MSc Program Environmental Technology & International Affairs

Implementation of the EC Landfill Directive in Croatia (with Emphasis on Municipal Solid Waste) Progress, Problems and Achievements

A Master's Thesis submitted for the degree of "Master of Science"

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"One man's trash is another man's treasure"
English proverb

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List of Abbreviations

AZO	Environmental Protection Agency of Croatia
COM	European Commission
DOC	dissolved organic carbon
EC	European Communities
EIA	environmental impact assessment
EPEEF	Environmental Protection and Energy Efficiency Fund
EU	European Union
EUR	Euro
IPA	Instrument for Pre-Accession
Kn	kuna (Croatian currency)
MBT	mechanical-biological treatment
MEPPPC	Ministry of Environmental Protection, Physical Planning and Construction of the Republic of Croatia
MS	Member States (of the EU)
MSW	municipal solid waste
OG	Official Gazette of the Republic of Croatia
PGZ	Primorje – Gorski Kotar County
RWMC	regional waste management centre
TOC	total organic carbon
WM	waste management
WMC	waste management centre

ABSTRACT

Croatia is a country in which waste material is predominantly landfilled. Almost all municipal solid waste ends up in landfills or dumping sites, while very little is recycled or recovered. In the past, the disposal of waste (landfilling) was not organized optimally and open dumping of waste was a common practice. With the goal of environmental and human protection in mind, one of the country's stated top priorities in the environmental domain is the reduction of waste input into the environment. Currently, Croatia is in the process of joining the EU, during which it has to adapt its legal regulations to those of the Union. Within the scope of the implementation of Chapter 27: Environment, the country has to align its legislation regarding landfilling with the Council Directive 99/31/EC on the Landfill of Waste.

Aware of the urgency of the problem, Croatia has done a lot to improve its landfilling situation in the last ten years. The start of the implementation of the Landfill Directive was a welcome new step in the process of achieving further environmental improvements. The country has transposed the said Directive into its own legislation in an exemplary way. However, the practical progress of carrying out provisions implemented on paper is lagging behind. Due to difficulties with the remediation of the existing waste management system and the set up of a completely new future one, it is uncertain whether the deadlines prescribed by law will be observed. This interdisciplinary thesis shows that very high investment costs for the establishment of the new system and the remediation of old legal and illegal landfills and dumps, in connection with delays due to problems connected with politics and public rejection of new landfill locations are the most important reasons for the practical steps lagging behind the legal ones.

I. INTRODUCTION

1. Background and Motivation

Waste management (WM) is the most pressing problem of environmental protection in Croatia, according to its National Strategy of Environmental Protection (*OG No. 46/02*). Not only is it the most important problem, but also one of the most difficult areas regarding the alignment of Croatian legislation with the standards of the European Union. In its Opinion ("avis") on Croatia's Application for Membership of the European Union (*COM(2004)257*), the European Commission stated the following:

> *"Waste management is the single biggest problem in the environment sector in Croatia. Not only does the legislative framework need to be aligned with EU requirements and standards, but existing Croatian regulations are not yet being implemented. (…) This sector poses a major challenge for Croatia and will require major efforts to align with the acquis."*

As a candidate country to the European Union[1], the Republic of Croatia needs to transpose and implement the so-called *acquis communautaire*, or the total body of EU's legislation. The legislation to be transposed is divided into 33 Chapters, comprising all the necessary sectors. When all chapters have been negotiated and closed, Croatia will be able to become an EU member. According to present projections, Croatia has the prospect of joining the EU in 2011 at the earliest, provided the ambitious aim of meeting all conditions is achieved by the end of 2009 (*European Parliament, 2008*). Waste management is integrated into Chapter 27: Environment, which comprises 200 major legal acts on various sectors of environmental protection (*Screening Report 27, 2007*), including the Council Directive on the Landfill of Waste (*1999/31/EC*), hereinafter Landfill Directive, which forms the research basis of this thesis.

As opposed to the most EU member states (MS), where waste is considered to be a strategic resource providing the possibility of material and energy recovery, Croatia is facing complex problems of WM that are a danger to human health and the environment. While the country is proud of having a beautiful landscape and nature, it has not yet completely solved the problems of illegal dumping sites or even

[1] Croatia was granted the candidate country status in 2004 and accession negotiations with the EU began in 2005.

existing legal landfills at which waste is often dumped in an uncontrolled manner. As the county is advancing economically and coming closer to Western European standards, waste quantities are rising, but the infrastructure that is supposed to manage this waste is far from sufficient. Also, there is only limited recycling activity, data on waste flows and quantities are still not completely reliable and administrative capacities are weak. One of the reasons for the system not working properly is the fact that legal acts are not being carried out fully. The government is, however, aware of the problem, as can be seen from the 2005 Strategy on Waste Management (*OG No. 130/05*), hereinafter the Strategy. The document urges for actions to be taken if one wants to alleviate the problem becoming even more serious. The present unorganized WM system has negative implications on environmental parameters like water – especially ground water, air, the sea and soil, as well as on climate, human health and animals. As the Strategy accurately points out, the solution of the waste problem is not only important for the life quality of Croatian citizens, the success of Croatia as a tourist resort and its reputation regarding environmental protection, but also for the negotiation talks surrounding the accession of the country to the EU.

Admittedly, Croatia has become aware of the problem of its WM system already some time ago. After the dissolution of Yugoslavia in 1991, when Croatia became an independent state, it inherited the Federation's old WM system, which was based on a mix of controlled and engineered dumping. With the aim of setting up new national legislation in this sector, it passed the first Waste Law in 1995 (*OG No. 34/95*) which already contained provisions common in European waste laws like the prevention of waste, material recovery or remediation of dump sites, to name a few. In 1996, the European Investment Bank issued the "Rijeka – Istria Region Solid Waste Study" (*Rambøll, 1996*), which already at that time introduced a completely new and modern WM structure for this region, and became an often cited source in later WM plans of the region's County government. However, the pre-accession process has put the requirement on Croatia to implement several new laws regarding WM that it has not had before. One of them is the Landfill Directive, a crucial document for a country relying almost exclusively on landfilling to take care of its waste. Thus, only two years ago, in 2007, Croatia passed its first law on landfilling, the Ordinance on the Methods and Conditions for the Landfill of Waste, Categories and Operational Requirements for Waste Landfills (*OG No. 117/07*), hereinafter Croatian Landfill Ordinance.

In order to limit the scope, this thesis will take municipal solid waste (MSW) management as its basis. While some other types of waste, most notably waste from agriculture, forestry and construction, make up much larger portions of the overall yearly quantities, MSW is a far more problematic waste type due to its diverse composition and contact with people's daily lives. Also, whilst there are many directives dealing with special types of waste, including hazardous waste, mining waste, electrical and electronic equipment, batteries and accumulators, there is none dealing specifically with MSW. However, the Landfill Directive refers particularly to this type of waste, since the final disposal and treatment of most other types is regulated in their respective regulations.

2. Research Aims and Questions

In view of the information given above, it is evident that Croatia is facing problems regarding its WM system based on landfilling, especially since it is a pressing issue to be worked out before the forthcoming EU accession. As the EC Progress Report of 2008 points out, a lot has been done to improve WM, but the process is not over (*COM(2008)674*). However, it is also important to note that the country has been aware of the problem for a longer time already.

This thesis analyses the transposition of the Landfill Directive into Croatian law, the progress of the ongoing implementation of the said Directive in practice, the problems encountered during the process, as well as the successes achieved so far and difficulties encountered. The aim of the thesis is to give tangible reasons behind these difficulties.

In order to be able to establish a starting point for this evaluation, past developments of Croatia's WM regarding landfilling practices will be explored. In the last ten years, Croatia has undertaken many actions to improve its WM, and the start of the implementation of the Landfill Directive was a welcome new step in the progress. This thesis will analyse whether the provisions implemented on paper have been carried out in practice and to which extent deadlines are being observed. As there seem to be delays and problems, the possible weak areas and reasons behind them will be explored. Questions of how good Croatia is doing and what more needs to be done to fulfil the EU requirements regarding landfilling and remediation of open dump sites will be looked at. In the end, the question of whether Croatia can be

regarded as a model pupil will be answered. Can its experiences serve as a lesson for other countries in the region which also aspire to join the EU and will very soon face the task of improving their landfilling situation.

3. Structure of the Thesis

In order to get a basis for further analyses, at first the legal framework will be described including a short introduction to the EU Legislation on Waste Management. The emphasis will be on the Landfill Directive and its recently passed Croatian counterpart. Croatia's legal framework on WM before and after the Landfill Directive will be discussed, with special emphasis being put on the new legislation and the provisions that will lead to a completely different WM system in the near future.

In the second part, the thesis will provide a perspective for future discussions by looking into what has been done in WM in Croatia in the past and what is the present starting point. To this end, basic data on Croatia, the quantities of waste, existing legal and illegal landfills and dumps, and the effectiveness of the waste system as a whole will be analysed – always putting the emphasis on MSW – with a concluding assessment of the overall situation.

In order to assess the practical side of the implementation of the Landfill Directive, a case study will be carried out to exemplify in greater detail past, present and prospective landfilling practices. Due to availability of data, the County of Primorje – Gorski Kotar, with the town of Rijeka as its centre, was selected for the case study. Several other features make this County especially suitable: the region's ground water and nearby coast are under special stress from landfills due to the porous karstic terrain; Rijeka is an industrial town and the main Croatian harbour; and the region is among the richest parts of Croatia due to industry and extensive tourism in summer.

In a last step, a comprehensive evaluation of the implementation of the Landfill Directive will give answers to the research questions posed in the previous chapter. Conclusions will be drawn regarding the transposition of the Directive into Croatian law, the practical steps undertaken to implement the provisions and achieve progress in landfilling practices, the problem areas encountered and the reasons behind them as well as lessons from the case of Croatia.

II. RESEARCH METHODOLOGY

In general, it needs to be noted that material on WM in Croatia, and especially on landfilling, was found to be rather sparse, with the exception of legal texts. As regards English language documents, there was not very much to work with, with the exception of European Union legislation. The majority of material was found in the Croatian language, including laws, studies, reports, articles and analyses. Some crucial material, most notably studies carried out by independent institutions with proposals of future WM and landfill systems for Croatia, could only be obtained through contacts in the Croatian Ministry of Environment (MEPPPC).

1. Legislation Side

In order to assess the transposition of the 1999 Council Directive on the Landfill of Waste into Croatian law, primary documents will be used, of which the Landfill Directive and its Croatian counterpart, the 2007 Croatian Landfill Ordinance, are most decisive for this thesis. Furthermore, in order to gain a comprehensive insight into WM legislation, the most important laws on both sides will be looked at, without going into too much detail. This includes the respective Waste Laws, as umbrella laws governing WM. In addition, greater importance will be given to the implementation of the Waste Law in Croatian national regulations, which have a vertical structure, starting from the Waste Management Strategy and going down to regional Plans providing a detailed framework for the establishment of the new WM system of the country. Throughout this comparative approach, emphasis will be placed on landfilling of municipal solid waste. All the legal acts are easily accessible via internet pages of the Official Journal of the EU and Croatia respectively.

2. Practical Side with Case Study

The practical side of the Thesis is divided into the assessment of the past and present WM structure of Croatia and the exemplifying case study. For the description of the overall WM system of the county, those chapters of the Strategy and the National Waste Management Plan (hereinafter the Plan) referring to the landfill of waste, especially MSW, will be consulted. In addition, web pages such as those of the Ministry of Environment, the Agency of Environmental Protection and

the Environmental Protection and Energy Efficiency Fund alongside newspaper articles, NGO reports and analyses will be used as references. Even though substantial information has been found on WM in Croatia, it needs to be noted that English documents and texts on the topic are rather sparse, while more material can be found in Croatian. As regards landfilling, literature could be found in specialized Croatian journals and from landfill operators.

For the case study on the Primorje – Gorski Kotar County two important and influential studies dealing with the WM system in the region and including data on waste types, quantities and costs could be obtained from the Croatian Ministry of Environment, one from 1996 and the other from 2006. They provided a very good basis of information. In addition, the county's regional Waste Management Plan for the period from 2007 – 2015 was used, as well as articles from specialist journals and newspapers, web pages of county authorities, public utility companies and landfill operators.

3. Analysis Side

For the analysis of the transposition of the Landfill Directive into Croatian law the progress and screening reports of the European Commission on the status of Croatian negotiations for EU membership will be of great help. However, the analysis will be done on the basis of findings from the chapters on the legal and practical side of this Thesis, while critically assessing additional reports and articles on the progress of the adjustment of the WM system to European standards.

III. THE LEGISLATIVE FRAMEWORK

This chapter gives an overview of EU and Croatian legislation regarding WM and, in particular, landfilling, while dealing with those laws and regulations necessary for this thesis. It provides the necessary basis for analysing the past and the present, but also the future WM system of Croatia, which will be aligned with EU's legal acts in this sector. Furthermore, the rather complicated vertical structure of existing Croatian laws and regulations is explained to the extent necessary for the scope of this thesis.

1. EU Legislation on Waste Management

The first law to be passed in the EC concerning waste and marking the beginning of everything that was to follow was the 1975 Directive on Waste (75/442/EEC). Until the 1970s, not much has been done regarding WM legislation, with the emphasis being, as basically everywhere else, on final waste disposal and not waste prevention or recycling. These approaches were to come later with concerns about sustainable development and resources. Another important step was the 1989 Community Strategy on Waste Management (*SEC/89/934*) which laid down some basic principles including the waste hierarchy with prevention and recycling/reuse on top, the cost-efficient use of BAT, basic standards on disposal sites, the "polluter-pays" principle etc. Otherwise, the 1980s were still marked by a focus on air pollution and emissions prevention. In the 1990s, sustainable development became an important concept and changed also the way of thinking regarding waste, which was reflected in the Fifth Environmental Action Programme. The present period (2002-2012) is covered by the Sixth Environmental Action Programme, which made WM one of the most important points, and introduced so-called "thematic strategies", of which waste prevention and recycling is a crucial one.[2]

The most important framework directive of the present EU waste legislation is the Waste Framework Directive[3] (*2006/12/EC*), which in Article 1 defines **waste** as

[2] Information retrieved from the *EC Environment* homepage.
[3] This Directive was revised and thus modernized and streamlined in its provisions in 2008 by Directive 2008/98/EC. The 2006 Waste Directive itself had codified (i.e. replaced) the old Waste Directive 75/442/EEC since the latter had so many amendments that it was more sensible to pass a new, comprehensive directive.

> *"any substance or object in the categories set out in Annex I which the holder discards or intends or is required to discard"*

Waste management is defined in as

> *"the collection, transport, recovery and disposal of waste, including the supervision of such operations and after-care of disposal sites"*

The Waste Directive also defines categories of waste in Annex I as well as excludes some types of waste from its scope in Article 2, like radioactive waste or waste waters. It obliges member states in Article 3 to encourage "prevention and reduction of waste production" by developing clean technologies that do not use natural resources excessively, to produce products that have the least possible impact on the environment, to recover waste by means of recycling and reuse, to use waste as a source of energy, etc.

Most importantly, the Waste Directive (*2006/12/EC*) makes evident the **goals of waste management**:

- protection of men and environment,
- minimization of greenhouse gas emissions,
- conservation of resources,
- protection of future generations,

and the **means** to achieve them:

- waste prevention,
- waste recycling,
- waste disposal,

which, in this order, represents the hierarchy of waste management[4].

A second set of legal acts comprises the EU legislation on waste operations and includes the Landfill Directive (*1999/31/EC*) as well as a directive on waste incineration. Furthermore, there is a category of legislation on specific waste streams including batteries, packaging waste, waste oils, etc.

It needs to be emphasized that waste legislation is strongly interlinked with several other legal acts in the domain of environmental protection, most notably the EIA Directive (85/337/EEC), the Directive on public access to environmental information (2003/4/EC), the Directive on ambient air quality assessment (96/62/EC), or the EU Water Framework Directive (2000/60/EC), among others. A state cannot properly

[4] However, as found by *Brunner et al.* (2006), this hierarchy cannot universally be applied. While it works for well developed countries, those that cannot invest a large enough share of GDP into waste management, shall prioritize the improvement of waste disposal so as to achieve the first goal of protecting human health.

implement waste legislation without implementing these other legal acts as they complement each other.

2. Council Directive on the Landfill of Waste

Council Directive *99/31/EC* of 26 April 1999 on the landfill of waste entered into force on 16 July of the same year and put the deadline for its transposition in the MS of the EU to two years after this date.

In Article 2 it defines a **landfill** as

> *"a waste disposal site for the deposit of the waste onto or into land (i.e. underground)".*

Article 1 refers to the necessity of meeting the requirements of the Waste Directive (75/442/EEC) and, to that purpose, gives the overall **objective**

> *"to prevent or reduce as far as possible negative effects on the environment, in particular the pollution of surface water, groundwater, soil and air, and on the global environment, including the greenhouse effect, as well as any resulting risk to human health, from landfilling of waste, during the whole life-cycle of the landfill"*

to by achieved by the introduction of "stringent operational and technical requirements on the waste and landfills". The directive's objective reflects the above mentioned goals of waste management.

Municipal waste is defined as

> *"waste from households, as well as other waste which, because of its nature or composition, is similar to waste from household"*

In Article 2, gives a description of four **waste categories**:

- municipal,
- hazardous,
- non-hazardous and
- inert waste

to be deposited on three **classes of landfills** (Article 4):

- landfills for hazardous waste,
- landfills for non-hazardous waste,
- landfills for inert waste.

Municipal solid waste is to be landfilled together with non-hazardous waste to landfills for non-hazardous waste.

However, the landfill also gives a list of actions excluded from its scope of application (Article 3(2)), including, among others, the spreading of (sewage) sludge, the use of inert waste for redevelopment in landfills or the deposit of unpolluted soil or non-hazardous inert waste from extraction of mineral resources or quarries. Furthermore, in Article 5(3), waste types **not accepted** in a landfill are given: liquid waste, flammable waste, explosive or oxidising waste, hospital and other infectious clinical waste, used tyres (with certain exceptions), and any other type of waste not meeting acceptance criteria laid down in Annex II.

In Article 6, the Landfill Directive defines the **conditions** under which waste can be accepted at a landfill, with the aim of avoiding risk:

- waste must have been subjected to treatment before being landfilled;
- hazardous waste that fulfils Annex II criteria must go to hazardous waste landfills;
- non-hazardous landfills are meant for use for municipal waste, non-hazardous waste and stable, non-reactive hazardous waste that has the same leaching[5] behaviour as non-hazardous waste;
- inert waste can only be deposited at landfills for inert waste.

In Article 7, the necessary application parameters for obtaining a permit for a landfill site are defined. Article 14 obliges Member States to close down as soon as possible all existing landfills that do not comply with the provisions of the Directive. In order to assess the progress of implementation, Member States must report to the Commission on the implementation of the Directive every three years (Article 15).

