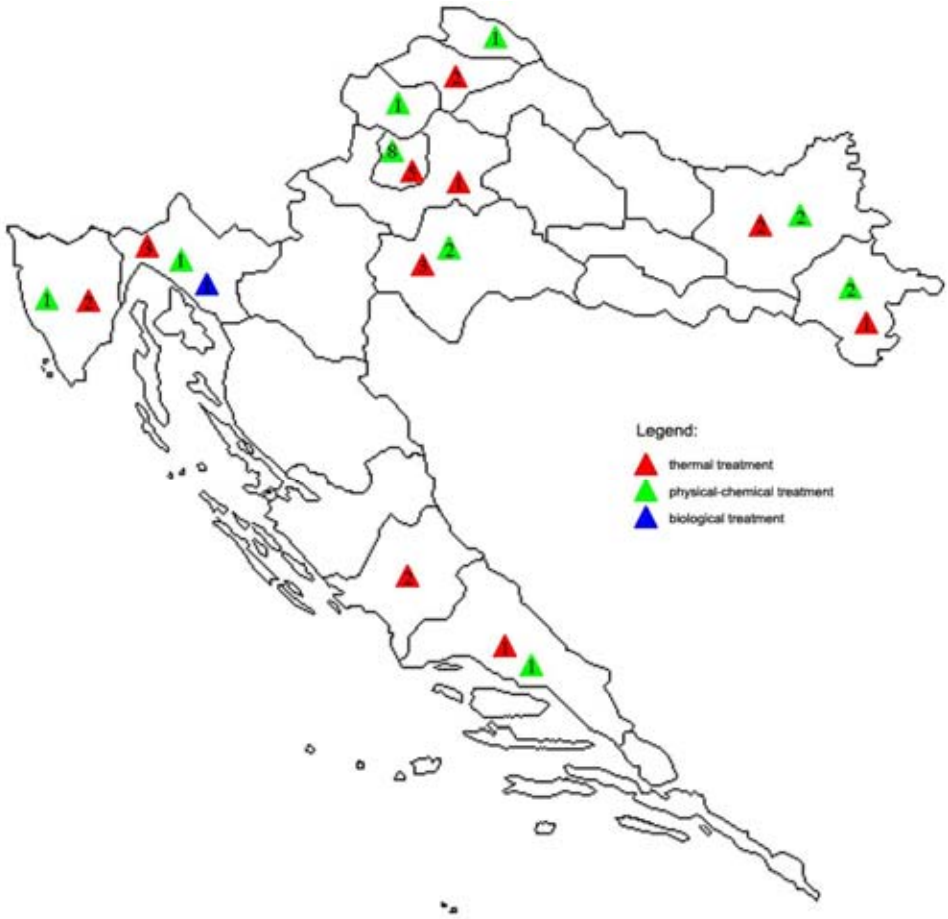


FIGURE 9 Territorial distribution of economic entities holding a permit for hazardous waste treatment

A preliminary estimate of currently available capacities according to hazardous waste treatment method, based on analysis of issued permits for hazardous waste disposal, is shown in Table 6.

TABLE 6 Number of treatment operators and treatment capacity for each type of hazardous waste

Treatment method/ Hazardous waste type	Number of treatment operators	Hazardous waste treatment capacity
Thermal treatment		
Co-incineration: Waste oils I and II category Meat-and-bone meal	17	about 25,000 tons per year
Incineration: Packaging from plant protection products Infectious waste Incineration plants run by economic entities	1 2 3	about 3,700 tons per year

Material recovery: sludge incorporation into brick products oily waste	 1 2	capacity unknown 1,200 tons per year of oily packaging 1,728 tons per year of oil filters 3,000 tons per year of oily water from ships
Chemical physical treatment: Sterilization/infectious waste	6	about 1,770 tons per year
Solidification/oily waste	4	about 500 tons per year sodification
Neutralisation/acids and bases electrolysis	2 1	about 100-200 tons per year 17 m^3
Biological treatment Biological treatment/waste oils	2	about 200 tons per year
In situ bioremediation/polluted soil	2	about 40,000 tons per year

It is necessary to point out that the overview of existing installations for hazardous waste treatment is incomplete in the part relating to permit capacities, since the procedure of harmonising the permits for hazardous waste treatment issued pursuant to the old Waste Act and the new Waste Act is still in progress.

4.5.4. Hazardous waste export

At present in Croatia there are no controlled locations for landfilling hazardous waste so that hazardous waste intended for landfilling (waste which cannot be recycled, recovered etc.) is exported for landfilling abroad (to for example salt mines in Germany). In 2004, 12 companies exported hazardous waste from Croatia, and a total of 12,805 tons of hazardous waste was exported. The share of individual hazardous waste types (in %) in the total realized export of hazardous waste in 2004 is shown in Figure 10.

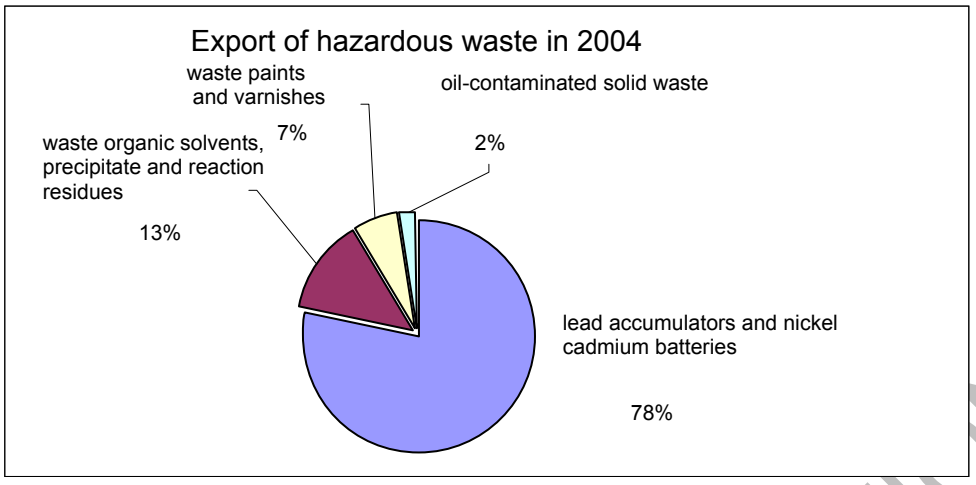


FIGURE 10 Export of hazardous waste in 2004

In 2005, out of 12 companies holding the approval of the MEPPPC for hazardous waste export, 11 exported waste from Croatia, and a total of 13,157.02 tons of hazardous waste was exported. More than 68% of the total quantity of exported hazardous waste consisted of lead accumulators and nickel cadmium batteries, 11.08% were waste paints and varnishes, 4.51% waste from metal surface treatment and protection of metals and other materials, 1.84% oil-contaminated solid waste, 1.43% ash and residues containing lead, 0.91% laboratory chemicals composed of or containing hazardous substances including laboratory chemical mixtures, 0.40% non-halogenated organic solvents and the remaining 11.75% were waste medicinal products, sludge containing hazardous substances, electronic equipment, precipitate and reaction residues, spent absorbents, etc. The largest amount of hazardous waste was exported to Slovenia (67.94%), mostly lead accumulators and batteries, and to Austria (25.81%), mostly waste paints and varnishes. To Germany, the following was exported: waste hydrochloric acid, waste paints and varnishes, waste sludge containing hazardous substances, waste salts containing nitrates and nitrites etc. In 2005, waste in the form of nickel cadmium batteries was exported to the Czech Republic (1.34%), and transformers and condensers containing PCBs was exported to Switzerland (0.17%).

4.6. SPECIAL WASTE CATEGORIES

4.6.1. Medical waste

Pursuant to the Ordinance on medical waste management (in the process of adoption), hazardous medical waste, according to hazardous properties defined under a special regulation, is divided into:

1. infectious,
2. chemical waste containing hazardous substances,
3. sharp objects,
4. citotoxics and citostatics,
5. dental amalgam waste and
6. other hazardous waste – all waste for which it is supposed that it possesses some hazardous property.

Medical institutions dispose of infectious waste in the following manner:

- thermal treatment in their own thermal treatment installations,

- individual treatment – sterilisation followed by landfilling on a municipal landfill or
- delivery to authorised persons which posses devices for treatment – sterilisation of infectious waste.

Disposal of infectious waste of private medical practices is organised through contracting companies or through medical centres in the area in which they are located.

A little over half of the medical institutions produce chemical waste. Medical institutions handle this category of waste in one of the following manners:

- thermal treatment of generated chemical waste in their own thermal treatment installations,
- neutralisation and dilution followed by discharging chemical waste into the sewage system (note: this is forbidden. Waste can be managed only by authorised legal and natural persons),
- delivery of chemical waste to authorised persons which ensure recovery and/or disposal.

The possibilities for disposing of sharp objects according to the Instruction are the same as for disposing of infectious waste, which is by thermal treatment. The majority of medical institutions incinerate sharp objects in their own installations for thermal treatment/energy facilities; some institutions possess needle destruction devices – devices used exclusively for incinerating sharp objects, while some treat sharp objects and then landfill them along with inert-municipal waste.

A little over half of the medical institutions produce pharmaceutical waste. These are mostly smaller quantities of medicinal products, between 0.1 and 5 kg per week, except in some hospitals in which quantities reach up to 60 kg per week. At present, pharmaceutical waste in medical institutions in Croatia is handled in the following manners:

- thermal treatment in their own thermal treatment installations,
- landfilling on municipal landfills or
- temporary storage followed by delivery to companies authorised for collecting hazardous waste

Less than one third of the medical institutions produce citostatics. Management of this type of hazardous medical waste and the possibilities available for its disposal are the same as for pharmaceutical waste.

Estimated quantities of medical waste in Croatia at this moment amount to about 19,500 tons per year, and it is estimated that of that amount, 2,700 tons per year constitutes hazardous medical waste. About 50 to 60% of hazardous medical waste ends up in treatment or in export for treatment or disposal, which amounts to about 1,500 tons per year.

By definition, medical waste is any waste from the Waste Catalogue pursuant to the Regulation on categories, types and classification of waste with a waste catalogue and list of hazardous waste (OG 50/05).

4.6.2. Waste oils and other oily waste

The new Ordinance on waste oil management divides waste oils into waste lubricants and waste cooking oils.

The consumption of lubricant and cooking oils is steadily increasing. At this time estimated quantities of fresh oils placed on the market in Croatia amount to 35,000 tons per year of lubricant oils and 50,000 tons per year of cooking oils. After use, those oils become waste oils.

Collected waste oils may be:

- materially recovered in such a way so as to obtain new products or to enable their re-use through purification or
- thermally treated in such a way so as to be used as fuel.

Waste lubricant oils which have not been recovered and/or disposed of in the prescribed manner represent hazardous waste.
In Croatia, collection of waste oils is carried out by a large number of companies and about 20 hold a permit from the MEPPPC for performing waste oil management activities.
Authorisation for waste oil treatment is held by 17 companies. In Croatia there are no installations for the regeneration of waste oils and domestic manufacturers of motor and industrial oils take over oils from their customers/distributors and use them as an energy-generating product. It is supposed that industrial heating plants and boiler plants, of which only a small number meets the prescribed requirements (power >3 MW_t), incinerate waste oils illegally, without prior analysis, a permit from the competent ministry and reporting of data on incinerated waste oils to the competent county authority (for the EEC).

Activities of collection of oily waters, oily packaging and oily filters are also carried out by a large number of companies (about 20 hold a permit) while for the treatment of that type of waste, seven companies possess a permit from the MEPPPC.

In Croatia two specialized plants for the disposal of oily waste have been constructed:

- Waste recycling plant in Grubišno Polje,
- Centre for collection, storage and pre-treatment of oily waste substances in Split.

4.6.3. Waste batteries and accumulators

The new Ordinance on the management of waste batteries and accumulators defines a waste battery or accumulator as a battery or accumulator which cannot be re-used and which is intended for treatment and/or recycling. Most waste batteries and accumulators are classified as hazardous waste (lead batteries, nickel cadmium batteries, mercury batteries, separately collected electrolytes from batteries and accumulators).

The Ordinance establishes a system of collection, treatment and high level of recycling and controlled recovery and/or disposal of leftovers after treatment and recycling of waste batteries and accumulators regardless of their form, volume, mass and materials from which they were made. Persons authorised for managing end-of-life vehicles, waste electrical and electronic devices and equipment and other equipment and devices which contain batteries and accumulators as constituent parts have the obligation to remove the batteries and

accumulators at their own expense and, as holders, ensure their delivery to authorised persons for collection, treatment and/or recycling.

For achieving the rate of a minimum of 25% of the collection rate, the Ordinance prescribes 26 September 2012 as the deadline, and for the rate of a minimum of 45% of the collection rate, 26 September 2016.

Consumption of batteries and accumulators is steadily increasing. The estimated quantity of waste accumulators in 2005 is 8,500 tons per year (collected and exported). The estimated quantity of new accumulators and batteries placed on the market is 11,000 tons per year.

Collection of waste batteries and accumulators is organised through sale points. At present, waste batteries and accumulators are exported for treatment abroad, mostly to Slovenia[8]. Activities of waste battery and accumulator collection are performed by 17 companies which possess a permit of the MEPPPC, while 13 companies currently hold permits for temporary storage of waste batteries and accumulators.

4.6.4. Waste containing PCBs

In the territory of Croatia there are no registered transformers containing PCBs intended for disposal. About 43 tons or 1992 condensers with PCBs are registered for disposal and are currently stored inside industrial installations, or on the factory premises of the waste holders. Also there are about five tons of waste liquids containing PCBs registered, as well as 5 kg of waste metal and 12 kg of other material contaminated by PCBs.[9]

In Croatia PCBs are used in closed systems (as dielectrics in transformers and condensers) while the use of PCBs in open systems (paint, veneer etc.) has not been registered in Croatia. The total registered quantity of PCBs in closed systems in Croatia amounts to 1,384 tons (data on weight represents total weight of the device containing PCBs) of which 22,859 condensers: 656 tons, and 304 transformers: 729 tons.

After termination of operation and use all this equipment will become hazardous waste which will need to be managed in a legally regulated manner.

In Croatia there are no special areas designated for treatment or disposal of waste containing PCBs. Eight companies hold a permit from the MEPPPC for temporary storage of this category of hazardous waste. Final disposal of waste containing PCBs is performed by export for disposal abroad, in conformity with the Basel Convention.

4.6.5. Waste containing asbestos

After the bankruptcy proceedings and closing down of the factory Salonit d.d. in Vranjic, in Croatia manufacturing of asbestos cement products no longer exists, but asbestos cement waste and pulpy waste generated during several decades of manufacture in the Salonit d.d. factory still remain.

[8] Source: CEA Report on Hazardous Waste Export for 2004/2005
[9] Source: National Implementation Plan for the Stockholm Convention, 2004, MEPPPC

4.6.6. Waste from mining and exploitation of mineral resources

The Mining Act prescribes the basic conditions and requirements relating to performing the activities of exploitation of mineral resources, but the provisions of EU Directives covering management of waste from mining activities have not been transposed into the Act.

The development of the Strategy for the Management of Mineral Resources in the Republic of Croatia is in progress and will, among other things, also contain the basic measures and goals relating to managing waste generated from the exploitation of mineral resources.

In Croatia today no large mineral exploitation fields or mineral exploitation procedures including refinement of mineral deposits (flotation, separation etc.) are in function.

Today in Croatia the following are exploited: architectural building stone, gravel, sand, clay and limestone for the needs of the construction industry, cement plants, lime factories and brick and ceramic factories.

Suitable waste which is generated during exploitation is used as material for filling/closing used exploitation fields.

4.6.7. Construction waste

According to the Strategy, construction waste is generated during the production of building products or semi-manufactured products, construction, demolition and reconstruction of construction works.

Types of construction waste are defined under the Regulation on categories, types and classification of waste with a waste catalogue and list of hazardous waste, under key number 17.

In Croatia at present there are several mobile installations for recycling construction waste which have still not reached the level of cost-effectiveness by incorporation of recycled construction materials.

In general, the types of materials which may appear in construction waste depend on the types of construction works, for example:

- ground excavation – soil, sand, gravel, clay, loam, stone;
- structural engineering - bitumen (asphalt) or cement bound material, sand, gravel, crushed stone;
- building construction – concrete, brick, mortar, plaster, gas concrete, natural stone;
- mixed construction waste – wood, plastic, paper, cardboard, metal, cables, paint, varnish, rubble.

Types of construction waste are also differentiated depending on whether an existing building is being demolished or a new building is being constructed. Taking into account the geographical features of Croatia, in Dalmatia and the maritime coastlands stone is the predominant construction waste, in the north-western region concrete and brick while in the east, brick and mixed waste (rubble) are predominant.

Based on the data on collected construction waste under the project LIFE TCY/CRO/000114 CONWAS and the data of the Central Bureau of Statistics on the population in corresponding counties (cities and municipalities), the average quantity of construction waste by counties

has been calculated and the expected increase in waste quantities in the coming five to ten years.

TABLE 7 Estimated quantities of construction waste in Croatia

County	Estimated quantities of construction waste 2001 - 2005 (tons)	Assumed quantities of produced construction waste 2006 - 2015 (tons)
Zagreb	78,992.15	111,026.57
Krapina-Zagorje	36,329.21	51,062.13
Sisak-Moslavina	47,285.46	66,461.57
Karlovac	36,164.69	50,830.89
Varaždin	47,127.83	66,240.01
Koprivnica-Križevci	31,746.99	44,621.64
Bjelovar-Bilogora	43,956.94	45,269.05
Primorje-Gorski Kotar	113,329.07	246,131.96
Lika-Senj	19,911.83	43,245.20
Virovitica-Podravina	30,845.89	31,766.64
Požega-Slavonia	28,349.52	29,195.76
Brod-Posavina	58,384.54	60,127.32
Zadar	48,530.61	99,170.77
Osijek-Baranja	109,164.38	112,422.93
Šibenik-Knin	33,809.55	69,088.76
Vukovar-Srijem	67,633.79	69,652.65
Split-Dalmatia	138,865.62	283,767.52
Istra	76,544.65	166,242.30
Dubrovnik-Neretva	36,798.15	75,195.86
Međimurje	30,206.15	42,455.93
The City of Zagreb	140,175.00	581,297.87
TOTAL	1,254,152	2,345,273

The estimated quantity for 2006 to 2015 also includes the greater part of the quantities of construction waste which ends up on dumps. The trend in demolition of old buildings along the entire Adriatic Coast which will further intensify in the upcoming years was also taken into account, as well as the decrease of inflow of construction waste in war affected areas. Quantities for the period from 2001 to 2005 are based on data from questionnaires.

The only fixed plant intended exclusively for the processing of construction waste is part of the waste landfill Jakuševac. Apart from installations for recycling construction waste at the Jakuševac landfill in Zagreb, construction companies and quarries have installations in which they recycle part of their construction waste and re-use it. Also, part of the asphalt, obtained by reconstruction of the asphalt wearing course, is recycled in asphalt mixing plants.

Collection and transport of construction waste is carried out for the lesser part by authorised collectors and utility services. The greater part is organised and performed by contractors and their sub-contractors, using their own machinery and equipment.

At the point of waste generation, in most cases individual usable fractions are not separated but the waste is mixed. The situation is similar in the case of packaging waste as a part of

construction waste in which many valuable secondary raw materials are found. The present level of recycling construction waste is under 7%, and about 11% of secondary raw materials are separated from construction waste.

Aside from the data reported to the CEA it can be concluded that most construction waste is deposited at landfills and that it is usually a case of uncontrolled landfilling of construction waste in dumps. In certain units of self-government, more than 80% of waste deposited in dumps constitutes construction waste.

According to CEA data, a total of 136 companies hold permits for construction waste management in conformity with the Waste Act.

4.6.8. By-products of animal origin

By-products of animal origin are handled in accordance with the Veterinary Act (OG 41/07) and the Ordinance on the method of handling by-products of animal origin not intended for human consumption (OG 56/06). Management of by-products of animal origin according to veterinary health principles and principles of veterinary protection of the environment includes the reception, collection, sorting according to level of risk (categories 1, 2, 3), temporary storage in reservoirs with cooling devices, autopsy of dead animals, thermal processing and incineration of animal semi-finished products containing proteins.

By-products of animal origin are generated in slaughterhouses, facilities for processing meat, eggs, milk, intestines, in coolers, storage houses, hatcheries of day-old chicks, on markets, in butcher shops, fish markets, hospitality and catering facilities and soup kitchens, facilities for animal breeding and upkeep, zoos, hunting, port terminals, border crossings, in the transport of animals and products and in other places in which animals are kept and bred and in places where food of animal origin is produced.

In Croatia there are two open-type facilities for processing by-products of animal origin located in Agroproteinka d.d., Sesvetski Kraljevec, for category I and II and for category III. Apart from those facilities there are also five closed-type facilities, one facility for thermal processing of by-products generated in poultry slaughter houses and four facilities in fish processing facilities. The facilities mentioned form part of those facilities and perform the activities of thermal processing of by-products only for the needs of those facilities. In order to perform proper collection of by-products it is necessary to build a sufficient number of reservoirs. At the present there are four reservoirs in Croatia: Pula, Rijeka, Biljani Gornji and Gruda.

The EU clearly defines the division of waste of animal origin into three categories, which has been fully transposed into national legislation through the Ordinance on the method of handling by-products of animal origin not intended for human consumption.

In 2006, the following quantities have been thermally processed:

- 64,972 tons of by-products of animal origin of all types in Agroproteinka d.d. and
- 9,634 tons from the poultry slaughter house in KOKA d.d., Varaždin

Figure 11 shows the distribution of slaughter houses for poultry and ungulates, fish processing facilities and rendering plants in Croatia in 2004.

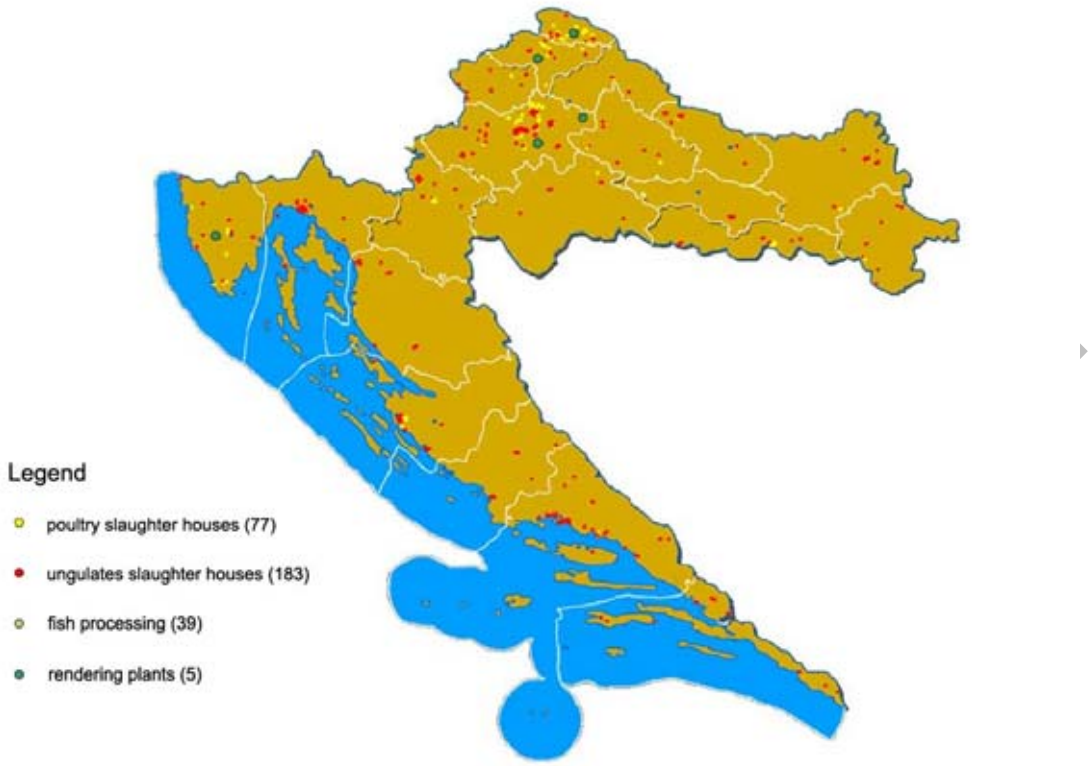


FIGURE 11 Locations of slaughter houses and rendering plants in Croatia in 2004

4.6.9. Sewage sludge from waste water treatment plants

According to the Waters Act (OG 107/95 and 150/05), cities and municipalities are obligated to collect and treat municipal waste waters before discharging to receiving wasters, in conformity with the provisions of this Act or some other. The Waters Act prescribes that treatment of sludge which is generated in the process of waste water treatment is a public sewerage system activity performed by legal persons, organised in conformity with the Act regulating utility services, on the basis of which treatment of sewage sludge constitutes one of their obligations.

