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Organization for Vocational Education and Training

Leonardo Pilot Project Recy-Occupation

Survey of the Greek recycling sector

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CONTENTS

1. INTRODUCTION

It may be accurate to say that waste is resources out of place. Waste consists of the residual materials and byproducts that are generated by human use of Earth resources and wind up unwanted and unused. Today humans are generating waste of all kinds at an unprecedented rate. We must learn to deal with harmful, contaminating, polluting wastes as well as with the unwanted but potentially useful materials that for one reason or another have accumulated in the wrong place in the resource cycle. The resource cycle is a complicated, interconnected set of processes through which useful materials are transferred from the environment to the human user and then back into the environment. The cycle as it now operates is "leaky" and inefficient. Materials often turn up where they weren't intended to be; or they fail to reenter the cycle and languish somewhere as wastes; or they have negative environmental side effects that were unanticipated or underestimated.

In order to reduce the production of wastes and decrease their harmful, polluting impacts we have to close the resource cycle and stop its leaks. The ideal solution would be to mimic nature by becoming highly efficient users, reusers and recyclers of Earth materials. Material recycling out of waste has been correctly considered to be the most important intervention in the Waste Management for the last 10 years or more with vital outcomes and advantages summarized as follows:

- Reduction in Raw Material
- Reduction of Energy and Water consumption
- Increase of Disposal site's lifetime
- New investments with parallel increase of jobs

The waste management in Greece rests among those areas that special and extra attention needs to be put forward. This is particularly realized, if one considers the fact that in spite of the rapid increase in the amount of waste their management is either in their very early stages or significantly underpaced. Specifically, the amount of household waste measured up to 3.600 ktons in 1998 following an increase in the rate of 600 -700 ktons per annex within the time period 1987-1994 [1]. In simple terms this figure means that an average Greek citizen produces more or less 1 kg of waste in his daily activities. According to OECD data (Organization for Economic Co-Operation and Development) the former figure is comparable with the corresponding average European one, but, thankfully, rests behind the double figures achieved by the Americans. However, if this rate of increase is to be continued in the years to come a landfill as large as Little Prespa lake (48 km^2) would be required every 13 years[2]. Moreover, the control and, sometimes, legislation regarding the disposal sites in Greece seem inadequate. For example, there are 29 uncontrolled disposal sites only in Attica[1] (The more common Attica's disposal sites are presented in Fig. 1.1 below). In general, 2/3 (~3430) out of approximately 5000 disposal sites in Greece operate without permission and do not respect the sanitary conditions of waste disposal[1].

Fig. 1.1. Distribution of Disposal Sites in Attica region[1]

A representative waste management planning to be established in Greece needs to be in a position to handle waste with the following composition[1] (1991 data):

WASTE COMP.	(%)
Paper	20
Metals	4,5
Glass	4,5
Plastics	8,5
Textile, wood, tyres	5
Inert materials	3
Biodegradable	49
Others	5,5

A typical analysis of waste reveals that almost 40 % results from packaging materials[1]. The most common packaging materials are:

- Paper
- Glass
- Metals (tin, steel, aluminium)
- Plastics

It is worth mentioning the increase in the use of plastics as packaging materials between 1985-1990 approximately by 10 % in favour of glass (- 2,5 %), metals (- 3,5 %) and paper (- 4 %), while more than 60 % of the various packaging materials were consumed in the food and liquor industries[1].

The increase in the complexity of waste has caught disposal authorities on the hop and today's hazardous waste is showing up the cracks in the disposal system. It has to be recognized, however, that during the last years a systematic effort is under way with the joint cabinet decision 14312/1302 of 9 July 2001 attempting to address the problem of the waste management on a

National Framework. These latter describes analytically the directions and management of waste as well as sets up future targets concerning the management of solid waste, hazardous waste and trasnfrontier shipment of waste. In this context a series of major works have been completed or are under construction throughout the country between 1994-1999 with the budget shown below.

Budgets of Public Works on Waste Management in the time period 1994-1999 (in million euros)	
Attica Region	97,3
Salonica Region	54,9
12 Other Regions	113,3
TOTAL	**265,5**

In the following a general survey of the Greek Waste Sector is attempted. Because wastes come from so many different sources and take so many forms, a classification scheme has been followed with wastes classified into two major categories, that is hazardous and non-hazardous waste. Within each category wastes (and their corresponding waste management procedures) have been further classified according to their source: industrial waste, municipal or household waste and so on.

2. LEGISLATION[3-5]

E.C. LEGISLATION AND HARMONIZATION WITH THE CORRESPONDING GREEK NATIONAL LEGISLATION		
TOPIC	**E.C. LEGISLATION**	**NATIONAL LEGISLATION**
1. SOLID WASTE	➢ Directive 75/442/EEC of 15 July 1975 on waste which *requires Member States to take all necessary steps to prevent waste generation, to encourage reuse & to ensure safe disposal* amended by the following measures: ➢ Directive 91/156/EEC of 18 March 1991 ➢ Directive 91/692/EEC of 23 December 1991 ➢ Commission Decision 96/350/EC of 24 May 1996 ➢ Directive 96/59/EC of 16 September 1996 ➢ Decision 94/3/EC of 20 December 1993 establishing a list of waste pursuant to article 1a of Council Directive 75/442/EEC on solid waste ➢ Directive 99/31/EC of 26 April 1999 on the landfill of waste *intended to prevent or reduce as far as possible negative effects on the environment from the landfilling of waste, by introducing stringent technical requirements for waste & landfill*	➢ Joint Cabinet Decision 49541/1427/86 on solid waste (*already been replaced*) ➢ Joint Cabinet Decision 69728/824/96 setting up a system for the coordinated management of waste within the community in order to limit waste production ➢ Joint Cabinet Decision 114218/97 of 17 November 1997 relevant to the establishment of a general framework & waste management programs ➢ Joint Cabinet Decision 113944/97 of 17 November 1997 concerning a National Framework of Waste Management ➢ Joint Cabinet Decision 14312/1302/00 of 9 June 2001 about a National Waste Management Plan.