In reference to the WM goal of protection of future generations, the Landfill Directive obliges states to an after-care period of landfills “for as long as may be required by the competent authority, taking into account the time during which the landfill could present hazards” (Article 13). Sufficient financial resources must be planned in the beginning of the landfill operation for after-care, including landfill gas and leachate monitoring, of at least 30 years (Article 10).

Annex I gives the general requirements for all landfill classes, including those regarding location, water control and leachate management, soil and water

[5] Leachate is defined as “any liquid percolating through the deposited waste and emitted from or contained within a landfill” (Article 2, *99/31/EC*)

protection (e.g. by leachate collection and bottom sealing), gas control, noise and odour prevention, etc. Annex II defines waste acceptance criteria and procedures, obliging states to set up national lists of waste that can be accepted or refused at each landfill class. Finally, Annex III defines the control and monitoring procedures for the time of operation as well as the after-care phase, including meteorological data; water, leachate and gas control, protection of groundwater and the topography of the site.

In conclusion, it can be said that the Landfill Directive provides a stringent set of rules for the operation and after-care of landfills, intended to comply fully with the goals of WM. The implementation of the Landfill Directive should make landfills environmentally compatible and friendly, and liberate them from their past image of being a nuisance to men and the environment.

3. Croatian Waste Legislation before the Landfill Directive

Since its declaration of independence from Yugoslavia in 1991[6], Croatia not only had to set up a new government structure[7], but also a new legislative framework for most sectors, including WM. The legislation in the field of environmental protection was far from being complete, with many regulations on specific areas missing, including a legal act on landfills. Waste and matters related to waste were regulated through the following acts and regulations (listed from oldest to newest):

- Constitution of the Republic of Croatia (OG No. 56/90), which provided for the set up of a Ministry of Environmental Protection
- Law on Environmental Protection (OG No. 82/94)
- Environmental Protection Strategy and Environmental Protection Programme
- Act on Physical Planning (OG No. 30/94)
- Act on Protection of Nature (OG No. 30/94)
- Act on Waste (OG No. 34/95)
- Ordinance on Waste Types (OG No. 27/96)
- Ordinance on Packaging Waste Handling (OG No. 53/96)
- Ordinance on Requirements for Handling Waste (OG No. 123/97)

In addition, there were some other relevant acts, like those regulating environmental impact assessment and handling of hazardous matters.

[6] Croatia subsequently gained international recognition as an independent state in 1992.
[7] Before 1990, Croatia had a status of a socialist republic within Yugoslavia, and thus an own constitution and government responsible to the federal government in Belgrade, the capital of the Socialist Federal Republic of Yugoslavia.

4. Present Croatian Regulations in the Field of Waste Management

With the beginning of the new millennium, Croatia started reviewing and renewing several old legal acts, strategies and plans in order to align them with European standards, as well as passing new ones that did not exist before. It took several years for the set up of some crucial regulations, like the one on landfilling. The largest motivation came from the prospective EU membership and the pre-accession negotiations that included the implementation of the Union's *acquis*. Within that process, Croatia got a package of laws on waste and related matters that needed to be transposed, which made it necessary to review the entire waste legislation of the country and, if necessary, renew legal acts and set up new ones.

However, as the European Commission pointed out in its "avis" on Croatia's membership in 2004 (*COM(2004)257*), the alignment of WM, as the biggest individual problem of environmental protection in Croatia, with EU's *acquis* was expected to require extensive efforts. Since then, many new legal acts have been passed and progress is unequivocal. However, some deadlines were not obeyed; the Waste Act *(OG No. 178/04)* stipulated that all national laws were to be aligned with EU legislation by the end of 2006. Instead, many were passed by the end of 2007, including the Landfill Ordinance.

4.1. General Regulations

The legal framework for environmental protection that also concerns waste is given with the following legal acts:

- Environmental Protection Act (OG No. 110/07)
- National Environmental Strategy and National Environmental Action Plan (OG No. 46/02)
- Regulation on environmental impact assessment (OG No. 64/08)
- Regulation on information and participation of the public and public concerned in environmental matters (OG No. 64/08)
- Strategy for Sustainable Development of the Republic of Croatia (OG No. 30/09)

In addition, the Environmental Protection Act (*OG No. 110/07*) stipulates that every four years the Croatian government needs to submit to the Parliament a State of the Environment Report, which is, alongside the Environmental Protection Strategy, a basic document on environment in Croatia. In fact, it is a basis for changes of the

Strategy and the National Environmental Action Plan, as it points out to the problem areas that need further attention.

4.2. Waste Regulations

Waste is regulated by the Waste Act (*OG No. 178/04*) and numerous bylaws – regulations and ordinances – which refer to different aspects and types of waste in more detail. The Waste Act made it obligatory to pass a National Waste Management Strategy as well as WM plans and reports as implementing documents on the national, regional and local (municipal) level. The following is a selection of the most important legal acts on waste (for a full list, see Annex 1):

- Waste Act (OG No. 178/04)
- Waste Management Strategy of the Republic of Croatia (OG No. 130/05)
- Regulation on categories, types and classification of waste with a waste catalogue and list of hazardous waste (OG No. 50/05, 39/09)
- Ordinance on waste management (OG No. 23/07, 111/07)
- Waste Management Plan of the Republic of Croatia for 2007-2015 (OG No. 85/07)
- Ordinance on the methods and conditions for the landfill of waste, categories and operational requirements for waste landfills (OG No. 117/07)

4.3. Responsibilities of Counties, Cities and Municipalities

For a better understanding of the case study in part V of this thesis, it is necessary to shortly describe the division of responsibilities regarding WM among the different levels of administration.

Articles 13, 14 and 15 of the Waste Act (*OG No. 178/04*) deal with this topic and stipulated that while the **government** of the Republic of Croatia is responsible for the management of hazardous waste (Article 13), **counties** are responsible for the management of all other types of waste (Article 14) and “shall ensure in their respective areas conditions and implementation of the prescribed waste management measures”. **Cities and municipalities** are responsible for the management of municipal waste in particular (Article 15). They should cooperate and thus ensure the implementation of the prescribed measures regarding separate waste collection.

The Waste Management Strategy (*OG No. 130/05*) describes in chapter 4.4 on "Responsibilities for implementation of planned measures" in more detail the WM responsibilities of municipalities and towns regarding MSW:

Regional government units, i.e. counties, are responsible for:

- adopting regional WM plans,
- determining locations in development plans of the county for WM facilities,
- establishing county-level waste management centres (WMC)[8],
- conducting and co-financing remediation and closing of old landfills,
- collecting data for the registry of emissions to the environment
- educating administrative bodies and the general population

Local government units, i.e. cities and municipalities, have the following responsibilities:

- determining locations in their development plans for WM facilities
- adopting WM plans
- organizing the **collection and safe disposal of municipal waste**[9] in accordance with standards set down in the their WM plans
- educating and informing administrative bodies and the public
- **enabling separate collection** of secondary raw materials and bio-waste and **organizing transport to WMC**
- submitting data
- encouraging the purchase of environmentally-friendly products.

In accordance with Article 10 of the Waste Act (*OG No. 178/04*), a county's WM plan needs to contain provisions on measures to prevent and reduce waste generation, WM measures in accordance with BAT, measures regarding the utilization of valuable waste components and separate collection, measures for the remediation of uncontrolled landfills and areas polluted by waste, monitoring measures, financial plans for individual measures and deadlines[10].

Article 11 governs the contents of a WM plan of a city or municipality, which should contain measures on separate collection of municipal waste, measures regarding the management and monitoring of municipal waste landfills, a list of uncontrolled

[8] Later chapters will deal with the future WM system of Croatia which will be based on WMC, approx. one for every county, instead of landfills for every municipality.
[9] As regards detailed provisions regarding management of public utilities, which includes municipal waste collection and transport, by local self-government units, they are written down in the Public Utilities Management Act (*OG No. 26/03*).
[10] In the execution of these measures, the counties are obliged to cooperate with local self-government units.

dumps and areas contaminated with waste, a schedule of remediation activities, sources and amounts of financial means necessary for remediation.[11]

5. Transposition of the Landfill Directive into Croatian Law

Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste has been transposed into the following Croatian legal acts:

- Waste Act (OG No. 178/04)
- Ordinance on Waste Management (OG No. 23/07, 111/07)
- Ordinance on the Methods and Conditions for the Landfill of Waste, Categories and Operational Requirements for Waste Landfills (OG No. 117/07)

The last of these three legal acts, the Croatian Landfill Ordinance, can be seen as the counterpart of EU's Landfill Directive.

5.1. The Croatian Landfill Ordinance

The Croatian Landfill Ordinance (*OG No. 117/07*), adopted in November 2007, has basically taken over the provisions of the Landfill Directive, with a few additions and changes, where the Landfill Directive (*99/31/EC*) allows for them. Most of the provisions of the Croatian Landfill Ordinance are a mirror image of the Landfill Directive with most Articles and Annexes even having the same number. Within the individual Articles, the structure is somewhat different than that of the Directive, but the basic content is mostly the same. Hence, the individual Articles and their provision need not be described in great detail, but, as there are some differences, the most important ones will be dealt with in the following paragraphs.

While Article 3(4) of the Landfill Directive provides MS with possibilities for exemptions from certain provisions for small landfills on islands and isolated settlements, the Croatian Landfill Ordinance has refrained from including such landfills in its scope, as they will be closed down within the framework of the new WM system.

[11] It is important that these individual county, municipality and city plans are in accordance with the National Strategy and the National Plan on WM, as well as with the National Strategy on environmental protection and the programmes of environmental protection. Also, counties can cooperate and pass a common Plan.

Article 5(1) of the Croatian Landfill Ordinance on waste not acceptable on landfills includes the prohibition of landfilling "municipal waste, if the amount of its biodegradable component exceeds 35% of the total amount (by weight)."[12] This is a direct application of Article 5 of the Landfill Directive which obliges states to "set up a national strategy for the implementation of the reduction of biodegradable waste going to landfills."

Article 5(2) contains provisions on underground storage for inert, hazardous and non-hazardous waste, as well as a list of waste prohibited in such landfills, a provision that is not contained at all in the Landfill Directive.

Article 6 of the Ordinance also contains several additional provisions on waste accepted to different classes of landfills, not provided for in the Directive, of which the following are of interest for this thesis:

Article 6(7) is an exception from the above mentioned Article 5(1) and states that

> *"it shall be permitted to deposit municipal waste with a high content of biodegradable substance in a separate landfill cell for which special procedures are used solely for the purpose of producing energy from the landfilled waste"*

Article 6(9) prohibits the

> *"mixture of waste with other substances or other waste in order to reduce the content of hazardous substances in waste and meet the waste acceptance criteria"*

Article 6(10) allows a derogation and states that "in emergency cases it may be permitted to landfill waste with pollution parameters up to three times higher than the limit values referred to in Annex 3"

However, some crucial parameters are excepted from this provision, and cannot be exceeded, and according to the next paragraph of the Article, such an action can only be carried out for 12 months for previously determined waste quantities and with the existence of a preliminary study.

As requested in Article 14 of the Landfill Directive on "existing landfill sites", the Croatian Landfill Directive contains additional provisions under chapter X

[12] For more information on the step-wise reduction of the biodegradable portion in municipal waste, Article 22(5) of the Ordinance refers to the National Waste Management Plan (*OG No. 85/07*). This will be dealt with in the following chapter of the Thesis.

"Transitional and final provisions", Article 21 and 22. Thus, under Article 21(2), the Ordinance provides that for those existing landfills

> *"which do not meet the requirements established by this Ordinance, the operator shall, within one year from the entry into force of this Ordinance develop a landfill restoration plan and/or landfill closure plan".*

Article 21(3) sets the dates for the restoration and/or closure of old, non-compliant landfills, stating that

> *"existing landfills referred to in paragraph 2 of this Article must be remediated and/or closed by 31 December 2011 at the latest".*

Article 22(1) states that the provisions from the above mentioned Article 5(1) on the limitation of biodegradable waste in municipal waste to 35% are to be applied to all landfills as of 31 December 2016. However, Article 22(4) provides the possibility of exception from Article 5(1) for existing landfills that will be allowed to operate until the establishment of the new WMCs.

Article 22(2) provides an exception from Article 6(1) on the necessity of pre-treatment of waste before landfilling for existing landfills with valid remediation or closure plans until the start of work of the new WMCs.

As regards the Annexes of the Landfill Ordinance, they are very similar to those of the Directive, but contain more detailed information on the basic landfill equipment (Annex 1(5)), provisions regarding a risk assessment study for underground storage (Annex 1(6)), an additional Annex (Annex 3) with detailed provisions on "basic criteria for the acceptance of waste at various categories of landfills", including, for example, the exact limit values for heavy metals, sulphates, salts, DOC, TOC, etc.

5.2. Extensions and Expected Difficulties

According to a report of MEPPPC from September 2008 (*Blažević-Perušić, J. et al., 2008*), Croatia had requested a transitional period for the full implementation of Article 14(c) (regarding the compliance of existing landfills with provisions of the Directive) of the Landfill Directive until 31 December 2015[13], as well as a transitional period for the full implementation of Article 5(2)(c) (regarding the reduction of

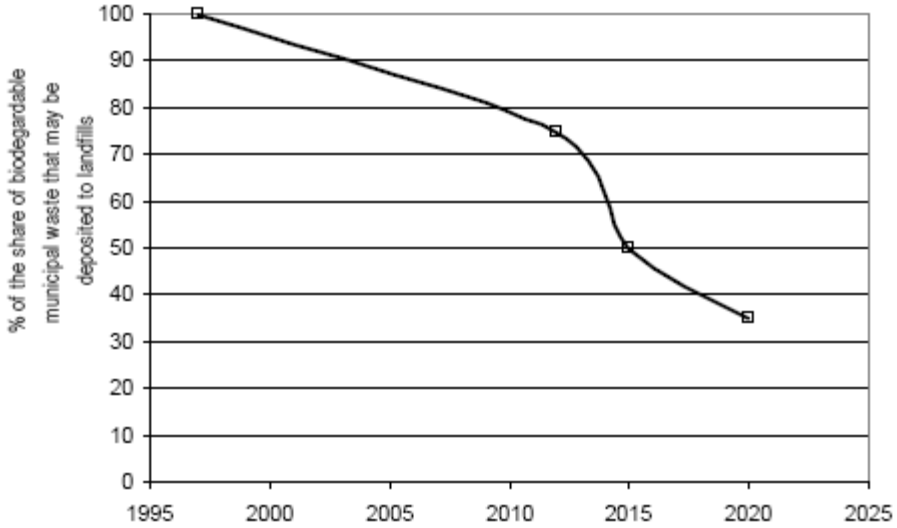
[13] The Landfill Directive requires that all existing landfills comply with its provisions by 2009. This was, of course, not attainable for Croatia, as the Directive was passed in 1999 and referred to the then MS of the Union.

biodegradable municipal waste going to landfills to 35% of the total amount of biodegradable municipal waste produced in 1997) until 31 December 2020.

In fact, the Landfill Directive (*99/31/EC*) in Article 5(2)(c) provided for the possibility of a postponement. It states that "Member States which in 1995 (…) put more than 80% of their collected municipal waste to landfill may postpone the attainment of the targets set out in paragraphs (a), (b), or (c) by a period not exceeding four years". Thus, also the MS of the EU had the possibility of extension regarding the step-wise reduction of biodegradable municipal waste portion to 35%.
According to the Waste Management Plan (*OG No. 85/07*)

> *"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)"*

As the construction of these WMCs within the framework of the new WM system is planned to be finalized in 2015, Croatia requested a transitional period for the reduction of biodegradable municipal waste percentage until the end of 2020. The following graph shows the step-wise reduction until 2020, with individual steps at 2012 (reduction to 75%), 2015 (50%) and finally 2020 (35%) in comparison to 1997 as base year[14].



Graph 1. Targets for the reduction of the share of biodegradable waste in total municipal waste. Source: *OG No. 85/07*.

As regards the compliance of existing landfills with provisions of the Landfill Directive, the prolongation of the transitional period until the end of 2015 might become obsolete, as the Strategy (*OG No. 130/05*) provides for a set-up of a new

[14] In 1997, Croatia produced an estimated 1,015,000t of MSW, of which 74.5% was biodegradable waste.

WM system by the end of 2011 and remediation or closure of existing landfills by the end of 2009. In fact, the remediation of old landfills is seen as a precondition for the new system to start working, and when it does so, old landfills will no longer be used. However, as not all planned WMC are at the same stage of planning and construction, with most only being in the phase of documentation and permit acquisition at present, a probable delay in planned actions beyond 2011 needs to be taken into consideration[15].

6. The Future System of Waste Management

Croatia's future system of WM will represent an enormous change as opposed to the past and present system. Basically all aspects of WM will change with the aim of fulfilling the foremost goals of furthering sustainable development and bringing the system in line with Western, i.e. EU's, standards. The efforts and investments necessary for the new system, the set up of which is starting or about to start in the different Counties, will be massive. This chapter will describe the features of the new integrated WM system taking, above all, the National Strategy of Waste Management (OG No. 130/05) and the National Waste Management Plan (OG No. 85/07) as a basis, since these are the documents that provide guidelines for the management of different waste types, from their production to final disposal, with the aim of establishing the new integrated WM system. The Strategy was set up as requested by the Waste Act (OG No. 178/04), and takes into account the above mentioned goals of WM set down in EU legislation. For its implementation it obliges the governments on all levels (national, regional, local) to set up WM plans as implementation documents for the new system.

6.1. General Principles of the Waste Management Strategy

The aim of Croatia's Waste Management Strategy (*OG No. 130/05*) is to set up a framework for achieving the aim of a reduction of waste quantities and sustainable management of produced waste. For that purpose, the Strategy's basic principles are defined in chapter 1.2 and are basically the same as those in the European legislation:

- Hierarchy of waste management: prevention -> recycling/reuse -> final disposal in an environmentally-friendly way

[15] The specialized Croatian journal on construction engineering has reports on the progress of different WMCs (http://www.casopis-gradjevinar.hr/hrv/search_advanced.asp?s=200903&j=h)

- Use of BAT regarding costs and environmental acceptability
- Producer responsibility
- Independence and proximity
- Support of activities favouring approximation and accession to the EU[16]
- Elimination of shortcomings of previous policies and practices regarding WM
- Polluter-pays principle
- Right of the public to access information, participate in decision-making processes and access to justice
- Education
- Preparation for an open market
- Step-wise approach (gradual improvement of the system)

According to chapter 1.5 of the Strategy, the vision to be pursued is the ideal state of a zero-waste society[17]. To come closer to this goal, it is necessary to close the waste flows into a circle, but this can only be done if all target groups are educated and public participation encouraged – something which is still one of the biggest shortcomings of the present system. Thus, in view of the goal to be achieved, the Strategy formulates the following priorities to be pursued:

- aligning Croatian legislative regulations with those of the EU and ensuring their implementation
- providing education regarding the environment and WM
- preventing waste generation
- increase the fees for burdening the environment with waste
- increase financial means for WM
- remediate existing landfills
- provide more and better data on waste quantities and flows
- construct facilities and installations for waste treatment
- increase the portion of controlled collection and disposal of waste

[16] This means that those options of WM need to be selected which have been proven to be the best according to Western European standards, but which also fit the possibilities of Croatia.
[17] At first sight, a zero-waste society might seem as an ideal state in WM. However, if analysed more critically, one sees that the necessary 100% recycling is economically not feasible and it could lead to some toxic substances in secondary raw materials (e.g. flame retardants in plastics produced out of recycled plastic materials).