For sludge generated from waste water treatment, belonging under key number 19 08 05 according to the Waste Catalogue, the recommended treatment methods are biological and thermal treatment.

Since there is no legal obligation to keep registers on the quantities and quality of stabilised sludge or to deliver such data to Croatian Waters, data in this Plan provide a framework overview of the number and treatment level of waste water treatment plants.

At present in Croatia there are 18 I treatment level plants, 22 plants of I and II treatment level, one plant is not defined and one is not operational. The mentioned plants cover the treatment of waste waters with the capacity of approximately 1,699,000 PE, also including data on plants and capacities for treatment of municipal and industrial waste waters. Since the above mentioned data obtained from Croatian Waters is not uniform it is nor possible to make an estimate of the quantities.

4.6.10. Packaging and packaging waste

Packaging represents all products regardless of the nature of the material they are made of, or if they were used for containing, keeping, handling, delivery, and representation of goods, from raw material to final products, from manufacturer to users or consumers, and it can be:

- sales or primary packaging – smallest packaging unit in which the product is sold to the final buyer;
- grouped or secondary packaging – packaging unit which contains more products packed in primary packaging so that the product is accessible to the buyer in a grouped package, and it can also be separated and taken out individually;
- transport or tertiary packaging – protective packaging that allows for transport, transhipment, and handling of certain amounts of products packed only in sale packaging or both in sale and grouped packaging; this type of packaging does not include containers for road, railway, sea and air transport of goods.

Packaging also includes non-returnable objects used for the purpose referred to in paragraph 1 of this Article, as well as additional means used for packaging which serve the purpose of wrapping or tying goods, packing, waterproof sealing, preparations for shipping and labelling of goods.

Packaging material means any material from which packaging is produced, such as: glass, plastic, paper, cardboard, wood, metal, multi-layered mixed materials and other materials.
Packaging waste defined in the categories of the Waste Catalogue means any packaging or packaging material which remains after the product is unpacked and separated from the packaging, excluding production residues.

Return and/or collection of used one-time-use packaging is organised through sale-points, with payment of the returnable fee to consumers. In that way, dumping of huge quantities of such waste on overloaded landfills and into nature is prevented, while large quantities of packaging waste are re-processed into new products.

In the first year since the entry into force of the Ordinance, 910 million units of packaging or 78,000 tons has been collected.

Table 8 shows the number of companies which have obtained a concession for recovery of waste packaging.

TABLE 8 PACKAGING – RECOVERY OPERATORS

Type of waste packaging which is recovered	Number of companies
Wood	3
Polymer materials (plastic), textile	6
PET	3
Paper and cardboard	2
Multilayer packaging consisting primarily of paper and cardboard	1
Glass	2
Metal (Fe/Al)	2

Textile	1
TOTAL	**20**

Concession for waste packaging collection was obtained by 11 companies for the collection of:

a) paper and cardboard, multilayer waste packaging and
b) grouped (secondary) and transport (tertiary) waste packaging made of wood, textile and other packaging materials.

4.6.11. Waste tyres

Waste tyres are tyres from personal vehicles, busses, cargo vehicles, machinery, work vehicles and tractors, airplanes and other aircraft and similar corresponding products which the holder cannot or will not use due to damage, deterioration, expiry or for other reasons and consequently discards or intends to discard. Waste tyres are non-hazardous waste and are listed under key number 16 01 03 in the Waste Catalogue.

The new Ordinance on the management of waste tyres ensures the disposal of previously discarded tyres in the territory of Croatia (70 to 100 thousand tons), by organising occasional collection of discarded tyres from citizens, with the payment of a special fee to those citizens for the tyres delivered.

Concession for collecting waste tyres has been granted to 21 companies. For recovery of waste tyres a total of four companies have been granted a concession: two companies for recovery for material purposes and two for recovery for energy purposes.

4.6.12. End-of-life vehicles

End-of-life vehicles are vehicles which due to damage, deterioration or for other reasons the holder discards, intends to discard or must discard.

It can be estimated that the number of end-of-life vehicles generated on an annual basis in Croatia ranges from 70,000 to 80,000 vehicles per year.

4.6.13. Electrical and electronic waste

Pursuant to the Ordinance on the management of waste electrical and electronic equipment and devices, waste electrical and electronic equipment (WEEE) is:

a) waste electrical and electronic equipment including assemblies and component parts from economic activities (industry, trade & craft, etc.);
b) waste electrical and electronic equipment generated in households or in manufacturing and/or catering industries when by type and quantity similar to WEEE from households.

The estimated quantity of new electrical and electronic equipment and devices placed on the market is between 55,000 and 60,000 tons per year.

The situation and problems of the present system reflected in the increase of total waste quantities which end up on landfills, resulting in the decrease of capacities of existing landfills and at the same time increase of risks to human health and the environment, have imposed the adoption of county plans and as a result, the adoption of a national waste management plan as a necessity «conditio sine qua non».

4.7. LANDFILLS

In Croatia the largest quantities of generated waste still end up on landfills. Until the adoption of the new Ordinance on landfills, landfills were grouped into five categories, according to legal status, size, types of waste landfilled, state of activities, environmental impact and equipment:

- legal landfills,
- landfills in the process of being legalised,
- official landfills,
- unofficial landfills and
- illegal landfills.

Remediation of landfills started in 2004 when the EPEEF in cooperation with the MEPPPC and local self-government units began the remediation of 292 official non-sanitary landfills. The total value of the investment is estimated to be HRK 2.8 billion, of which the EPEEF is securing 48%, or HRK 1.5 billion. For this purpose the EPEEF has already paid HRK 230 million and until now a total of 28 municipal waste landfills have been remediated.

After remediation, the majority of the former landfills will be turned into transhipment stations and recycling yards, while the remainder will be closed within a five-year period.

In Croatia there are also a large number of surfaces polluted by inappropriate and uncontrolled landfilling of various types of waste (illegal landfills). The Strategy estimates that in the territory of Croatia there are over three thousand illegal landfills. For the remediation of 512 illegal landfills, in the territory of 140 units of self-government, two national parks and two nature parks, the EPEEF has approved HRK 43.6 million, which represents 66% of the total estimated necessary investment.

Until now 217 illegal landfills have been remediated in the territory of Croatia.

4.8. HOT SPOTS

The Strategy has identified high risk locations which have been created by long-term inappropriate management of industrial (technological) waste and whose existence presents a real danger to the environment and human health.

For the nine priority locations shown in Figure 12 the EPEEF has allocated, for the period from 2005 to 2008, HRK 162 million for remediation. Remediation of the mentioned locations must be carried out according to special remediation programmes.

Until now the remediation of the basin of red mud and waste base of the alumina plant near Obrovac has started as well as the remediation of the location Mravinačka Kava – asbestos in Vranjic.

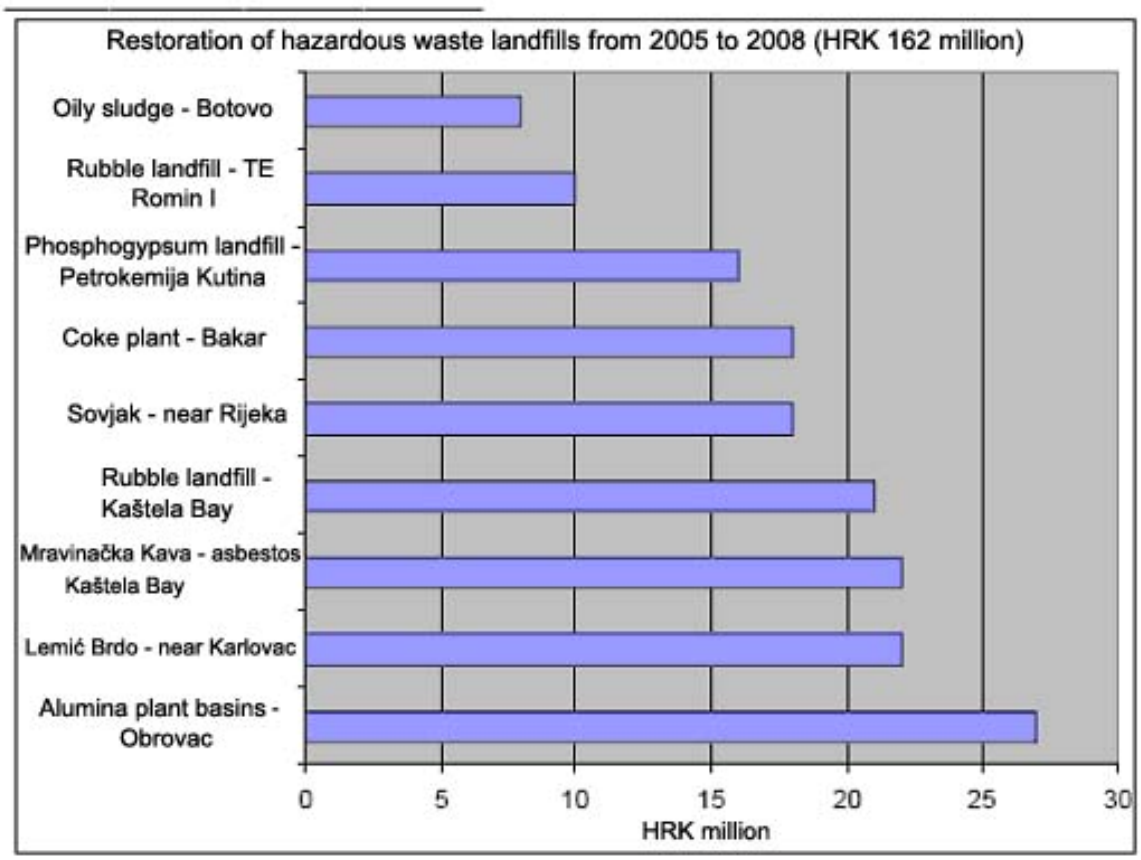


FIGURE 12 Distribution of allocated EPEEF funds for remediation of nine hot spots.

4.8.1. Other locations

Apart from the nine priority hot spots for remediation contained in the Strategy, the EPEEF has received four more applications for co-financing:

- the town of Vukovar for remediation of the location of the closed-down factory Borovo in Vukovar;
- the company DIV d.o.o. from Samobor for remediation of fuel oil in the closed-down screw factory TVIK in Knin;
- the town of Komiža, island of Biševo for remediation of tar from the Salbunara beach;
- the town of Šibenik for remediation of pollution in the area of the closed-down factory of electrodes and ferroalloys in Šibenik.

For the location of the closed-down factory Borovo, a Waste Management Plan has already been drawn up in conformity with the Waste Act, while for the closed-down screw factory TVIK a Preliminary Examination Report has been developed.

4.9. WASTE MANAGEMENT ON ISLANDS AND IN MARITIME PORTS

Even though Croatia is a country with islands, this Plan does not analyse islands and the coastal area separately because the waste management system on islands and on the coast is included under all existing laws and subordinate regulations in the area of waste management.

The waste management system on islands ensues from the Regulation on organisation and protection of the protected sea coast (OG 128/04) and the Strategy.

Waste management in maritime ports is defined under the Ordinance on conditions and methods of maintaining order in ports and in other parts of the internal maritime waters and territorial sea of the Republic of Croatia (OG 90/05).

The port authority is responsible for performing supervision over maintaining order in ports and in other parts of the internal maritime waters and territorial sea, especially for keeping the coast and sea clean from pollution from maritime facilities. The authority managing the port is responsible for cleaning the port from debris endangering navigation safety and polluting the sea and for organising the waste management system in maritime ports. The authority managing the port must provide waste reception facilities in the port.

The Ordinance prescribes the procedure for reporting and reception of waste from vessels and cargo residues. All ports open for public traffic and special purpose ports must develop and apply a plan for receiving and handling waste and cargo residues which may also be developed on a regional level. The implementation of the abovementioned Ordinance also includes provisions of the MARPOL 73/78 Convention.

The costs of reception of waste in ports, including waste treatment and landfilling are covered in an appropriate manner from the fees charged for the use of reception facilities.

5. ORGANIZATIONAL PLAN FOR THE WASTE MANAGEMENT SYSTEM OF CROATIA

On the basis of the status analysis, problems arising from the status analysis and causes of the current status of waste management, the counties and the MEPPPC propose a plan for the period from 2007 to 2015, whose implementation and control aim at the establishment of a self-sustainable system.

The Strategy regulates the management of different types of waste in Croatia, from their generation to final disposal, with the basic objective to establish an integrated waste management system organized in accordance with current European requirements and standards.

The objectives of an integrated waste management system are:

- minimization of generated waste;
- minimization of waste deposited to landfills in the course of the primary separation of useful waste;
- reduction of the share of biodegradable waste in the municipal waste deposited;
- minimization of adverse impacts of the deposited waste on environment, climate and human health;
- generated waste management fully on the principles of sustainable development, and
- energy recovery of waste.

The waste management system of Croatia will be organized as an integrated unity of all actors in the system at the national, regional and local level as shown in Fig. 13.

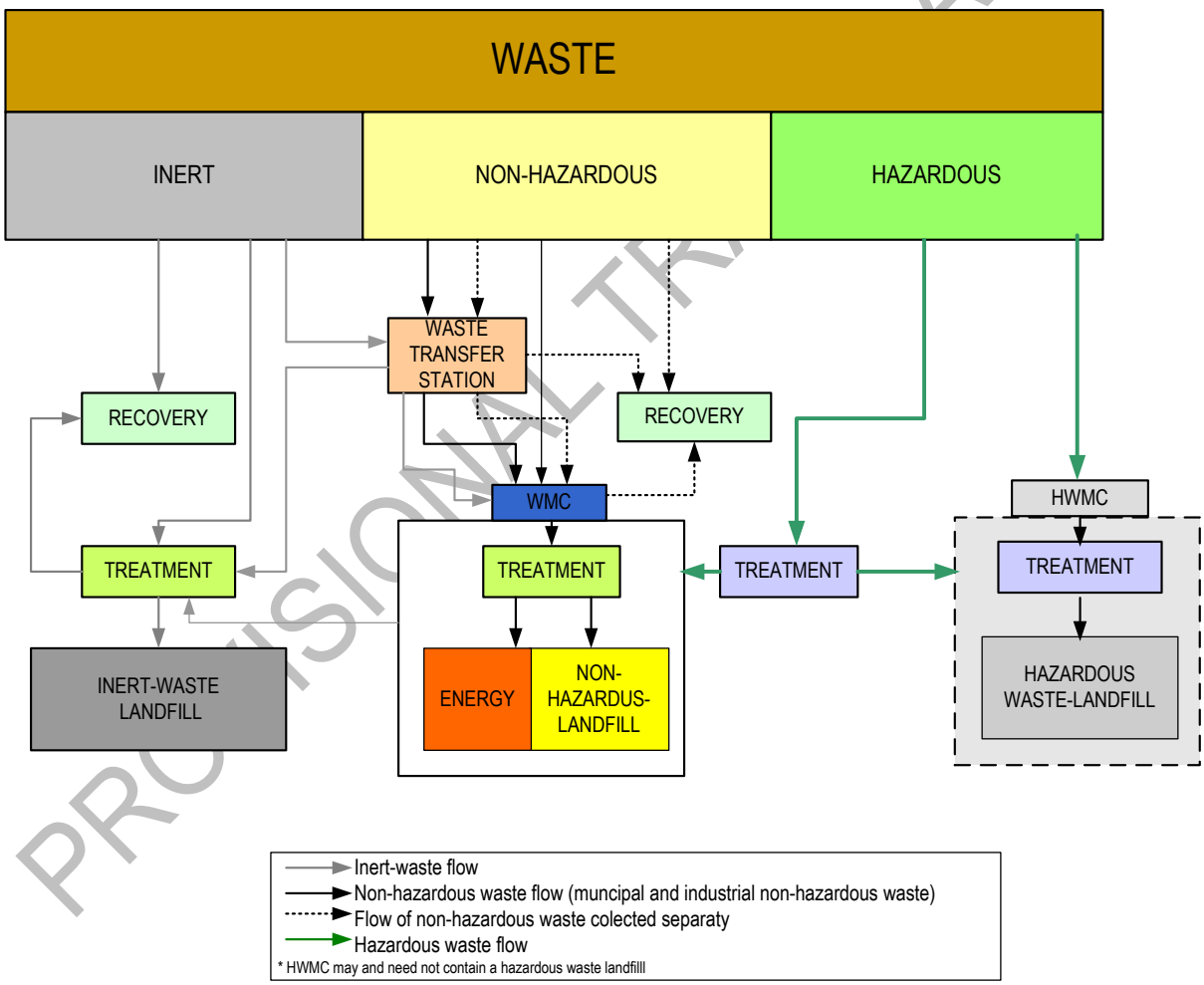


FIGURE 13: Waste collection flow chart

5.1. MUNICIPAL WASTE MANAGEMENT PROCEDURES

Given the difference in the quality of specific waste treatment procedures, a strict waste disposal hierarchy has been defined by European directives and the Waste Act.

WASTE GENERATION PREVENTION ➔ REUSE ➔ MATERIAL RECOVERY ➔ ENERGETIC RECOVERY OR OTHER TYPES OF TREATMENT PRIOR TO FINAL DISPOSAL OF RESIDUAL WASTE

This strict sequence has been established with respect to the overall evaluation of sustainability and ecological acceptability respectively. A large number of European countries are making great effort to reduce amounts of waste deposited to landfills, which calls for the need to increase the share of recycled and biologically treated waste in the total amount of the generated waste.

5.1.1. Waste Generation Prevention

There is a wide range of possible waste disposal procedures that create various environmental impacts. The waste generation prevention, like other waste minimization measures too, is certainly the most convenient method to solve waste problems. These measures apply to the process or the point of waste generation and include the prevention of generation by modifying the production or utilization process, reduction at the source itself and the product reuse. The recycling or material recovery procedures also receive high marks regarding environmental impacts that mainly relate to separately collected fractions of waste that may be used as secondary raw materials.

The Plan makes provisions for continuation of activities of the preventive waste minimization by:

- acting on economic operators through regulatory measures with the aim to implement waste generation reduction measures;
- implementing a systematic horizontal and vertical education of the society, and
- promotional activities aiming at education and change in the behaviour pattern, the so-called "consumer mentality".

5.1.2. Public Education and Communication

No integrated waste management system can be implemented if viewed from the techno-economical aspect only and if the dimension and role of environmental education are neglected. Environmental education is an unavoidable segment of each integrated waste management system. Eco-education and eco-culture are interrelated and have a cause-and-effect relationship. An eco-education will facilitate acquisition of ecological knowledge and skills with the aim to raise public awareness of an effective participation in implementation of the waste management system. Ecological education is intended to help an individual develop new perceptions and build up new values that will induce him to change the behaviour. Therefore, in order to attain development objectives and carry out the tasks as set, substantial changes in terms of welfare, economy, education and culture are to be made, and a spiritual, intellectual, creative and efficient rehabilitation of individuals is to be brought into focus of interest.

The establishment of an environmental education system by drawing up a national environmental education plan and its implementation in institutional and non-institutional forms will provide basic prerequisites for a successful and adequate environmental protection. A national environmental education plan will recognize the life-long duration of environmental education, create the feeling of environmental accountability at local and global levels, provide the recognition of environmental problems as personal ones and encourage taking adequate measures. It will make correct, complete and timely information publicly available, promote sustainable development principles and partnership of all relevant partners, make use of all available resources, investigate the most effective approaches to environmental education and apply them. In this connection the planning determinants of environmental education in light of sustainable development should include fostering of a visionary, problem-related, interdisciplinary, research-based and active approach. Since it has been made obligatory to the State and the local and district (regional) self-government units to adopt environmental programmes and provide conditions for its implementation, this document will primarily review the role of environmental education and public communication regarding waste management. Special consideration will be given to the public education concept, the NIMBY syndrome and the role of the public.

For the achievement of the objectives specified the following measures are proposed:

a) to set up a national coordinating body i.e. a council in charge of environmental education and promotion of environmental protection and sustainable development;
b) to provide the public fully, correctly and timely with information on environmental status and all activities and achievements of counties and other factors in the field of waste handling, environmental protection and sustainable development;
c) to establish public databases on waste and environment to be maintained by city enterprises and to network the same with the future central database;
d) to carry out tasks relating to the promotion of environmental protection and sustainable development intended to be the main drivers of operations in this field of activities;
e) to ensure a continuous promotion of environmental protection through (all) city enterprises in the context of their activities;
f) to establish partnership relations with other stakeholders (government bodies, scientific, expert and educational institutions, economy sector, associations, individuals, etc.) and to cooperate in joint educational and promotional projects dealing with waste handling and environmental protection and encourage and support any good ideas and initiatives in this regard;
g) to ensure a systematic and comprehensive capacity-building of the municipal, city, county and government staff for taking development-related decisions regarding waste handling and environmental protection and for communicating adequately in decision-making processes, and
h) to conduct public opinion surveys at specific periods of time.

This also requires the development of a communication strategy that will cover:

- promotional messages, slogans;
- educational and promotional activities;
- pre-school children, primary, secondary and eco-schools, colleges;
- companies;
- households,
- city and state administration and
- programme of activities.

The national environmental education plan will consist of:

- educational and promotional tasks;
- tasks of environmental advisers;
- modes of working with the public and
- tools used in working with the public.

5.1.3. Separate Waste Collection

Primary recycling is based on separate collection of reusable waste material at the very point of waste generation. In this way separate flows of different types of reusable and hazardous waste materials are created. Separate flows of certain types of waste (e.g. tyres, medicines, oils, electronic waste, construction waste, accumulators, glass, metal and plastic packaging, etc.) guarantee good quality recycling in a long-term. This is a dynamic system that is constantly being supplemented.

Apart from applying measures for avoidance and minimization of waste at the point of generation and individual ordinances covering primary separation and collection of specific categories of waste (packaging waste, waste tyres, waste oils,…), separate collection of waste as part of a public utility system is foreseen for wastes not covered by individual ordinances, or specifically:

- paper and cardboard
- glass
- plastics
- metals
- hazardous waste
- bulky waste and
- other.

A separate collection system may be organized in several different ways:

- recycling yards (RY) and green islands equipped with containers and bins with a capacity ranging from 1,100 to 5,000 litres in which, depending on their size and design, some ten different types of reusable waste materials and hazardous waste produced by citizens are separately collected;
- containers and bins for individual types of waste placed at a number of waste collection points in settlements or bins for separate collection placed beside containers for the collection of municipal waste; and
- small-scale stations for the purchase of waste, whose number, size and design are directly and exclusively dependent on market conditions (including small-scale purchase organized in sorting facilities and paper, glass, plastics and metal mills respectively).

When selecting a micro-location it is particularly important that the RY location is easily accessible for the population. It may be assumed that a catchment area of a RY has a radius of approximately two to four kilometres and covers between 5,000 and 50,000 inhabitants, i.e. one recycling yard per settlement. Smaller figures correspond to less populated areas.

Recycling yards are places where citizens may be informed about waste management in a simple and acceptable way, especially as regards the reduction of amounts and harmfulness of their wastes and a better utilization of various wastes. Information on the RY operation

(working hours, types of waste, etc.) may also be made available to the population by mass media.

In recycling yards it is also necessary to organize the collection of bulky waste so as to enhance the quality of service and reduce costs as follows:

- Throughout the year, on all working days including Saturdays, the citizens may deposit their bulky waste free of charge and in an environmentally sound manner;
- Quantities of waste collected in recycling yards increase, reducing consequently the average charge;
- Throwing around of bulky waste on public grounds is thus abandoned;
- This ensures a good quality, separate collection of bulky waste and more efficient recycling and recovery (tyres, metals, cooling equipment, electronic waste, etc.);
- The process of sorting and preparation for further treatment is more uniform and efficient.

For the reasons of higher cost-effectiveness it is important that waste collectors, whose waste collection places are equipped with numerous containers for various categories of waste, use polyvalent vehicles with several loading mechanisms and several separate loading spaces.