E.C. LEGISLATION AND HARMONIZATION WITH THE CORRESPONDING GREEK NATIONAL LEGISLATION		
TOPIC	**E.C. LEGISLATION**	**NATIONAL LEGISLATION**
2.1 TOXIC & HAZARDOUS WASTE	➢ Directive 78/319 of 20 March 1978 on Toxic & Hazardous Waste ➢ Directive 91/689/EEC of 12 December 1991 amended by Commission Directive 94/31/EC of 27 July 1994 on the management, recovery and correct disposal of hazardous waste ➢ Decision 94/904/EC of 22 December 1994 ➢ Decision 96/350/EC of 24 May 1996	➢ Joint Cabinet Decision 72751/3054/85 on toxic & hazardous waste and disposal of PCBs and PCTs ➢ Joint Ministerial Decision 19396/1546 of 18 July 1997 setting up measures and requirements to the management of hazardous waste
2.2 TRANSFRONTIER WASTE SHIPMENT	➢ Regulation EEC/259/93 of 1/2/1993 on the supervision and control of transfrontier waste shipment (*it sets up stringent requirements to the control of waste shipments, taking into account the principles of self-sufficiency and proximity for waste disposal*)	➢ *Immediately implemented on the National Legislation*
2.3 PCBs & PCTs	➢ Directive 76/403 of 6 April 1976 on the disposal of PCBs/PCTs ➢ Directive 76/769/EEC ➢ Directive 85/467/EEC ➢ Directive 87/101/EEC ➢ Directive 96/59/EC of 16 September 1996 relevant to the disposal of PCBs/PCTs intended *to approximate the laws of the Member States on the controlled disposal of PCBs, the decontamination or disposal of equipment containing PCBs and/or the disposal of used PCBs in order to eliminate them completely* ➢ Commission Decision 2001/68/EC of 16 January 2001 establishing two reference methods of measurement of PCBs	➢ Joint Cabinet Decision 72751/3054/85 on Toxic & Hazardous waste and disposal of PCBs/PCTs ➢ Decision 1310/86 ➢ Joint Cabinet Decision 7589/731/00

E.C. LEGISLATION AND HARMONIZATION WITH THE CORRESPONDING GREEK NATIONAL LEGISLATION		
TOPIC	**E.C. LEGISLATION**	**NATIONAL LEGISLATION**
2.4 WASTE OILS	➢ Directive 75/439/EEC of 16 June 1975 on the disposal of waste oils, which *promotes the safe collection and disposal of waste oils* Amended by ➢ Directive 87/101/EEC of 22 December 1986 ➢ Directive 91/692/EEC of 23 December 1991	➢ Joint Cabinet Decision 71560/3053/85 on the disposal of waste oils ➢ Joint Cabinet Decision 98012/2001/96 setting out measures and specifications on waste oil management
2.5 BATTERIES& ACCUMMU-LATORS	➢ Directive 91/157/EEC of 18 March 1991 on batteries and accumulators containing certain dangerous substances intended *to introduce measures for the upgrading and controlled disposal of spent batteries and accumulators containing dangerous materials in the Community* Amended by the following measures: ➢ Commission Directive 93/86/EEC of 4 October 1993 ➢ Commission Directive 98/101/EC of 22 December 1998	➢ Joint Cabinet Decision 73537/1438/95 concerning batteries and accumulators containing certain dangerous substances ➢ Joint Cabinet Decision 19187/1702/00 about an action plan on the management of batteries & accumulators
2.6 AMIANTHUS	➢ Directive 87/217/EEC on the prevention and minimization of environmental pollution from amianthus emissions	➢ Joint Cabinet Decision 8243/1113/91
3. PACKAGING MATERIALS	➢ Directive 85/339/EEC on packaging of liquid nourishment replaced by ➢ Directive 94/62/EC of 20 December 1994 on packaging and packaging waste aiming at *harmonizing national measures concerning the management of packaging and packaging waste to provide a high level of environmental protection and to ensure the functioning of the internal market* ➢ Commission Decision 2001/171/EC of 19 February 2001	➢ Joint Cabinet Decision 31784/954/1990 setting out different types of packaging of liquid nourishment ➢ *The relevant Bill has been approved and forwarded for voting*

E.C. LEGISLATION AND HARMONIZATION WITH THE CORRESPONDING GREEK NATIONAL LEGISLATION		
TOPIC	**E.C. LEGISLATION**	**NATIONAL LEGISLATION**
4.DIRECTIVE IPPC	➢ Directive 96/61/EC of 24 September 1996 concerning the integrated prevention & control of the pollution	➢ *to be incorporated into National Legislation*
5.1. WASTE INCINERATION	➢ Directive 89/369 89/369/EEC of 8 May 1989 on the prevention of environmental pollution resulting from new and existing municipal waste-incineration plants ➢ Directive 2000/76/EC of the European Parliament and of the Council of 4 December 2000 on waste incineration aiming at the *prevention or reduction air, water and soil pollution caused by the incineration or co-incineration of waste as well as the resulting risk to human health*	➢ Joint Cabinet Decision 82805/2224/1993 which defines measures and specifications on the prevention of environmental pollution resulting from new and existing municipal waste-incineration plants
5.2 HAZARDOUS WASTE INCINERATION.	➢ Directive 94/67/EEC of 16 December 1994 on the incineration of hazardous waste aiming at *the prevention or reduction of the effects of hazardous waste incineration on the environment and the ensuing risks for public health*	➢ Joint Cabinet Decision 2487/455/99 setting out measures and specifications for the prevention of environmental pollution as a result of hazardous waste incineration
6.1 TREATMENT OF URBAN WASTE WATER	➢ Directive 91/271/EEC of 21 May 1991 which refers to the treatment of urban waste water	➢ Joint Cabinet Decision 5673/400/97 of 14 March 1997 defining measures and specifications for the treatment of urban waste water
6.2 AGRICULTURAL SLUDGE MANAGEMENT	➢ Directive 86/278/EEC of 12 June 1986 on the environmental and especially on the protection of the soil from the sludge originating from agricultural waste	➢ Joint Cabinet Decision 80568/4225 of 22 March 1991 on methods, specifications and requirements for the use in agriculture of the sludge originating from household and urban waste treatment

E.C. LEGISLATION AND HARMONIZATION WITH THE CORRESPONDING GREEK NATIONAL LEGISLATION		
TOPIC	**E.C. LEGISLATION**	**NATIONAL LEGISLATION**
6.3 WATER PROTECTION FROM NITRO-COMPOUNDS	➢ Directive 91/676/EEC concerning the protection of subsoil and surface water from nitro-containing compounds used in agriculture	➢ Joint Cabinet Decision 16190/1335/97 of 25 June 1997
7. ENVIRONMENTAL IMPACT STUDIES	➢ Directive 85/337/EEC on the assessment of environmental impact amended by ➢ Directive 97/11/EEC	➢ Law 1650/86 ➢ Joint Cabinet Decision 69269/5387/90 ➢ Joint Cabinet Decision 73508/90