6.2. Strategic Goals of the New Waste Management System

In order to prevent waste from being produced, to reduce quantities finally deposited and alleviate risks emanating from waste, the Strategy provides guiding objectives in chapter 3.1 (*OG No. 130/05*). It is most important to reduce the quantities of waste produced at their source and use material and energy recovery. This involves a great improvement in separate collection and recycling. The Waste Act (*OG No. 178/04*) stipulates in Article 5(1) that, in addition to quantities, also the hazardous content of waste needs to be reduced, e.g. by increased use of clean technologies in production. Furthermore, the Strategy calls for the set-up of infrastructure for the new WM system, in order for the system to work properly in future, which calls for a construction of new regional (county) landfills, incinerators, facilities for mechanical-biological treatment (MBT) etc. The new system should work alongside the ARD (Avoidance – Reuse – Disposal) principle. Also, hazards from waste should be reduced by remediating existing landfills and uncontrolled dumps. An additional benefit should be the creation of new jobs in Croatia. Finally, in order to achieve all this, administrative structures, experts and the public have to be better educated and informed.

To sum up the most important innovations introduced by the Strategy, the bases of the new WM system are:

- establishing an integrated WM system
- remediation and closing of existing landfills, including closure of all island landfills (only transfer and recycling stations on islands in future)
- remediation of uncontrolled dumps and areas contaminated with waste
- construction of regional/county WMC – max. 21[18] - with pre-treatment of waste before final disposal (thus reducing volume)
- set-up of efficient information system

The date for the completion of the establishment of the new integrated WM system is set to be 2025. The following two graphs show the quantitative objectives regarding waste quantities and landfill sites.

[18] There are altogether 21 counties in Croatia, but some of them will form partnerships and build regional landfills together, thus the number of new centres is limited to 21.

Table 1. Quantitative objectives with respect to waste quantities. Source: *OG No. 130/05.*

Objectives	Percentage (%) / year				
	2005	2010	2015	2020	2025
Population covered by the organized collection of municipal waste	80	85	90	95	100
Quantity of separately collected and recycled municipal waste	6	8	12	18	25
Quantity of treated waste	2	10	20	25	30
Quantity of waste disposed in landfills	95	80	68	58	45
Quantity of disposed bio-degradable municipal waste as related to the quantity produced in 1995	95	85	75	55	35

Table 2. Quantitative objectives with respect to landfill sites. Source: *OG No. 130/05*.

Objectives	Year				
	2005	2010	2015	2020	2025
Regional centres for waste management	0	1-2	2-3	3	4
County-level centres for waste management	0	3-7	7-10	10-14	14-21
Official landfills[19]	187	100	50	30	14-21
Percentage of remedied landfills (% of the number determined for 2000)	5	65	75	85	100

6.3. Management of Municipal Solid Waste

The management of MSW will experience a complete redesigning in the next 15 years. The framework for the new system is given in chapter 4.2.1 of the Strategy (*OG No. 130/05*). While keeping the hierarchy, the "polluter-pays" principle and the responsibility of producers in mind, and strengthening the role and competences of county-level environmental protection offices, the following actions will be undertaken (the process is in the starting phase at the moment):

- organization of county-level WMC (i.e. new big and modern landfills instead of numerous existing ones),
- organization of a network of transfer/handling stations (so that waste can be collected in more remote towns and islands before being transported to the big centres),
- organizing a network of collection points for the separate collection of waste, so-called "green islands" (located at special points in cities, e.g.) and a network of recycling yards

[19] Official landfills include the following categories: legal landfill sites, landfill sites awaiting legalisation, official landfills, accepted landfills (more information in part IV on present and past waste management in Croatia).

- upgrading or closing down disposal sites, as well as equipping existing landfills that will remain operation for a certain time (until the WMC start operating),
- building composting facilities
- encouraging the use of biomass and biogas
- building a waste-fuelled power plant in Zagreb

As mentioned before, the planned number of county level centres (sanitary landfills) is limited to a maximum of 21. These new centres will be built according to newest technologies, contain the general infrastructure including scales for vehicles and waste registration, a recycling yard for separately collected waste, pre-treatment devices, installations for the separation of secondary raw material and recycling, composting facilities, MBT, facilities for the use of biogas, etc.

Since this is a lot of new investment and cannot be done at once, the construction will be divided in stages. In part V of the thesis, this stage approach will be exemplified on the basis of one county's newly to be built WMC.

6.4. Costs of the New Waste Management System

Chapter 5 of the Strategy (*OG No. 130/05*) deals with the investment costs needed for the establishment of the new WM system, breaking down the costs in different categories. The total investment cost needed until the end of the envisaged process in 2025 will amount to **3.25 billion euro**. In other words, these are the costs necessary to comply with the EU's waste *acquis*. Here is the breakdown of the costs in categories:

Table 3. Breakdown of investment costs for the new waste management system until 2025. Source: *OG No. 130/05*.

1. General measures Incl. analysis of present situation, setting up programme for management of all types of waste, set-up of a waste information system, alignment of Croatian waste-related regulations to EU's…	€ 30 million
2. Avoidance measures Incl. education, encouragement of cleaner production and consumption, reduction of packaging…	€ 40 million
1-2 Total	**€ 70 million**
3. Waste management centres with biocomposting plants	€ 460 million
4. Waste collection – equipment	€ 434 million
5. Waste collection points (recycling yards, islands, etc.)	€ 96 million

6. Waste-to-energy plant - first phase in the City of Zagreb	€ 290 million
7. Waste-to-energy plant - second stage	€ 439 million
8. Mechanical - biological treatment plant (4 plants)	€ 83 million
9. Handling station with baling	€ 64 million
10. Extension of landfill sites	€ 52 million
11. Improvement/upgrade of landfill sites	€ 344 million
3-11 Total (Municipal waste – phase I & II)	**€ 2,262 million**
12. Hazardous waste	€ 125 million
13. Construction waste	€ 95 million
14. Agricultural and forestry / wood processing waste	€ 200 million
15. Other principal waste streams	€ 250 million
16. Rehabilitation of old burdens	€ 100 million
17. Industrial and mining waste	€ 150 million
12-17 Total	**€ 920 million**
OVERALL TOTAL (phases I and II)	**€ 3,252 million**

It is planned that the costs of waste collection and of constructing the handling stations (points 4 and 9) will be covered by awarding concessions (or another method in accordance with European standards). This would reduce the initial investment by € 498 million to € 2.754 billion[20]. This amount of course does not include operation and maintenance costs.

It is evident that the investments necessary are very high. If calculated with the present GDP of Croatia, they amount to about 5.5% of a year's GDP (at current prices). This amount refers to a period of 20 years, but it has to be kept in mind that many of the major investments need to be done in the first phase of investment. For example, the investment-intensive WMCs are planned to go into operation in 2011.

In its 2007 Screening Report on Croatia's progress regarding transposition of environmental laws (*Screening Report 27, chapter II.c.*), the European Commission pointed out to the high investment costs as an obstacle that is expected to cause problems in the implementation phase. It emphasizes, above all, the establishment of the WMCs.

[20] Since these costs were calculated in 2005, they refer for the period 2005-2025. Some investments have already been made, e.g. for aligning legislation, determining the actual state, setting up development plans for the new landfills, remediating some of the old landfills, etc.

6.5. Funding Sources

The funds necessary for these investments will come from the national, county and municipality/city budgets, from the Environmental Protection and Efficiency Fund (different charges paid for burdening the environment with waste, CO_2, etc.), from grants, loans, international aid, foreign investments for different WM projects, etc. Waste disposal costs will be covered in the same way as until now – with fees charges for the service of waste collection, transport and disposal. In Croatia, this fee[21] is mostly based on the size of the occupied apartment (in Kn/m²). In addition, many projects, most notably the construction of new WMCs, will be co-financed by EU's pre-accession, cohesion and structural funds. (cf. *AZO*)

In addition, the Strategy points out to the fact that charges for MSW imposed on producers of waste, including the general population, are too low to sustain the future system. As regards MSW, it proposes that the fees for municipal waste collection and disposal shall be based on quantities rather than on apartment size like now, as well as that a form of taxation or customs shall be introduced to encourage recycling.

A lot of hope is being put into the funds programme of the European Union for candidate countries, the Instrument for Structural Policies for Pre-accession (*ISPA*), which provides assistance for infrastructure projects in the priority areas of environment and transport. Croatia applied for ISPA funding for a number of projects, especially regarding rehabilitation of municipal waste landfills and construction of the new WMCs (incorporating very large landfills). Since 2007, the new *IPA* fund, Instrument for Pre-Accession Assistance, a single and unified instrument for pre-accession funding, has been set up, and replaced, i.e. incorporated, the ISPA. However, as is always the case with funds, a lot of time passes between the application and the approval, which has repercussions on the progress of projects to be funded[22].

[21] The basis of the fee system for financing costs of landfilling is set down by the Waste Act (OG No. 178/04) and the new Landfill Ordinance (OG No. 117/07).
[22] This will be shown on the basis of the new WMC for the Primorje-Gorski Kotar county, dealt with in the case study.

6.6. Timetable of Implementation

In 2007, the National Waste Management Plan 2007-2015 (*OG No. 85/07*) was worked out, as prescribed by the Waste Management Strategy (*OG No. 130/05*). The Plan represents the fundamental document on WM in Croatia and gives the necessary basis for an implementation of the provisions of the Waste Act (*OG No. 178/04*) and the Strategy from 2007 until 2015, in view of the establishment of a new integrated WM system. In chapter 1, the Plan set out a basic timetable for the period until 2015:

Table 4. Timetable for the establishment of an integrated waste management system in Croatia. Source: *OG No. 85/07*.

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)									

The Strategy (*OG No. 130/05*) provided under chapter 2.6.1. a plan on rehabilitation of existing landfills from 2005-2009, listing the number of landfills and financial means necessary for their remediation – 2,581 million Kn (about € 350 mill.), half of which is to be provided by the EPEEF. However, as will be shown on the example of the case study landfill later, above all large existing landfills have not been rehabilitated to a sufficient degree yet. Although plans for rehabilitation have been passed for most official landfills, the process of remediation is slow, and thus, it is questionable whether it will be finished by the end of 2009.

IV. CROATIA AND ITS WASTE MANAGEMENT STRUCTURE – PAST AND PRESENT

After having established a framework for analysis by looking at legal regulations governing the WM system, this part of the thesis explores the past and present WM practices of Croatia. It refers, above all, to the time after Croatia's independence declaration in 1991 and gives information on waste types and quantities, landfills and prevalent practices. Even though the past WM system is still being applied, Croatia is just about to start the set-up of a completely new one, as shown in previous chapters. The provisions on the legislative side have already been established. What is missing now are practical steps. However, the non-sanitary landfills will continue operating until the new WMCs are built and ready for operation, which will not happen before 2011.

1. Basic Information on Croatia

The Republic of Croatia is a Central European country situated at the Adriatic Sea. It has a population of 4.436 million people, which is not projected to grow much, and a density of 81 inh./km². The capital Zagreb is its largest city with approximately 780,000 inhabitants. The country's main characteristic is its long coastline with numerous islands. Geographically, it is a mix of plains, dense forests and mountains and a rocky, karstic coastline. The country declared independence from Yugoslavia in 1991. It became a parliamentary republic and has a stable market economy. In 2007, the GDP (purchasing-power parity) amounted to $ 70.665 billion, or at current prices to $ 58.558 billion; the per-capita GDP (at current prices) amounted to $ 13,199. The Croatian National Bank reported the 2008 GDP per capita at 10,682 EUR. While the GDP was projected to rise by ~ 2.4% in 2008, it is projected to fall by 3.5% in 2009 due to the present economic crisis.[23]

Administratively, Croatia is divided into 21 Counties (županija) plus the capital Zagreb's city district. Each county has an own assembly with representatives elected by popular vote for a four-year term. The assembly elects the executive county leadership, passes the county's yearly budget, and is responsible for the

[23] Data are taken from the homepage of the International Monetary Fund and its World Economic Outlook 2009 (www.imf.org) and the Croatian National Bank (www.hnb.hr)

management of many sectors, including the landfilling of all types of waste except hazardous waste. In addition, every county has a prefect who presides over the executive government.

2. Past and Present Waste Management Structure

2.1. Main Stakeholders of the Waste Management System

As regards environmental protection, the highest authority at national level is the Ministry of Environmental Protection, Physical Planning and Construction (MEPPPC). According to the Law on Environmental Protection, the Minister of Environment has the competence to prescribe the methods of work to local and regional, i.e. municipal and county, governments (*OG No. 110/07*), each of which have own environmental departments. In addition, the Government decided to establish the Croatian Environmental Agency (*AZO*) for the purpose of collecting, integrating and processing environmental data. This Agency is very important in respect to WM, as it set up the first information system in order to improve the availability of data on waste types, quantities and streams. Another important institution in this respect is the Environmental Protection and Energy Efficiency Fund (*EPEEF*) which provides great funds for the preparation and development of other projects, many of which are connected with WM, and especially landfill remediation. The Croatian Bureau of Statistics (*DZS*) collects data on waste and delivers it to Eurostat, EU's Statistical Office. There are also other national administrative bodies, e.g. those competent for agriculture and forestry, which participate in the WM system. The Croatian Waste Market (*Burza*) that operates under the auspices of the Croatian Chamber of Economy publishes the demand and supply information by types of waste. And last, but not least, the Environmental Protection Inspectorate (*Zastita*) oversees the enforcement of the Waste Act and related bylaws.

On the regional level, there are State Administrative Offices in the different counties (plus the City of Zagreb Office). They are responsible, among other things, for the management of non-hazardous and MSW, and for passing regional plans of WM, as well as determining locations for storage, recovery and disposal of waste and providing data on waste quantities. According to the Waste Act, hazardous waste

remains a responsibility of the national government[24] (*OG No. 178/04*). On the local level, the city and municipal offices have the responsibility of ensuring the conditions regarding WM, passing local WM plans and determining locations of MSW landfills.

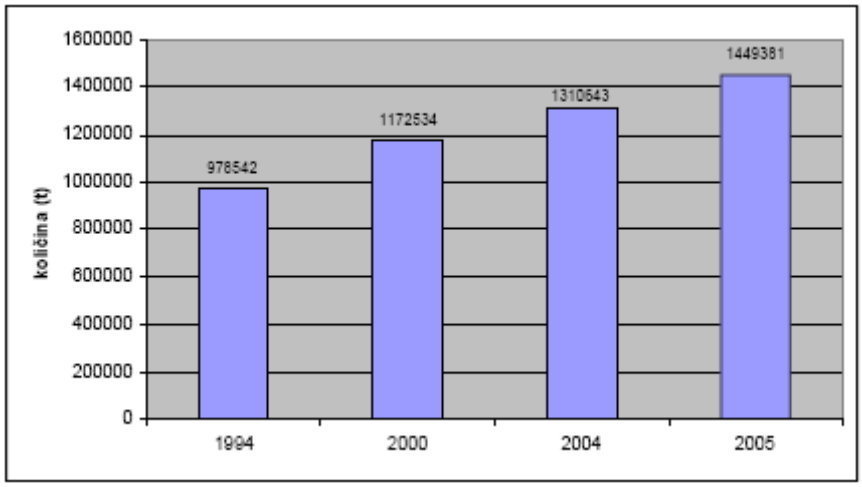
As regards other stakeholders, there are companies producing, collecting and treating waste, legal persons carrying out EIAs, feasibility and other studies, laboratories and non-governmental organizations promoting public awareness. As regards NGOs, it should be pointed out to the non-profit Croatian Cleaner Production Centre (*CRO-CPC*) which promotes the concept of cleaner production, including waste avoidance activities.

2.2. Municipal Solid Waste Quantities

According to Article 3 of the Waste Act (*OG No. 178/04*), **MSW** is

> *"waste from households, as well as waste resulting from production activities and/or services when the waste is in its properties and composition similar to waste from households."*

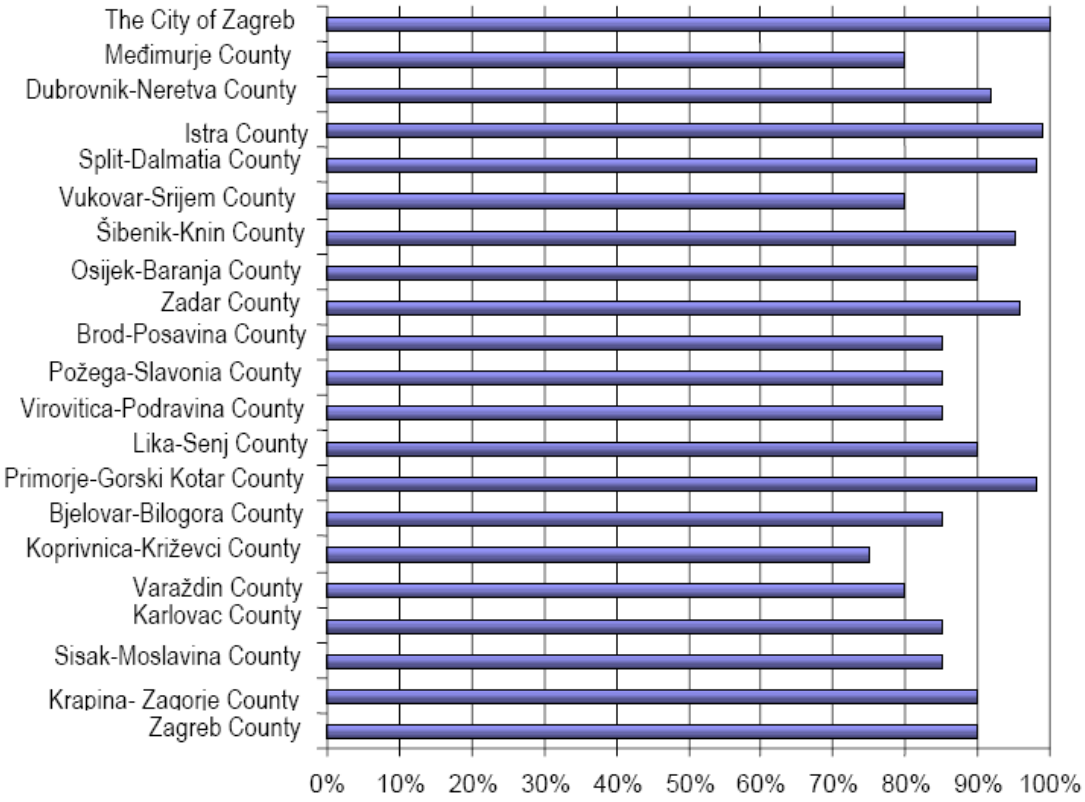
According to *AZO (2007)* the amount of solid waste in Croatia has been steadily rising, which is connected with the economic progress of the country – the amount of waste increases with the GDP, albeit not linearly (*cf. Fellner, 2005*). The following diagram shows the growth of MSW since 1994.