For economic reasons, separately collected material is only transported at shorter distances (up to 50 km and max. 80 km) to loading stations equipped with a plant for additional waste selection and baling.

The homogeneity degree of separately collected material generally does not suffice for a direct sale for an acceptable economic compensation. Besides, transportation costs are very high as a result of low density of separately collected waste material. It is therefore necessary to separate impurities from such materials and to sort and press them into bales of adequate density at the local level to make transportation costs acceptable. Here it should be stressed that a higher classification degree of individual waste materials (paper, polymers) always results in a higher market value of the material prepared.

In the segment of separate waste collection the Plan stipulates that:

- the number of recycling yards and the amounts of separately collected waste respectively should be increased in conformity with physical plans, taking strictly into account the pertinent costs;
- the number (types) of separately collected waste material (construction debris, hazardous household waste, etc.) should be increased;
- recycling yards should be made accessible; education should be systematically carried out and adequate public communication promoted;
- in thinly populated areas minimally one recycling yard should be arranged for each settlement and adapted to the settlement size by the number and size of waste containers (in this areas educational and promotional actions are to be undertaken in order to promote the composting of household and green waste respectively);
- densely populated settlements and towns should be equipped with a larger number of waste containers for separate waste collection – presumably 30 to 50 containers per 1,000 inhabitants, and
- tourist centres showing marked seasonal oscillations in the number of users of utility services should be equipped for peak loads (predictable number of waste containers from 50 to 100 per 1,000 visitors).

Table 9 shows estimated shares of waste that will be separated by primary separation from municipal waste until 2015 and the primary separation methods. Primary recycling and separate collection are being constantly supplemented and changed depending on the state of technology and market conditions. A successful and high-standard implementation of primary waste separation requires further education at all levels of the society both through existing projects already in progress and the future ones that will involve individuals, non-governmental organizations, educational institutions, public and government institutions and local self-government units. In order to be able to monitor the current level and growth of public awareness it is necessary to carry out an analysis of the public awareness level.

TABLE 9: Estimated increase in the share of waste to be separated from municipal waste by primary separation until 2015

	2004			2015		
	Separation from municipal waste		Method	Separation from municipal waste		Method
Type of waste	%	t		%	t	
Biowaste	0.01	182[10]	organized collection	3	59,000	organized collection
Paper and cardboard	3.69	48000[11]	RY, organized collection	6	117,000	application of special regulations, organized collection, recycling yards
Glass	1.00	13000[12]	RY, organized collection	6	117,000	application of special regulations, organized collection,
Metal	0,02	300[10]	organized collection	6	117,000	recycling yards, organized collection
Plastics + PET	0,2	2548[13]	RY, organized collection	2	39,000	application of special regulations
Total	4.92	64,452		23	451,000	
Other	95.08	1,245,548		77	1,502,000	
Total	100	1,310,000		100	1,953,000	

[10] Ipz
[11] CEA
[12] Vetropack straža d.o.o.
[13] CCC-CEA

5.1.4. Prevention and Minimization of Waste from Production Processes

Industrial waste minimization and prevention fall under the major national objectives of waste management that necessitate complex changes in the mindset and management of processes from the production to final disposal in relation to the conventional method of industrial waste management.

Industrial waste minimization and prevention combine and include:
- various technological and logistic solutions in production processes and
- socio-economic elements of the society, from trust build-up and infrastructural development to business and cultural habits.

Implementation of industrial waste minimization and prevention is a slow development process whose results need not be visible immediately. The main results will be manifested in a specific mid-term / long-term period, but are nevertheless of a multiple benefit to the entire society.

In existing production processes it is necessary:
- to develop and implement a systematic control of all waste-generating process stages;
- to introduce improvements aiming at the reduction of waste amounts;
- when deciding on new production processes to prefer those generating the least amount of waste, and
- to promote use of raw materials or semi-products the least harmful to the environment.

Industrial waste minimization and prevention at the point of generation may be best achieved by applying cleaner production. The methods of applying cleaner production in production processes with the aim to prevent and minimize waste generation are shown in Table 10.

TABLE 10: Application of cleaner production aiming at minimization and prevention of industrial waste from production processes

PRODUCT DESIGN	PRODUCTION PLANNING	PRODUCTION EQUIPMENT DESIGN	EDUCATION, PRODUCTION MONITORING
Less harmful products	Replacement of raw materials and catalysts	Interconnecting of operations	Introduction of work procedures
Easily recyclable products	Change of working conditions	Modification of devices	Material saving
Product replacement	Maintenance procedures	Raw material processing	Setting up a control team
	Implementation optimization	Automation, waste generation control	Waste classification
			Material handling improvement
			Use of recyclable packaging

In order to activate and implement the industrial waste prevention and minimization process it is necessary to start the following activities:

1. Preparation and implementation of an action plan for education and promotion of industrial waste prevention and minimization alternatives among all stakeholders, non-governmental organizations, general public and economy sector;
2. Establishment of an information system aimed at making all relevant technical information available to all stakeholders and encouraging them to apply cleaner production;
3. Identification of the industry that generates the greatest amount of waste and/or uses the worst waste management practices;
4. Development of instructions/guidelines for application of cleaner production by specific branches of industry / economic activities;
5. Elaboration of conditions for the provision of incentives to stimulate implementation of industrial waste prevention and minimization projects (apart from the charges payable for non-disposed waste charges are to be introduced that would stimulate producers to waste minimization and reuse); and
6. Development of guidelines for building project engineering aimed at a more specific and appropriate use of environmentally sound materials (non-hazardous materials, selective disassembly, recyclable materials, etc.) and avoidance of any new construction waste.

5.2. MUNICIPAL AND NON-HAZARDOUS INDUSTRIAL WASTE

In order to attain objectives outlined in the Strategy, the priority measures include planning, designing, construction and establishment of municipal and non-hazardous industrial waste management centres and waste transfer stations.

5.2.1. Municipal Waste Projections

For the preparation of projections, inputs of the LIFE project "Guidelines Development for Starting Implementation of the Waste Management Plan in the Republic of Croatia", Ekonerg 2006 were used. The specific amount of waste ranged from 1.09 to 0.59 kg/capita/day (depending on the development level of each individual county) and the specific amount for tourists was 1.90 kg/capita/day. Street sweepings were not included in waste projections, because the basic input data needed for evaluation were not available.

When preparing projections of municipal waste to be generated by 2015, the following elements were taken into account:

- change in the population number;
- change in the number of overnight stays and
- change in the standard of living.

In the future the share of waste separated by the primary separation system will depend on the development level of waste management systems in each of the counties. The data currently available did not allow inclusion of this information in preparation of these projections. Therefore the amount of generated waste includes also the waste which will result from primary separation and so less waste will undergo treatment in the end. The rise in the number

of overnight stays in the first planning period was estimated taking into account the total number of overnight stays to be reached by 2010 as stated in the Croatia's Tourist Development Strategy[14]. Projections of generation of municipal and non-hazardous industrial waste up to year 2015 are shown in Table 11.

TABLE 11: Municipal waste projections by 2015

County	Population number (2001)	Amount of municipal waste generated 2010 (t/y)	Amount of municipal waste generated 2015 (t/y)
Bjelovar-Bilogora	133,084	46,000	51,000
Slavonski Brod-Posavina	176,765	63,000	69,000
Dubrovnik-Neretva	122,870	52,000	62,000
City of Zagreb	779,145	353,000	392,000
Istria	206,344	114,000	127,000
Karlovac	141,787	47,000	56,000
Koprivnica-Križevci	124,467	33,000	40,000
Krapina-Zagorje	142,432	39,000	47,000
Lika-Senj	53,677	21,000	25,000
Međimurje	118,426	31,000	38,000
Osijek-Baranja	330,506	144,000	159,000
Požega-Slavonija	85,831	32,000	35,000
Primorje-Gorski Kotar	305,505	133,000	148,000
Sisak-Moslavina	185,387	71,000	79,000
Split-Dalmacija	463,676	178,000	198,000
Šibenik-Knin	112,891	44,000	52,000
Varaždin	184,769	51,000	61,000
Virovitica-Podravina	93,389	33,000	37,000
Vukovar-Srijem	204,768	53,000	64,000
Zadar	162,045	81,000	90,000
Zagreb	309,696	102,000	123,000
TOTAL	**4,437,460**	**1,721,000**	**1,953,000**

To facilitate the designing of each element of the waste management system in a particular region or county, preliminary measurements both of the amounts and the origin and the composition of municipal waste are recommended prior to the development of design documents. Before determining capacities and types of facilities for pretreatment and treatment of specific types of waste it is necessary to carry out a series of investigations of the waste composition and amount in at least two characteristic seasons of the year.

[14] Ministry of Tourism of the Republic of Croatia, 18 September 2003. WWW.STRATEGIJA.HR Central Government Office for Development Strategy and Coordination of EU Funds

5.2.2. Reduction in the Share of Biodegradable Waste

In order to reduce gaseous effluents emitted into the environment resulting from the disposal of waste containing a high share of biodegradable components, the following objectives are set as shown in Figure 14:

- By 2012 the share of biodegradable municipal waste deposited to landfills must be reduced to 75 per cent of the mass share of biodegradable municipal waste generated in 1997;
- By 2015 the share of biodegradable municipal waste deposited to landfills must be reduced to 50 per cent of the mass share of biodegradable municipal waste generated in 1997;
- By 2020 the share of biodegradable municipal waste deposited to landfills must be reduced to 35 per cent of the mass share of biodegradable municipal waste generated in 1997.

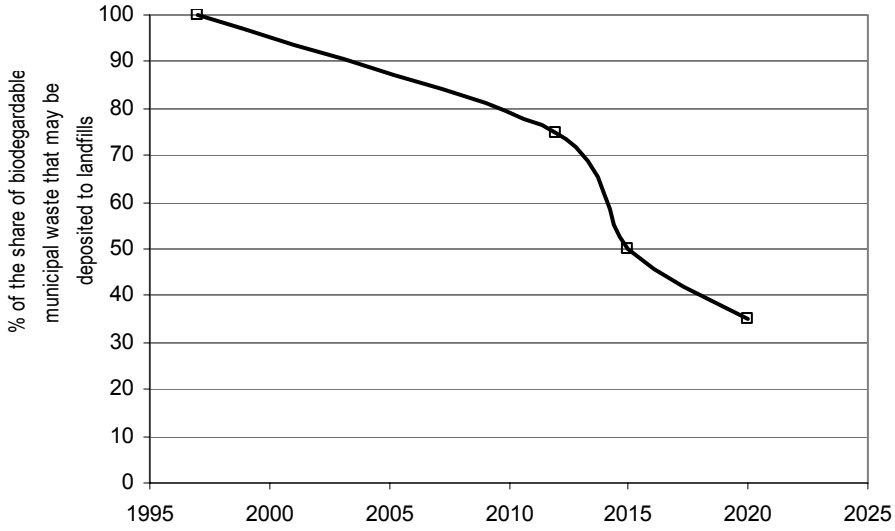


FIGURE 14: Reduction in the share of biodegradable waste in the municipal waste by 2020

For certain categories of municipal waste, specific solutions within the waste management system are foreseen in accordance with the Strategy, the Waste Act and ordinances of Croatia regulating this area, as shown in Figure 15.

The maximum possible reduction in the share of biodegradable waste in the municipal waste will be achieved by applying waste treatment technologies within the framework of the Waste Management Centre (WMC).

BIODEGRADABLE WASTE 28-40%	household waste, green waste, sawdust	→ waste minimization
		→ separate collection – composting in WMCs
		→ mixed waste – treatment in WMCs
PAPER AND CARDBOARD 22-26%	newspapers, various publications, notebooks, cardboard, paper packaging	→ separate collection – recovery in paper industry
		→ mixed waste – treatment in WMCs
GLASS 4-7%	bottles - containers	→ disposal according to the Ordinance (Official Gazette Nos. 97/05, 115/05)
	other glass containers, glasses, flat glass	→ separate collection – recovery in glass industry
		→ mixed waste – inert residues in further treatment
PLASTICS (polymeric products) 11-18%	bottles - containers	→ disposal according to the Ordinance (Official Gazette Nos. 97/05, 115/05)
	other containers, foils, various objects	→ separate collection - recovery
		→ mixed waste – combustible residues
METALS 4-7%	aluminium vessels - containers	→ disposal according to the Ordinance (Official Gazette Nos. 97/05, 115/05)
	other cans, various objects	→ separate collection - recovery
		→ mixed waste – inert residues
HAZARDOUS MUNICIPAL WASTE 0.5-1.5%	obsolete medicines	→ disposal according to the Ordinance (Official Gazette)
	waste oils	→ disposal according to the Ordinance (Official Gazette)
		→ separate collection – treatment in HWMCs
OTHER WASTE 10-18%	nappies, multi-layered waste, textile, footwear and clothing, rubber, leather, bones, etc.	→ mixed waste – treatment in WMCs

FIGURE 15: Average municipal waste composition, disposal measures and procedures

The composition of individual waste categories differs geographically, changes seasonally, depends on various features of the site and is indicated in a range.

Figure 16 shows the projected reduction in the share of municipal waste that will be deposited to landfills by 2015. The planned reduction will be achieved by primary separation (Table 9), the municipal waste treatment and increased share of organized waste collection (Table 13).

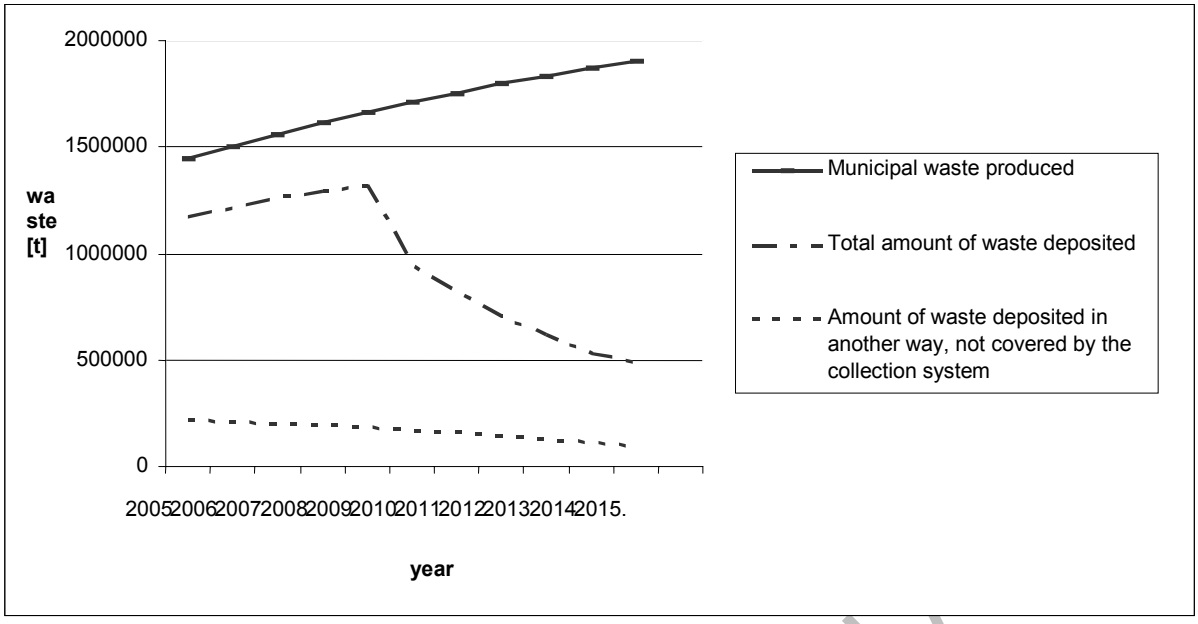


FIGURE 16: Projected minimization of municipal waste to be deposited to landfills by 2015

5.2.3. Projected Amounts of Non-hazardous Industrial Waste

In view of the existing input data on the origin of certain components of municipal waste currently deposited to landfills, no precise projections of non-hazardous industrial waste flows in terms of further treatment, recycling and depositing are possible.

To determine non-hazardous industrial waste amounts that will have to be deposited to landfills in the period by the year 2030, two assumptions were used as a baseline:

- In 2015 the total non-hazardous industrial waste amount will be twice the size of the municipal waste amount;
- In 2015 the average share of non-hazardous industrial waste to be deposited after treatment to a landfill inside a waste management centre will be 15%.

The amount of non-hazardous industrial waste deposited in 2004 and two above mentioned assumptions resulted in the amounts to be deposited in all years of the planning period by all counties and regions respectively up to 2030. The amounts by years were totalled up and gave the total amount of approximately 7,915,000 tonnes to be deposited in the planning period from 2010 to 2030 as shown in Table 12.

TABLE 12: Estimated amounts of non-hazardous industrial waste that will be deposited to non-hazardous waste landfills by 2030

County	Amounts of non-hazardous industrial waste to be deposited 2010- 2030 [t]
Krapina-Zagorje	120,000
Sisak-Moslavina	270,000
Karlovac	220,000

Varaždin	60,000
Koprivnica-Križevci	580,000
Bjelovar-Bilogora	135,000
Primorje-Gorski Kotar	1,160,000
Lika-Senj	135,000
Virovitica-Podravina	270,000
Požega-Slavonija	155,000
Slavonski Brod-Posavina	80,000
Zadar	80,000
Osijek-Baranja	1,040,000
Šibenik-Knin	155,000
Vukovar-Srijem	155,000
Split-Dalmatia	580,000
Istria	580,000
Dubrovnik-Neretva	120,000
Međimurje	620,000
City of Zagreb	710,000
Zagreb	690,000
Total	**7,915,000**

5.2.4. System of Organized Municipal Waste Collection

A part of municipal waste will be collected through a separate collection system (RY) and by implementation of special regulations for specific waste categories (packaging waste, waste tyres, electrical and electronic waste, etc.). The waste collected separately may be conveyed directly to material or energy recovery, i.e. to a transfer station (TS) or a WMC, and processed for further material or energy recovery. The remainder of the mixed municipal waste is collected in the organized way by companies licensed for municipal services of waste collection that will transport the waste collected to a TS and/or a WMC. Non-hazardous industrial waste is collected separately by an organized system of municipal waste collection and transported separately to a TS and/or a WMC. Non-hazardous industrial waste may also be collected by licensed collectors that convey the same to a TS and/or a WMC. In the WMC the waste undergoes the secondary separation of useful raw materials. The rest is processed and afterwards permanently deposited to a landfill.

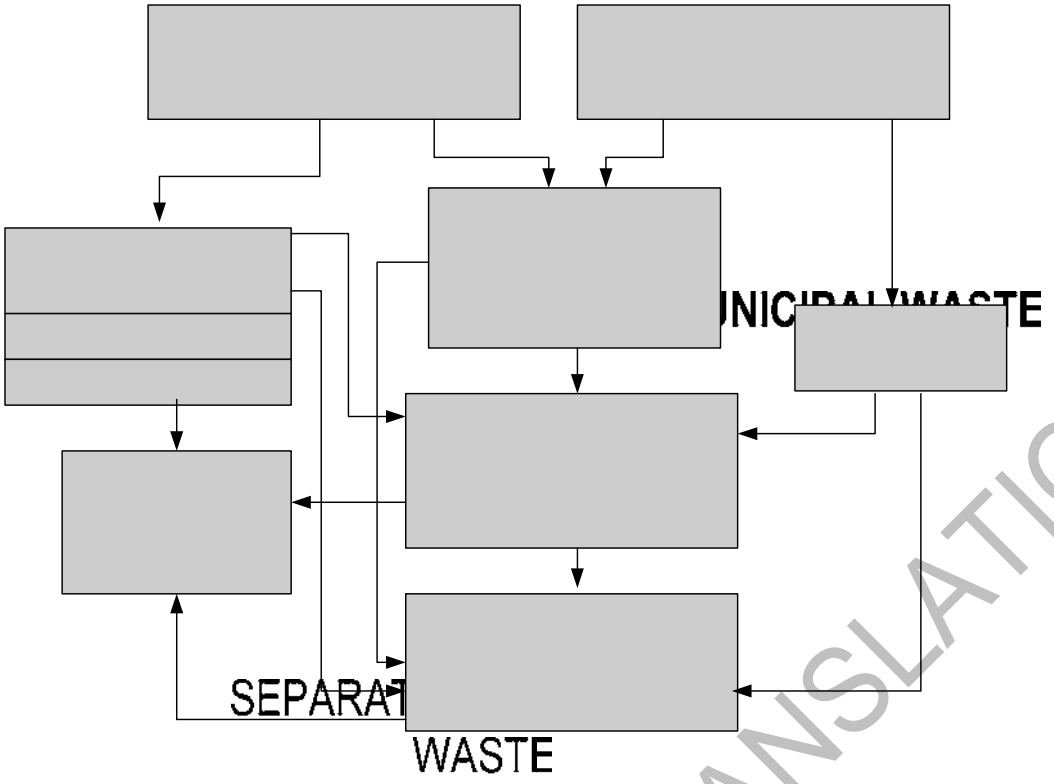


FIGURE 17: Block diagram of the municipal and non-hazardous industrial waste management system

The existing system of organized waste collection needs to be maintained and permanently improved with the aim to finally cover the population to the maximum extent.

The Table below gives a projection of the increase in the share of population that will be covered by the system of organized municipal waste collection.

TABLE 13: Projected increase in the share of population covered by the organized waste collection system

Planning period	Share of population covered by organized waste collection system
2007-2010	90%
2011-2015	95%
2016-2020	98%

5.2.5. Waste Management Centre (WMC)

Waste collected in a transfer station is transported to the WMC located at a certain distance from the inhabited area. The WMC receives also wastes collected through the waste collecting network of the area close to the WMC. Waste treatment operations carried out in the WMC prior to the permanent deposition of wastes to a landfill for non-hazardous waste, which is at the same time a constituent part of the WMC, are as follows:

- acceptance, treatment of sorted or unsorted waste;
- collection of reusable or recyclable waste and collection and further transferring of hazardous waste;
- collection and distribution of waste that may be used for other purposes;
- energy recovery of certain waste fractions and
- deposition of treated waste.

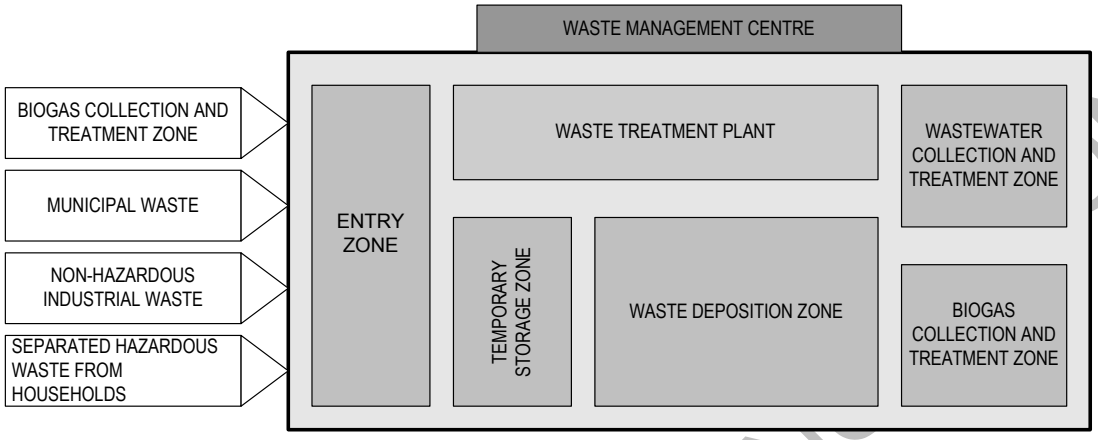


FIGURE 18: WMC composition

Basically, a WMC consists of:

a) entry zone
b) waste treatment plant
c) temporary storage zone
d) waste deposition zone
e) biogas collection and treatment zone and
f) wastewater collection and treatment zone.

Entry zone

An entry zone consists of a platform for cleaning wheels and vehicles, a weighbridge for weighing wastes that enter the WMC, a doorman's booth and an office building, a parking area for the staff and visitors and a building for maintaining equipment and vehicles. The entire WMC area is fenced.

Waste treatment plant

The equipment used for waste treatment processes is located in the area destined for the waste treatment plant.