However, there are still several directives (or certain articles of them) that Greece is accused of violating. The most important of them listed below[6]:

- ☹ Directive 75/442/EEC of 15 July 1975 on *solid waste management*
- ☹ Council Directive 76/464/EEC of 4 May 1976 on *the pollution caused by certain dangerous substances discharged into the water resources of the Community*
- ☹ Directive 78/319/EEC of 18 March 1991 on *measures and requirements concerning the management of solid waste*
- ☹ Council Directive 80/68/EEC of 17 December 1979 on *the prevention of groundwater from the pollution caused by certain dangerous substances*
- ☹ Directive 85/337/EC of 24 December1996 on *the assessment of the environmental impact*
- ☹ Directive 91/156/EEC of 18 March 1991 on *measures & requirements concerning the management of solid waste*
- ☹ Directive 91/271/EC of 21 May 1991 on *the treatment of urban waste water*
- ☹ Directive 91/676/EC on *the prevention of ground and surface water from the pollution caused by nitro- containing compounds used in agriculture*
- ☹ Directive 91/689/EEC of 12 December 1991 on *the management of dangerous waste*
- ☹ Council Directive 92/43/EEC of 21 May 1992 on *the conservation of natural fauna and flora*
- ☹ Directive 94/62/EC of 26 April 1994 on *the management of packaging and packaging waste*
- ☹ Directive 96/61/EC of 24 September 1996 on *integrated prevention and control of I.P.P.C. pollution*

- Council Directive 98/83/EEC of 3 November 1998 on *the quality of water for human consumption*

3. WASTE MANAGEMENT IN GREECE

3.1. *HAZARDOUS WASTE*

3.1.1. Hazardous Industrial Waste[7]

The most common source of environmental pollution with hazardous waste is that from the various industrial activities. The present section refers to those hazardous waste generated by industries and shipyards according to Commission's Decision 94/904 which has been implemented in Greek legislation through the joint cabinet decision 19396/1546/97. Pollution from PCBs will be treated independently in the following section.

Systematic studies carried out in the last decade or so revealed an 18 % reduction in the total volume of hazardous industrial waste, recording a decrease from 340 ktons in 1998 to almost 280 ktons in 1998, respectively. Small in number but highly active heavy industries (metallurgy, petrochemical, chemical/pharmaceutical manufactures) account for almost 90 % of the total hazardous waste production, while numerous small-scale industries (tan yards, metal treating units, textile factories) contribute smaller quantities to the total production. However, the aforementioned 18 % reduction can not be fully assigned to an organised waste management policy.; instead, it registers directly the corresponding decrease in the number of large-scale active industries. Indeed, several large-scale industrial units involved in steel and fertilizers production or metal and textile processing and batteries-accumulators production do not operate any more. Of course, the contribution of technological innovations, which replaced old and traditional procedures as well as the implementation of more severe legislation, cannot be neglected from the parameters that account for the observed decrease in the volume of hazardous wastes. The amount of hazardous wastes generated in 1988 and 1998 from the various industrial units and other especially polluting activities in Greece is presented in the following figure 3.1.1a.

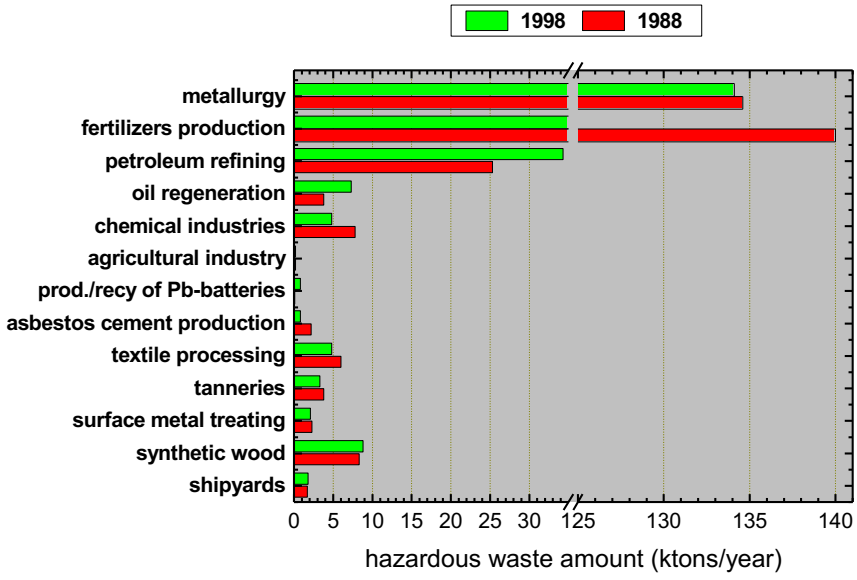


FIG. 3.1.1a. Amounts of hazardous wastes (in ktons) generated from various industrial activities in Greece for the years 1988 and 1998 [7]***.***

The lack of a systematic and integrated infrastructure to deal with the management of hazardous waste has classified the latter as a severe and growing environmental threat. The most common management procedures applied so far include:

- Provisional storage according to joint cabinet decision 19396/1546/97 (paragraph 12, article 2)
- Transfrontier shipment for final disposal to other E.U. members
- Utilization
- Stabilization/treatment

in the relative percentages demonstrated in fig. 3.1.1b

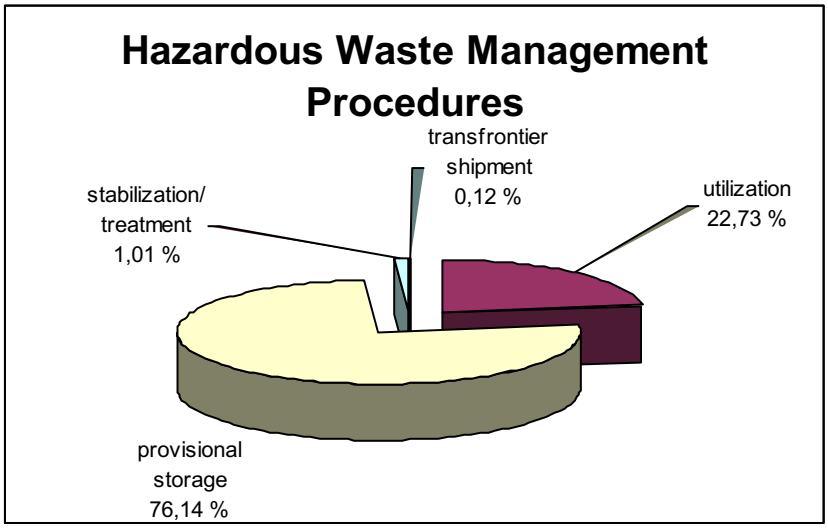


FIG. 3.1.1b. Relative Percentages of the most common procedures applied in the management of Hazardous Waste in Greece[7]

Applied Policy

The applied strategy so far has been mostly based on the development of the appropriate legislation and its harmonization with the corresponding European legislation for wastes. Additional motivations have been set up during the last years such as tax incentives and other benefits to industries that are willing to adopt clean and innovative technologies and to improve their infrastructure.