Graph 2. Estimated quantities of generated MSW in Croatia in 1995, 2000, 2004 and 2005. Source: *AZO, 2007*

[24] In addition to management of hazardous waste, also the incineration of waste is a national, not county, responsibility (*NN 178/04*)

The Plan (*OG No. 85/07*) shows that on average **92.8%** of Croatian population is **covered by organized waste collection**, ranging from around 85% in some counties to 100% in Zagreb. This percentage will further increase in future, the goal being to achieve a country-wide 100% coverage. The following graph shows the coverage by county:



Graph 3. Share of population covered by the organized system of MSW collection by county for 2005. Source: *OG No. 85/07*.

Mixed MSW is collected in containers, bins and bags, mostly two-three times per week, which is more than the EU average. In addition, the increasing packaging material is becoming a more and more serious problem (*OG No. 130/05*).

According to most recent official data from the Plan (*OG No. 85/07*) and *AZO (2007)*, the average amount of **waste produced in 2006 per capita** per day was 0.90kg, which makes **327kg/capita/year**. This is in the range of Central and Eastern European countries, but still below Western Europe. The table below shows a comparison of waste quantities in Croatia with Austria, Denmark and Slovenia that was worked out by a Danish consultancy for the purposes of the Strategy.

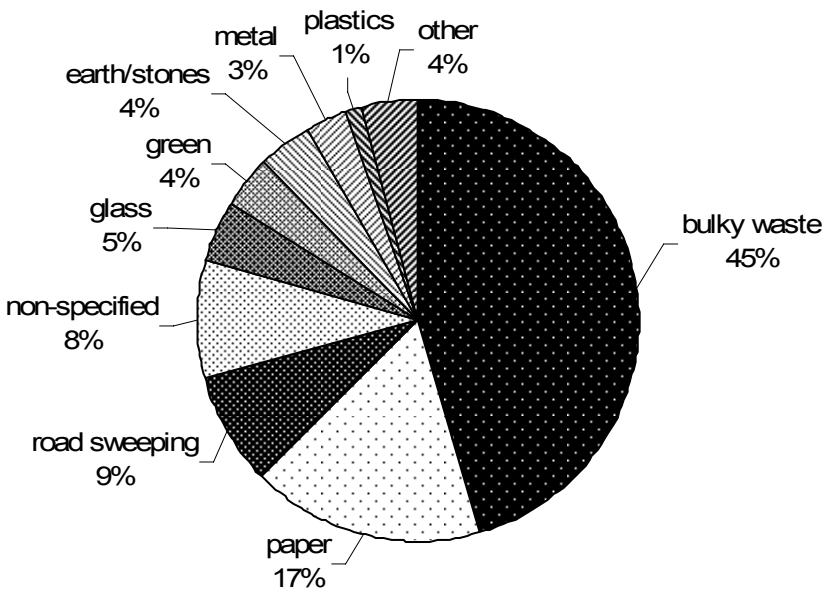
Table 5. Quantity of waste in three selected EU countries and Croatia (2000). Source: *Final report on the Framework National Strategy for Waste Management, with an emphasis on municipal waste (Carl Bro Consortium in the scope of the EU CARDS Program for Croatia, 2003), taken from OG No. 130/05*

	Austria	**Denmark**[25]	**Slovenia**	**Croatia**
Population (mil.)	8.1	5.4	2	4.45
Total quantity of waste (mil. tons)	48.6	13	8.4	12.6
Total quantity of waste per capita (kg)	6000	2407	4200	2840
Quantity of municipal waste (mil. tons)	3.1	3.1	0.8	1.2
Total quantity of municipal waste per capita (kg)	383	574	400	270

Out of **187 companies** that **collected mixed MSW** in 2006, 175 registered waste collection to AZO. 84 companies that run landfills registered the processing of MSW (meaning mostly landfilling). The registered amount of collected MSW in 2006 was 1,894,361.53 tons, of which 1,744,922 was mixed MSW. All of the mixed MSW was disposed of at landfills. The amount of **officially processed** (i.e. mostly landfilled) **MSW** was **1,335,003 tons**[26], of which 1,317,116 tons mixed MSW. (*AZO, 2007*)

According to *AZO (2007)*, the amount of **separately collected** components from MSW was **149,440 tons**[27]. The biggest share is made up by bulky waste (68,278 t) and paper and cardboard (24,923 t). The amount of separately collected MSW increased from 4.5% in 2004 (*OG No. 130/05*) to **8%** in 2006 (calculated with the registered amount of collected waste). This is probably due to the set-up of recycling yards and "green islands" with containers for separate collection (*OG No. 85/2007*). The graph below shows the individual portions of separately collected MSW:

[25] The total quantity of waste for Denmark does not include all waste streams.
[26] The amount of processed MSW being smaller than the amount of collected MSW is due to the fact that mostly only landfill operators fill in registration forms and not companies that process separately collected components from MSW, and that a substantial number of landfill operators does not provide data. (*AZO, 2007*)
[27] This only forms part of the separately collected MSW, because the other part has been registered on forms for waste from production. Due to this, the exact amounts of separately collected MSW cannot be given. (*AZO, 2007*)



Graph 4. Separately collected types of MSW registered by waste collection companies. Source: *AZO, 2007*

The above mentioned quantities include waste generated by tourism. The amount differs greatly from one county to the other. According to the Plan (*OG No. 85/07*), **waste from tourism** is calculated based on overnight stays and amounts to **97,700 t/year**. A tourist approximately produces 1kg of waste per night. In overall terms, this quantity is not very significant, but it can be of great importance for individual counties or municipalities and makes it necessary to adjust the WM system during the peak season.

In conclusion, *AZO (2007)* states that even if the number of registration forms was satisfactory and the quality of registered data better than in previous years, caution needs to be applied when dealing with quantitative data on MSW, since they are almost always based on the estimates of collection companies and not weighing of waste.

2.3. Municipal Solid Waste Types

The following table shows the average annual composition of MSW from 1997 to 2000. It can be assumed that the figures are similar today. The table's source, the Plan (*OG No. 85/07*) emphasizes that waste from different regions shows differences in quantities of its components and takes this fact into account in the following table on the average annual composition of MSW. However, as there are

uncertainties (especially regarding kitchen and bio waste), these differences can be regarded as marginal and negligible.

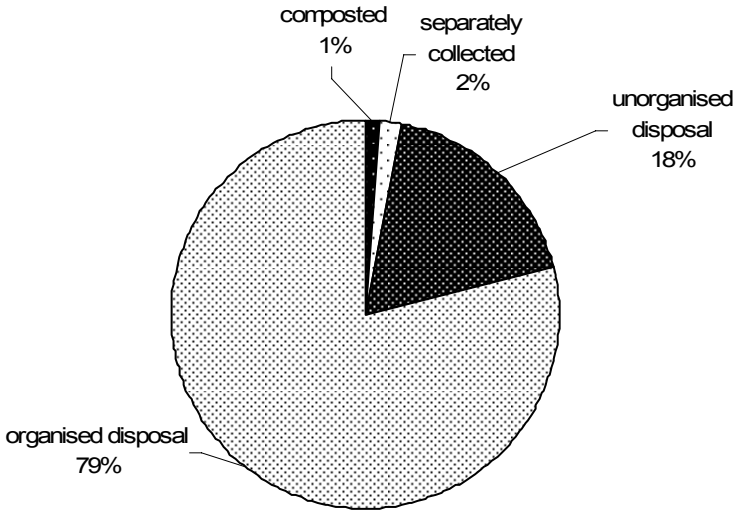
Table 6. Average annual composition of MSW from 1997-2000. Source: *OG No. 85/07*.

Waste component	mass %, continental region	mass %, coastal region	mass %, average value	mass %, bio-degradable
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	
Textiles[28]	7,8	8,2	8,0	
Glass	6,6	7,0	6,8	
Metals	4,1	4,0	4,1	
Inert waste	1,5	2,2	1,9	
Plastics	11,6	12,3	12,0	
Rubber	0,9	0,5	0,7	
Special	0,4	0,2	0,3	

2.4. Number and Types of Landfills

As reported by *AZO, 2007*, virtually all collected MSW is landfilled, without the existence of a systematic monitoring of its composition. The system could be described as a combination of controlled dumping and engineered landfilling. Controlled dumping is the next step after the worst method, open dumping, with a designated disposal area, soil covers, fire prevention, and prevention of surface water entering waste by simple measures. Engineered landfills introduce more measures and planning including some form of leachate removal and venting of gas (cf. *Fellner, 2005*). Croatian landfills cannot be ascribed to either type, with some being better planned and managed than others, but with the tendency going towards controlled dumping. In 2004, 90% of MSW was landfilled, and only 1% composted (*OG No. 130/05*). The remaining 9% are not mentioned in the Strategy, so it can be assumed that they are dumped and/or composted (the latter e.g. by rural population not yet included in the waste collection system).

[28] It needs to be noted here that, today, as much as ~60% of textiles is made of synthetic fibres and, thus, not biodegradable (cf. de.wikipedia.org/wiki/Faser#Textilfaserverbrauch)



Graph 5. MSW management in 2004. Source: *Dragičević et al., 2007*

The following table gives a comparison of treatment and disposal rates in Austria, Denmark, Slovenia and Croatia, showing big differences between Croatia and the two EU-15 members, but also regarding its neighbour Slovenia that became independent at the same time, but prospered faster economically. It is, however, notable that, regarding the rates of recycling and composting, Slovenia is also still far away from a sustainable WM system in western European terms.

Table 7. Treatment and disposal of municipal waste in selected EU counties and in Croatia (2000). Source: *Final report on the Framework National Strategy for Waste Management, with an emphasis on municipal waste (Carl Bro Consortium in the scope of the EU CARDS Program for Croatia, 2003), taken from OG No. 130/05*

	Austria	**Denmark**	**Slovenia**	**Croatia**
Waste collected for recycling	34.3%	14%	10%	10%
Waste collected for biological treatment	21.7%	-	12%	1%
Waste collected for incineration	14.7%	81%	-	-
Waste collected and deposited on landfill sites	28.5%	5%	73%	89%

Before the transposition of the Landfill Directive and adoption of the new Ordinance on landfills in 2007, Croatian landfills were subdivided into five categories (shown in table below), according to their legal status, size, types of waste landfilled, state of activities, environmental impact and equipment.

Table 8. Landfills registered in the Landfill Register[29], excluding closed and illegal/open dumps. Source: *Dragičević et al., 2007*

Landfill category	Number	Area (m²)	Volume (m³)[30]	Landfilled (m³)
Legal	25	2,977,545	25,972,000	12,829,500
In the process of legalization	40	2,156,454	19,555,000	8,640,000
Official	36	1,457,616	14,614,000	9,492,900
Unofficial/accepted	86	1,583,344	7,948,070	3,091,213
Total	**187**	**8,174,959**	**68,089,070**	**34,053,613**

According to the Strategy (*OG No. 130/05*) there were **252 active landfills in 2004**, including the 187 registered ones as shown above. 31 of them started operating after 1 January 2000, 29 were reported as having been closed, and 65 of them are illegal landfills, i.e. waste dumps.

The Strategy (*OG No. 130/05*) gives the following definitions:

- legal landfills are facilities for the permanent disposal of waste that were included in planning documents and received a permit;
- landfills awaiting legislation are different in as much as an environmental impact assessment (EIA) has not yet been completed;
- official landfills are unorganised and big, but anticipated, areas for permanent disposal without EIA or a permit, but operating with the approval of the competent local authority and included in the official organized waste collection;
- accepted landfills are similar to official landfills, but smaller, and operating mostly unofficially, but with the knowledge of the authorities;
- uncontrolled dumpsites are mostly formed by citizens, without any permit or authorization, i.e. illegally.

Approximately 67% of active landfills and dumps have not been included in physical planning documents, do not possess a permit, nor has an EIA been carried out for them (*OG No. 130/05*).

[29] AZO continuously compiles information on landfills in the Landfill Register. The interactive map of all landfills in Croatia can be accessed under http://odlagalista.azo.hr/viewer.htm

[30] By definition, the volume given for legal landfills and those in the process of legalization is given in the official permit issued by the authorities, while the volume for official and accepted landfills is probably anticipated or estimated.

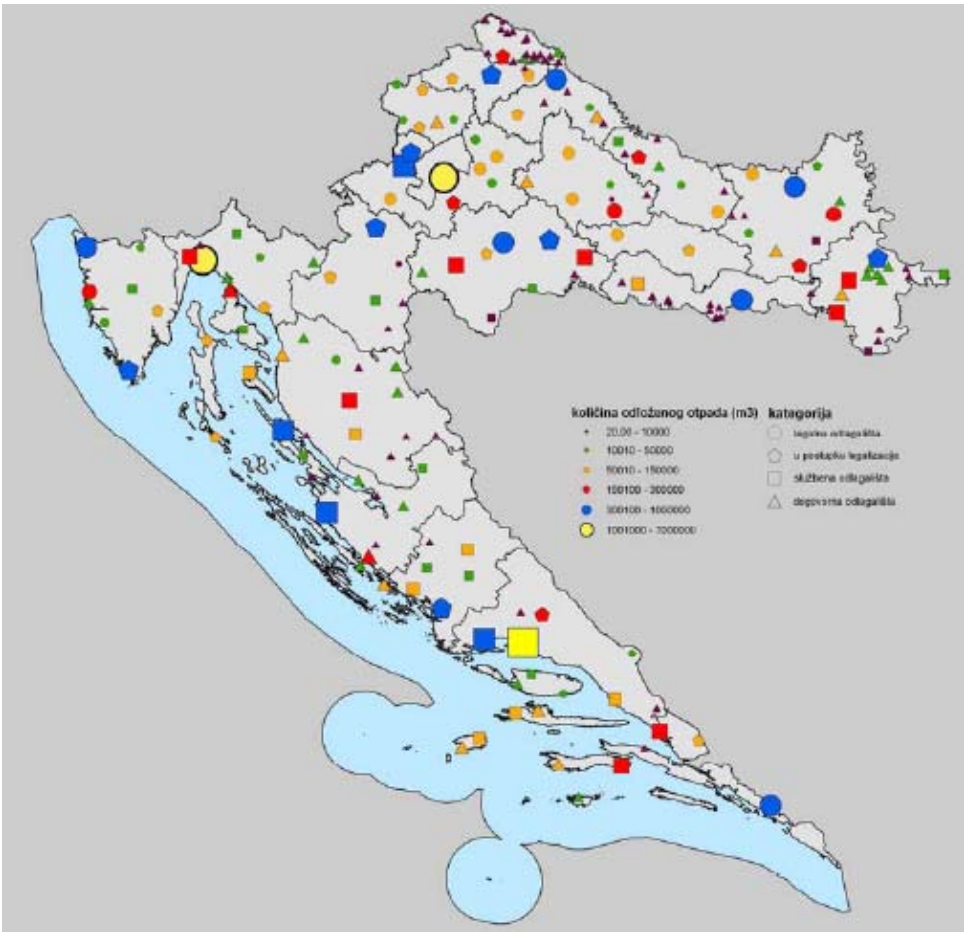


Figure 1. Landfills and their locations according to size and type. Categories: legal (circles), in the process of legalization (pentagrams), official (square), unofficial/accepted (triangles). Source: *Dragičević et al., 2007.*

Exclusively MSW is deposited to 25 landfills, while 227 landfills accept MSW, waste of similar composition and non-hazardous production waste. However, almost half of the construction waste also goes to municipal waste landfills, thus increasing remediation costs, taking up valuable volume and ignoring the need for useful recovery of a large portion of construction material. Municipal waste landfills also receive a large amount of waste tyres as well as waste from animals[31]. Above all the latter practice contributes very much to the possible spreading of disease vectors and contaminating water, air and soil. However, as new Ordinances have been passed on most types of waste, these unsustainable practices should have started to be discontinued. (cf. *OG No. 130/05*)

[31] According to the Strategy (*OG No. 130/05*), waste from animals comprises many sources, incl. waste from slaughterhouses and facilities for meat, fish, egg or milk production, marketplaces, restaurants, breeding farms, zoos, hunting, and all places where animals are kept, bred or animal-origin food is produced.

Managing waste on the numerous inhabited islands is especially challenging. MSW collected from islands is either transported to the island's own landfills or, if the island is smaller and does not have a landfill, by trucks or containers on ferries to the mainland.

As regards further registered facilities for WM, there are 73 facilities for mechanical treatment of waste (sorting and recycling stations), 3 for biological treatment (composting), 30 for thermal treatment and 2 for chemical-physical treatment of waste (cf. *Dragičević et al., 2007*).

2.5. Remediation of Landfills and Open Dumps

In 2004, in a cooperated effort of the EPEEF, the MEPPPC and local authorities, **rehabilitation of 292** official non-sanitary landfills started. At the time, the total investment was estimated to amount to approx. 2.8 billion Croatian Kuna (~381 million EUR at exchange rate Kn/EUR 0.13552). The EPEEF agreed to co-finance 48%. By 2007, 28 MSW landfills were remediated. Some of them were to be closed within a five year period, but the majority redesigned into transhipment stations or recycling yards, to serve in the new, future WM system. (cf. *OG No. 85/07*)

However, there were **3,000 uncontrolled, open dumps in 2004**. Some were or are being rehabilitated, but their exact number cannot be estimated as new ones are created (cf. *OG No. 130/05*). This is a serious problem in Croatia because it seems that monitoring by environmental inspectors is not sufficient, penalties are too low, and public awareness and education are insufficient. By 2007, the EPEEF provided funds amounting to 43.6 million Kuna (~ 5.94 million EUR at exchange rate Kn/EUR 0.13562) – or 66% of the estimated total cost of investment – for the remediation of 512 illegal landfills/dumps, of which some are located in national parks and protected areas. Until 2007, 217 illegal landfills were eliminated.

2.6. Costs of Landfilling

According to *Fellner* (2005), the costs of landfilling of a country are a factor of different parameters, including the landfill strategy (landfill equipment, technology used for emission treatment), GDP and the capacity of the disposal site.