Temporary storage zone

In a WMC an area must be provided for the acceptance and treatment of construction waste. This zone includes also an area for the collection of bulky waste, which, after separation and temporary storage, is transferred to a licensed waste collector. Depending on the distance between the WMC and populated areas, this zone may also include a recycling yard for the collection of separately collected waste whose useful properties may be reused or waste generated in the waste pretreatment process. A temporary storage area includes, among other things, an area for temporary storage of hazardous waste separated earlier during waste inspection. This waste is separated, temporarily stored and transferred to a licensed waste collector.

Waste deposition zone
A waste deposition zone includes a non-hazardous waste landfill and may also include an inert waste landfill designed according to valid regulations.

Given the construction schedule for waste management centres as shown in Table 13, and until establishment of a waste treatment plant inside the waste deposition zone, some counties/regions will have to make provisions for a contingency landfill for deposition of municipal waste in the period until the WMC are constructed and the waste treatment system established respectively (the capacity to cover 5 years at most). In addition to municipal waste, this landfill will also receive the treated non-hazardous industrial waste currently deposited along with the municipal waste. Counties/regions that have already ensured the space for waste deposition at existing landfills until the construction of a WMC need not make provisions for that.

A non-hazardous waste landfill may only be used for the deposition of:
- pre-treated municipal waste;
- non-hazardous waste of any origin that meets the criteria for deposition of waste to non-hazardous waste landfills, and
- stable and non-reactive pre-treated hazardous waste, if pollution limit values found in eluate do not exceed limit values for non-hazardous waste.

In case that pre-treatment of waste results in waste containing a high share of a biodegradable component, then – according to a special regulation laying down conditions for deposition of waste to a non-hazardous waste landfill – such waste may only be deposited in non-hazardous waste landfill sites provided that gas generated in the process of biodegradation is used for energy purposes (the so-called bioreactor landfill).

Throughout the entire planned life cycle of the WMC non-hazardous industrial waste will also be deposited inside the waste deposition zone of the non-hazardous waste landfill. Although this type of waste represents a segment of a special waste flow, a separate area for the deposition of residues that cannot undergo further treatment must be provided after it has been treated in establishments outside the waste management centre.

An inert waste landfill is planned for possible residues from construction waste treatment (unless they can be used otherwise) and other types of inert waste that reach the WMC or remain after treatment of various types of waste. The present Plan has foreseen no central (for a region or a county) landfill for inert waste (construction waste residues) as part of a WMC, but only for a portion collected from adjacent towns and settlements.

At initial stages of the WMC construction it is possible and recommended to provide and arrange a certain space for construction waste (acceptance, sorting, plant, recyclate) and to recycle construction waste in mobile or semi-mobile plants. Investments in stationary plants should only be made when constantly sufficient construction waste flows are ensured. In this way investment risks are minimized and the overall system of construction waste management optimized. Particularly at initial stages of establishing the system it is expected that substantial amounts of construction waste will be recovered and used within the framework of temporary landfills/recycling yards, thus failing to reach the WMC.

Large quantities of earth material from excavations may be used for construction works without being additionally treated in the plant. A high sensitivity of construction waste to

transportation costs due to the minimum possibility of compacting will affect considerably the input amounts of recycled construction waste within the WMC. As a rule, the recycled construction waste is disposed of at the point of generation or within a radius of 30 km from the source.

Waste-to-energy zone
A non-hazardous waste landfill used for deposition of treated municipal waste containing a high share of a biodegradable substance is designed in the manner that allows the collection of gases generated at the methanogenic stage of waste decomposition. The gases collected are converted into electricity by a power plant. In case of insufficient amounts of gas generated in specific zones, it will be collected and flared off at the gas pumping station.

Wastewater reception and treatment zone
All wastewaters generated in a WMC must be collected and treated, if required for the reason of their generation and composition. Rainwater is collected in a rainwater pond separately from other waters and conveyed to a receptacle and a rainwater down-pipe system respectively. Sanitary wastewaters are conveyed by the public discharge system, if infrastructure is in place, or collected in septic tanks and drained from time to time. Leachates and wastewaters generated during waste treatment are collected separately and treated up to the quality that allows their discharge into the receptacle.

TABLE 14: WMC construction schedule

WMC construction procedure	Year 1	Year 2	Year 3	Year 4	Year 5
Adoption of the Waste Management Plan of the Republic of Croatia					
Adoption of waste management plans by counties and the City of Zagreb including the selected WMC site					
Establishment of a waste management company Site investigations					
Preparation of design documents					
Obtainment of building permit					
Construction of infrastructure					
Inviting tenders for selection of partners (PPP, concession…)					
Establishment of a company to manage the waste management centre and PPP contracting					
Public procurement procedure for contracting construction works					
Construction works stage 1					
Installation of waste treatment equipment					
Test run					
Start of operation					

5.2.6. Recycling Yard (RY)

A recycling yard is a facility intended for sorting and temporary storage of special types of waste. RY play a significant role in the overall waste management system, because they serve as a link used by local self-government units to ensure connectivity between citizens, licensed waste collectors and licensed waste processors and/or a waste management centre.

The sites for the establishment of RY that enable implementation of measures for separate waste collection are to be provided by towns and municipalities. Recycling yards are either owned by local self-government units or a local self-government unit has authorized certain companies to manage RY and receive separately collected household waste on its behalf.

Separately collected household waste temporarily stored at a recycling yard site may be directly transferred to licensed waste collectors or processors or hauled to the waste management centre site to be stored until delivery to licensed companies.

RY must obtain a permit to carry out non-hazardous waste management operations from the government office in the county and a permit to carry out hazardous waste management operations from the MEPPPC.

5.2.7. Transfer Station (TS)

A transfer station is a facility where waste is temporarily stored, prepared and reloaded for shipment to a WMC. According to the waste management concept in Croatia, a waste flow includes its passing through a TS. A waste transfer station is a facility where municipal waste collected through a waste collection network is unloaded from collection vehicles, inspected (possibly including separation of bulky waste), briefly held, reloaded onto larger transport vehicles and transported to a waste management centre for further treatment. At TS located on islands waste can be preliminary sorted and compacted in order to reduce the volume and facilitate transportation to a land-based waste management centre. By transporting wastes by heavy-duty trucks local self-government units may reduce costs of transportation to larger distances. In some cases, especially in towns and larger settlements or on islands, a transfer station may also include special facilities with appertaining equipment for preliminary treatment of waste and temporary storages for the reception of special types of waste collected in recycling yards. Moreover, a plant for construction waste treatment before its reuse or deposition of a non-usable fraction of waste may also be installed at the transfer station site. Such a plan must obtain a corresponding permit.

TS play a significant role in the overall waste management system, because they serve as a link between the waste collection network of local self-government units and waste management centres. Wastes that may be received by TS include municipal waste from households and industries that generate waste similar to municipal waste, green waste, hazardous household waste (cleaning agents, pesticides, herbicides, oils, anti-freezing agents, paints) and separately collected waste that may be recycled (construction waste, packaging waste, etc.).

Local self-government units shall implement programmes with separated flows of various wastes and therefore provisions must be made in TS that receive such wastes for their separate delivery, temporary storage and transportation.

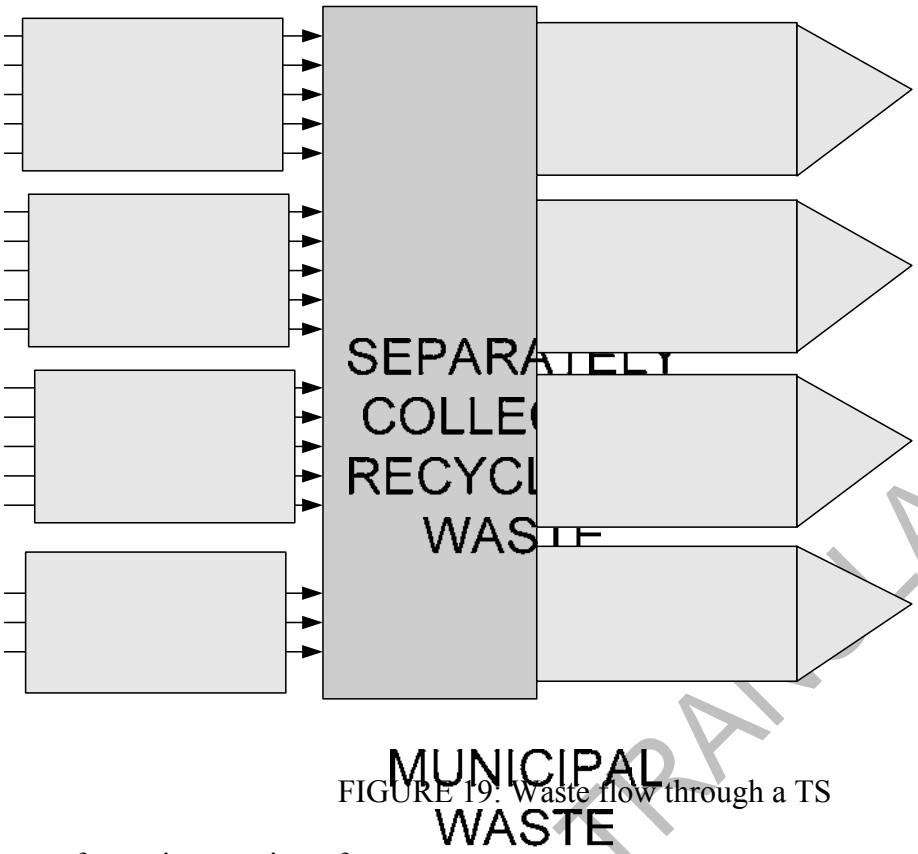


FIGURE 19: Waste flow through a TS

A transfer station consists of:

- an access road for connection to the public access (public road);
- road infrastructure as part of the transfer station, taking into account dimensions of transportation means when designing and constructing;
- a control point at entry to a transfer station site located on the access road (doorman's booth) where wastes are weighed and charged;
- a closed building for receiving wastes;
- a parking area;
- an area for receiving recyclables deposited by citizens (recycling yard);
- a buffer zone – an open space with planted vegetation and a fence surrounding the transfer station site;
- a reception zone serving for inspection of in-coming wastes and for retaining the unacceptable waste that is eliminated (or not accepted to the transfer station);
- construction and demolition waste collection floors;
- a possibility to install a mobile or a stationary plant and to provide space for construction waste acceptance and treatment (a stationary plant requires a permit from the competent authority) and
- equipment to reduce the volume of waste (baler).

A TS must obtain a permit for carrying out the non-hazardous waste management operations from the government office in the county and a permit for carrying out hazardous waste management operations from the MEPPPC.

Most of the activities in the area of the transfer station take place inside the building, i.e. waste loading and unloading. Waste is unloaded from collection vehicles and dumped on a floor, into a transport container or directly into another vehicle, or may be baled and

temporarily deposited to be kept for a specific period of time (e.g. on islands). A direct loading onto another transport vehicle makes the waste transfer much simpler, but limits the possibility to inspect and sort wastes. When waste is not directly loaded, it is temporarily unloaded on the floor and then transferred to another transport vehicle.

When designing and constructing a TS, the time schedule shown in Table 14 must be taken into account.

5.2.8. Municipal Waste Treatment Technology and Utilization Procedures Prior to Final Disposal

With the aim to reduce amounts of waste to be deposited and/or with the aim to eliminate or at least reduce harmful effect of waste on environment (e.g. emission of gaseous effluents arising from decomposition of waste, leachate, etc.), contemporary waste disposal systems include various waste treatment and utilization technologies.

The selection of a waste treatment technology must be based on the cost-effectiveness analysis, taking into account measures for waste management in line with the best available technology not involving excessive costs.

The text below gives an overview of contemporary municipal waste treatment technologies that the Plan has foreseen to be applied in the course of establishing WMC. Other municipal waste disposal technologies, not specifically mentioned here, may also be used, if offered through a public procurement system and if they satisfy conditions determined by this Plan and special regulations.

5.2.8.1. Mechanical Biological Treatment (MBT) of Waste

The concept of mechanical biological treatment of waste was developed in an effort to reduce the amounts of biodegradable waste deposited to landfills and to recover useful raw materials from waste by automated separation.

Given the large number of MBT variants developed so far, this term covers plants differing considerably with respect to the level of equipment and operating conditions.

As a rule, MBT technologies consist of individual processes such as:

- shredding and pelletising
- crushing and milling
- screening and other mechanical separation methods
- magnetic separation of metals

} mechanical treatment

- biological drying
- biological stabilization
- composting and
- anaerobic digestion.

} biological treatment

The MBT technology combines two key processes: mechanical (M) and biological (B) treatment of waste, whereby various elements of M and B processes may be configured in different ways to cover a wide range of specific goals:

- maximization of recyclable raw material amounts (glass, plastics, paper, etc.);
- composting;
- production of energy-rich refuse-derived fuel (RDF) of defined properties;
- production of biologically stable material that can be landfilled and
- production of biogas to be used to generate heat and/or electricity.

A MBT process may be designed to have one or more primary outputs. Apart from primary products of MBT processes (solid fuel, biogas, compost, biologically stable residue), all MBT processes have secondary outputs too, such as:

- recyclables (paper, metals, plastics)
- residues that are deposited to landfills
- wastewaters and
- emissions into the atmosphere.

Some of the most common applications of primary products arising from specific MBT processes are shown in Table 15.

TABLE 15: Possible applications of MBT process outputs

Process output	Application
Compost	in forestry to enhance land quality to enhance quality of pastures in gardens in polluted soil
RDF	secondary fuel for thermal power plants secondary fuel for cement works secondary fuel for industrial power plants fuel for waste-to-energy plants ("incinerators")
Biogas	electricity and heat generation (co-generation) mixing with natural gas generation of gas for transport and industry
Residue to be landfilled	deposition to landfills biologically stable residue suitable for deposition to landfills

At present a great variety of MBT technologies with diverse combinations of elements used for mechanical and biological treatment may be found on the market, enabling a selection of the plant suitable for a specific purpose.

A part of the mechanical treatment system represents components arranged to form a functional line for the purpose of:

- separating components for material recovery and
- separating components for energy recovery (RDF).

Apart from separation of individual useful components of municipal waste, mechanical components are used in the process of preparing waste for biological treatment. Biological treatment may be aerobic or anaerobic (with or without the presence of oxygen), including a combined application of both methods. The following is the basic division of MBT systems with respect to biological treatment methods applied.

Aerobic MBT systems
MBT systems for aerobic biological treatment are available in two basic designs and, given the treatment sequence, may be divided into:

- MBT processes – mechanical waste treatment taking place prior to the biological element, and
- BMT processes – biological element taking place prior to mechanical treatment.

In aerobic MBT systems the first stage is separation of recyclable materials and the combustible component (RDF) from the waste, which is then followed by aerobic treatment of the biodegradable component, resulting in biologically stable material, i.e. compost, as the major process outputs. The compost quality and, consequently, the possibility of its application depend on the quality of in-coming waste.
It is known from experience that RDF produced in this manner contains a relatively high percentage of moisture and in some cases must therefore be additionally dried using external energy sources, depending on the plant that receives it.

In aerobic BMT systems the waste is, after preparation, first transferred to aerobic treatment during which waste is dried by energy generated by its biodegradation. After biological treatment the waste undergoes the process of mechanical treatment when recyclables and RDF are separated. This way of biological treatment enable a high quality mechanical separation, which results in the production of a good quality RDF and better separation of recyclables. The treatment also results in a biologically stable material that may be additionally treated prior to final disposal, if required.

Anaerobic MBT systems
In anaerobic MBT systems, after separation of recyclables and the RDF, anaerobic digestion breaks down the biodegradable component of waste within a reactor to produce biogas as the main process output. Anaerobic digestion processes may be commercially designed as dry or wet and single or two-stage processes respectively. Secondary outputs of such a treatment are an inert component, wastewater and digestate, which undergoes aerobic treatment prior to final disposal. Wastewater released as a process by-product is purified in an adequate plant and a part of it may be returned to the process. The RDF produced by treatment in such a MBT system needs also to de additionally dried, depending on the requirements of the plant that will receive it.

Assessing the suitability of mechanical biological treatment of waste
To select an optimum MBT technology it is necessary:

- to identify precisely all future process outputs, including their utilization for energy generation;
- to evaluate the MBT technology configuration, its suitability for a specific application and possible impact on environment;
- to quantify process inputs and outputs, and
- to identify market demands for recyclables.

The selection of MBT technology depends on the following parameters:

- usability and functionality;
- balance of in-coming amounts of waste and market demands (what amount of material may be absorbed against the total amount of materials produced by a MBT plant);
- economics;
- legislation and
- market demands (demand for MBT process outputs, e.g. recyclables, solid fuel, biogas, etc.).

Thermal treatment of waste

Thermal treatment of waste is a set of procedures applied to reduce the amount of waste, while separating and/or destroying potentially hazardous substances contained in waste. Thermal treatment of waste can also be used for the recovery of energy value from waste and generation of electricity and/or heat.

Thermal treatment procedures include:

- incineration (combustion)
  - moving grate combustion
  - combustion in rotary kiln
  - fluidized bed combustion
- pyrolysis (degasification)
- gasification
- drying
- disinfection (sterilization)
- hydrating and
- other procedures and their combinations.

There is a special regulation mandating energy recovery from waste in the system of waste disposal, especially when it comes to municipal waste. From the aspect of energy optimization it is desirable that, prior to thermal treatment, less easily combustible substances of inorganic origin (metals, glass. etc.) are separated and the moisture content in the organic residue reduced. Pure incineration procedure without any special utilization of the heat produced may only be applied during disposal of special types of waste and disposal of hazardous waste.

Incineration

Waste incineration, which is at the same time the commonest technology, involves oxidation of combustible substances contained in waste. There are various modifications of incineration procedures such as moving grate combustion, combustion in rotary kiln and fluidized bed combustion. These plants are often used for incineration of other types of waste apart from the municipal waste, if incineration temperatures and other conditions are adjusted. Heat produced by this process may be converted into energy and therefore such a plant may be called a "waste-to-energy plant".

Pyrolysis

Pyrolysis is the process of chemical decomposition of organic molecules at high temperatures in the absence of oxygen. During the process organic materials contained in waste decompose and convert into pyrolytic gas, oil and a solid residue rich in oxygen.

Considering possible process temperatures, three pyrolysis variants may be distinguished:

- low-temperature pyrolysis (up to 500°C)
- medium-temperature pyrolysis (from 500°C to 800°C) and
- high-temperature pyrolysis (over 800°C).

As the temperature reaction rises, so does the pyrolytic gas content in reaction products, but the share of the liquid and solid residue decreases. Pyrolytic gas is usually burnt and a solid residue is either burnt or first gasified and then gases produced are burnt. Flue gases may be conveyed into a steam generator and the steam produced is used for heating or driving a turbine connected to the power generator.

Gasification

Gasification process occurs when at elevated temperatures gasification agents (e.g. oxygen, water vapour, air or carbon dioxide) are fed into a reactor containing fuel rich in carbon. The reaction product is a gas mixture known as synthetic gas (syngas). The syngas produced by gasification may be burnt, used in co-generation plants or applied for the synthesis of various liquid hydrocarbons by some form of the Fischer-Tropsch process. The result of a high process temperature is vitrification of slag produced in the process.

Gasification is still not widely used in thermal treatment of waste, because fuel must have a relatively homogeneous consistency, which means that municipal waste is to be pre-treated. There are some smaller plants where gasification is applied for treatment of liquid hazardous waste or highly energetic materials such as plastic waste. During thermal treatment of municipal waste gasification can be applied after pyrolysis as a method of subsequent treatment of a solid residue.

Other procedures

Other advanced thermal treatment procedures include the plasma arc procedure which basically represents a form of gasification. Plasmas are normally generated by passing electricity through a flow of gas and thus achieving temperatures ranging from 5000°C to 15000°C. The procedure mostly involves pre-treatment of waste after which the crushed waste in a container is fed into a reactor with plasma torches. At these high temperatures organic material contained in waste is broken into basic components and inorganic material melts. At the gaseous stage organic molecules dissociate and in this manner eliminate harmful emissions almost completely. This is at the same time the main advantage of the plasma arc procedure over conventional gasification. After melting, inorganic components vitrify and may be deposited or used as a construction material.

Managing residual waste from thermal treatment

Residual waste generated by thermal treatment may be divided into two categories:

- waste generated by combustion and
- waste generated by flue gas scrubbing.

Combustion waste (slags) is usually used as a material in road construction (e.g. in asphalt production). Waste resulting from flue gas scrubbing (fly ash) is additionally treated and stabilized and afterwards deposited to landfills or transported to hazardous waste landfills.

Thermal treatment process supervision and control

Process supervision and control systems in thermal treatment plants play an important role in optimization of process parameters, given differences in the composition of waste that is incinerated. The supervision and control system design depends most of all on the plant structure and requires the in-depth knowledge of process parameters and their interdependence. The system design is therefore crucial to the achievement of maximum usability of the waste thermal treatment plant. Incinerators must comply with the highest standards regarding efficient elimination of waste, protection against environmental emissions and quality of residues.

Conditions for the start of operation, operating conditions, conditions for operation stoppage, in-coming waste control method, employees' qualifications, air, soil and water protection methods and the managing of residues from thermal treatment of waste are laid down by the latest Ordinance on Methods and Conditions for Thermal Treatment of Waste.

TABLE 16: Factors to be considered when designing heat and power generation plants

Factors	Consideration aspects
Waste	- quantity and composition - availability, regularity of supply, seasonality of quantities - possibilities of changing waste quantities and composition - impact of waste sorting and recycling
Energy sale possibilities	<u>thermal energy</u> - sale to local community - sale to industry - use in the plant - ground, pipe-laying possibilities - demand duration, contract duration - obligations regarding heat availability, i.e. is there any other source when the incinerator is out of operation - steam (hot water) properties: pressure, temperature, flow rate, condensate recovery - seasonality of demand - subsidies - customer's share in financing incinerator operation <u>electricity</u> - national network, industrial network (rarely), consumption in incinerator, consumption during pre-treatment of waste - electricity charge (preferential tariff) - subsidies, loans - technical requirements – voltage, power, network connection
Local conditions	- refrigerant selection: water or air - time-dependent meteorological conditions - cooling tower - accessibility of water/river or sea

	- cooling water temperature - cooling water flow rate - permissible cooling water temperature increase
Combining electricity / heat	- shares of thermal and electric energy subject to the season of the year - shares of thermal and electric energy in the future
Other	- selection between energy generation increase, reduction of investment costs and system complexity - acceptable noise level - availability of space - architectural restrictions

5.3. HAZARDOUS WASTE

Measures laid down by this Plan aim at reducing hazardous waste generation, involving all hazardous waste producers in waste collection and stimulating them to deposit waste at places intended for that purpose.

A network of hazardous waste collection centres will be organized as part of:

- existing hazardous waste storages owned by companies licensed for hazardous waste storing;
- waste management centres and
- recycling yards in towns constructed for hazardous household waste.

A hazardous waste collection site/temporary storage as part of a WMC enables systematic separation of hazardous waste from municipal waste and provides a network/conditions for small-scale hazardous waste producers (up to 200 kg) to manage their own hazardous waste in the manner determined by law.

For the establishment of separate collection of hazardous waste generated by households it is necessary to develop a network of RY in towns that will provide space for the collection/deposition of smaller amounts of hazardous waste such as batteries, accumulators, medicines, polluted paint and varnish packaging.

Hazardous waste separated and collected in a WMC, a RY and storages of licensed waste collectors will be transported by licensed waste collectors/licensed forwarders (concessionaries) to:

- hazardous waste management centre (HWMC) for treatment/deposition/export or
- industrial facilities that possess a permit for hazardous waste treatment.