The existing legislation and especially the joint cabinet decision 19396/1546/97 aims at the harmonization with the EC Directive 91/689 of 12/12/1991 on "Hazardous Waste". Therefore, measures have been established in order to reduce their volume, to improve their utilization, their recovery/recycling, and the restoration of their disposal sites as well as to promote clean, innovative and environmental friendly technologies.

Objectives - Actions

The main objectives of the National Framework on the Management of Hazardous waste include:

- A drawn up of an inventory of the quantities and types of hazardous waste produced in Greece on a continuous and updating basis
- Minimization of the total volume of hazardous wastes
- Gradual reduction in the danger originated from their use
- Increase in the rates of re-use, utilization and treatment of wastes
- Gradual reduction in the provisionally stored amounts and minimisation of the corresponding amounts that are finally disposed of to other EU members

The following actions need to be undertaken in order to meet the aforementioned objectives:

⇒ Development of a dynamic data base system recording the types and quantities of waste, the general technical requirements and the precautions to be taken
⇒ Promotion of measures that prevent the production of hazardous waste on site (such as bounties for those industries implementing clean and innovative technologies)
⇒ Development of alternative ways for the handling of hazardous waste
⇒ Promotion of the waste treatment on site
⇒ Relocation of old, small- and medium-size industries, especially those located nearby inhabited areas, and their replacement by industrial parks
⇒ Construction of central facilities, which process and finally dispose of hazardous waste. This task has to be undertaken in close collaboration with local municipalities and civilians in order to surpass the societal attitude towards waste disposal that is best summarized by the acronym **NIMBY**, which stands for "not in my back yard".
⇒ Support of private interventions operating under the supervision of the Ministry of Environment, Physical Planning and Public Works.

3.1.2. Polychlorinated Biphenyls (PCBs)[7]

PCBs were used in the past as lubricants and heat exchangers in electrical transformers and capacitors and constitute significant contaminants being highly toxic, persisted and easily dispersed in the environment. Law 1310/86 has prohibited the emporium of devices containing PCBs.

With the first reports on PCBs dated since 1987 and 1989, their quantities have been estimated to be 1400 tons in 1991 distributed as it is demonstrated in Table 3.1.2 with their major part being possessed by the Public Power Corporation (PPC).

TABLE 3.1.2. Number of Devices containing PCBs in Greece in 1991 [5].

	TRANSFORMERS	CAPACITORS
Operating equipment	644	19.687
Auxiliary equipment	51	1.430
Useless equipment	6	473
TOTAL	**701**	**21.590**

Joint cabinet decisions 72751/3054/85 and 19396/1546/97 determine the collection and management of PCBs at National level. Since Greece lacks any infrastructure dedicated to the treatment/processing of equipment and of PCBs contained therein, the National management policy provide the following:

- Safe storage of PCBs provided by certain licensed undertakings
- Transfrontier shipment of PCBs to other EU countries for treatment and final disposal, according to Directive 259/93, which sets up the requirements to the control of waste shipments. (*The quantity of PCBs transferred to other countries -U.K., France, Germany- between 1991 and 1998 measured up to 794 tons*)

The above decisions also require by the waste holders to keep inventories with the following information:

- the names and addresses of the holders
- the location and description of the equipment
- the quantity of PCBs contained in the equipment
- the date and type of treatment planned
- the date of declaration

while the cost of the waste disposal should be borne by the holder or the producer of the waste in accordance with “the polluter pays” principle.

Objective – Actions

The objectives set up by the Council Directive 96/59/EC of 16 September 1996 on the disposal of PCBs (and PCTs) are expected to be met by the National legislation as well. Specifically, the equipment and PCBs contained therein must be destroyed by 2010 at the latest with the exception of those with PCB concentrations between 50 and 500 ppm. These latter will be destroyed after the end of their useful lifetime. Moreover, the legislation aims at the elimination of PCB volumes, which are exported and disposed of to other countries.

Certain actions have been planned in order to materialize the desirable objectives, namely:

- ⇒ Compilation of inventories of equipment containing PCBs subjected to continuous updating and upgrading
- ⇒ Construction and operation of plants involved in the treatment of hazardous waste accompanied by public information and promotional campaigns via the collaboration of local municipalities and other authorities
- ⇒ Support of private initiatives operating under the supervision of competent authorities and complying with the requirement set up by legislation.

3.1.3. Waste Oils[7]

64.000-70.000 tons of waste oils are collected annually in Greece originating from a variety of sources including automotive (e.g. vehicle servicing), industrial (e.g. petrochemical manufacture) as well as other sources (hydraulic fluids, freezing circuits), with Attica contributing almost 50 % of the total waste oil production. The most common management procedures include:

- Regeneration
- Reuse without regeneration
- Energy production out of waste
- Uncontrolled waste disposal

The volumes of waste oils generated in Greece between 1987 and 1997 are presented in figure 3.1.3a and record a decrease in the order of 9 %. This reduction seems to be mostly the effect of the gradual replacement of the waste oils in favour of their synthetic counterparts since the latter exhibit longer lifetimes. Moreover, as can also be traced from the same figure the quantity of regenerated oils increased by 93 % followed by a parallel 85 % decrease of the amount disposed of without control.

The collection of waste oil is carried out either by the organized collection network of the existing regeneration firms or by licensed undertakings, which collect and then sell the product to the 12 industries, which are involved in the process of waste oil regeneration in Greece, or to other licensed energy recovery plants.

The existing national legislation on the management of waste oil complies with the corresponding Directive 87/101/EEC of 22 December 1986, which promote the safe collection and disposal of waste oils. Waste Oils containing PCBs are treated as hazardous waste. Therefore, products originating from oil regeneration processes or in the case of energy production out of waste oils the latter should not contain PCB concentrations higher than 50 ppm.

Objective - Actions

The objectives set up by the National Framework on the management of waste oil include:

- Control and elimination of unauthorized disposal
- Increase in the quantities of regenerated oil
- Increase in the amounts of energy derived from waste oil

The materialization of the objectives requires certain actions to be taken including public awareness and sensitization campaign that will enhance responsibility mechanisms, financial support for private measures and initiatives encouraging the employment of the best available technologies.

