

# Environmental Management of Municipal Solid Waste of the Municipality of Ellassona

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## ABSTRACT

*Waste management is one of the major problems worldwide. The formation of modern economic and social environment tends to address the issue of waste management not as a useless material from which should get rid of with the least painful way for the environment, but as a resource that the management should be done through integrated systems aimed mainly to sustainability. The aim of this study is to develop a local management plan for municipal solid waste of Ellassona municipality following the hierarchy management set by the European Union and fulfilling the objectives set out in the new National Waste Management Plan. The plan is based on decentralized management with emphasis on prescreening and its purpose is to maximize the pre-sorting of materials at source to improve recycling and minimization of the residue that will be available in Landfill.*

**Keywords:** decentralized management, Municipal solid Waste, Separation at source

## I. INTRODUCTION

The objective of this project is the depiction of the management methods of municipal solid waste in accordance with the management hierarchy that applies in the European Union and their application to the municipality Ellassona through the development of a Local Management Plan at decentralized level. The large geographic size of the municipality, the existence of many small settlements, the waste management with transfer via transfer station to the central landfill of Larissa combined with limited recycling application in Ellassona municipality, make it necessary to reduce the volume of waste generated, operating collection and disposal costs. The design will be done to achieve the objectives set at the top of the hierarchy of waste management options such as prevention - minimization, reuse and recycling - composting and down by the legislation (Directive 2008/98 / EC) on the prevention and waste management. The expected outcome is the design of a management system with emphasis on decentralized scale management of municipal solid waste and application methods as Sorting at Source (SaS), taking into account environmental, economic and social criteria and to achieve the objectives set by the New National waste Management Plan. (N.W.M.P.).

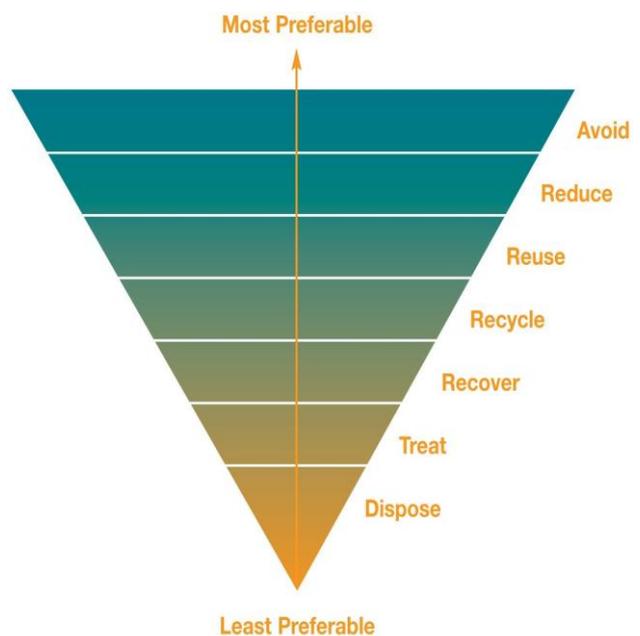
## I.METHODOLOGY

The methodology applied for the subject approach involves two parts:

The first part focuses on the theoretical approach through bibliographic research and collection of information from studies, articles and websites and focuses on management systems and waste treatment methods. Additionally, it investigates the European and the national state in the management of municipal solid waste.

The second part involves the collection of data by the competent bodies (local government, FO.S.D.A.) and the analysis of the study area. It reflects the current state of waste management and determines the amount, the composition and the management costs.

Then, the elements are processed and a proposal for optimal environmental management plan for municipal solid waste in the Municipality of Ellassona is composed. The main axis of the proposal is the use of sustainable management systems based on the management hierarchy applied by the EU with basic principles of prevention, reuse, recycling, recovery and then disposal and includes economical approach documenting its viability.



Shape 1. Waste Disposal Hierarchy

### III. SELECTED RESULTS:

#### A. Approach Design

The Decentralized Management System it includes the following levels (PROSYNAT, 2012) indicated below with the corresponding infrastructure:

##### **1<sup>st</sup> Level: Sorting at source (residential - business - services - neighborhood - municipality)**

Sorting at source is the most important step in implementing a decentralized waste management program and ensures the lowest operating cost management and the larger environmental gains (Panagiotakopoulos, 2007). It is greatly dependent on information, awareness and participation of citizens. The infrastructure is based on a network separate sorting bins, in a green point network in the residential tissue or nearby places (Andreadakis, et al., 2000).

##### **Activities at the level of home, neighborhood, workplace, services**

This level requires the action of citizens which through education and awareness programs enhance their environmental awareness and implement sorting at source.

Material support is important for citizens' action as it relates to the distribution of small composters, sorting and recycling bins but also in ensuring the infrastructure from the municipality like separate bins and green spots.

At this level, the distribution of household waste is expected so that the aim of the ESDA which involves household composting of at least 3% can be achieved. Domestic composting will be applied to most remote as well as to underpopulated areas whereas the development of a brown bin network is financially unprofitable.