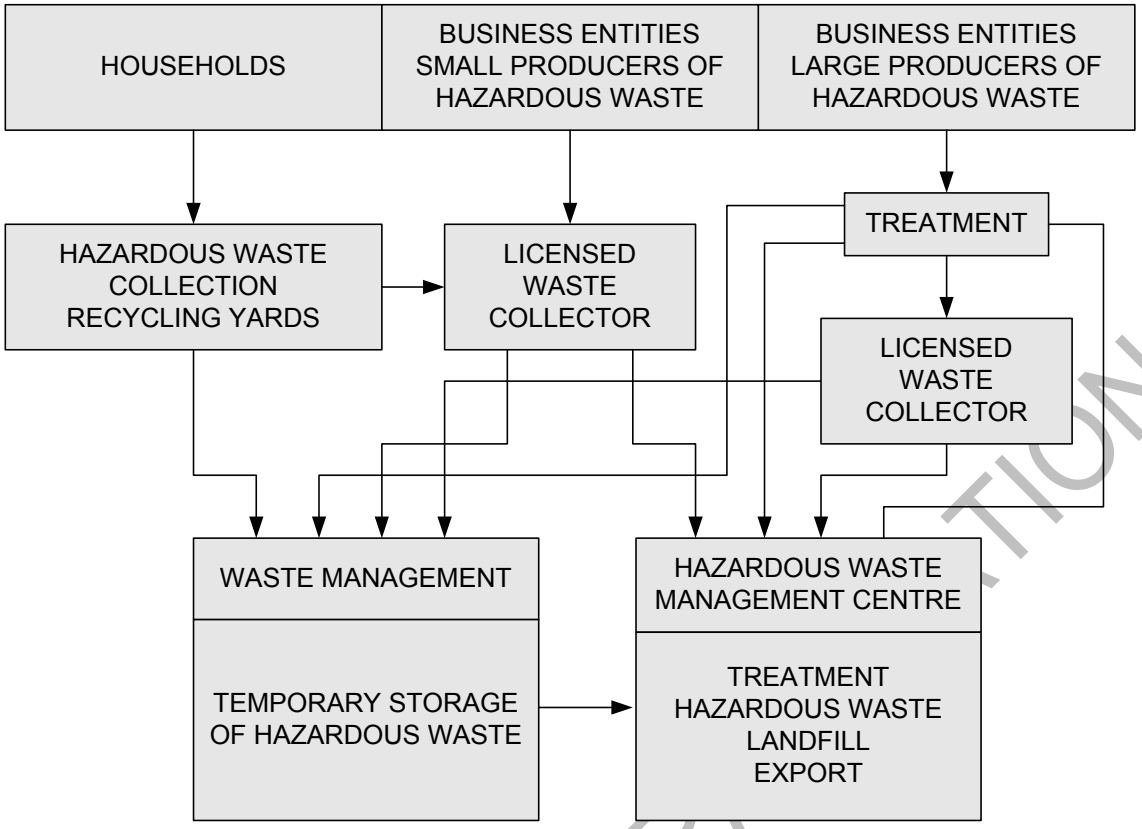
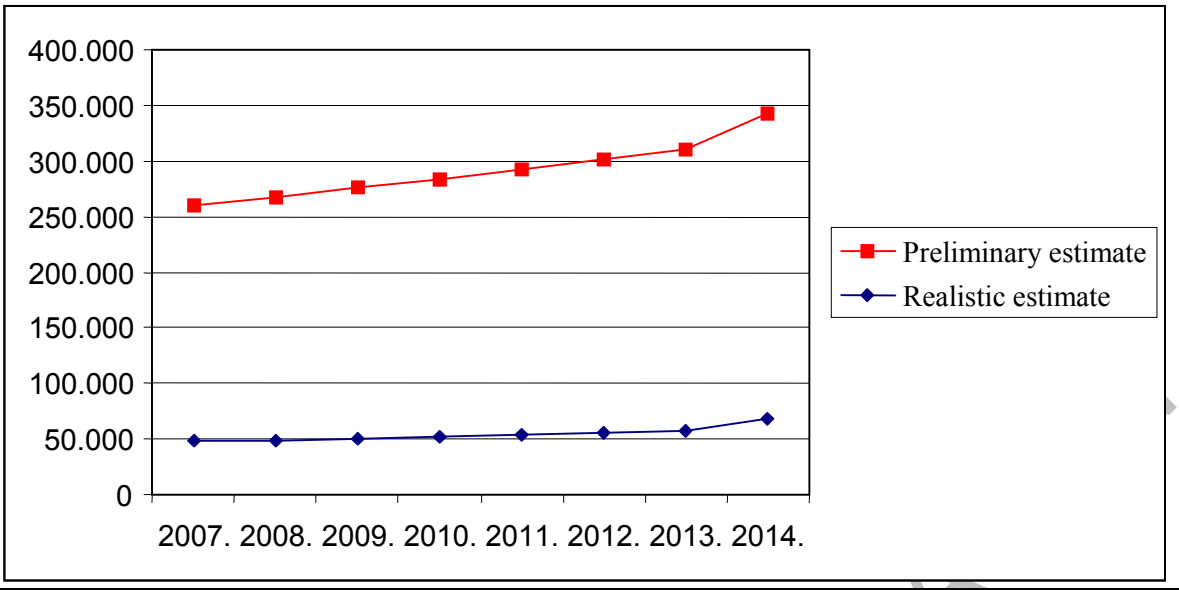


FIGURE 20: Planned system of hazardous waste management in Croatia

5.3.1. Projected Hazardous Waste Amounts

The analysis of a realistic and optimistic scenario of the increase in hazardous waste amounts in the period between 2007 and 2015 can serve to develop guidelines for estimating the required capacities of facilities and equipment that must be provided for hazardous waste management in Croatia. Both the optimistic and the realistic scenario of the increase in hazardous waste amounts in the forthcoming 8-year period build upon the same assumptions, except that for the initial hazardous waste amounts requiring the provision of management conditions and capacities the optimistic scenario uses a preliminary estimate of the amount of individual hazardous waste flow as a basis for the next 8-year period.

Projections of the expected rise in hazardous waste amounts in the period from 2007 to 2015 under the realistic and optimistic scenario are shown in Figure 21.



	2007.	2008.	2009.	2010.	2011.	2012.	2013.	2014.
Realistic estimate	47.632	49.061	50.533	52.049	53.610	55.219	56.875	67.788
Preliminary estimate	212.365	218.736	225.298	232.057	239.019	246.189	253.575	274.368

FIGURE 21: Projections of expected rise in hazardous waste amounts in the period from 2007 – 2015 under the realistic and optimistic scenario

5.3.2. Hazardous Waste Management Centre (HWMC)

Based on a preliminary estimate of hazardous waste amounts and hazardous waste categories for which conditions are to be provided, the following are basic guidelines for the establishment of a hazardous waste management centre:

- HWMC is a central point for hazardous waste storage, treatment and deposition in Croatia;
- At the first stage, the storage and treatment of approx. 60,000 t/year of hazardous waste in the HWMC is to be anticipated.

The HWMC construction and start of operation must be based on the construction schedule shown in Table 17.

TABLE 17: Construction schedule of the HWMC

HWMC construction activities	Year 1	Year 2	Year 3	Year 4	Year 5
Adoption of the Waste Management Plan of the Republic of Croatia					
Identification of the HWMC location					
Site investigations and design documents preparation					
Obtainment of building permit					
Public procurement procedure for contracting works and supply of equipment					
Execution of works and supply of equipment					
Start of operation					

In a HWMC conditions are to be provided for the following hazardous waste treatment technologies:

- physicochemical treatment – neutralization, settling, dewatering, sludge thickening and treatment;
- lime or cement conditioning;
- distillation and water separation;
- incineration;
- controlled deposition and
- treatment of wastewater produced by the facility.

Preliminary amounts, hazardous waste flows and methods of treating hazardous waste in a HWMC are shown in Table 18.

TABLE 18: Hazardous waste flow, preliminary amounts and treatment methods applied in the HWMC

Hazardous waste flow	Preliminary amounts of hazardous waste	Treatment method
Hazardous clinical and infectious waste	approx. 1,000 t/y	Thermal treatment
Wastes from the production and preparation of pharmaceuticals	approx. 700 t/y	Thermal treatment
Cytostatics-based waste medicines	approx. 50 t/y	Thermal treatment
Wastes from wood preserving chemicals	approx. 3,000 t/y	Thermal treatment
Wastes from the production and use of organic solvents	approx. 1,000 t/y	Thermal treatment
Waste oils, emulsions, oily waste, waste petroleum , etc.	approx. 10,000 t/y	Thermal treatment
Residues and sludge from distillation reactions at petroleum processing and pyrolysis	approx. 20,000 t/y	Thermal treatment
Thermal process residues	approx. 10,000 t/y	Pre-treatment/deposition
Wastes from the production, finishing and use of pigment dyes, lacquers, etc.	approx. 1,500 t/y	
Wastes that contain or are contaminated by PCB, PCT and/or PBB	approx. 50 t	Temporary storage/ export for disposal
Wastes from the production and use of glues	approx. 1,000 t/y	Thermal treatment
Wastes from photographic industry	approx. 400 t/y	Thermal treatment / physical-chemical treatment
Wastes from metal or plastic surface treatment	approx. 10,000 t/y	Physicochemical treatment / deposition
Wastewater treatment wastes	approx. 10,000 t/y	Thermal treatment / physical-chemical treatment / deposition

Wastes that contain zinc	approx. 60t /y	Physicochemical treatment / deposition
Inorganic wastes that contain cyanides	approx. 50 t/y	Physicochemical treatment / deposition
Acids and acidic solutions	approx. 1,000 t/y	Physicochemical treatment / deposition
Bases and alkaline solutions	approx. 1,000 t/y	Physicochemical treatment / deposition
Organic solvents	approx. 1,000t/y	Thermal treatment

Hazardous waste landfills

Basic technical characteristics of hazardous waste landfills are estimated as follows:

- in-coming waste amounts: approx. 12,000 tonnes/year;
- area requirement: 6.8 hectares in total, work zone of some 4.5 hectares, landfill capacity: approx. 12,000 m^3/y of waste

The landfill may receive wastes exhibiting the following technical characteristics: treated waste, residues from waste treatment carried out in the HWMC and wastes that required no treatment.

The following types of waste may be deposited:

- thickened sludges from the process of treating the sludges produced by industrial effluent treatment;
- ashes from a thermal treatment system;
- wastes from the flue-gas scrubbing system of an incinerator;
- solid wastes;
- solidified wastes;
- sludges that contain heavy metal oxides or hydroxides resulting from treatment of water from the metal processing industry;
- sludges from the wastewater treatment system used by the HWMC.

The landfill receives wastes according to the plan and keeps a record of the waste location and type. Total amounts of wastes are estimated at 12,000 tonnes yearly.

The landfill should be preferably sited near the HWMC and form a part of it, and, if impossible, then it should be sited as close to the HWMC as possible. Landfills are to be constructed with connections to infrastructure: water supply, sewage, electrical and telephone grid, etc. While filling a "cell", a mobile shelter is to be provided for the protection against rainfall.

The landfill site must consist of three zones:

a) entry / exit zone with accompanying facilities;
b) work zone with a waste deposition area, and
c) surrounding zone of the landfill – a green belt.

5.4. SPECIAL CATEGORIES OF WASTE

5.4.1. Clinical Waste

The Ordinance on Clinical Waste Management lays down the collection, transportation, storage, treatment, recovery and/or disposal of clinical waste, including recovery and/or disposal of wastes generated by treatment, recovery and/or disposal of clinical waste.

The Ordinance determines the system of clinical waste management according to the "polluter pays" principle and in this manner ensures that clinical waste is treated in conformity with the EU Directive on Waste. The Ordinance aims at energy recovery of non-hazardous waste generated by hazardous waste treatment on disinfection and sterilization equipment, due to its high energetic value.

5.4.2. Asbestos-containing Wastes

The latest Ordinance on Asbestos-containing Waste Management Methods and Procedures makes it obligatory to waste producers and waste processors to take all necessary measures to ensure that asbestos emissions in the air, the discharge of asbestos and asbestos-containing materials into water and generation of asbestos-containing waste are prevented or minimized in conformity with the Ordinance and special regulations.

Plants that use asbestos in the production process are subject to measures and limit values according to special regulations laying down limit values of air emissions and discharge into waters respectively and obliged to apply best available techniques.

5.4.3. Mining and Mineral Wastes

The Waste Act prescribes the adoption of an ordinance to govern the management of waste generated by exploitation of mineral raw materials in 2007, in collaboration with the Ministry of Economy, Labour and Entrepreneurship as the authority responsible for the mining industry sectors and implementation of the Mining Act and the pertinent enforcement regulations.

5.4.4. Construction and Demolition Waste

Managing newly-generated (future) construction waste

Each individual or several local self-government units must determine a site for temporary deposition of construction waste from which all reusable materials will be previously separated. Such temporary sites should be located in a radius of 30-50 kilometres. Temporary deposition of such wastes will be carried out in a transfer station and/or a recycling yard. It is also planned to use existing landfills which will operate until establishment of a WMC, with the aim to use a portion of material recovered from the construction waste managed (daily covers, transport roads and ramps) and from landfill rehabilitation and in this manner reduce the costs of rehabilitation and construction waste management. The recovery of the material collected will be carried out by mobile construction waste recycling plants.

Considering the amounts of construction waste generated, the use of quarries may be organized in certain counties. Quarries may also be used as possible landfills for construction waste of mineral origin (excavation waste, possibly separated scrap concrete) and as possible locations to place construction waste recycling equipment and facilities. Because of smaller amounts and in order to optimize capacities, mobile construction waste recycling plants would be used at the 1st stage of construction.

A local self-government unit, in whose area a public utility company operates, will decide on granting a concession for construction waste recycling or treatment to a company or to a private operator through a public competition. As regards options of the use of mobile plants, it is proposed to grant concessions to private partners in order to reach full exploitability of mobile plants. A concessionaire who will manage the recycled construction waste will be obliged to deposit and maintain the residual material at special construction waste sites. It will be transported in large containers loaded on trucks and trailers, whereby the maximum amount of construction waste to be transported is always determined considering its weight rather than its volume, as is the case with most of other waste types. The site will be financed and maintained by collecting charges for the waste delivery, acceptance and removal from the construction waste owner. Special locations for the separation of construction waste will be defined by waste management plans to be adopted by counties and by the City of Zagreb Waste Management Plan.

The existing construction waste will be managed in two ways:

- permanent disposal of total construction waste to the related landfill (e.g. as part of the landfill engineering concept or structure) by rehabilitation of the existing landfill, and
- partial or total disposal of construction waste in the same way as the newly generated construction waste, meaning that it is previously disposed of to temporary landfills or within the framework of plants and facilities (according to the Waste Act in force) used for construction waste recovery or recycling.

Construction waste should be recovered or recycled in full (or to the maximum extent possible), avoiding any permanent deposition to natural environment, as determined by the Waste Act and the Strategy. The objective to recover 80 per cent of the construction waste amount by 2015, as set by the Strategy, must be attained gradually.

Construction waste of the same type, such as:

- scrap asphalt and scrap asphalt mixed with scrap concrete (wastes arising from demolition of road bridges, roadway structures with stabilized layers, etc.) are to be hauled to permanent bitumen-mixing plant stations, for example, used by enterprises dealing with the maintenance of municipal, town, county or trunk roads;
- stone waste is to be directed to the collection in permanent quarries equipped or not equipped with crushers;
- scrap concrete and separated tile and brick scrap arising from demolition of buildings are to be sent to permanent landfills and construction waste recycling yards respectively; and
- paper, glass and plastic separated from construction waste are to be transferred to licensed waste collectors and processors.

All types of mixed construction waste are to be sent to construction waste recycling yards for treatment in mobile and stationary plants.

The construction and demolition waste management system will be laid down by the ordinance on construction waste management methods and procedures.

5.4.4.1. General Requirements for Construction Waste Management Facilities and Plants

Construction and demolition waste sorting, reclamation and recycling plants

Apart from the amounts being directly reused, construction waste is to be sent:

- to construction and demolition waste sorting and reclamation plants: in these plants mixed construction and demolition waste is unloaded and target materials removed. Such materials include large fragments that might be incompatible with the processing equipment and materials that are easily removed and achieve a good market prices (e.g. large reusable timber parts); and
- to construction and demolition waste recycling plants (stationary or mobile): these plants receive building and road construction waste and are equipped with the machinery for crushing, separation of waste fractions and iron metals reclamation.

Construction waste treatment plants may be:

- stationary/fixed plants: they cover a large area and are constructed using various stationary installations generally consisting of a number of conveyer belts and mainly two types of crushers. The equipment and infrastructure necessary for construction waste recycling centres cost approximately ten times as much as a mobile crusher. The closer the recycling centre is to populated areas, the larger likelihood there is that investments will have to be made in the protection against noise and dust and a building to accommodate a certain equipment, which may render the recycled material marketing more difficult; and
- mobile plants: these are the plants that are brought to the demolition area and consist of the same parts as those fixed, but their number is much lower.

According to cost-effectiveness studies, it is not financially profitable to construct stationary plants for construction waste recovery for quantities not exceeding 100,000 tonnes of construction waste yearly, and therefore the application of mobile or semi-mobile construction waste recovery plants is recommended.

Operations carried out by a construction and demolition waste require:

- appropriate physical plan of the plant;
- a location, building and operation permit, and
- an environmental impact study.

Account must be taken of the following factors: dust, noise, water, material storage, hazardous waste and materials, traffic, consultations with the community, maintaining documents, working hours, fences and health and human safety.

5.4.5. By-products of Animal Origin

As regards by-products of animal origin, control is to be established over dead animals in order to prevent the spread of infectious diseases. All livestock breeding facilities are to be registered with the Ministry of Agriculture, Forestry and Water Management (MAFWM), Department for Veterinary Science, and to be given a veterinarian identification number, and they are responsible for keeping a record of breeding and the number of livestock died. Based

on these records, necessary finance is to be secured from the MAFWM budget as a subsidy to cover costs of the disposal of by-products of animal origin.

The establishment of an efficient system for the disposal of by-products of animal origin requires the following:

- construction of at least five collecting points for temporary storage of by-products of animal origin at a temperature not exceeding 4°C in the counties of Vukovar- Srijem, Istria, Koprivnica-Križevci, Split-Dalmatia and Zadar; and
- introduction of new treatment technologies for by-products of animal origin of category III, using them for the generation of electricity, heat – biogas and high-quality fertilizers.

By upgrading the Agroproteinka d.d. knackery of open type, basic conditions under the EU criteria relating to the facilities for thermal treatment of by-products of animal origin have been met. As a result, current capacities for the treatment of by-products of animal origin satisfy the market demands, but an efficient collection is to be ensured and inspection activities intensified.

5.4.6. Sludge from Wastewater Purification Plants

Sludge resulting from purification of municipal wastewaters might be considered a municipal waste component. However, sludge management falls within the competence of legal entities that manage wastewater treatment plants rather than authorities responsible for waste management.

Sludge management is to be regulated as part of the water management strategy, because this strategy will define more precisely projected amounts, characteristics and options for final disposal of sludges from municipal wastewater purification plants.

A special ordinance has laid down the methods and conditions for the management of sludges arising from municipal wastewater purification plants when these sludges are used for agricultural purposes.

The construction designs of municipal wastewater purification plants must ensure a complete aerobic (or anaerobic) stabilization of sludges before sending them for deposition on agricultural land or to inert waste landfills.

5.4.7. Packaging and Packaging Waste

The recent Ordinance on Packaging and Packaging Waste has set up an integrated system for packaging and packaging waste management. The Ordinance lays down the packaging and packaging waste management method, or specifically:

- obligations of manufacturers, importers, packagers and sellers when producing, marketing and using packaging and packaging waste;
- providing manufacturers and consumers with information about essential properties of the product and packaging;
- method of collecting charges for packaging and packaging waste, collection and management of packaging and packaging waste;
- return of used products and packaging respectively for reuse, payment of the charge for recoverable waste after the product has been used; and

- purpose and use of charges paid for packaging and packaging waste.

In accordance with the 'polluter pays' principle, waste disposal costs are borne by manufacturers and importers of packaging through payment of the charge into the EPEEF when placing the product on the market.

5.4.8. Waste Tyres

The Ordinance on Waste Tyres Management has determined the disposal method for all tyres discarded in the area of Croatia and tyres imported either as a single product or mounted on vehicles and aircrafts or produced in Croatia as a single product or a part of a product.

The Ordinance lays down:

- types and amounts of charges to be paid by persons liable to charges;
- method and time of calculation and payment of charges;
- method of collecting waste tyres and the amount of indemnities payable to licensed waste collectors for the collection of waste tyres; and
- amounts of indemnities payable to entities dealing with the recovery of waste tyres.

In accordance with the 'polluter pays' principle, importers and manufacturers of tyres pay a charge to cover the costs of waste tyre management (collection, temporary storage, disposal and recovery). Persons liable to charges pay a charge for waste tyre management both when importing and manufacturing vehicles, airplanes and other aircrafts containing tyres as components according to the criteria laid down by the Ordinance.

5.4.9. End-of-Life Vehicles

The recovery and disposal system prescribed by the Ordinance on End-of-Life Vehicles Management ensures that this type of waste is managed in accordance with the EU Directive on Waste and the EU End-of-Life Vehicles Directive, at the same time applying the 'polluter pays' principle. The Ordinance lays down specific environmental protection measures which aim at setting up a system for collecting end-of-life vehicles for reuse, recycling and other forms of recovery of end-of-life vehicles and their components so as to reduce the disposal of waste and enhance the environmental performance of all economic operators involved in the lifecycle of vehicles, especially those directly involved in treatment of end-of-life vehicles.

The Ordinance on End-of-Life Vehicles Management determines:

- the method of end-of-life vehicles management:
- types and amounts of charges payable by persons liable to payment of charges for end-of-life vehicles;
- method and time of calculation and payment of charges; and
- ban on the marketing of motor vehicles containing hazardous substances.

According to the Ordinance the charge for end-of-life vehicles management is payable into the EPEEF by a legal or physical entity that manufactures of imports vehicles in Croatia.

Licensed waste collectors are granted two types of indemnities:

a) indemnities to cover the costs of taking the end-of-life vehicles and their temporary storage; and
b) indemnities for the quantities of end-of-life vehicles received from their holders at the holders' location.

The holder is entitled to an indemnity which depends on whether the holder has taken the end-of-life vehicle to the collector's storage or the collector has fetched the end-of-life vehicle at the holder's location.

5.4.10. Waste Oils

The recent Ordinance on Waste Oils Management determines persons liable to the waste oil charge, types and amounts of charges payable by persons liable to the waste oil charge, method and time of calculation and payment of charges, waste oil management methods, amounts of indemnities payable to entities licensed for collection of waste oils and charges payable by entities licensed for waste oil recovery. The waste oil recovery and disposal system based on the 'polluter pays' principle ensures that waste oils are managed in accordance with the EU Directive on Waste and the EU Waste Oils Directive. Importers of fresh lubricating oils into Croatia or manufactures of fresh lubricating oils in Croatia are liable to a charge for the disposal of waste lubricating oils when placing fresh lubricating oil on the market as a special product.

5.4.11. Waste Batteries and Accumulators

The recent Ordinance on the Management of Waste Batteries and Accumulators lays down the method of labelling batteries and accumulators, the method of collecting waste batteries and accumulators, obligations and responsibilities of manufacturers of batteries and accumulators and manufacturers of battery and accumulator components, types and amounts of charges payable by persons liable to charges, method and time of calculation and payment of charges and amounts of indemnities paid to persons licensed for the collection, recovery and recycling of waste batteries and accumulators.

The Ordinance has prescribed the system for the recovery and disposal of waste batteries and accumulators, based on the 'polluter pays' principle, and thus ensured that that waste batteries and accumulators are managed in accordance with the EU Directive on Waste and the Directive on Batteries and Accumulators and Waste Batteries and Accumulators. The Ordinance aims at setting up a system of collection, recovery and high-standard recycling, controlled use and/or disposal of the residues arising from the recovery and recycling of waste batteries and accumulators regardless of their form, volume, weight and material used for their manufacture.

The collection of waste batteries and accumulators is carried out at points of sale and the waste disposal costs are borne by manufacturers and importers through charges payable into the EPEEF when placing the product on the market. The EPEEF pays indemnities to waste collectors and processors for waste battery and accumulator quantities collected and treated.

5.4.12. Electric and Electronic Waste

The Ordinance on Electric and Electronic Waste Management has set up a system for separate collection of electric and electronic waste for its recovery and disposal, environmental protection and human health under the 'polluter pays' principle.

The Ordinance determines:

- persons liable to charges;

- types and amounts of charges payable by persons liable to payment of charges for electric and electronic waste;
- method and time of calculation and payment of charges;
- electric and electronic waste management methods;
- amounts of indemnities payable to the waste holder when transporting the electric and electronic waste to persons licensed for the collection of electric and electronic waste;
- amounts of indemnities payable to persons licensed for the collection of electric and electronic waste; and
- amounts of indemnities payable to persons licensed for the disposal and/or recovery of electric and electronic waste.

The electric and electronic waste disposal costs are borne by manufacturers and importers through charges payable into the EPEEF when placing the product on the market. The EPEEF pays indemnities to waste collectors and processors for electric and electronic waste quantities collected and treated.