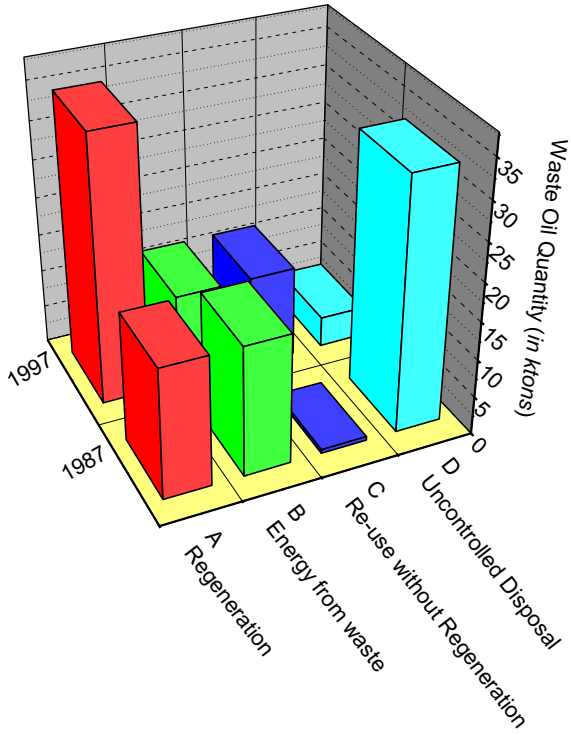


FIG. 3.1.3a Volumes of waste oil subjected to the various management procedures applied in Greece in 1987 and 1997 [7]***.***

3.1.4. Batteries and Accumulators[7]

The national market of batteries and accumulators suffered a considerable recession during the last 10 years as a result of the keen competition at international level. Consequently, the national production of Pb-batteries and MnO_2-accumulators hold only 14 % and 29 % of the market, respectively, while the demand for Ni-Cd batteries and Ag-Li accumulators is exclusively covered from imports. The production and consumption of batteries and accumulators in Greece in 1997 are shown in Fig. 3.1.4a.

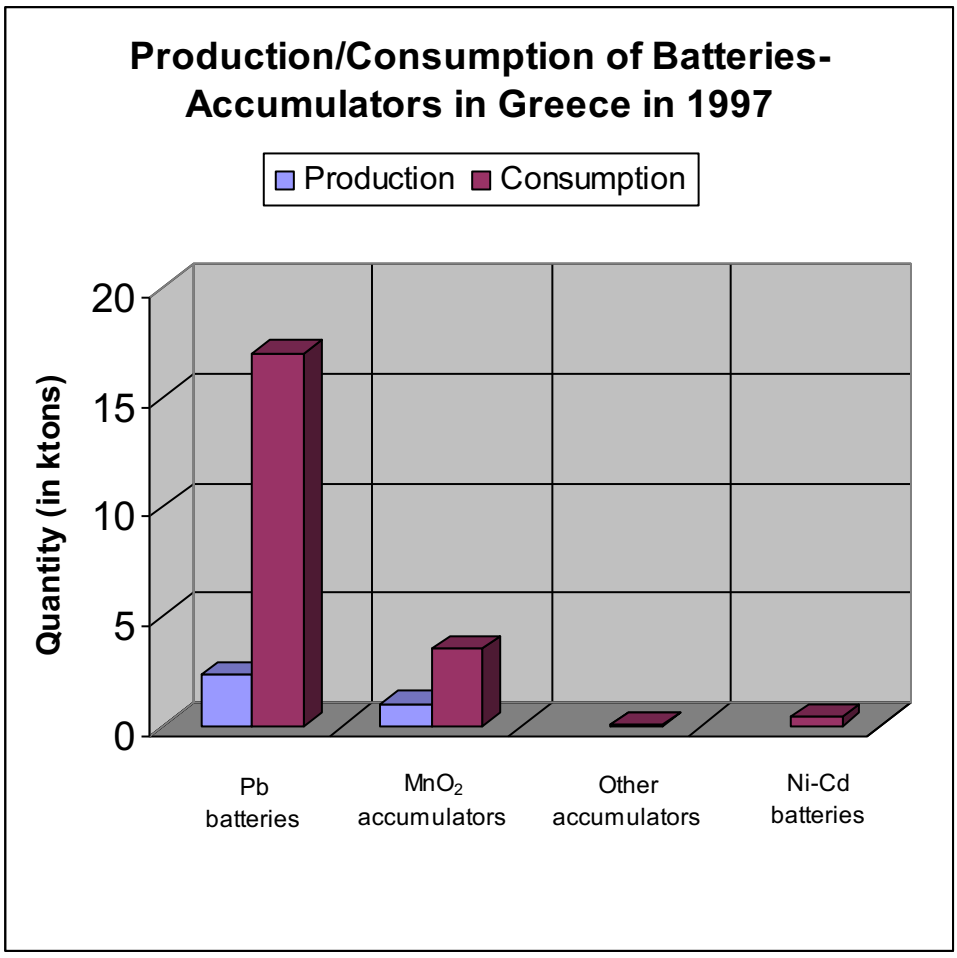


Fig. 3.1.4a. Quantities of Batteries and Accumulators produced/consumed in Greece in1997 (in ktons) [7]

In general the consumption of Ni-Cd batteries, Pb-batteries and Li-accumulators exhibit incremental trends in favour of those with mercury and MnO_2. Certainly, Pb-batteries finding use in car industry hold the major share of the market.

All the issues concerning the management of this class of waste are determined by the joint cabinet decision 73537/1438/95 harmonized with the corresponding Directive 91/157/EEC that introduced measures for the upgrading and controlled disposal of spent batteries and accumulators containing dangerous material in the Community.

The collection procedure of spent batteries so far includes mostly their separate collection and the recycling of batteries with Pb carried out by private undertakings. These latter, in turn, supply other firms (5 highly active and a larger number of smaller units) involved in the process of Pb-recovery with a total of about 21000 tons of Pb-batteries every year. However, this figure corresponds to 85 % of the total annual number of spent batteries due to inherent weaknesses of the collection network.