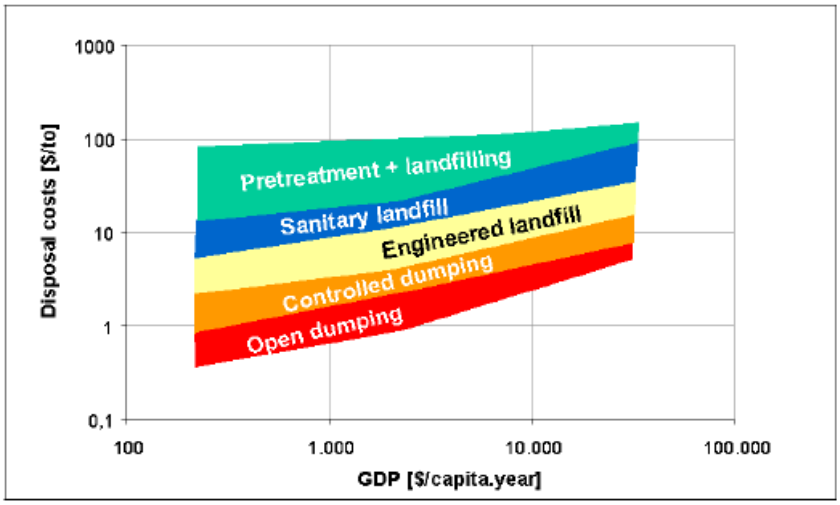
In Croatia, the collection of municipal waste takes place two-three times[32], in smaller places once, per week, and is, thus, more frequent than in the EU. This increases the costs and requires citizens to pay a relatively high prices compared to their income. The price is based on the square area of the house or apartment, with the average annual **amount per household** – i.e. per 60 m² – being 246 Kn or **32 EUR**. This does not include the costs of waste disposal or remediation of landfills. An exception is the city of Zagreb where the price of MSW collection is higher with 475 Kn/t per household and year (64 EUR), as it includes costs of landfilling and remedial activities for Zagreb's Jakuševac-Prudinec landfill. (cf. *OG No. 130/05* and *OG No. 85/07*) The following table gives a comparison of the costs of landfilling of some European countries and Croatia, showing that even though costs are lower in Croatia, they are in the range or even above those of the new EU members, like the Czech Republic and Hungary.

Table 9. Costs of MSW disposal in some European countries and in Croatia (including taxes), 2003. Source: Country Reports CEWEP Congress, Amsterdam, Sep. 2004, retrieved from *OG No. 85/07*, (selected data).

Country	**Costs of disposal**	
	kn/t	**EUR/t**
Austria	450 – 975	60 – 130
Czech Republic	240	32
Denmark	450 – 825	60 – 110
Germany	112 – 1.500	15 – 200
Hungary	75 – 150	10 – 20
Italy	675 – 825	90 – 110
Netherlands	825 – 975	110 – 130
Portugal	94 – 290	125 – 386
Sweden	375 – 750	50 – 100
Switzerland	150 – 968	20 – 93
Croatia	**150 – 450**	**20 – 60**
City of Zagreb[33]	450	60

[32] In tourist places along the coast, waste is collected every day during the season.
[33] The costs for Zagreb include costs for the remediation of the Zagreb landfill.

As shown in *Fellner* (2005), the costs of landfilling can be plotted against the GDP, which gives a general insight into which type of landfill a country can afford. The graph below shows this relationship.



Graph 7. Disposal costs of landfill strategies. Source: *Fellner, 2005*.

With a GDP per capita of about $14,000 (or €10,600) and disposal costs at 20-60 €/t, Croatia should actually be able to afford sanitary landfills, which are, in fact, the aim of the new WM system which is in the process of being set up. Instead, at the moment the country has mostly controlled dumping or engineered landfills. However, it has to be noted that the GDP per capita amounted to only half of today's GDP in 1999, with €4,751 (*HNB*), and in the first half of the 1990s the situation was even worse due to civil war raging in Croatia and economic activity having collapsed with the fall of Yugoslavia. At the time, sanitary landfills were economically out of reach.

However, Croatia is now in the position where it has to change its WM system. If we take 327 kg of MSW per capita and year and average disposal costs at 40 €/t, we can calculate the costs as amounting to €13/capita/year. This equals **0.12% of the GDP**[34].

The goals of WM are, first, the protection of human beings and the environment and, second, the conservation of resources. According to *Brunner and Fellner* (2006) highly developed countries, having reached the first goal, concentrate on the second one. However, those countries that have not yet managed to introduce full collection

[34] Compared to this, according to *Brunner et al.* (2006), Austria spent €106/capita/year in 2002, which was 0.40% of GDP (27.300 €/cap). The country produced 540kg waste/capita.

of all household waste, and thus fulfil the first goal, cannot start upgrading their present dumps to sanitary landfills[35]. As Croatia has almost reached full collection of all household waste, with some municipalities still in need of investment, and illegal dumps in need of being fully eliminated thus, it can start the upgrading to sanitary landfills. However, to finance this, the disposal costs will become higher, which will make it necessary to increase waste collection fees, since 0.12% is far from being sufficient.

3. Assessment of the Present Waste Management System

As the Croatian authorities are well aware of and emphasized in the Strategy (*OG No. 130/05*), management of MSW has been conducted in an unsustainable manner in Croatia for decades, with disposal of waste on non-sanitary landfills or even uncontrolled dumps. After the country's independence, nothing has been done until 1995, due to the state of war.

At present, the situation of MSW management in Croatia can be assessed as follows:

- landfilling is the only feasible option at the moment;
- there are too many landfills because regional and local authorities have rarely taken the opportunity in the past to collaborate and form partnerships;
- waste flows and quantities are still not precise enough which makes it more difficult to estimate quantities and plan capacities of future facilities, but steps have been undertaken to eliminate this problem (by AZO);
- laws are not being fully obeyed;
- waste prevention measures have been non-existent in the past, probably due to a lack of government and public awareness;
- the rate of recycling is poor;
- fees for MSW management are high from the point of view of citizens, but actually too low (with the exception of Zagreb) and will certainly not be sufficient for covering the costs of future landfilling;
- there is a lack of education on WM and knowledge on EU standards and trends in the field;

[35] Sanitary landfills are the next step after engineered landfills. They are more complex in design and techniques, with additional features like landfill gas control and utilization, extensive emission monitoring, leachate treatment, post-closure plan and aftercare, etc. (*cf. Fellner, 2005*)

- the free market system and the "polluter-pays principle" are applied to an insufficient extent (cf. *OG No. 130/05*).

Thus, as the Plan (*OG No. 85/07*) pointed out in 2007, "cities and counties organise the collection and landfilling of waste in a way which cannot be called an integrated waste management system".

In addition, a great number of existing landfills is at the end of their capacities, without the new integrated system having yet been installed. There is a huge number of illegal landfills and dumps which will consume a lot of investment for remediation. In the past, various types of waste, including electric and often hazardous waste, have been disposed of on landfills for municipal and non-hazardous waste. In this respect, the special type of geological features – most notably the karstic terrain prevalent in many parts of Croatia – has not been taken into account, which has posed a danger to ground and surface waters.

A great problem is the negative perception of the public, which is a result of the lack of awareness and education about WM. The prevalent attitude is a "not-in-my-backyard" attitude, which makes people protest against locations of new sanitary landfills or waste incinerators, prolonging the prevalent WM problem.

However, there are also some positive steps that have been undertaken in order to start with the process of improving WM. The Environmental Protection Fund (EPEEF) is working on rehabilitating illegal landfills, of which there are numerous, and the Environmental Protection Agency (AZO) has set up a register of landfills and waste quantities. Also, as pointed out in the State of the Environment Report (*Dragičević et al., 2007*), until 2004, there has been a lack of strategic documents, which would set priorities and steps for a better system. This has changed with the pre-EU-accession of Croatia and the passing of the new Waste Act and various ordinances, including above all the Landfill Ordinance, as well as the Strategy and the Plan on national level, and waste management plans and programmes on regional and local level. The course has been set for the future integrated WM system to come into existence and the first steps have been undertaken. The following chapter will deal with the features of the future system as well as the problems encountered in the actions undertaken so far.

V. CASE STUDY

THE FUTURE SYSTEM OF WASTE MANAGEMENT ON THE EXAMPLE OF THE PRIMORJE – GORSKI KOTAR COUNTY

In order to be able to assess the progress and problems of Croatia regarding the implementation of the Landfill Directive, the plans for a future system as well as the already undertaken steps in establishing the new WM system need to be assessed. However, as it would be too extensive for the scope of this thesis to describe processes in all of Croatia, one county was selected for conducting a case study, the Primorje – Gorski Kotar County, with the city of Rijeka at its core. The selection fell upon this county due to availability of data as well as the interesting features in economic and geographic terms – the county has a combination of tourism and industry on the one hand, and karstic mountainous terrain and coast on the other. By means of this case study, it will be above all exemplified how the county plans to implement the new provisions regarding the future WM system, set down in the Waste Management Strategy (OG No. 130/05) and Waste Management Plan (OG No. 85/07). Since the process of implementation has already started, the progress achieved and the problems encountered so far will be analysed. This will provide the final basis for the concluding analysis of Croatia's progresses in WM, with emphasis on landfilling of MSW, within the scope of the pre-accession process and implementation of EU's waste *acquis*, above all the Landfill Directive.

1. Basic Information on Primorje – Gorski Kotar County

1.1. Key Figures

The Primorje – Gorski Kotar County (PGZ) is one of 21 Croatian counties, situated in the northern Adriatic, in the north-west of Croatia. According to latest statistical information (*PGZ Homepage*), it has a population of 305,505 inhabitants, with Rijeka, its capital, having 144,043, and a density of 85 inh/km². The greatest part of the population lives in the coastal regions, above all in and around Rijeka. There are altogether 14 cities and 22 municipalities (which have the status of local self-government units), as well as 510 further settlements.

Figure 2. Location of the Primorje – Gorski Kotar County. Source: *PGZ Homepage*.

Geographically, as its name says in Croatian, it is a mix of coastal areas and islands (Primorje) and mountains (Gorski kotar), with the highest peak reaching 1,534m above sea level. The soil is characterized by karstic terrain which is very porous and thus problematic regarding landfill locations. The territory of the land area measures 3,588 km², the total area incl. the sea is 7,990 km², and the total length of the coast is 1,065 km. It has a number of islands, two of which are the biggest Croatian islands, Krk and Cres.

Figure 3. Subdivision of the Primorje – Gorski Kotar County into administrative districts/local self-government units, i.e. cities (red) and municipalities (green). Source: *PGZ* Homepage.

Economically, the county is among the richest in Croatia, alongside the City of Zagreb and Istria. It relies very much on tourism, but also industrial activity in Rijeka, the biggest and most important Croatian harbour. The County's share in the total revenue of Croatia amounts to 5.9%.

2. Responsibilities and Goals of the County According to Waste Management Legislation

2.1. Legal Responsibilities

The basic principles of protecting men and environment, avoiding emissions, preserving resources and sustainable development, to be achieved by means of waste prevention, recycling/reuse and disposal are the main guiding principles on all levels of administration, and thus also on county level. This is reflected in the main implementation document of the County, the Waste Management Plan of Primorje – Gorski Kotar County, hereinafter PGZ Plan (OG PGZ No. 17/07). All the guidelines discussed in the part of the thesis on legislative framework that apply on the national Croatian level, apply to the same extent in the individual counties. In Part III, chapter 4.3. of this thesis the responsibilities of counties, municipalities and cities were discussed.

To recapitulate, counties have to pass waste management plans on county level establishing the framework for implementation of national waste laws and strategies and determine locations of MSW landfills in their physical plans, while municipalities and cities need to pass their own waste management plans containing measures regarding MSW management. While counties are responsible for industrial and construction waste, packaging, electronic waste, waste cars and tyres, municipalities and cities organize the collection and handling of MSW.

2.2. Foundations of the New System

Waste management is one of the most important priorities of PGZ, which is shown through the fact, that PGZ, together with Istria, adopted the proposals made in the Istria – Rijeka Region Solid Waste Study (*Rambøll, 1996)* on an integrated WM system in these two regions more than a decade ago. This study, conducted by the Danish consultancy Rambøll, proposed already in 1996 only one sanitary landfill for each county, supplemented by recycling activities (both to be set-up by 2004), as well as an incineration plant in Rijeka (by 2009). This extensive study took into account all the influencing factors, analysed different scenarios and possibilities of WM including the costs that can be realistically invested, before it came to this conclusion. This study, and the acceptance of its recommendations by PGZ, is often referred to as a leading document (e.g. in *Hidroplan, 2006*), however, it is evident

that the recommendations have not been implemented in the proposed period until 2004 (and the idea of a waste incinerator was rejected altogether in the end). The situation is much different now that Croatia has to comply with EU legislation, without the option of bailing out.

The foundation for further steps in the establishment of the new system is given by several key documents, among them,

- the development plan of PGZ from the year 2000;
- the establishment of the company EKOPLUS in 2001 by the county, the city of Rijeka and the public utility company Čistoća, which will be the operator of the new regional waste management centre (RWMC) Marišćina;
- the environmental impact assessment for RWMC Marišćina in 2001;
- and the cooperation agreement between all units of local self-government of the county regarding their mutual relations and responsibilities in the new, integrated management system for MSW and non-hazardous technical waste.

Furthermore, the necessary analyses, projects and plans, particularly those for the establishment and operation of RWMC Marišćina, were issued in the last 3-4 years. Thus, all the fundamental documentation for starting the establishment of the new WM system is given. (cf. *Hidroplan, 2006*)

3. MSW Management in the County until Present

The system of MSW management in PGZ has been the same as in all other Croatian counties. It has relied on a number of landfills within the county, with each local community having a public utility company operating one landfill. This means that a large number of locations are used, and due to the limited area, often located too close to human settlements. These areas with their non-sanitary landfills cannot be used for other activities and pollute the environment. In the past, almost all types of waste have been disposed of at these locations, including hazardous waste. (cf. *Rambøll, 1996*)

3.1. Assessment of the Present WM System in PGZ

In spite of efforts made, legislation passed and studies conducted in the past decade, improvements of the WM system have not occurred to a sufficient degree. As the PGZ Plan (*OG PGZ No. 17/07*) points out, waste is still not being taken care of properly, as prescribed by the Waste Act (*OG No. 130/05*), and legislative provisions are often ignored. There is almost no primary selection of waste, no pre-treatment or analysis of waste before landfilling, disposal sites are at the end of their capacities even though the new RWMC will not start working before the end of 2011, and they do not comply with technical requirements. Also, even though the information system for registering waste quantities and flows has been set up nationally, waste data collection is not sufficiently carried out. Furthermore, what needed to be done (according to the adopted study by *Rambøll* from 1996 as well as national legislation), has not been achieved: the construction of a RWMC, transfer stations and recycling yards, and remediation of existing landfills. If one looks exclusively to present legislation, the official deadline for the first three facilities is 2011 (as prescribed by the national Plan, *OG No. 85/07*), but the existing landfills should be remediated by the end of 2009, which will hardly be possible.

Public awareness of the waste problem and the difficulties in solving it is raised by repeated newspaper articles as well as regional NGOs[36]. Thus, the most read PGZ newspaper, Novi list, wrote in February 2009 about Rijeka being smothered by waste (*Novi list, 18.02.2009*). It emphasised the problem of a growing waste quantity for which Rijeka's landfill Viševac does not have any more capacity.

3.2. Current Waste Collection and Disposal System and Costs

Until now, only MSW has been collected in an organized way. As Graph 3 showed before, around 97% of the county's population is covered by the collection system. This is quite a good result, especially since a decade ago several smaller settlements were not yet covered (*Rambøll, 1996*).

PGZ has **ten landfills** and nine public utility companies that collect waste and bring it to the landfills. Most of these landfills have been in operation for a very long time or are too small for the area they cover, and are, thus, at the end of their capacities.

[36] Particularly the citizens' action group *Smokvarijska lista* whose main scope of action is waste management in Rijeka and, in particular, the Viševac landfill.

Neither of the ten landfills is appropriately equipped, there is no pre-selection, the sanitary and technical conditions are not sufficient, there is no fire-protected access, etc. Exceptions are three larger landfills, including the biggest, Viševac, serving Rijeka, which are somewhat better, but by far not sufficiently equipped. (cf. *Hidroplan, 2006*) The figure below shows a map of PGZ's present landfill sites.

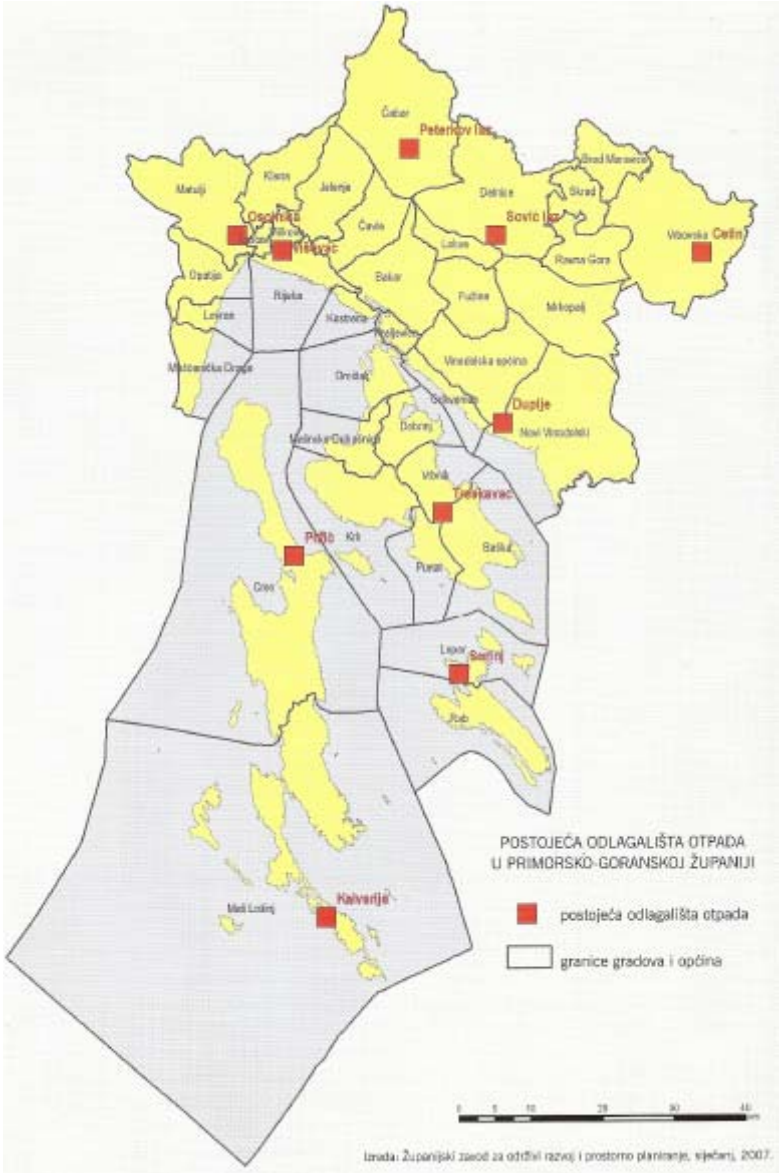


Figure 4. Existing landfills in the Primorje – Gorski Kotar County. Source: *PGZ Plan (OG PGZ No. 17/07)*

Collection is based on containers and bins placed on streets at several locations in the towns (depending on the size), including at some locations containers for separate collection of paper, glass, plastics/glass/metal, and bio-waste. As regards the efficiency of separate collection, *Hidroplan* (2006) stated in its study that it can be considered better than in the rest of the country. The public companies carrying out the collection are well equipped with various waste collection vehicles. Thus, the

state of collection can be assessed as sufficient, while the state of landfills themselves is insufficient.