5.4.13. Waste from the Titanium Dioxide Industry

Although titanium dioxide is not produced in Croatia, but only used as a raw material in further production, the Waste Act makes it obligatory to adopt an ordinance on managing wastes arising from the titanium dioxide industry in 2008 in accordance with the EU Directive on Waste from the Titanium Dioxide Industry.

5.5 LANDFILLS

The recent Draft Landfill Ordinance, harmonized with the best European practices, sets down essential operating and technical requirements for landfills, limit values of environmental emissions arising from waste disposal, obligatory procedures, rules and other disposal conditions, conditions and measures relating to the design, construction, operation and closure of landfills and after-closure waste management, with the aim to reduce effects of adverse environmental impacts, especially pollution of surface and ground waters, air and soil, as well as the global environment, including the greenhouse gas effect, and to reduce the risk to human health likely to arise from waste disposal and over the entire lifecycle of the landfill. The Ordinance also lays down compulsory procedures and other conditions for the acceptance of waste into underground storages, including conditions for the disposal of asbestos-containing waste.

5.5.1. Types of Landfills

According to the Landfill Ordinance landfills may be classified as:

1. *Inert waste landfill* permitted to accept only inert wastes;
2. *Non-hazardous waste landfill* permitted to accept:
   a) municipal wastes;
   b) non-hazardous wastes of any origin that meet the criteria for the reception of wastes to non-hazardous waste landfills according to the provisions of the Ordinance;

c) stable and non-reactive pre-treated hazardous wastes, if limit values of pollution found in wastes and eluate do not exceed limit values for non-hazardous waste as determined by a special regulation, and
d) wastes with considerably reduced share of biodegradable fraction, i.e. wastes whose biodegradable fraction will be used for biogas generation in a controlled process;

3. *Hazardous waste landfill* permitted to accept only hazardous wastes, if limit values of pollution found in wastes and eluate do not exceed limit values for hazardous waste as determined by a special regulation; and
4. *Underground storages* which imply a site for permanent underground deposition of waste into an appropriate borehole resulting from mine exploitation or exploration. An underground storage may receive inert, hazardous and non-hazardous waste only, with the exception of wastes as specified in the Ordinance.

Waste landfills are permitted to accept only pre-treated waste under the criteria laid down by the Ordinance.

Wastes are inspected at three levels:
- waste characterization
- conformity assessment and
- spot checks of shipments.

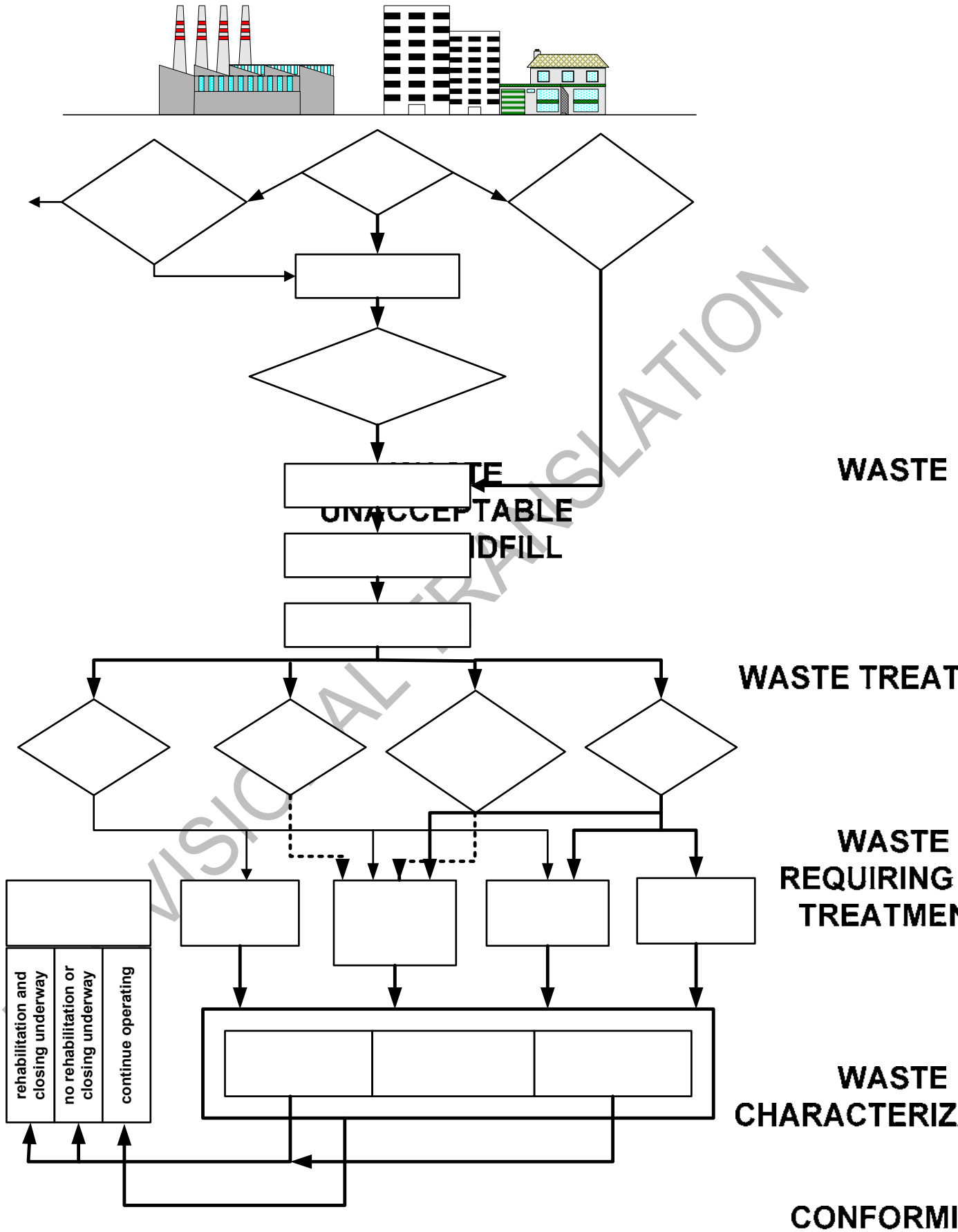


FIGURE 22: Reception of waste at landfills

5.5.2. Landfill Closure and Post-Closure Maintenance and Monitoring

A landfill or part of it will close and cease operating when all relevant conditions stated in the landfill operating permit are met, under the authorization of the competent authority at the request of the operator. A landfill closes according to the procedure as laid down in the landfill operating permit. A landfill or part of it is considered closed after the competent authority has carried out an inspection, accepted all the documents required and given the Approval for Closure. For the purpose of landfill closure the operator shall submit documentation containing reports on landfill closure measures taken, a programme for implementation of landfill maintenance and monitoring measures in the after-care period, as stated in the landfill operating permit, and a presentation of the spatial distribution of wastes deposited in the landfill body.

After a landfill has been closed, the operator shall be responsible for landfill maintenance, implementation of measures for the prevention of adverse environmental effects, control and monitoring in the after-closure phase as stated in the landfill operating permit. In the Approval for Landfill Closure the competent authority may prescribe extra measures for the prevention of adverse environmental effects and extra control and monitoring measures, as long as it deems measures stated in the permit insufficient.

The operator of a closed landfill shall be responsible for maintaining and protecting the closed landfill, checking regularly the condition of the landfill body, landfill control and monitoring, preparation of the annual report on the landfill status and implementation of prescribed measures over the period of time as stated in the permit or the Approval for Landfill Closure.

5.5.3. Waste Disposal Permit

An operator is permitted to carry out operations of waste deposition to landfills only if granted a waste disposal permit in accordance with the Waste Act. In addition to particulars defined by the Waste Act, the permit must lay down in detail:

- landfill category;
- types and quantities of waste that may be deposited to the landfill;
- the amount of biodegradable components of waste to be deposited in a calendar year;
- procedures of waste acceptance and characterization, including other operating conditions;
- control, operation monitoring and other forms of supervising the environmental pollution;
- methods for regular checks of the landfill body and landfill facilities;
- permissible changes in indicative parameters of groundwater;
- requirements as regards reporting on the types, point of generation and amounts of deposited waste;
- requirements as regards landfill closure and measures taken to prevent adverse environmental effects after its closure;
- period of time during which the operator, after closing the landfill, must ensure the fulfilment of all relevant obligations and which is at least 30 years for a landfill that receives hazardous or non-hazardous waste; and
- annual quantity and space for the deposition of residues arising from the processing of construction waste and asbestos-containing construction waste.

5.5.4. Waste Deposition Costs

Waste deposition costs include the landfill designing, construction and operating costs and estimated costs of the landfill closure, maintenance and monitoring for a period of 30 years after the closure. Waste deposition costs shall be defined in accordance with the waste quantities and properties and applying the 'polluter pays' principle.

5.5.5. Control and Monitoring during the Operational Phase

The operator of a landfill for hazardous and non-hazardous waste must carry out control and monitoring during the operational phase. Control and monitoring procedures include:

- measurement of meteorological parameters;
- measurement of landfill gas emissions;
- measurement of leachate and rainwater released from the landfill surface;
- measurement of parameters of groundwater pollution by hazardous substances, if in the influence area of the site; and
- control of the landfill body stability.

The landfill operator shall notify the competent authority of any adverse environmental effects revealed by the control and monitoring procedures and of the corrective measures taken at the operator's expense. Once a year the landfill operator shall submit a report on all control and monitoring results as specified above.

5.6. WASTE MANAGEMENT CENTRES (WMC) – LOCATIONS

The Strategy has laid down the establishment of regional and county WMCs on a long term basis.

The counties and the City of Zagreb are obliged to prepare waste management plans that will define the waste management system consisting of not more than one WMC in each county and the City of Zagreb.

The analysis of the draft waste management plans proposed by counties and the Draft Waste Management Plan of the City of Zagreb showed that in 2006 almost all of the counties proposed special locations to be central points of waste treatment and deposition. At the time of adopting this Plan some of the counties have still not finished the adoption of physical plans defining future locations of a county and/or regional WMC.

The draft plans available envisaged the possibility of establishing two regional waste management centres (RWMC):

- a RWMC for the northwestern Croatia covering the counties of Koprivnica-Križevci, Krapina-Zagorje, Međimurje and Varaždin, and
- a RWMC for eastern Slavonia – Antunovac in the County of Osijek-Baranja, covering the counties of Osijek-Baranja and Vukovar-Srijem.

The City of Zagreb and the County of Zagreb are planning the construction of a municipal waste thermal treatment plant to be located in the City of Zagreb, Žitnjak East, and a landfill for thermal treatment residues to be located in the County of Zagreb.

For this reason two concepts for non-hazardous (municipal and industrial) waste management have been proposed:

- the so-called county concept – one WMC in each county and
- the so-called regional concept – eight regional and five county WMCs.

Graphical presentations are shown in Figures 23 and 24.

During the preparation of this Plan some of the counties selected a location for the construction of a WMC from those proposed, and such locations were later included in the concept proposals.

Regardless of the concept selected, potential WMC locations, criteria and guidelines for their construction must be included in physical plans of the counties. Locations will be definitely selected upon completion of site investigations and the environmental impact assessment procedure that precedes issuance of a location permit.

5.6.1. County Concept of Waste Disposal

In their draft waste management plans a number of counties and the City of Zagreb have proposed locations for WMCs. Some of them have defined several potential locations and some of them none at all.

Consequently, the county concept was developed on the basis of county management plans available and investigations and analyses carried out for the Plan preparation purposes.

All WCM locations by counties are presented aggregately in Table 19 and Figure 23.

TABLE 19: County concept

County	WMC locations at the county level
Krapina-Zagorje	Not defined
Sisak-Moslavina	Alternatives: Četvrtkovac, Blatuša, Kurjakana, Banski Grabovac, Ćore and Rađenovci
Karlovac	Alternatives: Lemić brdo, Babina gora and Okić
Varaždin	Motičnjak
Koprivnica-Križevci	Piškornica
Bjelovar-Bilogora	Not defined
Primorje-Gorski Kotar	Marišćina
Lika-Senj	Lički Osik
Virovitica-Podravina	Jasenaš
Požega-Slavonia	Not defined
Slavonski Brod-Posavina	Alternatives: Šagulje-Ivik, Baćanska, Općine Gornja Vrba, Podcrkavlje, Vrpolje and Vrbje

Zadar	Benkovac (Biljane Donje)
Osijek-Baranja	Antunovac
Šibenik-Knin	Bikarac
Vukovar-Srijem	Stari Jankovci
Split-Dalmatia	Lećevica (Kladnjice)
Istria	Kaštijun
Dubrovnik-Neretva	Badovinje Rupe
Međimurje	Pustošija
City of Zagreb County of Zagreb	PTOO - Zagreb East (Resnik) Landfill location not defined

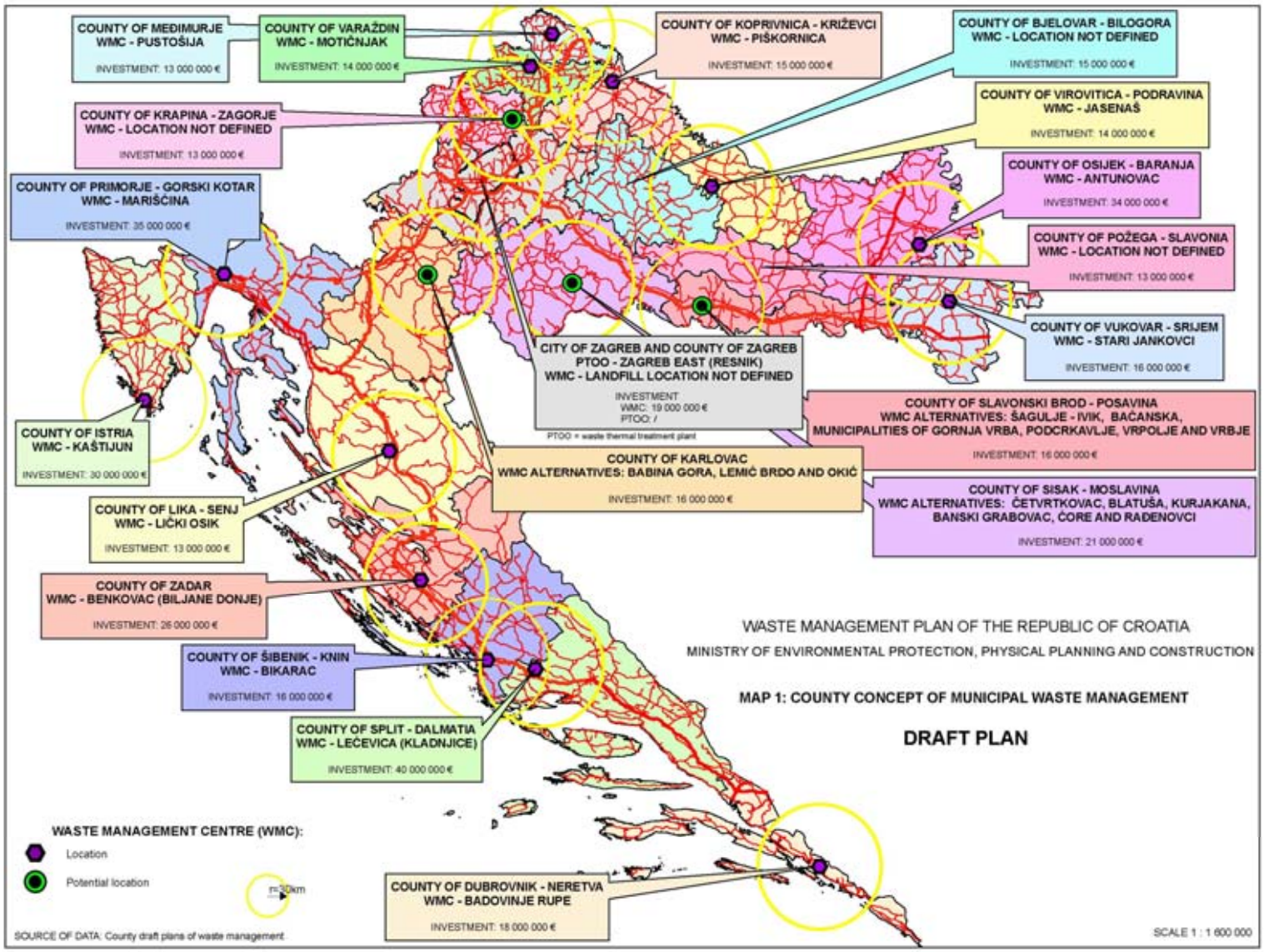


FIGURE 23: County concept of municipal waste management

5.6.2. Regional Concept of Waste Disposal

The planning of the overall waste disposal system at the national level enabled a different approach to planning a waste disposal system. When developing a regional concept, primary objectives were the rational use of the space as a limited resource and minimization of waste disposal costs. The regional concept of waste disposal arises partly from management plans developed at the county level, because some of the counties have recognized advantages of merging into a region that shares a WMC. Two RWMCs - northwestern Croatia (counties of Koprivnica-Križevci, Varaždin, Međimurje and Krapina-Zagorje) and Antunovac for eastern Croatia (counties of Osijek-Baranja and Vukovar-Srijem) – are based on county draft plans, while the City of Zagreb and the County of Zagreb plan joint municipal waste disposal by the process of thermal treatment.

Other RWMCs are included in the regional concept on the basis of optimization of spatial and economic parameters. The regional concept covers the counties of Bjelovar-Bilogora and Virovitica-Podravina with the joint centre in Jasenaš and the counties of Slavonski Brod-Posavina and Požega-Slavonia with the joint centre in Šagulje-Ivik, as proposed.

Given the geographic features of the County of Lika-Senj, some parts of its territory are attached to the neighbouring counties: the northeastern part is attached to the WMC in the County of Karlovac (35 per cent), the northwestern part to Marišćina in the County of Primorje-Gorski Kotar (15 per cent) and the southern part to the WMC in the County of Zadar (50 per cent).

For other counties not covered by the analysis (Sisak-Moslavina, Šibenik-Knin, Split-Dalmatia, Istria and Dubrovnik-Neretva) there is a possibility that they unite at a later stage in order to optimize individual waste management systems.

The WCM locations under the regional concept are presented aggregately in Table 20 and Figure 24.

TABLE 20: Regional concept

No.	County	RWMC/CWMC location
	Sisak-Moslavina	Alternatives: Četvrtkovac, Blatuša, Kurjakana, Banski Grabovac, Ćore and Rađenovci
	Šibenik-Knin	Bikarac
	Split-Dalmatia	Lećevica (Kladnjice)
	Istria	Kaštijun
	Dubrovnik-Neretva	Badovinje Rupe
1.	Karlovac	Alternatives: Lemić brdo, Babina gora and Okić
	35% Lika-Senj	

2.	Koprivnica-Križevci	Location not confirmed
	Krapina-Zagorje	
	Varaždin	
	Međimurje	
3.	Primorje-Gorski Kotar	Marišćina
	15% Lika-Senj	
4.	Slavonski Brod-Posavina	Alternatives: Šagulje-Ivik, Baćanska, municipalities of Gornja Vrba, Podcrkavlje, Vrpolje and Vrbje
	Požega-Slavonija	
5.	Zadar	Benkovac (Biljane Donje)
	50% Lika-Senj	
6.	Osijek-Baranja	Antunovac
	Vukovar-Srijem	
7.	Virovitica-Podravina	Jasenaš
	Bjelovar-Bilogora	
8.	City of Zagreb County of Zagreb	PTOO - Zagreb East (Resnik) Landfill location not defined

Following the adoption of this Plan, the Counties and the City of Zagreb will adopt final waste management plans to define their future system of waste management in regional WMCs, i.e. independently or in conjunction with one or more counties.

The final decision on the concept will depend on the decision which will have been made by each individual county. Calculations and cost estimates intended to help the counties in the decision-making phase may be found in Chapter 5. This Plan does not exclude any other alternatives of intercounty integration and after the adoption of all waste management final plans by the counties and the City of Zagreb it will be supplemented.

The counties and the City of Zagreb are bound to define WMC locations by the end of 2007.

Waste management plans at the county level will define in detail the contents of waste management centres, waste treatment technologies, coverage, distribution, intended use of transfer stations, flows of all types of waste across the county/region and possible impacts on humans and environment.

According to the former European practice, the construction of a WMC for less than 400,000 inhabitants proved not recommendable for financial (investment) reasons. However, when constructing a WMC account should be taken of low population density in some areas of Croatia and data arising from analyses carried out during the Plan preparation.

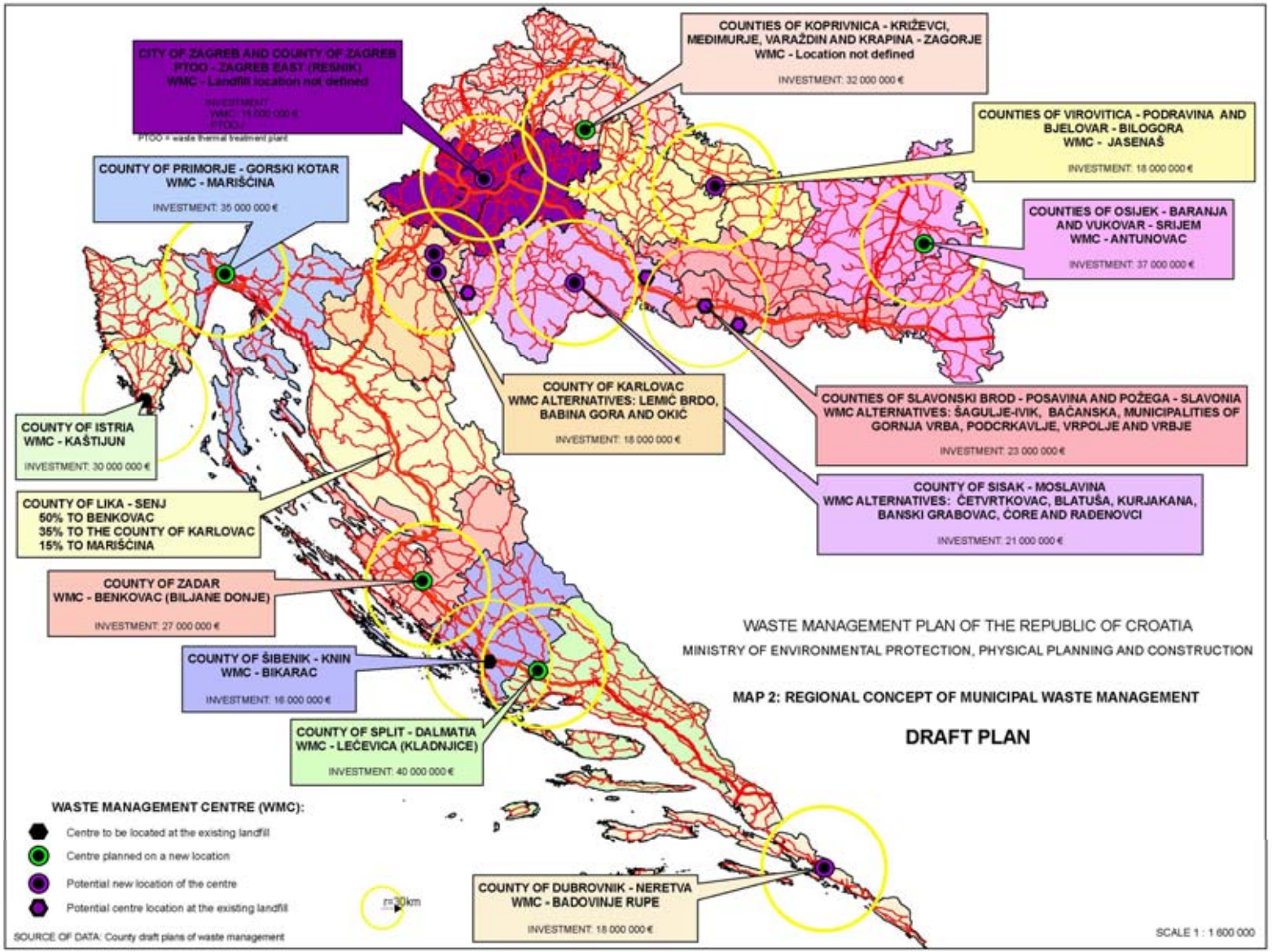


FIGURE 24: Regional concept of municipal waste management

6. WASTE MANAGEMENT SYSTEM FINANCING PLAN OF CROATIA

The Waste Management Plan was developed on the basis of waste management plans proposed by the counties and the City of Zagreb, which in some cases failed to define the key concepts of waste management in a county/region or the final location of a RWMC/CWMC in the physical planning documents. Therefore certain deviations from the planned investment amounts are expected during its implementation. However, in order to be able to plan the financing of the establishment of the waste management system alternative solutions have been provided – the establishment of county (CWMC) or regional waste management centres (RWMC).