Objectives - Actions

The objectives on spent batteries and accumulators containing dangerous substances include programs aimed primarily at:

- Reducing their amount in household wastes
- Encouraging their separate collection
- Encouraging safe management and ultimate disposal

For this reason the formation of an establishment is anticipated with the responsibility to promote an integrated project for the collection, storage, sorting, recycling and final disposal of batteries and accumulators through the following tools:

- Collection of batteries and accumulators in separate bins
- Development of an appropriate transportation network
- Establishment of a collection and provisional storage undertaking for spent batteries and accumulators
- Development of recycling units for accumulators containing mercury and batteries Ni-Cd
- Marking of the batteries and accumulators or the appliances in which they are incorporated in such a way as to indicate and assist separate collection and recycling requirements
- Educating civilians into recycling procedures
- Monitoring the market values of batteries and accumulators

It is expected that the separate collection of batteries and accumulators will exceed 80 % after a three years operation of the project.

3.1.5. Waste from Electrical and Electronic Equipment (WEEE)

EEE covers a wide variety of products ranging from mechanical devices like hair dryers or refrigerators to highly integrated systems like computers. It is worth mentioning, though, that technological innovations accelerate changes in product composition. Additionally, electronic appliances are increasingly being included as an integral part of other product groups, for instance, electronic systems in vehicles. On the other hand, these products contain significant quantities of valuable substances such as metals, precious metals, high quality plastics and other components, which should be recovered. However, the general move towards increasing integration makes disassembly and separation more difficult and hinders both recovery and environmentally sound treatment processes[8].

Sustainable Management of E-Waste in Greece

A LIFE-ENVIRONMENT program entitled "Sustainable Management of E-Waste in Greece" has been put forward since the 1st November 2001 by the non-governmental Ecological Recycling Society (ERS). The program is co-funded by the European Commission, the Ministry of Environment, Physical Planning and Public Works and the Municipality of Nea Smyrni. Producers, dealers and large-scale users of electronic equipment, including the National Bank of Greece, Intracom S.A, IBM Hellas, Athens International Airport, EPAFOS IT Systems and TELEdomi, participate in the project, while the collaboration of European organizations with previous experience in the field is expected to be beneficial to the project. These organizations are:

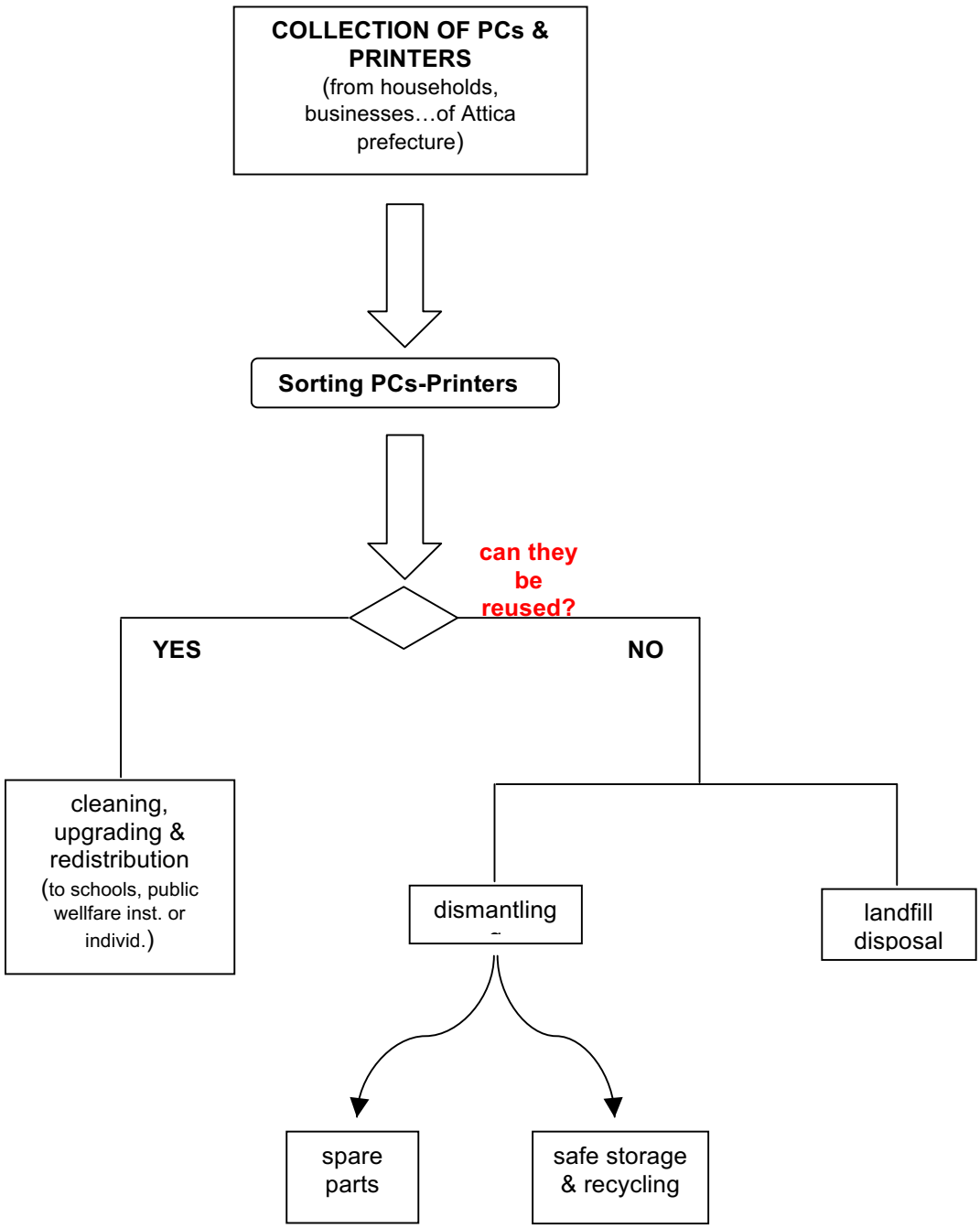
- GOAB from Germany, active in the fields of collection and valorization of used electrical and electronic equipment, training, orientation and certification in this field
- Recycle IT! from UK, involved in repairing computers for re-use

The objective of the project is the formulation of plans and proposals concerning regulations, agreements, administrative and financial tools, staff training for the reduction of electrical and electronic waste, the removal of barriers for the collection and management of electronic equipment with the expected goals summarized below:

- To prevent and reduce electronic waste intended for final disposal, as well as to increase the amount of materials recycled
- Environmental management of the dangerous substances contained in electronic devices
- The creation of a code of good practice for the sustainable management of e-waste
- The exchange of knowledge and experience at a European level
- To explore a collection system for the redistribution, re-use and recycling of electronic equipment in Greece
- To inform the public on how they can actively participate in this and similar projects

A representative flow diagram of the activities, which had already begun within the project framework, is given below:

FLOW DIAGRAM OF ACTIVITIES OF THE LIFE-ENVIRONMENT PROJECT "Sustainable Management of E-waste in Greece"



3.1.6. Hospital Waste[7]

Waste generated from hospitals can be divided in two classes:

- *Contagious waste*, that is virulent and potentially virulent biologic materials as well as materials and substances came into contact with blood or other fluids and can potentially be considered as carriers of dangerous microorganisms. These waste are included in the list issued from EC (Council Directive 94/904/EC and the corresponding joint cabinet decision 19396/1546 of 18/7/1997)
- *Waste similar with household waste* not subjected to any special treatment in order to prevent infection (food waste, packaging materials…). This particular class of waste is treated according to the provisions of joint cabinet decision 69728/824/1996 on solid waste management. The collection of this class of hospital waste, which is carried out together with the rest municipal waste is the responsibility of the corresponding municipalities.