As regards the **costs** of waste management, Article 20(2) of the Public Utilities Management Act (*OG No. 26/03*) stipulates that the public company providing the service of waste collection and disposal determines the height of the fee[37]. In PGZ the tariff models of the different companies vary: most calculate the price according to the size of the house/apartment in m² (which is the most common method), but two companies base their fees on the household independent of the size, and one company on the number of persons living in a household.

3.3. Municipal Waste Quantities

As regards total waste collected in Croatia, *AZO* reported (*2007*) that the Primorje – Gorski Kotar County produces the third largest share with 8% after the City of Zagreb (26%) and the Split-Dalmatia County (14%). A special feature is the large increase of MSW generation during the summer season, resulting from extensive tourism.

In its study on a concept for the establishment of an integrated waste management in PGZ, *Hidroplan* (2006) gave estimations of waste quantities in the county. Since waste is neither weighed nor controlled, it based its calculations on the following parameters:

- number of PGZ inhabitants;
- 0.2% population increase per year;
- number of tourist overnight stays[38] plus 50% for seasonal workers, not registered tourists and workers;
- the amount of 270kg of waste/inhabitant/year and 1kg of waste/tourist/night.

The amount of **MSW generated in PGZ** in 2005, according to estimations by *Hidroplan* (2006), is **92,775 tons**, of which 77,002 t is produced by the constant inhabitants of the county, and 15,753 t by tourists.

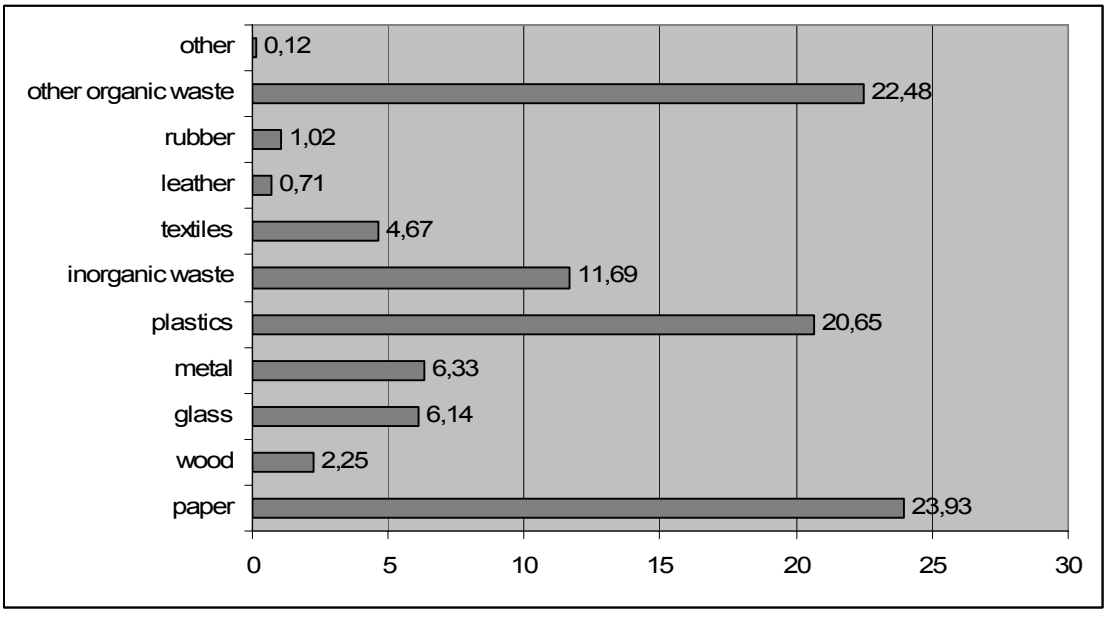
In *AZO* (2007) we can find the quantities of MSW officially registered by waste collection companies with AZO in 2006. According to AZO's data, the total amount

[37] In case of changes of the fee/tariff amount, the company needs to get an approval by the responsible local government (*OG No. 26/03, Article 21(1)*)
[38] There are 10,501,921 overnight stays per year in PGZ (*Hidroplan, 2006*)

of MSW collected in PGZ was **153,314.72 tons**. Of this amount 139,162.54 t were mixed MSW and the rest of 14,152.18 t was separately collected MSW. According to registration forms for companies managing MSW, the amount of landfilled mixed MSW was **91,045.57 tons**.

The PZG Plan (*OG PGZ No. 17/07*) gives a third figure regarding waste quantities. According to this document, in 2005 the amount of MSW collected by all public utility companies in PGZ was 186,867.5 tons and the amount of disposed of waste in the ten landfills was a total of 183,944 tons.

All three datasets, one from Hidroplan, the second from AZO, and the third from the PGZ Plan show somewhat different results, which exemplifies how difficult it is to obtain as exact an amount of MSW as possible. While Hidroplan relied on estimations, which is not optimal, AZO had to count on public utility companies collecting waste and operating landfills to fill in registration forms with their respective amounts of waste collected or treated, which is neither an optimal way, since reportedly not all companies completed this task. The PGZ plan took the data from a survey of all the County's public utility companies. Such discrepancies are, of course, not only the case in PGZ, but all over Croatia, and show the dire necessity of a new system which incorporates waste weighing installations and would, thus, provide exact waste quantity data. The following graph shows the mass percentage portions of different waste types in MSW landfilled.



Graph 8. Mass percentage (%) share of individual waste types in MSW. Source: *Hidroplan, 2006*.

While it has to be taken into account that the percentages in the above graph are estimations, it nonetheless shows that the fractions of paper, plastics and green/organic waste are comparably high, which leads to the conclusion that there is no pre-sorting or separate collection of MSW. However, *Hidroplan* (2006) also found out that the amount of metal in waste is rather low, which means that it is separated from the main MSW flow. While the share of plastics was very high in 2006, this has very likely decreased considerably since the new amendments to the Ordinance on Packaging (*OG No. 97/05*), which introduced financial stimuli for returning plastic bottles and some other packaging. Visually at least, plastic bottles have disappeared from MSW.

As regards non-hazardous waste, in 2005 it amounted to 33,954 tons, which means that the **overall amount of waste** that needed to be **disposed of** was **121,413 tons** (*Hidroplan, 2006*).

Even though the world is in the middle of a world-wide economic crisis, the future prospects for waste qualities remain the same, since economic upturn will happen sooner or later again. While the population is expected to grow only slowly, by 0.2% per year, but economic wealth will go up as well as the number of tourists and, thus, the amount of waste generated (*Samokovlija Dragičević J., 2007*). This will certainly not make it easier to deal with the waste generated in the County.

3.4. Viševac Landfill – a Special Problem

Viševac is the third biggest landfill in Croatia, after Zagreb's and Split's landfills. The landfill serves the city of Rijeka and the immediately surrounding municipalities. It is located 10 km north-west of Rijeka, in the Viškovo municipality. It started operating in 1964, and since then an amount of about 1.5 million m³ of waste has been landfilled on its area of 75,000 m². An amount of 55,440 tons was landfilled there in 2005[39]. (*OG PGZ No. 17/07*)

The landfill is better equipped than most other PGZ landfills. It is enclosed with a fence, has fire protection, built in wells for passive degasification; the waste is spread and baled, as well as covered with inert material every day; there is air

[39] Of this amount 44,234.64 tons are MSW and 11,205.73 tons are non-hazardous production waste (*Hidroplan, 2006*). At least as regards this amount, Hidroplan and PGZ Plan provide the same total amount.

quality, noise, landfill gas and groundwater quality monitoring; measures of rat control and disinfection are carried out regularly; journals on landfill operation and waste quantities are kept. (*Hidroplan, 2006; OG PGZ No. 17/07*)

Figure 5. The Viševac landfill with adjacent Sovjak[40] hazardous waste landfill. Source: *OG PGZ 17/07*.

However, the Viševac landfill has the most pressing problem among all PGZ landfills regarding its capacity. In fact, *Hidroplan* (2006) estimated in 2006 that the landfill will be able to operate one more year, while the PGZ Plan (*OG PGZ No. 17/07*) stated that its capacity will be exhausted by the beginning of 2008[41]. At the time of this thesis, i.e. May 2009, the landfill was still in operation, as there was no other option regarding disposal of waste from Rijeka.

[40] While it is not within the scope of this thesis to deal with the Sovjak landfill, it needs to be pointed out that this "black spot" is one of the most serious problems in the region as well, as the landfill, on which hazardous waste was landfilled from 1956 until the end of the 1980s, represents a constant danger to groundwater and soil due to its toxicity. The most hazardous waste came from Rijeka's refineries and shipbuilding.

[41] Most other landfills have enough capacity until 2010-2011 or even longer, so they can go on operating until the set up of the beginning of operation of the WMC in 2011. However, the second largest landfill, Osojnica, will also be out of space sooner than 2011, probably by 2010 (*OG PGZ No. 17/07*).

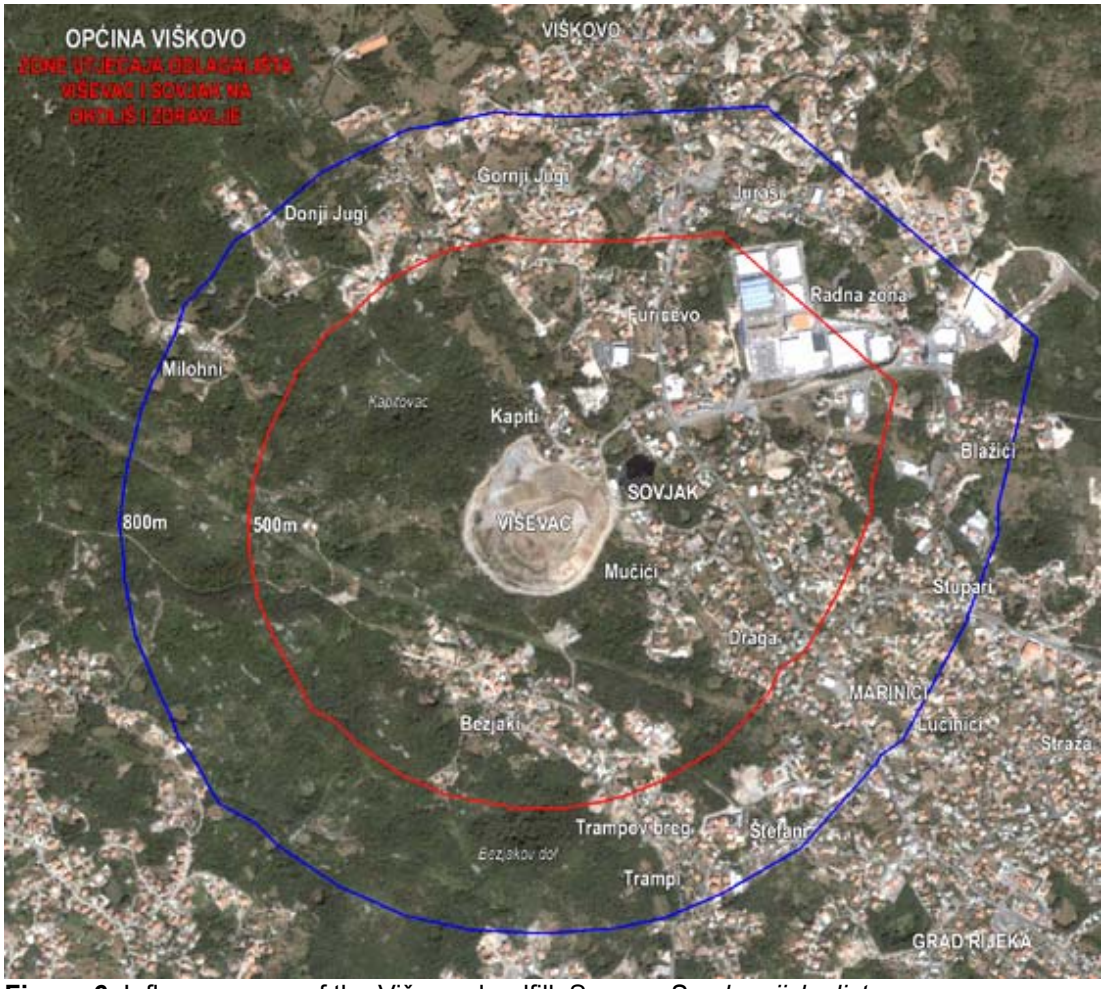


Figure 6. Influence zone of the Viševac landfill. Source: *Smokvarijska lista*.

The Viševac landfill is a constant bone of contention in the region, due to its obvious negative effects on the surrounding environment as well as vicinity to human settlements – there are many houses already within 500m of the landfill, as seen in the figure above (*Smokvarijska lista).* It is now obvious that landfilling is continuing in spite of a lack of space and growing annual waste quantities. In fact, according to a recent article in *Novi list* (18.02.2009) the landfill's maximum height of 330m above sea level is reported to have already been exceeded by 14m. The operator tried to obtain a license for extending the landfill, but the local government did not grant it due to great pressure from the opposition.

4. The New Integrate System of Waste Management

The new integrated system of WM in PGZ is based on the 1996 METAP study on waste management in Rijeka and Istria (*Rambøll, 1996*), adopted by the County, which is in line with the new requirements of Croatian legislation, aligned with the European Union one. The concept of the new system is based on the 2006 *Hidroplan* study which gives the technical and economic basis as well as the estimated waste quantities in the future[42]. According to *Hidroplan* (2006), the new system is actually not completely different than the old one, which should serve as a basis. Even if waste will be disposed of only at one location, the RWMC Marišćina, the collection of waste will remain the responsibility of the existing individual public utility companies, just as until now.

The main components of the new integrated waste management system will be, as proposed by *Hidroplan* (2006) and adopted by PGZ (*OG PGZ No. 17/07*):

- RWMC Marišćina – central waste management and disposal facility
- Transfer stations – waste will be redirected to RWMC Marišćina
- Network of recycling yards and "eco-islands"[43]
- Waste collection system

4.1. Central Waste Management Zone – RWMC Marišćina

The RWMC Marišćina will be the central waste management zone for PGZ consisting of buildings and facilities for the treatment, recycling and disposal of MSW and non-hazardous production waste. According to *Hidroplan* (2006), the RWMC should be able to take care of the county's waste for the next 50 years[44]. The location was determined by the EIA for a WM facility in PGZ (*Ekonerg, 2001*), which concluded that the location in Marišćina was the best among four possibilities. Another option was the location Rojno, proposed as the best one by *Rambøll* (1996). In fact, there was a lot of controversy regarding the selection of Marišćina, as can be seen from newspaper articles and NGO reports, like the one of *Mažuran* (2008), which gives an account of how the decision regarding Marišćina was taken, and shows that municipalities involved were fighting over the "best" location. It

[42] Basic assumptions: 275kg/inh. in 2009, increasing 2% by 2015, and 1.5% by 2030; 1kg/tourist/night; population covered by collection: 100% (*Hidroplan, 2006*)
[43] Sets of containers for separate collection of MSW put at various locations in towns.
[44] The estimated amount of waste landfilled at the RWMC will be 65,250 t in 2015 and grow to 73,100 t in 2035.

remains a question why Rojno, which was probably a better location regarding EIA, and therefore opted for by the Danish consultancy *Rambøll*, was not selected. While not proved, it can be assumed that (municipal) politics, but also business on the side of influential stakeholders played the crucial role.

As the basis of the new system lies in 1996, the new RWMC Marišćina is considered to be a pioneer in Croatia, complying with Croatian and EU laws, but having, in fact, been planned and projected already before or in parallel with the set-up of new, EU-conform legislation in Croatia, including the Strategy and the Waste Act. Nevertheless, the project is lagging behind the envisaged deadlines, which is mostly due to suits and legal proceedings initiated by the Viškovo municipality or private persons. Still, the delay is not too big because the operator, Ekoplus, made sure to go on with preparatory tasks in parallel. (cf. *Samokovlija Dragičević J., 2007*) However, while it was planned for the first phase of RWMC, which is necessary for the start of landfilling, to be finished by the end of 2010, it will probably not start before some time in 2011.

The RWMC Marišćina is located, just as the old Viševac landfill, in the Viškovo municipality, but further away from the city centre (11km). At a height of 463 to 515m above sea level, it will occupy an area of 42.5ha.

The concept of activities carried out at RWMC Marišćina will be based on the following key actions: acceptance of (non-) sorted waste, MBT, landfilling of the residual waste with as low organic content as possible, reduction of disposed waste to 30% of incoming amount, treatment of landfill gas and leachate. There will be no disposal of waste without prior treatment. (cf. *Ekoplus*)

According to *Hidroplan's* extensive study (2006) and *Ekoplus* documentation, RWMC Marišćina is divided into three basic elements:

a) Working zone – with three plateaus, for the acceptance and recycling of waste. The first plateau will have a guardhouse, a weighbridge, registration of incoming waste, parking space for the trucks and a spare room. The second plateau will have the MBT facility, waste water treatment, an installation for the production of refuse derived fuel and one for the treatment of separately collected MSW. The third plateau will have rooms for bulky waste and for construction waste, a

recycling yard, facilities for truck maintenance and electricity, the administrative building and an installation for landfill gas treatment.

b) Sanitary landfill for the final disposal of the unusable waste fraction, having three parts. The landfill will be built in phases depending on waste quantities.

c) Monitoring system for the operational time of the centre as well as at least 10 years after closure (ambient air, noise, soil and groundwater).

Figure 7. Planned design of RWMC Marišćina. Surce: *Ekoplus homepage*.

The RWMC will be built in three phases due to the complexity of the project. The first phase, to be finished by 2011, so that the centre can start operating as planned and stipulated by the Plan (*OG No. 85/07*), will comprise a new municipal road meant to ease the future traffic, the working zone and the first part of the landfill with 500,000 m³. According to *Ekoplus*, this will be sufficient for the first 8-10 years of operation. A protective belt will be built 50m around these first facilities with high vegetation for visual purposes.

With the construction of the bypass road leading to the RWMC in the beginning of 2009, the construction of the facility officially started, albeit with a delay. In May 2009, the last big obstacle fell, when the European Commission approved non-refundable IPA funds for RWMC Marišćina amounting to 8 million EUR, which Ekoplus awaited with great anticipation. These new developments were first reported by the county newspaper *Novi List* at the beginning of *May 2009*. The reporters also asked the operators for a prospective date when the RWMC will start working, but they did not want to give a definitive answer yet, since the detailed agreement with the European Commission is being set up at the moment.