This Plan includes the costs of financing the projects of:

- landfill rehabilitation and closure;
- dumps;
- hot spot remediation, and
- construction of WMCs and transfer stations.

The system of primary separation and recycling of secondary raw materials at the national level was established through ordinances referred to in Chapter 3.4. Special Waste Categories. Similarly, as regards the local level, the counties and the City of Zagreb shall establish, implement and provide the necessary finance for a comprehensive primary separation system, which will be defined by waste management plans for the counties or the City of Zagreb.

6.1. SOURCES OF FINANCING

The finance necessary for project implementation will be provided from:

- public sources and
- private sources.

Re. A) Public sources of financing include:

- state budget;
- budgets of local and regional self-government units and monies provided by public utility companies (owned by local self-government units);
- EU funds (ISPA and IPA programmes; structural funds available to member states);
- the EPEEF, and
- bank loans (World Bank, European Bank for Development, European Investment Bank, etc.).

Re. B) Private sources of financing include:

- private investments in WMCs (public private partnership, concessions, etc.) and
- private investments in primary separation and collection of waste – recycling and collecting plants.

6.1.1. Budgetary funds

Budgetary funds will be used to a lesser degree for investment works relating to remediation and construction of the future waste management system. They will be primarily used for

fostering and development of the system and preparation of programmes and projects dealing with development and remediation, especially of "hot spots".

6.1.2. Environmental Protection and Energy Efficiency Fund (EPEEF)

The EPEEF will provide a funding structure to support and encourage environmental programmes and projects dealing with:

1. Landfill rehabilitation and improvement of landfill management including the gradual closure of existing municipal waste landfills;
2. Remediation of dumps (illegal landfills) that pose threat to the environment and human health and prevention of uncontrolled waste deposition;
3. Construction of WMCs, HWMCs and inert waste landfills;
4. Rehabilitation of hazardous waste landfills – sites of a highly polluted environment;
5. Encouraging the avoidance and minimization of waste (setting up green islands for separate collection of municipal waste in containers for glass, paper, plastics, biodegradable waste. etc.), and
6. Establishment and improvement of the system for managing special categories of waste such as: packaging and packaging waste, electric and electronic waste, end-of-life vehicles, waste batteries and accumulators containing certain hazardous substances, waste tyres, infectious waste from medical institutions, waste from mining and exploitation of mineral resources and waste oils.

6.1.3. Finance provided by local and regional self-government units, public utility companies and bank loans

The finance coming from the budgets of local and regional self-government units and bank loans (World Bank, European Bank for Development, European Investment Bank, etc.) will be used to provide the land needed for a WMC and TS location and the infrastructure up to the WMC location. Bank loans will be used for the establishment of a collection system and construction of the municipal waste disposal system at the level of the local (regional) self-government.

At the national level bank loans will be used for remediation of "hot spots".

6.1.4. European funds

As early as 2001 Croatia started building its institutional system for the reception of EU funds which in the course of the time kept developing in compliance with EU requirements as regards the management of those programmes. In the period from 2001 to 2004 Croatia was a beneficiary of the CARDS programme which was the largest integral programme of assistance implemented in the country throughout that time. After becoming the EU candidate country Croatia was given access to pre-accession programmes (Phare, ISPA and SAPARD) which replaced the national component of the CARDS programme as the main source of financial assistance provided by the EU in the period from 2005 to 2006.

Early in 2007 Croatia was provided access to IPA (Instrument for Pre-accession Assistance) as an integrated instrument that replaced the CARDS programme and pre-accession programmes (Phare, ISPA and SAPARD). The recent IPA programme is designed for

providing assistance to candidate countries in capacity-building for the management of structural funds that will be available to them after the EU accession.

The Environmental Operation Programme (EOP) covers a 3-year programming period (2007-2009) for IPA component III amounting to 55,000,000 € and builds upon previous investments co-financed by ISPA. Therefore the Environmental Operation Programme priorities include:

- construction of waste management infrastructure with the aim to establish an integrated waste management system of Croatia amounting to 27,500,000 €, and
- protection of Croatia's water resources through improvement of water supply and discharge and wastewater treatment systems amounting to 27,500,000 €.

6.1.5. Private investments

In recent years the European Union has experienced a rise in co-operation between the public and the private sector aimed at the development and construction of environmental and transport infrastructure for the reason of numerous advantages such as a more rapid construction of infrastructure, more rapid implementation, lower total costs, a better allocation of risks, high-quality services, additional revenue-raising and a more efficient management.

A public private partnership (PPP) is a form of co-operation between government bodies and private sector entities that implies the participation of private sector both in project implementation and the decision-making process through a well balanced risk distribution. Subject to the level of the public and the private sector involvement and the allocation of risks, the contracts aimed at a long-term co-operation between these two sectors include activities of project funding, designing, implementation and operationalization.

This Plan envisages private investments in primary selection, collection and treatment of useful waste (plastic materials, glass, metal, tyres, paper, oils, etc.) and in industrial and thermal treatment of municipal, hazardous, non-hazardous industrial and construction waste through concession contracts and PPPs.

6.2. ESTIMATE OF FINANCE NEEDED FOR REHABILITATION OF LANDFILLS, HOT SPOTS AND OTHER SITES

In a separate chapter of this Plan the need was identified to remedy "hot spots" as residues of former industrial activities, giving priority to:

- Lemić brdo near Karlovac;
- alkaline water and red sludge pools at the location of the former alumina plant in Obrovac;
- the Bakar Coke Plant;
- a slag landfill in the Kaštela Bay;
- the TEF Šibenik and
- asbestos landfill in Mravinačka kava near Split.

In default of a legal entity responsible for those locations the rehabilitation falls within the competence of the State as determined by the Waste Act.

The owners or users of the locations:

- the Sovjak pit near Rijeka;
- a landfill of slags from the Plomin I Thermal Power Plant;
- a landfill of oily sludges in Botovo, and
- a phosphorus gypsum landfill in Kutina

are known and responsible for rehabilitation, but given the amount of investments needed financial assistance is expected from the government and other funds.

The rehabilitation of landfills and "hot spots" is co-financed by the EPEEF according to its work programme. The amount of 162 million kunas to be allocated by the EPEEF for rehabilitation of hazardous waste landfill sites will be apportioned according to the amount of pollution and harmfulness of impacts on the environment and human health. However, the costs of hazardous waste disposal at the locations mentioned exceed those planned and therefore additional funds will be required, most likely from loans. Remediation of hot spots will be financed by European structural and cohesion funds.

The exact amounts of additional funds needed for the remediation of five priority locations (the Sovjak pit near Rijeka, Lemić brdo near Karlovac, the landfill in Mravinačka kava in Solin, the surroundings of the "Salonit" plant in Vranjic and the slag landfill in the Kaštela Bay, the site of the former electrodes and ferroalloys plant in Šibenik) will be known upon completion of the development of remediation programmes, currently in progress, which include:

- the analysis of environmental pollution type and the analysis and summary of all current analyses;
- proposed production and other solutions including the eligibility assessment of the solution selected in relation to long-term effects on the environment (among several technologies offered only one is to be proposed);
- determination of environmental soundness of the activities;
- an overview of former site investigations and the conduct of additional site investigations, if required;
- measures for the establishment of original environmental quality or improvement of the existing state of the environment (including a cost-benefit analysis);
- the sequence and time frame for implementation of the rehabilitation programme including a detailed cost estimate;
- a plan for the provision of funds, including costs of the compensation for environmental decline and degradation, and
- prepared competition documentation for execution of works.

Upon completion of these programmes the preparation of remediation programmes for other "hot spots" will be initiated.

6.3. ESTIMATE OF FINANCE NEEDED FOR THE CONSTRUCTION OF WMCs AND ESTABLISHMENT OF A NON-HAZARDOUS (MUNICIPAL AND INDUSTRIAL) WASTE MANAGEMENT SYSTEM

For the purpose of this Plan an estimate was made of the finance needed for the construction of WMCs and establishment of a non-hazardous (municipal and industrial) waste treatment system under the county and the regional concept.

6.3.1. Baseline

The amounts of **municipal waste** used for the investment estimate and comparative analysis of the county and the regional concept arise from the projection that forms an integral part of this Plan. On the basis of estimated amounts of municipal waste to be treated in a WMC in 2010 capacities were determined for all WMC components associated with municipal waste and its disposal.

Amounts of municipal waste to be treated and amounts of refuse-derived fuel (RDF) after treatment, as estimated under the county and the regional concept, are shown in Tables 21 and 22. Based on the presented data estimates were made of the volume of landfills for non-hazardous waste in all county and regional WMCs respectively. The landfill volume affected directly the investment costs of mobile equipment for non-hazardous waste landfills. Given the accuracy of input estimates, the results obtained may be used as framework planning values.

The estimate of construction waste amounts was based on inputs from the LIFE project 04 TCY/CRO/00014 Draft Plan for Construction Waste Management in the Republic of Croatia, College of Civil Engineering, Zagreb 2006. Given the fact that the majority of wastes may be recycled during construction waste treatment, the estimate of waste amounts is more important for defining the treatment plant capacities than for its disposal. As other sources and inert waste amounts are unknown, in-coming amounts for planning inert waste landfills cover only construction waste that cannot be used after treatment and must therefore be landfilled. For the purpose of estimates within the framework of this analysis it was assumed that after treatment 3 per cent of the total amount of construction waste treated has to be landfilled.

TABLE 21: Estimated amounts of municipal waste to be treated and amounts of refuse-derived fuel under the county concept

County	Amounts of municipal waste to be treated [t/y]	Amounts of refuse-derived fuel (RDF) [t/y]
Krapina-Zagorje	32,000	11,000
Sisak-Moslavina	59,000	21,000
Karlovac	39,000	14,000
Varaždin	42,000	15,000
Koprivnica-Križevci	28,000	10,000
Bjelovar- Bilogora	38,000	14,000
Primorje-Gorski Kotar	121,000	43,000

Lika-Senj	18,000	7,000
Virovitica-Podravina	28,000	10,000
Požega-Slavonia	26,000	9,000
Slavonski Brod-Posavina	52,000	19,000
Zadar	72,000	26,000
Osijek-Baranja	119,000	43,000
Šibenik-Knin	39,000	14,000
Vukovar-Srijem	44,000	16,000
Split-Dalmatia	161,000	58,000
Istria	104,000	37,000
Dubrovnik-Neretva	45,000	16,000
Međimurje	26,000	10,000
City of Zagreb	410,000	/
TOTAL	**1,502,000**	**393,000**

TABLE 22: Estimated amounts of municipal waste to be treated and amounts of refuse-derived fuel under the regional concept

County	Amounts of municipal waste to be treated [t/y]	Amounts of refuse-derived fuel (RDF) [t/y]
Sisak-Moslavina	59,000	21,000
Šibenik-Knin	39,000	14,000
Split-Dalmatia	161,000	58,000
Istria	104,000	37,000
Dubrovnik-Neretva	45,000	16,000
Karlovac	47,000	17,000
35% Lika-Senj		
Koprivnica-Križevci	127,000	45,000
Krapina-Zagorje		
Varaždin		
Međimurje		
Primorje-Gorski Kotar	124,000	45,000
15% Lika-Senj		
Slavonski Brod-Posavina	78,000	28,000
Požega-Slavonia		
Zadar	78,000	29,000
50% Lika-Senj		
Osijek-Baranja	163,000	59,000

Vukovar-Srijem		
Virovitica-Podravina	67,000	24,000
Bjelovar-Bilogora		
City of Zagreb – County of Zagreb	410,000	/
TOTAL	1,502,000	393,000

6.3.2. Selecting the technology to estimate costs of the municipal waste management system

In the context of this Plan the MBT technology has been selected to estimate costs of the municipal waste management as a technology of municipal waste treatment most often planned and proposed in draft waste management plans of the counties.

The technology underlying the estimate of costs of setting up the system is based on the MBT technology with a bioreactor landfill, where the RDF is separated at the stage of mechanical treatment. The anaerobic treatment of biodegradable municipal waste treated (dried and partly stabilized) takes place in a so-called bioreactor landfill. A bioreactor landfill must be designed in such a manner as to meet all the requirements for a non-hazardous waste landfill in conformity with a special regulation. During the process of filling a bioreactor landfill, no methanogenic decomposition occurs. Instead, it is activated purposefully through the addition of liquid when the landfill has been filled up and the sealing layer and the accompanying infrastructure for capturing gas have been constructed. The average duration of biogas exploitation is five years, after which the organic matter from the waste is completely decomposed and remains in the landfill. The final result is a complete energy recovery of wastes and considerable reduction in the space needed for the final disposal.

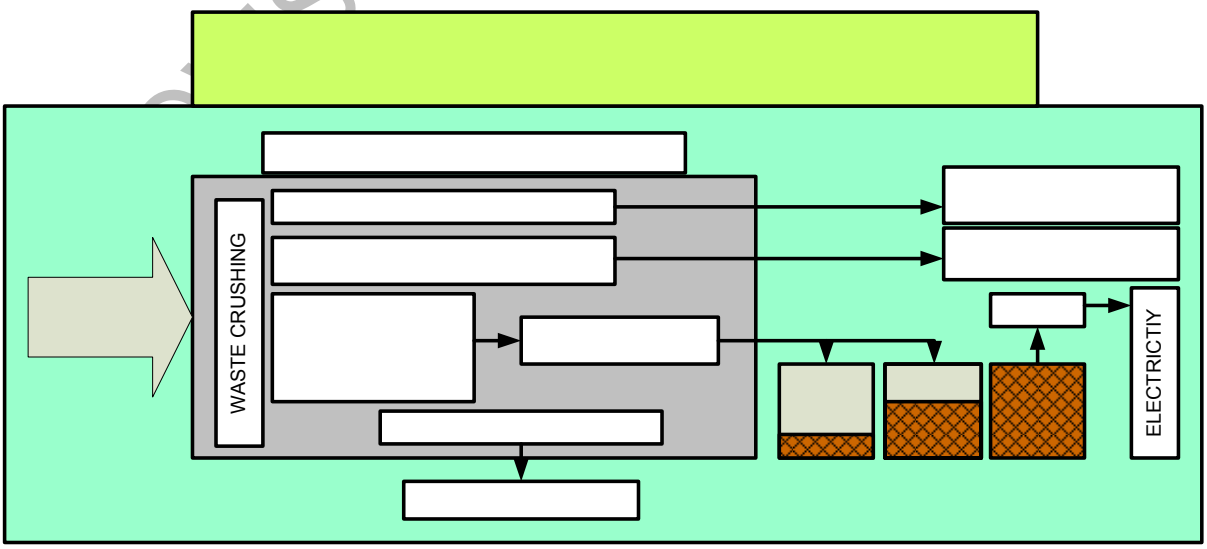


FIGURE 25: MBT and a bioreactor landfill

The MBT technology including a bioreactor landfill was used because of:

- 20-30% waste residues in the landfill;
- production of a high calorific RDF suitable for use in cement kilns;
- electricity generation from biodegradable treatment residues, and
- investment and treatment costs ratio.

This technology served as a basis to make a cost estimate for all counties so as to be able to compare the proposed municipal waste management concepts.

Given the large amount of data, the analysis was carried out statistically, taking no account of the time factor (phased investments), loan factors and similar. Given the scope of data and inputs used in making this estimate it is recommended to use the resulting estimate for planning purposes only.

To compute approximately correct amounts of total investments needed for setting up the system a standard centre was used (item no. 1.9 in Table 23), as well as for the estimate of costs of purchasing the mobile equipment needed for the landfill operation (item nos. 10,12 and 14 in Table 23). The calculation of the total investment was based on the MBT technology with energy recovers (bioreactor landfill). Several modules of diverse capacities, combined in accordance with estimated waste amounts, were used to make a cost estimate for the construction of a bioreactor landfill and a non-hazardous and inert waste landfill. In this calculation the costs of land and infrastructure beyond the WMC site were disregarded. Costs taken into account when making this estimate are shown in Table 23.

TABLE 23: Overview of costs of a WMC construction and setting up a non-hazardous (municipal and industrial) waste management system for the purpose of the investment estimate

1.	Costs of preliminary works (preliminary works, internal utility infrastructure, preparatory and excavation works)
2.	Costs of constructing internal road infrastructure
3.	Costs of constructing an entry/exit zone and a fence
4.	Costs of constructing a fence and an internal green zone
5.	Costs of constructing a temporary storage zone
6.	Costs of constructing a gas pumping station equipped with a flare
7.	Costs of constructing a leachate pre-treatment plant
8.	Costs of purchasing and mounting the equipment and monitoring costs
9.	Costs of constructing a bioreactor landfill
10.	Costs of purchasing the mobile equipment needed for the bioreactor landfill (machinery required for landfill maintenance)
11.	Costs of constructing a non-hazardous waste landfill
12.	Costs of purchasing the mobile equipment needed for the non-hazardous waste landfill (machinery required for landfill maintenance)
13.	Costs of constructing an inert waste landfill
14.	Costs of purchasing the mobile equipment needed for the inert waste management (crusher for construction waste)
15.	Costs of purchasing a MBT technology including energy recovery
16.	Transfer station

Tables 24 and 25 show the costs of constructing a WMC and setting up a non-hazardous (municipal and industrial) waste management system for each county according to the county concept and for counties and regions in accordance with the regional concept.

Table 24: Investment costs of constructing a WMC and setting up a system under the county concept

County	Investment cost of constructing a WMC and setting up the system [€]
Krapina-Zagorje	13,000,000
Sisak-Moslavina	21,000,000
Karlovac	16,000,000
Varaždin	14,000,000
Koprivnica-Križevci	15,000,000
Bjelovar-Bilogora	15,000,000
Primorje-Gorski Kotar	35,000,000
Lika-Senj	13,000,000
Virovitica-Podravina	14,000,000
Požega-Slavonia	13,000,000
Slavonski Brod-Posavina	16,000,000
Zadar	26,000,000
Osijek-Baranja	34,000,000
Šibenik-Knin	16,000,000
Vukovar-Srijem	16,000,000
Split-Dalmatia	40,000,000
Istria	30,000,000
Dubrovnik-Neretva	18,000,000
Međimurje	13,000,000
City of Zagreb County of Zagreb (no PTOO)	19,000,000
TOTAL	397,000,000

Table 25: Investment costs of constructing a WMC and setting up a system under the regional concept

County	Investment cost of constructing a WMC and setting up the system [€]
Sisak-Moslavina	21,000,000
Šibenik-Knin	16,000,000
Split-Dalmatia	40,000,000
Istria	30,000,000
Dubrovnik-Neretva	18,000,000
Karlovac	19,000,000
35% Lika-Senj	
Koprivnica-Križevci	37,000,000
Krapina-Zagorje	
Varaždin	
Međimurje	
Primorje-Gorski Kotar	35,000,000
15% Lika-Senj	
Slavonski Brod-Posavina	25,000,000
Požega-Slavonia	
Zadar	29,000,000
50% Lika-Senj	
Osijek-Baranja	40,000,000
Vukovar-Srijem	
Virovitica-Podravina	21,000,000
Bjelovar-Bilogora	
City of Zagreb County of Zagreb (no PTOO)	19,000,000
TOTAL	350,000,000

From Tables 24 and 25 it is evident that costs of constructing a WMC and setting up a system are lower under the regional than under the county concept. Similarly, the regional concept foresees a lower investment in utility infrastructure (access road construction) which was disregarded when making this estimate.

6.4. PRELIMINARY WORKS FOR CONSTRUCTION AND SETTING UP A SYSTEM

6.4.1. Co-funding Conditions

Up to 60 per cent of costs involved in preparing the design and technical documentation, conducting investigations on the WMC site and preparing the co-funding application documents will be co-funded from the EPEEF in the following manner:

A) Location permit documentation:
- conceptual design
- site investigations (for one site only)
- environmental impact study and
- location permit study;

B) Documentation for preparation of applications to the EPEEF and EU funds:
- Pre-feasibility Study and investment plan;

C) Documentation for applications to the EPEEF and EU funds:
- Feasibility Study
- Cost-benefit Analysis
- technical documentation for application (general design summary, EIS summary, other technical documents) and
- application form including all attachments (in Croatian/English);

D) Building permit documentation;
E) Tender documents (FIDIC, yellow book) for public bidding.

The documentation under C) and E) shall be prepared in English, if the project is selected for EU co-funding on the basis of documentation under B). If on the basis of documentation under B) the co-funding will be provided by the EPEEF, the rest of the documents shall be prepared in Croatian only.

A special co-funding application form shall be used to apply for co-funding from the EPEEF, and forms determined by the European Commission shall be used when applying for EU co-funding.

6.4.2. Co-funding Time Frame

Co-funding of costs of preliminary works will be provided to the counties according to the following time frame:

- The funds under A) Location permit documentation will be provided after:
  - definition of the WMC site by the physical plan;
  - establishment or selection of a county company responsible for waste management;
  - conclusion of an agreement between the county and all towns and municipalities on the joint establishment and use of the future CWMC, or
  - conclusion of an intercounty agreement (including all towns and municipalities) on the establishment of a RWMC;

- The funds under B) Pre-feasibility study and investment plan will be provided after:
  - adoption of the EIS and approval (revision) of the conceptual design;

- The funds under C) Co-funding application will be provided after:
  - adoption and approval of the pre-feasibility study and the investment plan;

- The funds under D) Building permit documentation will be provided after:
  - obtainment of the location permit,
  - selection of a private partner for a future PPP and
  - adoption and approval of co-funding;

- The funds under E) Tender documents will be provided after:
  - approval (revision) of the design submitted for the building permit.

6.5. CO-FUNDING STRATEGY FOR THE WMC CONSTRUCTION AND SETTING UP THE SYSTEM

According to the estimated cost of investment, the setting up a waste management system under the county concept requires the amount of 397,000,000 € and with the regional concept the value is lower and amounts to some 350,000,000 €.

A more realistic cost estimate for setting up the system will be only available upon adoption of waste management plans for the counties and the City of Zagreb, i.e. after the counties will have selected a waste management concept (CWMC/RWMC) and the technology of waste treatment prior to final disposal.

In order to set up the total system it is necessary to define strategically how specific system components will be funded.

In the following the term **public funds** means financial resources provided by the funds (EPEEF and EU pre-accession funds), the budgets of local and regional self-government units and bank loans.

Private funds will mean the monies invested by the private sector by means of a PPP model.

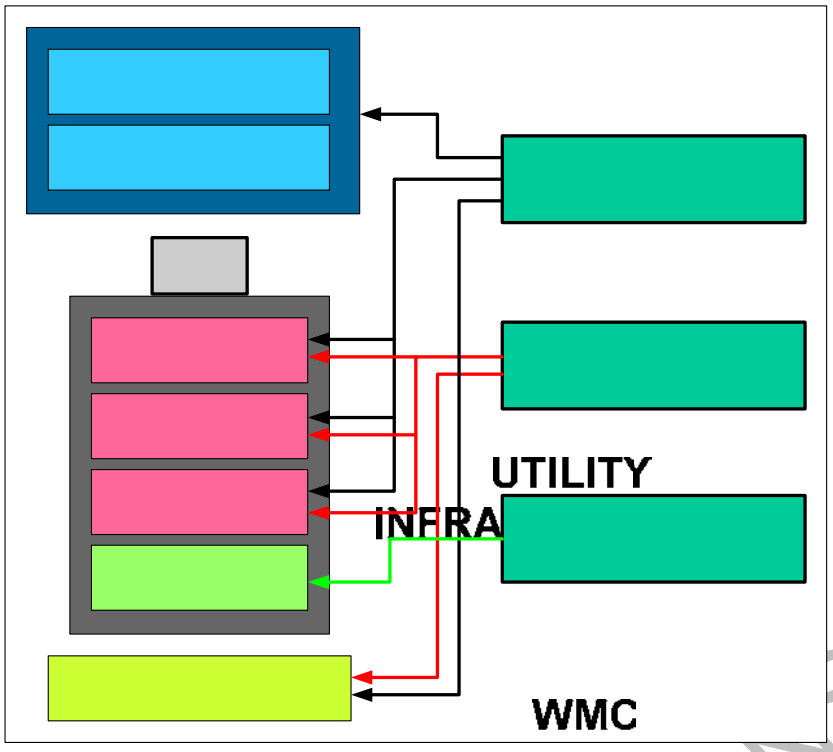


FIGURE 26: Schematic presentation of financing a WMC construction and setting up the non-hazardous (municipal and industrial) waste management system

The co-funding strategy foresees that private funds will be used to finance a waste treatment plant of a WMC on the PPP model. Public funds will be used for co-funding the construction of a WMC and setting up the system (landfills, wastewater treatment, installations, internal infrastructure, other equipment and TSs excluding a waste treatment plant (MBT).