Contagious hospital waste constitutes a class with particular interest since they demand the implementation of special management techniques in order to avoid the possibility of infection.

The total number of beds at National level presents an increase in the order of 10 % during the last decade sum up to 57.000 beds. The increase in the number of Hospitals followed by the parallel increase in waste per patient boosted the total volume of contagious waste. Specifically, the quantity of waste generated every year in Greece rises to 140 ktons per year with Attica and Salonica prefectures contributing 51 % and 14 %, respectively. The distribution of contagious waste over the various prefectures is shown in Table 1.6a.

TABLE 3.1.6a. Total amounts of contagious hospital waste per prefecture[5]

PREFECTURE	AMOUNT (kg/day)	PERCENTAGE (%)
Thrace	700	2
Macedonia	8650	22
Thessaly	1800	5
Epirus	650	2
West Greece, Central Greece	1050	3
Attica	20450	51
Aegean islands	2200	6
Ionian islands	750	2
Peloponnesse	2200	6
Crete	1500	4

Therefore, it is evident that the collection and management of contagious waste is regarded as a significant problem. Indeed, only 37 % of the hospitals possess incineration plants, which in most of the cases are out of date or even out of work. Consequently, the management of this type of waste takes place in areas outside the hospitals. For instance, there is one incinerator in Attica with nominal capacity of 0.5 tn/day unable though to fully satisfy the

needs. Additional de-activation techniques are implemented on a private basis.

In order to deal with the problem of contagious hospital waste, an integrated action plan has been worked out. The project provides the necessary waste processes such as sterilization, thermal treatment or any other method, which destroys any dangerous microorganism beyond doubt. Moreover, it anticipates the issuing of permits for the in-hospital and out-hospital treatment of waste quantities larger than 20 kg/day. This will be accomplished by the two large thermal treatment units with capacity 30 tons/day, which are under construction. One of them will operate in Attica and has been designed in order to cover the present and future needs of the area. The second plant is about to be built in the area of Salonica covering the corresponding needs of Central Macedonia.

Objective – Actions

The analysis of the objectives of the national plan on hospital waste reads:

- The implementation of the necessary measures for the separate collection of contagious hospital waste and waste similar with household one
- The integrated management of contagious hospital waste through the construction of Contagious Waste Treatment Units

The accomplishment of the objectives demands the following actions to be undertaken:

⇒ Preparation of studies concerning the geographical spreading of waste treatment plants. Specifically, the construction of plants with capacity larger than 50 kg/hour is suggested in every prefecture with the exception of distant or gnarled areas. In these areas alternative sanitary management will be implemented.

⇒ Setting up of integrated collection systems within the hospitals and safe transportation to Treatment Units under the responsibility of competent authorities (local municipalities).

⇒ Systematic organization of contagious waste management within the hospitals in order to provide a high level of environmental and public health protection

⇒ Establishment of a dynamic database system of the contagious waste produced and processed at National level

3.2. *NON-HAZARDOUS WASTE*

3.2.1. *Municipal/Household Waste*[5]

The terms household waste and municipal waste are often used as a synonym. Household waste is generally considered to include any waste generated from houses and from small commercial institutions. Municipal waste is waste collected by or on behalf of the municipalities including waste from households collected by the private sector. In the following they will be treated in the same context.

Data collected from regions all over Greece raised their amount to 3.9 million tons in 1997 (emigrants and tourists included) a figure corresponding to an average production of 0.97 kg of household waste/capita/year. Figure 3.2.1a exhibits the amounts of household waste (bars) as well as the average daily waste production per capita (continuous line) for the years 1991 and 1997, while figure 3.2.1b presents the corresponding amounts distributed along the various regions at National level. Attica region accounts for almost 38 % of the total waste production.

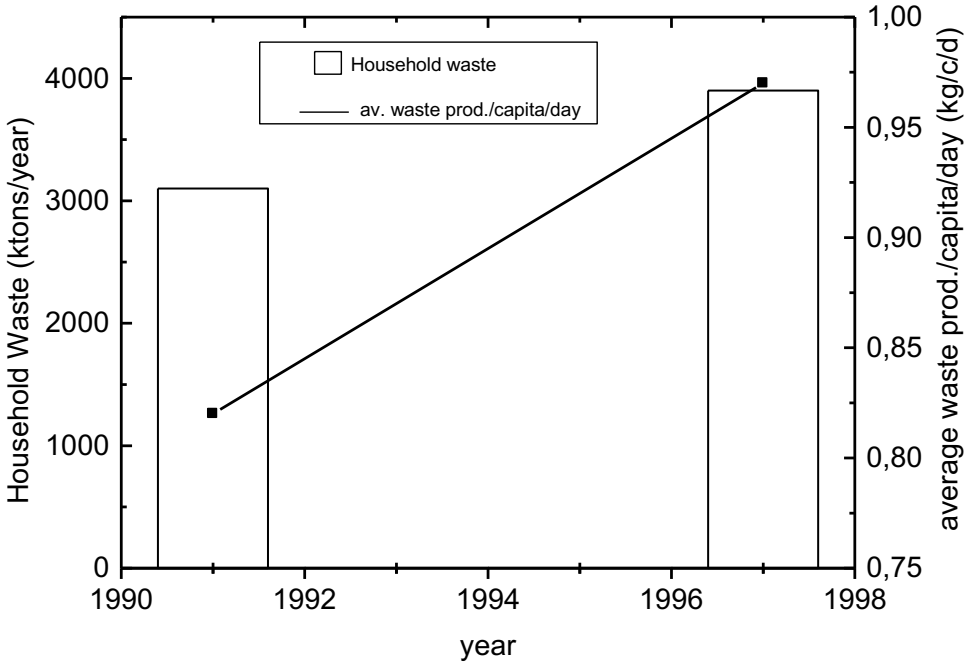


FIG. 3.2.1a. Household Waste Production in Greece in 1991 and 1997 [I5]