The required amount of bins for the domestic composting scheme to those areas is estimated to be approximately 400 bins of 220 or 330 litres respectively. Furthermore, the distribution of another 400 bins will also be accounted for the residents who have developed an environmental awareness and wish to voluntarily participate. The cost of each bin will approximately be 100 €.

In addition, the distribution of small domestic bins to the rest of the municipality's residences is accounted as well. Thus, more emphasis will be given to the collection of biodegradable and their disposal to the brown bin. These bins will be supplied by the municipality through funded programs. Approximately 2,000 bins will be distributed and the cost of each bin will be around 5€.

##### **Activities regarding the sorting at source, in municipality level.**

Mainly involve:

- a network of preselected materials
- a sufficient network of "green spots", for the collection of materials which cannot (and should not) be directed to preselected bins such as electrical and electronic appliances, batteries, tires and bulky items. Moreover, materials can also be gathered at green spots by residents as well as at the municipality's services, schools or businesses where they can either be exchanged or reused (Green Point Guide, 2015).

- a system of collection and transportation which will involve the required vehicles
- actions which aim to provide information, raise awareness, focus on the environmental education as well as the participation of the residents is needed for sorting at source, recycling and composting.

The above actions will be repetitive so that management implementation will not be weakened and will include indicatively the following:

- Actions of public consultation and social participation for the programme's planning and implementation through conventions with social organizations, open events and information days.
- Participation through transnational programmes of European cities that implement sorting and recycling activities as well as the exchange of experiences.
- Providing information to schools through school projects.
- Constant and repetitive updates regarding the action taken by the municipality by establishing a unity that will reports environmental issues.
- Actions that aim to raise awareness among residents and other professionals on the prevention of waste produced by indicatively decrease the usage of plastic bags and packaging.

The bin network for the separation of materials will include a bin for packaging materials for instance, plastic and metal, a bin for the organic waste, another bin for glass, a bin for paper as well as a bin for waste that cannot be separated to the existent bins.

Printed paper can be collected to special bins of yellow colour with an opening at the top, which they will be placed on production sites such schools, services and banks. Packaging made of paper or carton can be discarded to regular yellow bins. Those bins which enclose paper and carton and they will be collected once a day as well as those which enclose printed paper.

On the other hand, plastic and metal can be discarded to red bins which will be collected twice a week.

In addition, glass can be placed to blue bins which they can be found throughout settlements and near food business such as catering services and will be collected every fifteen days.

Packaging made of wood will be discarded to green bins. Brown bins will be for the organic waste and they will be collected four times a week. Those bins will be placed next to the bins containing recyclable materials and they can be found on catering businesses, sanitary facilities as well as street markets where bigger bins will be placed. Vegetable and other waste from street markets will be collected separately with the municipality's responsibility and will be composted.

Green bins for general waste will gradually decrease in number. For the green spot, a location within the existent WTS which spatially is centrally located in the municipality near the city of Ellassona and its operation will not require additional planning permits.

At the same time, the operation of the small green spots is chosen to every Municipal Unity whereas the following categories of waste will be collected:

- -Hazardous household waste

- Bulky waste (furniture)
- Bulky waste of electrical and electronic equipment “white appliances”
- EWE of small size (mobile phones, lamps)
- Waste of portable batteries (AFIS)
- Clothing and footwear waste

The amount of waste collected into the small green spots will be transferred into the main green spot for further separation, repairing, reuse, recycle or will be transferred to AMS (Alternative Management System) per category of waste.

The transportation system includes the existing vehicles owned by the municipality as well as a vehicle for bell type bins.

### 2<sup>nd</sup> level: the composting – sorting – separation (municipality – groups of municipalities)

Decentralised Waste Management Facility municipality areas are created.

The purpose behind the creation of (DWMF) is the recovery of recyclables and organic materials collected from the bin of general waste, to produce compost or casing material through composting or pre-sorted organic materials and vegetables, to distinguish and to promote the trade of recycling materials collected from recycling bins and green spots.

At this level, the cooperation with neighbouring municipalities will be achieved for instance with the municipality of Tyrnavos for joint activities at the premises of (DWMF). Also, the purpose of this cooperation will be the sustainable operation of aggregates and demolition processing establishments.

### 3<sup>rd</sup> level: Sanitary landfills

The waste remaining of the previous processing steps will be processed and gain the characteristics of aggregates, will be transferred to the sanitary landfill which is a smaller-scale facility and serves the entirely Module Regional and its location will be the subject of Regional Planning.

### Phases of project development

The development of the project can be separated into two phases:

#### 1<sup>st</sup> phase

In this phase, all 1<sup>st</sup> level management activities are included in relation to information, awareness, implementation of the sorting at source with five bins, the creation of green spots, the collection and transport with the Municipality’s vehicles. Additionally, this phase also includes the creation of composting establishments for organic waste from the 2<sup>nd</sup> level, collection and disposal facilities for recyclables (KDAY) of paper bins, plastic – metal and glass and diversion facilities or the reuse of other recyclable waste.

At this phase, general waste is led to the existing landfill of the Regional Unity.