Public funds provided by the local/regional self-government will be used for funding:

- purchase (making available) of the land for a future WMC, construction of utility infrastructure (access roads, water supply and discharge system, electricity) up to the future WMC.

The necessary co-funding for the construction of the municipal waste management system at county/regional levels will be provided in such a manner that 80 per cent of investments in the public component (WMC without MBT) will be covered by EPEEF and IPA and the remaining 20 per cent of the investment from local/regional self-government budgets.

The co-funding includes:

- construction of WMCs (without MBT and generation of electricity from biogas) and
- construction of TSs (number of TSs required by the region/county).

Future WMCs are equally entitled to co-funding regardless of whether the EU or domestic funds or both are used.

Once set up, the waste management system shall be financially self-sustainable, which means capable of covering operating costs during the landfill operation and costs of further construction, landfill closure and post-closure maintenance.

The following Tables 26 and 27 show the breakdown of estimated costs of the construction of WMCs and setting up the system under the county and regional concept.

TABLE 26: Breakdown of estimated costs of the construction of WMCs and setting up the system under the county concept

County	Investment in treatment plant (MBT) [Euro]	Landfills and infrastructure [Euro]	Transfer stations	System set-up costs *[Euro]*
	WMC		TS	CGO+PS
Krapina-Zagorje	7,000,000	5,000,000	1,000,000	13,000,000
Sisak-Moslavina	10,000,000	6,000,000	5,000,000	21,000,000
Karlovac	8,000,000	5,000,000	3,000,000	16,000,000
Varaždin	8,000,000	5,000,000	1,000,000	14,000,000
Koprivnica-Križevci	7,000,000	6,000,000	2,000,000	15,000,000
Bjelovar-Bilogora	8,000,000	5,000,000	2,000,000	15,000,000
Primorje-Gorski Kotar	18,000,000	11,000,000	6,000,000	35,000,000
Lika-Senj	6,000,000	5,000,000	2,000,000	13,000,000
Virovitica-Podravina	7,000,000	5,000,000	2,000,000	14,000,000
Požega-Slavonia	7,000,000	5,000,000	1,000,000	13,000,000
Slavonski Brod-Posavina	9,000,000	5,000,000	2,000,000	16,000,000
Zadar	15,000,000	6,000,000	5,000,000	26,000,000
Osijek-Baranja	18,000,000	10,000,000	6,000,000	34,000,000
Šibenik-Knin	8,000,000	5,000,000	3,000,000	16,000,000
Vukovar-Srijem	8,000,000	5,000,000	3,000,000	16,000,000
Split-Dalmatia	21,000,000	11,000,000	7,000,000	40,000,000
Istria	18,000,000	8,000,000	6,000,000	30,000,000
Dubrovnik-Neretva	8,000,000	5,000,000	5,000,000	18,000,000
Međimurje	7,000,000	6,000,000	0	13,000,000
City of Zagreb County of Zagreb (no TTP)	/	12,000,000		19,000,000
Total	198,000,000	131,000,000	68,000,000	397,000,000
Sources of funds	PRIVATE	PUBLIC (Funds 80%: 20% local self-government units)		

Table 27: Breakdown of estimated costs of the construction of WMCs and setting up the system under the regional concept

County	Investment in treatment plant (MBT) [Euro]	Landfills and infrastructure [Euro]	Transfer stations	System set-up costs *[Euro]*
	WMC		TS	WMC+TS
Sisak-Moslavina	10,000,000	6,000,000	5,000,000	21,000,000
Šibenik-Knin	8,000,000	5,000,000	3,000,000	16,000,000
Split-Dalmatia	21,000,000	11,000,000	8,000,000	40,000,000
Istria	18,000,000	8,000,000	4,000,000	30,000,000
Dubrovnik-Neretva	8,000,000	5,000,000	5,000,000	18,000,000
Karlovac 35% Lika-Senj	9,000,000	6,000,000	4,000,000	19,000,000
Koprivnica-Križevci Krapina-Zagorje Varaždin Međimurje	18,000,000	12,000,000	7,000,000	37,000,000
Primorje-Gorski Kotar 15% Lika-Senj	18,000,000	11,000,000	6,000,000	35,000,000
Slavonski Brod-Posavina Požega-Slavonia	15,000,000	7,000,000	3,000,000	25,000,000
Zadar 50% Lika-Senj	15,000,000	7,000,000	7,000,000	29,000,000
Osijek-Baranja Vukovar-Srijem	21,000,000	12,000,000	7,000,000	40,000,000
Virovitica-Podravina Bjelovar-Bilogora	10,000,000	7,000,000	4,000,000	21,000,000
City ofZagreb County of Zagreb (no PTOO)	/	12,000,000	/	19,000,000
TOTAL	171,000,000	109,000,000	70,000,000	350,000,000
Sources of funds	PRIVATE	PUBLIC (Funds 80%: 20% local self-government units)		

6.6. SYSTEM MANAGEMENT

The system will be managed on a PPP model. The county will, in agreement with the towns/municipalities covered by the system, establish a county public utility company (CPUC) fully publicly owned. The CPUC will finance the construction of a WMC from local/regional self-government budgets and funds. The company enters into a PPP agreement with a private partner (PP) for investing into the WMC and management. Supervision over execution of the agreement entered into is exercised by the county.

The CPUC will be in charge of the WCM construction until establishment of the system; it will manage the waste management system for the entire county/region, co-ordinate activities of local (town) public utility companies and organize transportation of waste from the TS to the WMC. A PP secures finance for the construction of a municipal waste treatment plant (MBT) and after construction manages the WMC for a period of time as agreed (10-15 years). In addition to management, the PP is obliged to finance further WMC construction from the revenues earned.

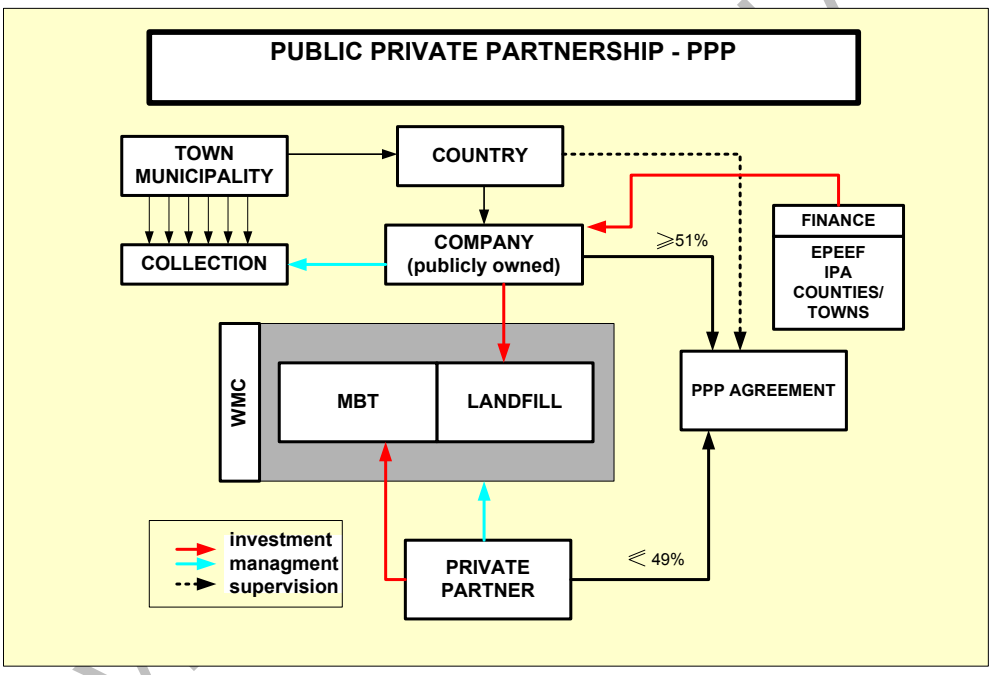


FIGURE 27: Public private partnership (PPP)

6.7. COSTS AND PROCEEDS

According to this Plan the calculation of costs should include all the costs involved in waste disposal (capital and operating costs), which means the costs relating to all stages from the WMC construction, collection, prevention, education, transport, pretreatment, treatment and final disposal to after-closure costs. The calculation should also include proceeds collected from the sale of secondary raw materials and energy generated by waste treatment.

These proceeds and costs serve as a basis for calculation of waste disposal charges per tonne of the waste collected. The charge will also include the cost of an annuity determined by a

special regulation. The annuity will be paid as compensation to owners for the loss of value of their real estate located in the vicinity of the landfill.

The foreseeable waste disposal charges for each county that will ensure self-sustainable operation of the WCM is to be determined through preparation of design documents, the cost-and-benefit analysis and the feasibility study. These charges will be subject to revision so as to avoid losses or excessive profit. The charges must include operating costs and raising the funds for capital construction of new WMCs and after-closure maintenance of old WMCs.

The aim is to keep the waste disposal charges at a level not exceeding 3 per cent of the total household income. When formulating waste management plans, the counties and the City of Zagreb will determine the waste disposal charges for the relevant county/region which will be reviewed on a yearly basis.

6.7.1. CALCULATION OF WASTE DISPOSAL CHARGES

6.7.1.1. Municipal waste

A total waste disposal charge (TWDC) is an amount payable by households for the disposal of municipal waste to public utility companies that provide the service of waste collection. This charge includes the collection, transport, treatment and deposition of wastes, monitoring, closure, maintaining and after-closure monitoring of landfills and a legally prescribed annuity (up to 30 per cent of the treatment charge). The TWDC includes the charge payable to the operator, when entering a WMC, for waste disposal and waste management costs covered by the county public utility company, as demonstrated in Figure 28. The charge is calculated on the basis of a 20-year lifecycle of a WMC. The TWDC is reviewed and corrected, if required, by the local-self government unit on a yearly basis.

The WMC construction concept arising from this Plan is based on principles of public and private investments in the construction, which must be taken into consideration when calculating the waste disposal charges. The TWDC must cover all WMC operating, maintenance, further extending and investment costs, bearing in mind that a segment of investments is provided in form of grants.

Account should be taken of the following:

- For investments in WMC infrastructure and equipment, in case of a landfill with a 5-year capacity for deposition of pre-treated wastes, public funds will be used, of which grants account for 80-100 per cent and reduce accordingly the TWDC;
- Further landfill construction works (phased; cells designed for up to 5 years each) for a landfill area sufficient for 20-25 years of operation will be financed by proceeds collected from waste disposal, i.e. they are included in the TWDC;
- A waste treatment plant (MBT) will be financed by private capital and the payback is included in the TWDC;
- Installation of additional equipment (e.g. for electricity generation - gas engines and power generator) is financed by proceeds collected from waste disposal and included in the TWDC;
- All operating, overhead and administrative costs of a WMC and wastewater treatment costs are included in the TWDC;

- All waste disposal system costs at the county/regional level, the management of the system of waste collection and transfer from TS to WMCs, including average transportation costs for all parts of the relevant county, are also included in the TWDC; and
- Transportation costs from the waste collection point (town, island, municipality or TS) are uniform for all towns and municipalities regardless of the distance from a WMC.

From the above it follows that the TWDC collected from households is reduced by the share of grants, proceeds from the sale of secondary raw materials, proceeds collected from deposition and treatment of inert and non-hazardous industrial waste and proceeds collected from generation of electricity from biogas calculated as an amount per tonne of waste.

Estimated WMC construction costs serve as a basis for calculation of a TWDC which will be exactly determine by each county taking into account the selected municipal waste treatment technology.

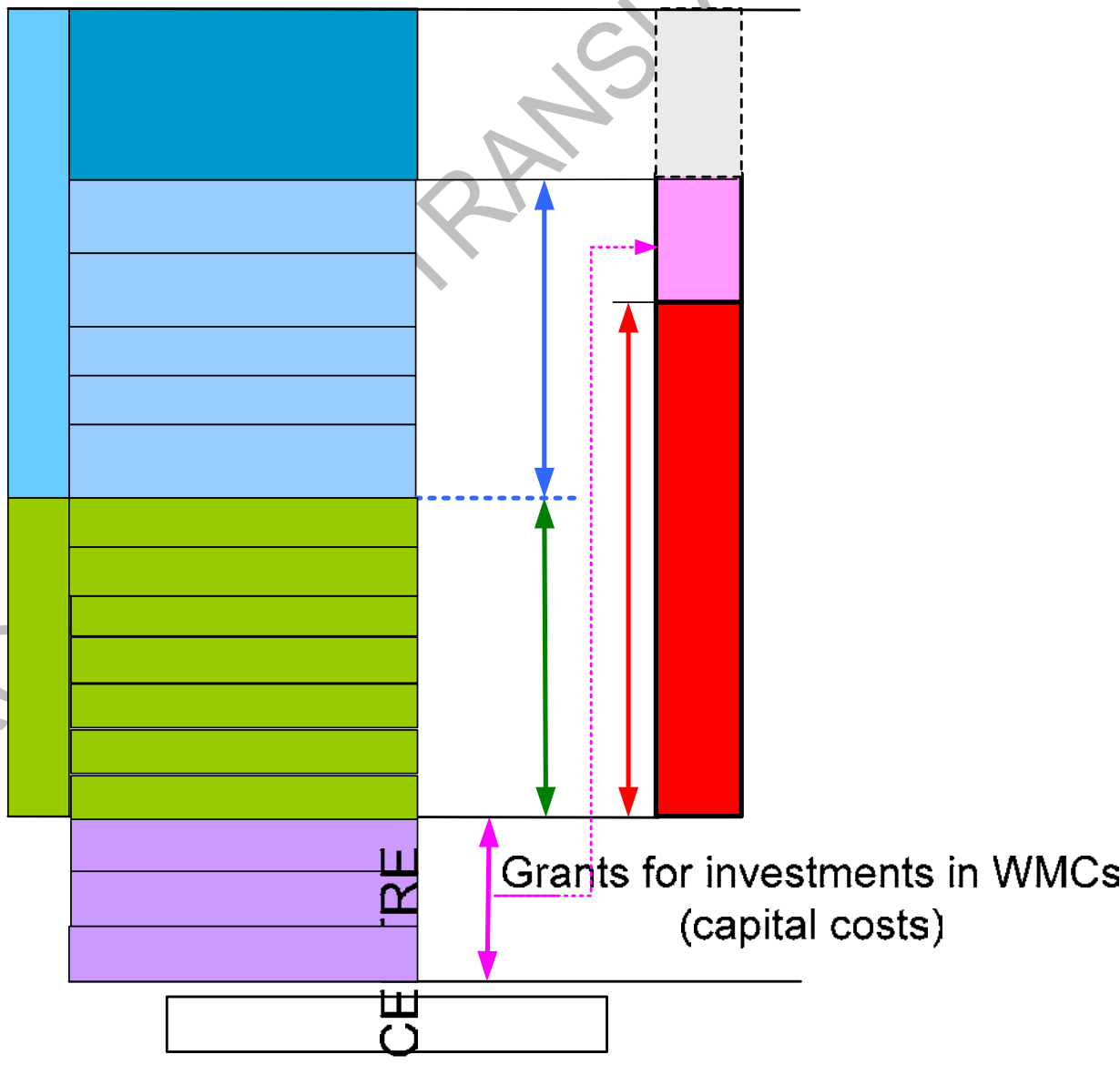


FIGURE 28: Municipal waste disposal charge

The establishment of a WMC construction concept according to this Plan, based on the principles of public and private investments in construction of the system, will make it possible to reduce the final waste disposal charge payable by households.

The charge for the disposal of other types of non-hazardous and inert waste partly treated and deposited to landfills inside a WMC will be determined under special commercial conditions. This charge is payable by business entities and is not reduced as a result of WMCs being co-financed by funds, but the proceeds collected are included when calculating the reduction of the final municipal waste disposal charge payable by households.

6.7.1.2. Construction waste

The construction waste disposal charge will depend on the type of waste, whether it is sorted and whether it contains other types of waste, which will indirectly encourage separation by waste types, reduction of waste amounts and sorting of waste according to the best practices and EU directives.

The foreseeable fee for the acceptance of construction waste to optimized recycling plants (exclusive of transport costs) in Croatia will range from 5-15 €/t, whereby this amount will be adjusted relative to the success of the sale of recycled aggregate in terms of quantity and quality. For these reasons it is recommended that, when deciding on the financing system, management and investments are left to the private sector (selection of a concession, a PPP or similar model) that will apply market principles in searching for optimum ways of selling the recyclate.

7. ACTION PLAN AND PLAN IMPLEMENTATION PROGRAMME FOR THE PERIOD 2007-2015

Actions	Goals	Source of funds	Respon-sible	Time schedule								
IDENTIFICATION OF ACTUAL AMOUNTS OF HAZARDOUS, NON-HAZARDOUS AND INERT WASTE				2007	2008	2009	2010	2011	2012	2013	2014	2015
Modification of regulations on notification of generation and flow of all types of waste	Establishment of a more efficient control and records on waste generation and flows Obtainment of realistic data on waste types and amounts Establishment of a reliable information system in compliance with EU requirements and standards Coverage of all entities liable to the EEC	GB[i], EUPAF[ii]	MEPPPC[iii] CEA[iv] GO[v], CC[vi], CCT[vii] EEC[viii]									
Determination of data collection methodology												
Institutional strengthening of government bodies responsible for waste management												
Improvement/development of waste information system (introduction of data quality control)												
Preparation of list of all entities liable to report the EEC for hazardous, non-hazardous and inert waste												
Education of the staff of government offices												
Education of business entities that produce hazardous waste												
Inclusion of unregistered business entities into the waste management information system												
Inspection control of potential entities liable to the EEC (waste producers)												

PREVENTION AND MINIMIZATION OF HAZARDOUS, NON-HAZARDOUS AND INERT WASTE				2007	2008	2009	2010	2011	2012	2013	2014	2015
Preparation and implementation of action plan for education and promotion of waste prevention and minimization options for all stakeholders – non-governmental organizations, public, economy sector	Provision of conditions for avoidance of generation and minimization of waste at the source of generation	GB, II[ix] ES[x] EUPAF	MEPPPC EPEEF[xi] CCPC[xii] ES									
Development of an information system to make all relevant technical information available to all stakeholders and encourage them to cleaner production	Reduction of hazardous waste risks											
Identification of industry producing most non-hazardous/hazardous waste and/or applying the worst non-hazardous waste management practices	Minimization of waste that is to be treated											
Preparation of instructions/guidelines for application of cleaner production by branches of industry/business activities	Pro-active approach to application of cleaner production											
Subsidizing and financing projects of cleaner production, waste recycling and recovery												
Transposition and application of the Directive on Integrated Prevention and Pollution Control (IPPC)												
Remediation of hot spots and landfills												

ESTABLISHMENT OF A SUSTAINABLE NON-HAZARDOUS AND INERT WASTE MANAGEMENT SYSTEM				2007	2008	2009	2010	2011	2012	2013	2014	2015
Determination of capacities and methods of collecting hazardous, non-hazardous and inert waste	Identification of locations for TSs, WMCs, HWMCs and hazardous waste storages Establishment of a sustainable system for waste collection, transport, storage, treatment and disposal Provision of conditions for management of all types of waste Harmonization of physical planning documents Construction of TSs, WMCs, HWMCs and hazardous waste storages Minimization of the share of biodegradable waste in municipal waste deposited to landfills Reduction of environmental emissions Preservation of human health	EPEEF PF[xiii] C/M/TB[xiv] EUPAF	MEPPPC MC[xv] R/LSGU[xvi] PP[xvii]									
Determination of capacities and methods of transporting non-hazardous waste from a waste collector to a TS/WMC												
Development of guidelines and criteria for waste collectors, forwarders and companies managing TSs and WMCs												
Development of a programme for opening and closing of a RY including the establishment of a secondary raw material collection system												
Selection of WMC and TS locations												
Feasibility study for a CWMC												
Selection of the location for a CWMC, hazardous waste storage												
Adoption of county waste management plans												
Amendments to physical planning documents by inclusion of a TS and WMC network in the area of Croatia												
Preparation of design documents for construction of WMCs and TSs												
Preparation of design documents for construction of HWMCs												
Establishment or selection of CPUCs												
Conclusion of agreements between counties/regions and all towns and municipalities regarding joint establishment and use of a future WMC												

Public procurement procedure for execution of works on TSs and WMCs											
Execution of construction works (TS and WMC)											
Construction of HWMCs											
Installation of waste treatment equipment (WMC)											
Operation of TSs and WMCs											
EDUCATION AND PUBLIC INFORMATION				2007	2008	2009	2010	2011	2012	2013	2014	2015
Development of programmes for education of public and specific target groups in hazardous, non-hazardous and inert waste management	Institutional strengthening	GB, CMTB ES EUPAF	MEPPPC CEA EPEEF RLSGU NGO[xviii] GO									
Preparation of an action plan for communicating the planned construction activities to the public – targeted information	Harmonization and consolidation of waste management issues											
Preparation of a programme for informing the public of the status regarding non-hazardous and inert waste management and the attainment of the goals established	Formulation of waste management policies											
Preparation of a programme for involving the population in local actions regarding establishment of a non-hazardous and inert waste management system	Supervision and control over implementation of individual activities of the Waste Management Plan of the Republic of Croatia											

INITIATION OF ACTIVITIES AND MONITORING OF NON-HAZARDOUS AND INERT WASTE MANAGEMENT PLAN			2007	2008	2009	2010	2011	2012	2013	2014	2015
Establishment of a waste management coordinating unit	Raising continuously the level of knowledge of administrative units and the public on sustainable management of hazardous waste	GB Government MEPPPC CEA GO, RLSGU									
Adoption of the work programme of the waste management coordinating unit	Continuous public information on hazardous waste management										
Report on implementation of the waste management plan	Harmonization with EU regulations										
Preparation of a national list of indicators (obligation imposed by the Environmental Protection Act)	Providing / facilitating access to information										
Definition of obligations and complying with requirements under international commitments – solve the issue of overlapping of competencies/activities of the CBS and CEA											
Complete compliance with EU requirements related to data (regulations, methodology)											
Development of a web service,…											

[i] Government budget
[ii] EU pre-accession funds
[iii] Ministry of Environmental Protection, Physical Planning and Construction
[iv] Croatian Environment Agency
[v] Government office
[vi] Chamber of Commerce
[vii] Chamber of Crafts and Trades
[viii] Environmental Emission Cadastre
[ix] International institutions
[x] Economy sector
[xi] Environmental Protection and Energy Efficiency Fund
[xii] Croatian Cleaner Production Centre
[xiii] Private funds
[xiv] County/municipal/town budget
[xv] Ministry of Culture
[xvi] Regional/local self-government units
[xvii] Private partners
[xviii] Non-governmental organizations

8. PUBLICATION OF THE WASTE MANAGEMENT PLAN OF THE REPUBLIC OF CROATIA

This Plan is published in the Official Gazette.

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Zagreb, 19 July 2007

Secretary:
Jagoda Premužić

Prime Minister:
Dr. Ivo Sanader

ABBREVIATIONS

CEA	Croatian Environmental Agency
CPUC	County public utility company
CWMC	County waste management centre
EE	Electric and electronic waste
EEC	Environmental Emission Cadastre
EPEEF	Environmental Protection and Energy Efficiency Fund
HWMC	Hazardous waste management centre
LSGU	Local self-government unit
MBT	Mechanical biological treatment
MEPPPC	Ministry of Environmental Protection, Physical Planning and
PP	Private partner
PPP	Public private partnership
RDF	Refuse-derived fuel
RSGU	Regional self-government unit
RWMC	Regional waste management centre
RY	Recycling yard
TS	Transfer station
TWDC	Total waste disposal charge
TWT	Thermal waste treatment
WMC	Waste management centre
WMIS	Waste management information system