4.2. Transfer Stations

Some cities and municipalities are located too far away from RWMC Marišćina to make it cost-efficient to transport waste directly to the centre. Therefore, Croatian legislation (e.g. the Plan, *OG No. 85/07*) stipulates the set-up of so-called transfer or transhipment stations for temporary storage (hours/days), compaction, and transport in bigger trucks or containers to the central WM facility. In fact, already *Rambøll* recommended such a system in 1996. *Hidroplan* (2006) proposed in its study 5 transfer stations (shown in the graph below), to serve places that are more than 40km away from the RWMC. Four of these stations will be built at locations of existing landfills which will be closed. As pointed out in the PGZ Plan (*OG PGZ No. 17/07*), what will be certainly necessary is an additional transport system from the transfer stations to RWMC, which has not existed before, including new vehicles with higher carrying capacities, suitable for longer distances.

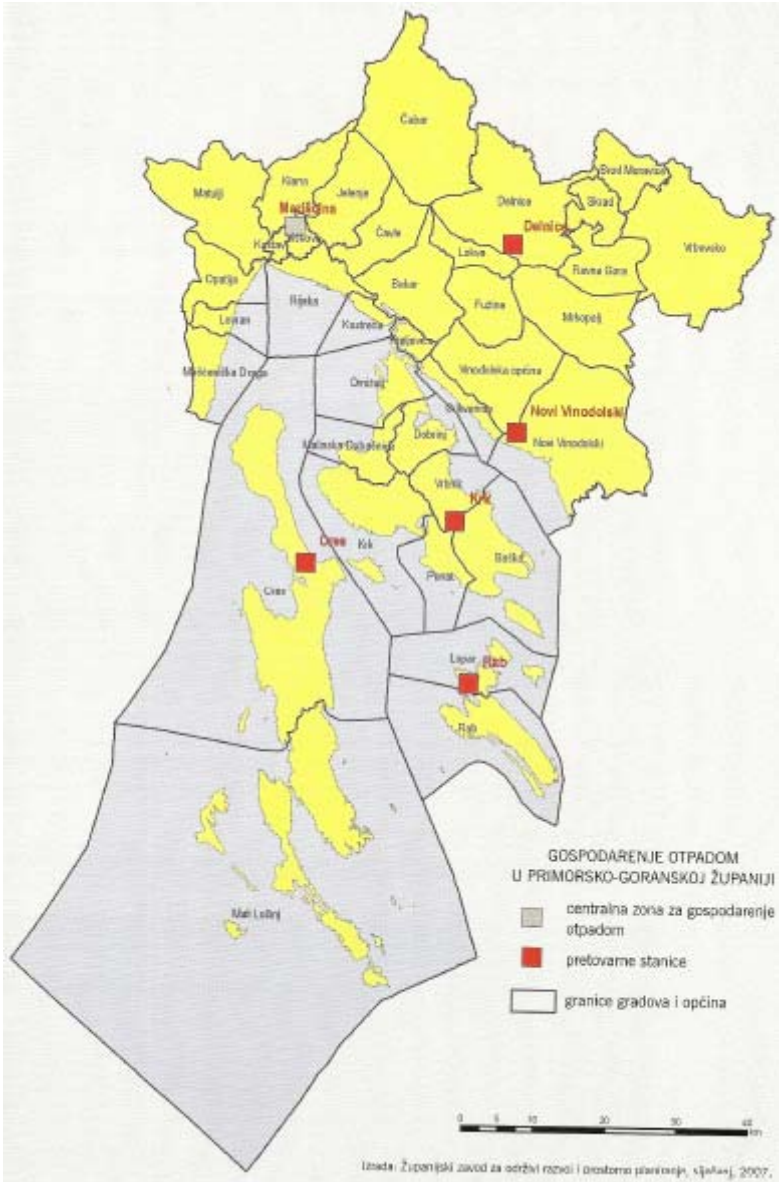


Figure 8. New WM system of the Primorje – Gorski Kotar County with RWMC Marišćina (grey) and locations of transfer stations (red). Source: *OG PGZ No. 17/07*.

4.3. Recycling Yards and Eco Islands

Another important feature of the new integrated WM system, as proposed by *Rambøll* (1996), but also now prescribed in Croatian legislation (e.g. in the Plan, *OG No. 85/07*), is a network of so-called recycling yards. These are specially equipped places for the separate disposal of useful portions of MSW. Such a recycling yard can be a public surface with containers for the various recyclable waste types or a facility for selection and temporary storage of special waste types. Recyclable waste can also be treated there, but not necessarily. Many of them will be located adjacent to transfer stations. The difference regarding the RWMC's own recycling station is

that these small recycling yards are exclusively meant to be temporary acceptance and storage areas, while the final treatment – fine sorting, compacting, baling – takes place at the RWMC. Recycling yards need to have separate containers at least for paper, cardboard, glass, plastics, metal, green (biodegradable) waste and hazardous components of MSW like batteries, accumulators and medicine. According to the PGZ Plan (*OG PGZ No. 17/07*) it was planned to set up 17 recycling yards by 2008, as a first step. This has not been achieved yet fully, but rather delayed, with the aim being to have the yards ready by 2011, when the RWMC starts operating. Further yards will be established by 2015, so that there is a total of 25, and again by 2025, when the County should have 33 yards, in order to be able to fulfil the Strategy's (*OG No. 130/05*) aim of having 25% separately collected waste by 2025. The separate collection system in PGZ will be supplemented by "green islands"[45] with containers or bins for separate collection of waste.

4.4. Prevention and Recycling Measures

While the most extensive measures planned for the future system deal with the third principle in the "waste hierarchy", namely final disposal, the two other, crucial principles – waste prevention and recycling/reuse – seem to be discussed insufficiently in various policy-defining documents. In its proposal for a new concept of WM, *Hidroplan* (2006) took into consideration the hierarchy and pointed to measures regarding prevention and recycling of waste, albeit not in too much detail. What Hidroplan proposes are the evident measures: education of the public, the administration and the experts; introduction of cleaner products and production processes; a Croatian waste market; introduction of fees for burdening the environment with waste. The study also pointed out to the necessity of reducing the pressure on PGZ's environment, especially the many protected areas, the vulnerable and porous karstic soil (which also requires the strictest conditions for constructing facilities) and islands. As regards recycling, the most important measures, also recognized by Hidroplan, are the provision of accessible recycling options for citizens. The number of recycling yards and "green islands" needs to be increased, and, if necessary, waste separately collected directly from households.

[45] There will be as many as deemed necessary by the public utility companies collecting MSW (*OG PGZ No. 17/07*)

Public awareness in Croatia is extremely low, and education regarding this topic is crucial. All these measures are also proposed in Croatian legislation, most notably the Strategy and the Plan. However, the extent to which they are dealt with as compared to final disposal of waste is rather low. Also, the PGZ Plan, which represents the uppermost implementing document in the county and gives general guidelines for the period 2007-2015, does not deal with these measures in any detail. It only points to them while quoting the goals given by the Strategy.[46]

4.5. Remediation of Uncontrolled Dumps

While the PGZ Plan does not at all mention the remediation of uncontrolled dumps[47], this is regulated by the County's Plan of remediation of soil contaminated with waste and uncontrolled landfills (*OG PGZ No. 34/04*), which stipulates that local self-government units, i.e. cities and municipalities, are responsible to pass own plans and carry out the remediation of open dumps. However, *OG PGZ No. 34/04* gives a list of such dumps, of which there were altogether 170 in PGZ, ranging from small ones (with a volume of a few dozen m³) to larger ones (of up to 20-50,000 or one of even 100,000 m³). The total costs of remediation were estimated at about 5.9 million Kn (~ 0.8 million EUR), which is very little, as there is only an average of about 5,000 EUR available for each dump. Financing for remediation is provided by the County, the local government, EPEEF, legal persons on whose ground the waste is located, public companies, etc.

Thus, it can be seen that even an economically well developed County like PGZ has a big problem with uncontrolled dumps that need to be cleaned up and eliminated. While it was found out that local self-government units have passed legislation – Plans, published in the County's Official Gazette – regarding remediation of open dumps, no information was obtained on the actual number and state regarding this topic. It can be assumed that actions have been undertaken, since financial means have been provided, above all by EPEEF, but that he problem still remains a pressing one, as can be judged from the latest Croatian-wide State of the Environment Report (*Dragičević et al., 2007).*

[46] An efficient compulsory measure could be the introduction of environmental education in kindergartens and schools, to shape the way of thinking of the young generations in a sustainable way. Some work is being done in this respect by NGOs, but this is too little.
[47] Here, remediation includes measures to remove the uncontrolled dumps from the land-scape. The waste needs to be transferred to official landfills and the ground rehabilitated.

4.6. Remediation and Closing of Existing Landfills

The Plan reported in 2007 (*OG PGZ No. 17/07*) that almost all public utility companies managing the existing landfills had started remediation activities, co-financed by the local self-government, the County and the EPEEF. Also, in 2007 the EIAs for most landfills, including Viševac, have been carried out. Thus, as regards Viševac, the remediation, which will also include the hazardous adjacent Sovjak landfill, will encompass the installation of a system for active extraction and flaring of landfill gas and a landfill cover of "composite" material which will also include stabilized material from treated waste of the Sovjak landfill[48]. By 2006, when *Hidroplan* (2006) published its study, part of the remediation actions at the Viševac landfill were already carried out with the help of EPEEF's financial help, namely the design of the final slopes", the construction of a waterchannel for the collection of rainwater, the final, multi-component cover of 3,500 m² on the first field of the first landfill cell, monitoring stations for air quality and noise measurements, a fire protected way and protective fence. The total costs of remediation were estimated at 45 mill. Kn[49] (about EUR 6.1 million). As seen from the PGZ Plan, in 2007 the remediation was planned to be finished by the end of 2009, the year when the RWMC was supposed to start working. As reported by *Samokovlija Dragičević* (2007), at the time several of the existing PGZ landfills were being remediated, with different stages of progress, but with many island landfills promising to be closed sooner, due to the stipulation of the Strategy (*OG No. 130/05*) that there are to be no landfills on islands. However, as already mentioned before in the thesis, and due to the fact that the RWMC will not start operating until 2011, it is obvious that the end of 2009 does not represent a realistically achievable deadline for remediation, since the landfill is still operating, even though its capacity is exceeded, and will most likely continue to do so until the opening of the RWMC.

[48] Remediation plans stipulate that all waste from the Sovjak landfill be taken out and stabilized. The stabilized material will be incorporated into the cover for Viševac. The Sovjak landfill will then be filled with inert and covered with "composite" material. Even though, hazardous waste management is a responsibility of the MEPPPC, in this case the remediation of the Sovjak landfill will be coupled with that of the Viševac landfill.

[49] From 1999 until 2006, 12 million Kn were invested into the remediation of Viševac (OG PGZ No. 17/07)

4.7. Costs of the New Waste Management System

As can already be assumed from the complexity of the new WM system described in previous chapters the costs will be substantial. According to the legislative document, the PGZ Plan (*OG PGZ No. 17/07*), which took the data from *Hidroplan* (2006), the total investment costs for the integrated system of WM in PGZ from 2007 – 2032 will amount to **EUR 50,893,879**. Of this figure, EUR 47,418,879 (or 93.2%) will be invested in the RWMC Marišćina, while the rest of EUR 3,475,000 will go to the set-up of the five transfer stations. The table below gives a more detailed list of the individual costs with deadlines.

Table 10. Overview of investments and deadlines for RWMC Marišćina. Source: *PGZ Plan (OG PGZ No. 17/07)*

Measure	Company	Investment (EUR)	Deadline
Construction of the central building for storing, treating and landfilling non-hazardous municipal waste	**EKOPLUS**		2009
Preparatory tasks	EKOPLUS	**3,718,879**	2009
• documentation, permits • purchase of land • education and public information • inspection		600,000 2,608,879 60,000 450,000	
1st phase	EKOPLUS	**900,000**	2008
• bypass road Marčelji-Studena			
2nd phase	EKOPLUS	**16,000,000**	2008
• construction of landfill cell A1 • area for treatment and storage of construction material • construction of a part of the working zone			
3rd phase	EKOPLUS	**400,000**	2008
• entry-exit zone			
4th phase			2010
• MBT			
5th phase	EKOPLUS	**3,000,000**	2009
• administration building • recycling of construction waste			
6th phase			
• recycling area	EKOPLUS	1,500,000	2010
Equipment	EKOPLUS	**1,000,000**	2009
Total investment by 2015 - Marišćina	**EKOPLUS**	**26,518,879**	
Investment costs for transfer stations		**3,475,000**	2010

• documentation, permits, consulting services • purchase of land • inspection • construction works • equipment		250,000 250,000 100,000 1,750,000 1,150,000	
Total investment by 2015		**29,993,879**	
7th phase			
• preparation for the second phase of composting		5,000,000	2016
8th phase		**1,650,000**	
• closing landfill cell A1 • inspection		1,500,000 150,000	
Total investment from 2015-2017		**6,650,000**	2017
Construction of cell 1B and 1C + inspection		**1,550,000**	2020
Closing cell 1B and 1C + inspection		**10,650,000**	2027
Construction of cell 2A to 2F + inspection		**2,050,000**	2032
TOTAL INVESTMENT		**50,893,879**	

Hidroplan (2006) also calculated the average expected and possible costs of disposal per ton waste from 2010-2032. It based its calculation on the investment costs for RWMC Marišćina and transfer stations (documentation, purchase of land, construction, equipment etc.) and all the estimated operational costs, including labour costs (Ekoplus, RWMC, transfer stations, etc.), transport costs (incl. fuel) and MBT operational costs. Not included were the collection and transport costs from households to transfer stations nor any other operational costs of the individual public utility companies and taxes for environmental pollution. According to estimates regarding population and waste produced, the result was an **average price** of **100 EUR/ton** waste. The following table shows the costs in a detailed breakdown.

Table 11. Structure of the average estimated costs per ton waste in the integrated WM system of PGZ County, represented as the average of all costs from 2010-2032 according to place of generation and type of cost. Source: *Hidroplan, 2006*.

Structure of costs by individual positions		%	EUR/t
Share of RWMC		**75**	**72**
EKOPLUS – administrative costs		6	5
Marišćina – operational costs		17	17
Marišćina – MBT costs[50]		23	22
Financing the investment by loan		21	20
Financing the investment by money flow		8	8
Share of transfer stations (TS)		**10**	**10**
Operational costs TS "N. Vinodolski"		1.5	1.5
Operational costs TS "Delnice"		1.5	1.5
Operational costs TS "Krk"		1.5	1.5
Operational costs TS "Cres"		1.5	1.5
Operational costs TS "Rab"		1.5	1.5
Financing by loan		2.5	2.5
Share of waste collection and transport costs		**10**	**10**
Costs of collection and transport from households to TS[51]		0.00	0.00
Costs of transport from TS/or directly to Marišćina		10	10
Gross profit of the integrated system		**5**	**5**
TOTAL		**100.00**	**97**
Average necessary cost incl. MBT t/y (2010-2032)	**97**		

No official data on collection and transport costs in Croatia could be found, but it can be assumed that they are similar to costs of other Eastern and Southern European EU-members predominantly landfilling waste, as listed in *Hogg's* study on WM costs in the EU (*2001*), and amount to around 60 EUR/t[52]. Thus, the total costs of waste collection, transport and treatment would amount to about 150 EUR/ton which is a fairly high amount if compared to Austria, where the overall costs amount to 200 EUR/t (*Brunner and Fellner, 2006*), of which 120 EUR is spent for waste collection and 80 EUR for disposal (*Brunner and Fellner, 2007*). Accordingly, disposal costs in Croatia would be higher than those in Austria, a country with a double as high GDP.

Today, the costs for waste disposal in PGZ amount to **50 – 60 EUR/ton**, depending on the city or municipality. The new average fee of 100 EUR/ton would be double as high, and it should be the same all over the County (*Hidroplan, 2006*). The study also calculated the average costs per household and month: assuming that a

[50] MBT costs were estimated to 35 EUR/t minus revenues achieved with MBT of 40-50%, according to European practices, which gives a total of 22 EUR/t.
[51] The costs of collection and transport of waste from the households to the TS, a service provided by the public utility companies, are not included here, as they were not estimated by *Hidroplan*.
[52] The prices need to be adjusted to today's prices, thus the amount was increased by about 20-30%.

household has 3 members and produces 1 ton of waste per year, the tariff would amount to **8 EUR/month and household**. Amounting to 1.5% of the monthly income, it can be judged as an overall affordable amount, but as incomes vary strongly across the country, many households could find it too high. At this point it should also be noted that PGZ is experiencing growth, just like the rest of Croatia (albeit less in 2009 and very likely in 2010 due to the economic crisis), which will make the tariff more easily affordable in future.

4.8. Inspection

In order for the entire system to work, regular inspection of waste management activities connected with penalties in case of non-compliance with regulations is crucial. Article 65 of the Waste Act (*OG No. 178/04*) stipulates that the MEPPPC inspectorate as well as the regional county inspectorates is responsible for the implementation of this Act and further national legal acts passed pursuant to it. The responsible county inspection office has to oversee the implementation of the county WM plan and report on the fulfilment of provisions and effectiveness of measures to the county assembly once per year. The county inspectorate is overseen by the MEPPPC inspectorate. In case of non-compliance permits can be withdrawn or penalties imposed. However, as pointed out by the Strategy (*OG No. 130/05*), the number of inspectors as well as the amount of penalties is too low at present and should be increased in future.

VI. CONCLUSIONS

This part of the thesis gives a concluding analysis of the different issues addressed regarding landfilling of MSW in Croatia: the transposition of the Landfill Directive into Croatian legislation; the practical steps taken in order to implement the new legal framework regarding MSW management; and the reasons behind the problems of WM and landfilling in Croatia. What needs to be kept in mind is the urgency of the WM issue in Croatia. As mentioned in previous parts of the thesis, WM is considered to be a priority area regarding environmental protection in Croatia. This is not only due to the hazards it poses to men and environment, but also the fact that the future system will be completely different than the present one, which will make necessary a huge amount of investment. The greatest part of investment will go into the set up of RWMC for managing MSW in large, modern landfills.

Chapter 3 in Part IV of this thesis examined the present state of WM and landfilling in Croatia. To recapitulate, there are many shortcomings that are a relic of the past system: waste quantities and flows are insufficiently monitored; landfills are mostly uncontrolled and waste is dumped without prior treatment or pre-selection; the capacity of most municipal landfills is used up already; the number of open dumps is very high. However, current legislation is quite good and there is hope that, even if regulations were not followed in the past sufficiently, they will be in future due to Croatia's aspirations to join the EU soon and improve the environmental situation.

1. Analysis of the Transposition of the Landfill Directive

Part III of the thesis dealt with the legal framework with emphasis on the transposition of the Landfill Directive into Croatian law, which was carried out with the passing of the Croatian Landfill Ordinance in 2007. Shortly before that, the Commission Progress Report on Croatia (*COM(2007)663*) stated that there was good progress regarding WM and that a "significant amount of legislation and implementing legislation has been adopted for transposition of the *acquis* in this area". This referred most of all to the Waste Act (2004) and the implementing document, the Strategy of Waste Management (2005), which gave a very good framework for all other bylaws.