#### 2<sup>nd</sup> phase

The 2<sup>nd</sup> phase includes the completion of the sites corresponding to the Decentralised Waste Management Facility DWMF relating to:

-General waste processing facilities for further recovery of recyclable and organic waste plus the separation of aggregates and the residue.

-Composting of organic waste which derive from general waste and

-The disposal of the residue to sanitary landfills XYTY

The implementation of the two phases is chronically placed for the first one to take place in 2016 and for the second in 2018 respectively.

### B. Approaching Management cost

The management cost involves the costs of consultation activities, prevention and information, the costs of collection as well as the costs for the recycling management and the costs required for managing general waste and those of the disposal.

#### Management cost

Table I: Total management cost for the year of 2020 (€).

year	Management Cost					
	Information / Aware (€)	Collection (€)	Recycle (€)	Process of general waste (€)	Availability (€)	Total Costs (€)
2020	20.000	639.936	319.715	133.214,40	51.452,51	1.164.318

#### Income

The main income derives from the recycling process and disposal of recyclable materials and the use of compost from the composting of pre-sorted organic waste.

Table II : Total cost for the year 2020(€)

Income from recycling (€)	Income from disposal compost (€)	Total (€)
259.908,00	93.675,00	353.583,00

#### Total Management Cost

Table III : Total Management cost for the year 2020

Management cost (€)	Management Income(€)	Total Management Cost (€)
1.164.318	353.583,00	810.735,00

Table IV : Management Cost €/ton

Amount of waste for the year 2020 (tons)	Total Management cost (€)	Total Management costs per ton (€)
8.800	810.735,00	92,12

#### IV. CONCLUSIONS:

This project aims the formation of a Local Municipal Solid Waste Management Plan (LMSWMP) of the Municipality of Ellassona. The plan is based on the decentralized management with emphasis on the sorting and fully follows the guidelines and objectives of the new ESDA.

The aim of (LMSWMP) of Ellassona Municipality is to maximize the pre-sorting of materials at source with the purpose of improving recycling by limiting the mixing of materials and the minimization of the residue to be placed in landfills.

The design approach is alternative and includes three levels and progresses in two phases.

The design of LMPW for Ellassona Municipality focuses on both economical and technical approach to the implementation and operation of the alternative proposal of USW.

Calculating the management costs, nowadays costs are also taken into account amounting to 838.260,00 € per year, corresponding to 95,25 € / tn and taking into account the population served in 26,1 € / resident.

In addition to this cost, a special burial fee will also be added in the following years, which is set to be applied on 1/1/2017. Therefore the value of the existing management in the following years will be progressively increased and finally in 2020 will be amounted to 1.252.910,00 € which corresponds to 142,38 € / tn or 39,00 € / resident.

The proposal analyzing the management cost is formed by the cost in regards to informative actions and awareness, the collection and recycling costs as well as the cost of composting and processing of mixed waste and the cost of the disposal. At the same time, the income which derives from the disposal of recyclable materials and the produced compost is also taken into account.

The total management cost resulting in 2020 is 810.735,00 € which corresponds to 92,12 € / tn or 25,24 € / resident. Comparing the final cost, we find that there is a significant financial benefit with the implementation of LMPW in relation to the cost, as it would have been in 2020. The cost is steadily reduced in the following years, after 2020, as the profits from recycling will continue to increase as recyclability level is also rising.

The financial benefit is not limited to these rates though. In the proposed LMPW a small amount, which will be continuously reduced as the recycling rate is increased, ends up for disposal to landfills. With the existing method, most of the USW ends up to Sanitary Landfills, exhausting its lifetime and creating the requirement for new establishments. This addition to the environmental burden creates further financial costs to the amounts already mentioned. If the above are taken into account, in addition to the external environmental cost of the environmental pollution of the Sanitary Landfills and pollution from the transportation process of the USW from their place of production to the Sanitary Landfills which are centrally located, we discover that the cost of the existing management increases further.

The economic benefits of further cost reduction should be calculated along with the energy saved from the use of

recyclable materials that bring economic, environmental and social benefits.

Additionally, recycling of glass saves energy due to less required melting temperature in the furnace. Finally, the use of recycled paper ensures to reduce the degree of vertical integration of the production process.

The advantages of the proposed LMAW based on decentralized management with emphasis on the sorting are summarized below:

- It complies with National and European policy on waste management

- It constitutes the management method that simply requires resources and establishments and it is directly applicable

- It enables and sensitizes residents on environmental issues since the successful implementation of decentralized management involves them and great emphasis is also given on awareness-raising.

- Recyclable materials of high quality are also produced and better sales prices are achieved which significantly reduce the management costs.

- It contributes to the reduction of unemployment as the application of decentralized management with emphasis on sorting requires activating an awareness – raising network. Additionally, several professions are supported for reusing materials and recycling industry is also triggered.

- The operating costs of the facilities ensure the sustainable implementation of the program as only small decentralized establishments are required as opposed to huge headquarters.

- It is the safest solution environmentally, as it follows and contributes to the completion of the product life cycle, leaving the smallest environmental footprint.

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