Even though the requirement of the Waste Act (*OG No. 178/04*) that all laws concerning WM be aligned with the EU waste *acquis* by the end of 2006 was not fulfilled, the greatest part of legislation complied by the end of 2007 – including the new Landfill Ordinance. Overall, it can be said that Croatia put a lot of effort into transposing EU waste laws as soon as possible, and achieved very good results.

All new waste laws comply with European standards and have, in fact, often very similar or even identical provisions like their European counterparts. This can, above all, be said of the legal act under scrutiny in this thesis, the Croatian Landfill Ordinance, which has been transposed in an exemplary way. The new waste management and landfilling legislation is geared towards the achievement of the main goals of WM: reduction of waste generation, reduction of hazards for men and environment, waste recovery through recycling and reuse, reduction of greenhouse gases, and sustainability through non-exportation of waste problems into future by means of an integrated and efficient WM system.

2. Analysis of Practical, Implementing Steps

With the new legislative framework in place, Croatia started the process of practical implementation in 2005, with the passing of the Waste Management Strategy, and 2007, with the passing of the Waste Management Plan with more detailed provisions. These two documents set up a framework of steps that is well worked out and provides a very good basis for practical steps. In order to fulfil the goals of WM – now fully imbedded in Croatian legislation – enforcement steps needed to be taken to reduce waste quantities, provide financial means to set up the new WM structure, strengthen the “polluter pays” principle, and upgrade the municipal landfill system to sanitary landfills.

The construction of regional waste management centres with sanitary landfills for pre-treated waste which would replace the numerous municipal landfills in existence can be seen as the basis and the most important step in the process. It is also among the most investment-heavy steps (cf. chapter 6.4 in Part III). This development also calls for the remediation and closure of existing non-sanitary (mostly uncontrolled) landfills. Landfills on islands are to disappear altogether. EIAs have been carried out for most new WMC and remediation/closure of old landfills. Activities to set up the new system are advancing in all counties, and a number of

landfills and dumps have been remediated and closed, with the emphasis being on island landfills. The process has been furthered mostly by the provision of funds by the EPEEF. However, the deadline for remediation of all existing landfills, set for the end of 2009, will not be reached. Since construction of the new WMCs has not yet started in most counties, even though it was planned to, it is questionable if WMCs will start working by the end of 2011 as stipulated by the Waste Management Strategy. The improvement of the Croatian WM system seems to be marked by substantial delays, today as well as in the past (cf. *Fundurulja et al., 2001*).

In view of the urgency of the waste problem and EU accession, Croatia seems to have finally awoken and started undertaking important steps towards an improvement of the situation. More and more funds are being invested by national and local governments and the EPEEF into remediating existing landfills and dumps and establishing the new system. Recycling has been recognized as a crucial activity and so-called “green islands” with containers for separate waste collection have been placed at many locations. A database of landfills and waste flows and quantities has been set up by AZO, which is a big step forward, even though the data is still not as accurate as it should be.

Waste management has been identified as a priority regarding environmental protection by the government, but there is a lack of public awareness and not much has been done in this respect.

3. Analysis of Problem Areas and Reasons Behind

The future system foresees a complete change to a system made up of sanitary landfills, pre-treatment of waste, MBT, recycling and means of waste prevention. This system should start operating in 2011, which means that many of the steps should have been undertaken already. As seen above, some progress has been made, but there seem to be problems resulting in delays. Even though the legislative framework is given, implementation cannot be judged as sufficient. Construction of WMCs should have started in order for them to be able to start working with 1 January 2012, and remediation and closure of all existing landfills should already be coming to an end. This has been exemplified in the case study of Primorje – Gorski Kotar County, in part V of the thesis. The reasons for these problems and delays are manifold.

In general terms, **administrative capacities** in Croatia are not sufficient, especially at local level, as judged by the Progress Report of the Commission in 2007 (*COM(2007)663*). Also, there is a split regarding environmental issues, including WM, among several bodies, which need to be better coordinated. The number of **inspectors** is too low and should be substantially increased, as well as their income, in order to provide impartial judgements and prevent corruption.

The most important reason behind the delays are probably the **high investment costs** necessary and the lack of resources to cover them. As shown with the WMC Marišćina in the case study, many landfill and WMC operators are waiting for EU funds, even though they only cover a part of the total costs necessary for WMC construction or existing landfill remediation. The bigger part is covered by national and local funds and through the EPEEF.

It needs to be noted that the amount invested for WM has been far too low to be able to operate a sustainable system. As shown in chapter 2.6 of part IV, the **expenses** amount to about 0.12% of GDP at present. This is far too little, and should be four times as much (cf. *Fellner, 2005*). Studies (*Hidroplan, 2006*) of the new system of WM take this into account, and suggest that costs need to be increased substantially, but still remain within the amount affordable to the population. It is upon local governments and politicians to introduce new waste collection and disposal tariffs, even if it can be anticipated that the population will be against it. It would also be recommendable for the government to consider introducing fees according to waste quantities produced by citizens or households, instead of basing them on the size of apartments.

Politics and political bickering is another crucial problem regarding WM and, above all, municipal landfill improvements. Often locations for new WMCs or companies to carry out remediation are selected, only to be rejected by other political groups shortly after, supported sometimes by citizens' organizations or NGOs. Thus, a project is delayed due to different political positions or sheer quarrelling between parties. Many bring forward arguments that new technologies have not yet been assessed properly and that investments should not be done prematurely. The discussions are further fired up by environmental protection NGOs, of which there are many in Croatia. (cf. *Samokovlija Dragičević, 2006*)

A connected problem is physical planning and finding **locations** for new WMCs, which is also connected with public opinion and politics. The present delay of the start of WMCs construction can be greatly attributed to the complicated bureaucratic system paired with problems regarding permit acquisition. It takes a long time for all the necessary documentation to be obtained before starting construction works, and that was also the fate of the case study's WMC, Marišćina. At first there was a delay due to differences in opinion regarding the location of the WMC in the Primorje – Gorski Kotar County, to be followed by protests of the municipalities concerned and citizens' groups which filed complaints before court (cf. *Samokovlija Dragičević, 2007*). The operators of the landfill continued with the acquisition of documentation in spite of court proceedings, otherwise the delay would have been even greater.

Complaints of the **local population** against landfills being built in their vicinity is strongly connected with the prevalent lack of **public awareness** on waste issues. There is too little education and campaigns on the new advanced future system. Thus, it is not surprising that people still think that landfills and waste are something unwanted and polluting. The public receives most information from local newspapers and articles, which mostly deal with illegal waste dumping or problems regarding the set-up of the new system. While the public perceives the problem of "inappropriate municipal waste disposal" as one of the "most disturbing" (*Cifrić, 2005*), it appears that it does not understand the benefits of the new WM system, but rather anticipates the same problems as until now.

What also needs to be assessed is **government awareness regarding the waste hierarchy**. While waste prevention should be the priority among the means to reach WM goals, it is not being emphasized enough in the most important implementing documents, the Strategy (cf. *Zelena akcija*) and the Plan. Most attention is given to final disposal of waste, followed by recycling, and only then, to an insufficient degree, to waste prevention, which is mentioned, but not dealt with in detail. The same is true for the very important regional WM Plans as shown in the case study chapter on Primorje – Gorski Kotar County. However, it needs to be noted that Croatia is not an exception in this respect. Even though, WM is more advanced in the EU, prevention is still not sufficient, mostly due to the fact that changes need to be made where they are most difficult – consumer behaviour and production of goods. Also, Croatia produces less waste than Western countries, which also

means that there is less waste generation to be prevented. Nevertheless, as the pronounced aim is to reduce the volume of MSW to be landfilled to 30% of the total amount, waste prevention and waste recycling will necessarily become much more important in future. For now, as pointed out in *Brunner and Fellner* (2006) the waste hierarchy cannot be applied to its full extent due to economic incapability of Croatia to put the greatest emphasis on waste prevention – this will be like that until the full set-up of appropriate, environmentally-friendly final disposal. However, even then, waste prevention might be neglected, as it is in many Western European countries, where waste quantities are rising instead of falling.

In the end, it would be interesting to **compare Croatia to other similar EU member states** to see how good the country is really progressing. A study (*BiPRO, 2007*) conducted on behalf of the European Commission on landfilling in the countries that joined the EU in 2004, the EU-10[53], came to similar results for these countries as this thesis has shown for Croatia. Some of the problems encountered by the EU-10 sound very familiar: low priority for WM, lack of administrative capacities, high share of landfilling, high content of biodegradable waste in total MSW, low separate collection, existence of a large number of old, non-sanitary landfills, open dumping, insufficiently high penalties for non-compliance, low pre-treatment, etc. These problems are due, just like in Croatia, to high investment costs, organisational problems, lack of awareness, deficits in execution of conditioning plans for landfills, and many more. However, just like Croatia is attempting to do, these countries profited from EU accession by aligning their legislation and undertaking positive changes and turning to good practices. They have still not reached the goal of "Western-European-like" waste management like in Austria or Denmark, but are progressing.

Croatia is attempting a quite big, integrated step with the introduction of the new WM system. Sometimes it is better to undertake smaller steps, one at a time, to get to best results and achieve the goals of sustainable waste management. Such a process should normally take several years, but since Croatia has been procrastinating, it will have to do a lot in a short period. In fact, it will have to take a

[53] The EU-10, the Czech Republic, Hungary, Poland, Slovakia, Slovenia, the Baltic states, Cyprus, Malta, have had a comparable economic and waste management situation like Croatia and are, thus, good suited for a comparison.

giant leap and introduce waste prevention, recycling and disposal measures at a high level of efficiency in the next decade.

It can be said that Croatia is on a good path even if progress is not as fast as it could be. Taking its economic possibilities into consideration, it can be argued that the country is doing everything it can. The crucial parameters lacking for faster progress are political willingness, financial means and public awareness. Nevertheless, the way it aligned its waste management and landfill laws with EU legislation and the steps it has set for the future can be taken as a model for other countries in the region aspiring to join the EU. In fact, they can also look at the difficulties Croatia is facing and assess the way it deals with these problems in order to avoid doing the same mistakes. This refers most of all to lack of political unanimity and coordination and education of the public.

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Source: *MEPPPC*

- Waste Act (OG No. 178/04)
- Waste Act (OG No. 111/06, 60/08)
- Regulation on categories, types and classification of waste with a waste catalogue and list of hazardous waste (OG No. 50/05, 39/09)
- Ordinance on packaging and packaging waste (OG No. 97/05, 115/05, 81/08, 31/09)
- Decision on requirements regarding packaging labelling (OG No. 155/05, 24/06, 28/06)
- Waste Management Strategy of the Republic of Croatia (OG No. 130/05)
- Ordinance on waste tyre management (OG No. 40/06, 31/09)
- Ordinance on the register of legal and natural persons dealing with intermediation activity in organising waste recovery and/or disposal, and of legal and natural persons dealing with the activity of non-hazardous waste export (OG No. 51/06)
- Regulation on the criteria, procedure and manner of determining compensation to real estate owners and local self-government units (OG No. 59/06)
- Decision on the allowed quantity of waste tyres to be used for energy purposes in 2006 (OG No. 64/06)
- Regulation on supervision of transboundary movement of waste (OG No. 69/06, 17/07, 39/09)
- Ordinance on waste oil management (OG No. 124/06, 121/08, 31/09)
- Ordinance on waste batteries and accumulators management (OG No. 133/06, 31/09)
- Ordinance on the management of end-of-life vehicles (OG No. 136/06, 31/09)
- Ordinance on waste management (OG No. 23/07, 111/07)
- Decision on the allowed quantity of waste tyres to be used for energy purposes in 2007 (OG No. 36/07)
- Ordinance on the method and procedures for managing waste containing asbestos (OG No. 42/07)
- Ordinance on methods and requirements for thermal treatment of waste (OG No. 45/07)
- Ordinance on medical waste management (OG No. 72/07)
- Ordinance on the management of waste electrical and electronic appliances and equipment (OG No. 74/07, 133/08, 31/09)
- Decision on National target of share of returnable packaging in 2008 (OG No. 82/07)
- Waste Management Plan of the Republic of Croatia for 2007-2015 (OG No. 85/07)
- Ordinance on the methods and conditions for the landfill of waste, categories and operational requirements for waste landfills (OG No. 117/07)
- Ordinance on construction waste management (OG No. 38/08)
- Ordinance on management of wastewater treatment sludge when used in agriculture (OG No. 38/08)
- Ordinance on management of waste from the titanium dioxide industry (OG No. 70/08)
- Instruction on handling waste containing asbestos (OG No. 89/08)
- Ordinance on the management of polychlorinated biphenils and polychlorinated terphenils (OG No. 105/08)
- Ordinance on managing waste from research and mining of mineral raw materials (OG No. 128/08)

Appendix II – Administrative Structure in the Waste Management System

Source: *OG No. 130/05*

National level

Croatian Parliament
- adoption of the Law on Waste and other relevant regulations;
- adoption of the Waste Management Strategy.

Parliamentary Committees
- Provision of opinions about relevant laws and documents.

Government of the Republic of Croatia
- adoption of Waste Management Plans;
- adoption of Ordinances;
- determination of mandatory locations.

Ministry of Environmental Protection, Physical Planning and Construction (MEPPPC)
- preparation of new legislation;
- preparation of new standards;
- Preparation of waste management strategies and waste management plans for the Republic of Croatia;
- adoption of implementing regulations;
- preparation of reports on environmental situation and production of environ-mental protection programs;
- approval of projects/activities based on evaluation of environmental impacts;
- issuance of waste management permits (except for inert landfill sites);
- inspection and supervision activities relating to implementation of laws and subordinate acts;
- hazardous waste management (implementation of measures);
- supervision of AZO and Fund activities.

Central National Administration Bodies
in charge of:
- industry, mining, energy;
- sea, tourism, transport;
- agriculture, forestry, water management;
- environmental protection;
- health care;
- science, education;
- finance;
- administration;
- justice;
- European integrations.

Participation in the elaboration of solutions regarding various waste management issues.

Environmental Protection and Energy Efficiency Fund (EPEEF)
- collection of charges (charges for: motor vehicles, air pollution by sulphur and nitrogen oxides and by carbon dioxide, pollution to environment by hazardous and non-hazardous technological (industrial) waste, environment users);
- project financing and definition of requirements for the allocation of funding (remedy of landfill sites, encouragement of waste prevention and reduction, waste treatment and use of valuable properties of waste, encouragement of cleaner production and prevention of emissions in the production process).

Environmental Protection Agency (AZO)
- preparation of waste management reports in the scope of reports on environmental situation;
- development and coordination of an uniform information system for environmental protection (ISZO);
- development of indicators for monitoring the situation in the field of waste, identification and determination of the priority set of indicators;
- cooperation with the European environmental agency.

Environmental Protection Agency (AZO)
- accreditation of testing laboratories;
- standardization of marks;
- standardization of terms used in the field of waste management;
- publication of appropriate standards.

Regional level

County authorities / City of Zagreb

- adoption of waste management plans;
- definition of specific locations on development plans and delivery of permits for the non-hazardous and inert landfill sites;
- creation of favourable preconditions and implementation of measures for the management of industrial waste, packaging waste, construction waste and other kinds of waste;
- delivery of appropriate permits;
- collection of information about waste (Cadastre of Environmental Emissions - KEO, etc.).

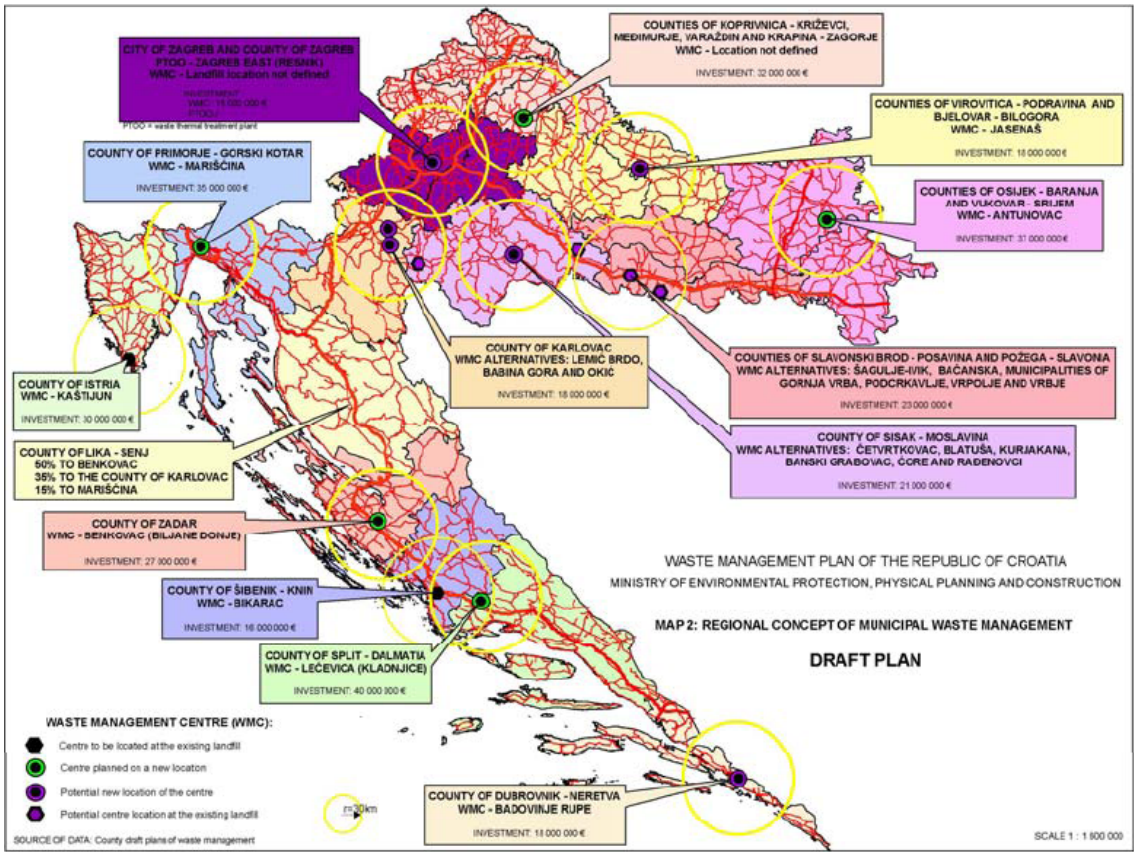
Local and community level

Local authorities (districts and towns, including the City of Zagreb)

- adoption of waste management plans and determination of specific locations in development plans;
- implementation of municipal waste management measures;
- collection and distribution of information.

Appendix III – County Concept of Municipal Waste Management (WMC)

Source: *Waste Management Plan (OG No. 85/07)*



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