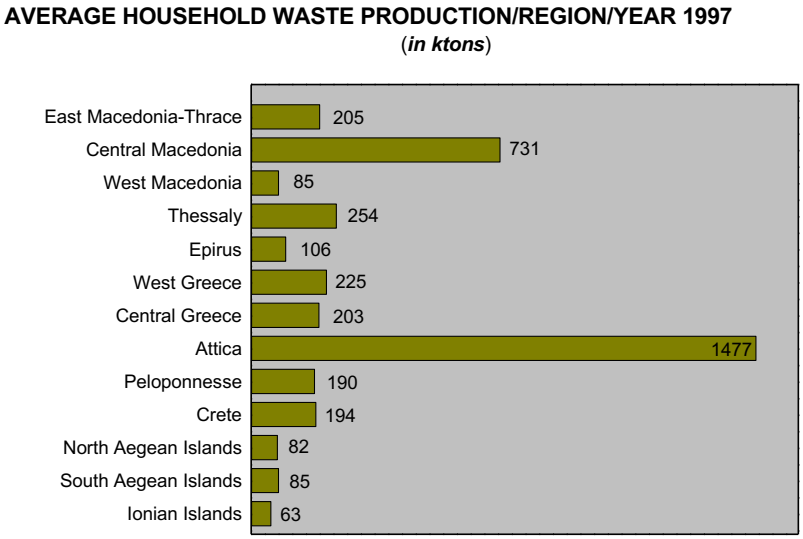


FIG. 3.2.1b. Average Household Waste Production per Region in Greece in 1997 (in ktons)[5].

Data collected from various urban, rural and tourist areas covering 30 % of the population allowed for the determination of the waste composition and the results are presented in fig. 3.2.1c. The class named as “others” describes collectively the hazardous substances included in household waste with the most common of them being medicines, solvents, paints, batteries and pesticides. These waste originate either from houses or from various commercial activities and their total amount has been estimated to be almost 4.525 tons in 1997 which corresponds to 0.12 % of the total household waste production. Table 3.2.1a contains the amounts of the hazardous waste distributed over the various population groups.

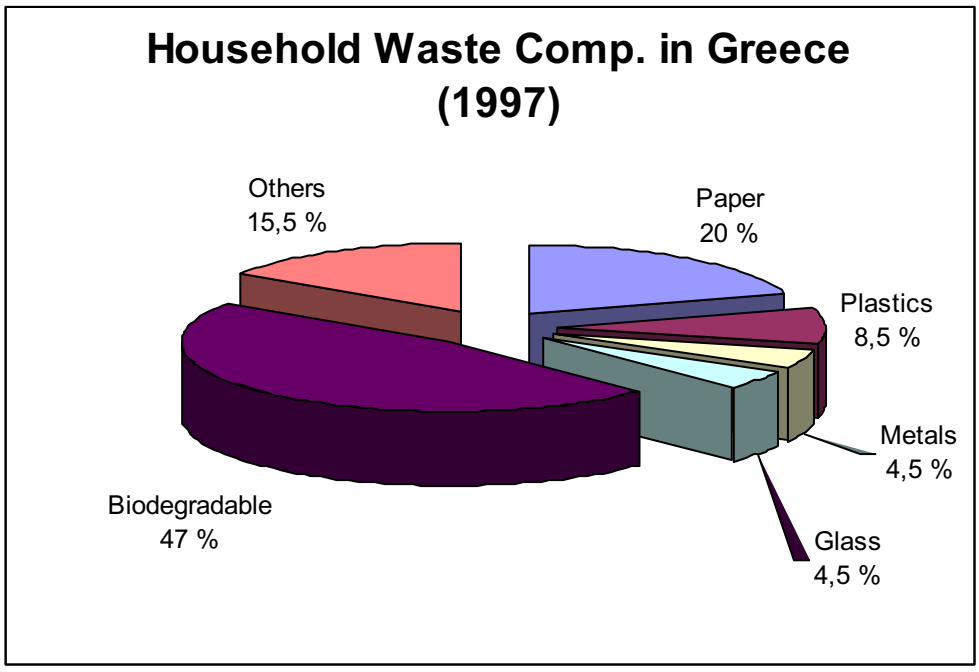


FIG 3.2.1c. Average Composition of Greek Household Waste in 1997 [5].

TABLE 3.2.1a. Hazardous Household Waste (in tons/year) generated by the different population groups		
POPULATION GROUP	**AMOUNT (tons/year)**	**%**
Urban	2.417	53,4
Semi-Urban	661	14,6
Rural	1.447	32,0
TOTAL	**4.525**	**100,0**

The situation before 1994

The enormous development of the big cities combined with the improvement in the quality of life and the increase in the number of tourists resulted in dramatic environmental problems in the late 80s and in the beginning of the 90s. These problems proved beyond any doubt the insufficiency of the applied waste management. The most common procedure of that time was the disposal of household waste in open dumps with the sanitary landfilling finding little if no use. Thus, 3430 unauthorized landfill sites had been recorded at National level accepting 35 % of the household waste production. Moreover, almost 65 % of these household wastes were disposed of to 1420 authorized disposal sites. However, an indicative but yet thorough inspection of 302 out of the 1420 former sites revealed that almost 50 % of them are characterised by porous and permeable underlying materials, permitting the migration of leachate. Along the same lines 81,4 % of the inspected sites did not fulfill crucial requirements being potentially dangerous for the water resources. Finally, most of those disposal sites suffered from additional problems such as self-combustion, unpleasant smell and biogass emissions. These significant problems necessitated a change in the waste management policy towards more integrated solutions.

Present situation - Objective and Actions

The management of household/municipal waste presents manifold interest since it must deal with significant and complicated parameters such as collection and transport, exploitation/recycling and final disposal. The responsibility for these tasks has been assigned to the Municipalities.

Organized collection and transport of household waste are realized for the 85 % by weight of the total waste production with the remainder corresponding to rural and highland areas. 8,69 % of household waste is recycled and the other 91,31 % ends up either in sanitary landfills or other disposal sites

The recycled materials (paper, metals, plastics and glass) and the biodegradable organic waste represent 37,5 % and 47 %, respectively, of the total household waste. The corresponding recycling rates of paper, metals, plastics and glasses sum up to 21 % of their disposed quantities.

The National Framework on household waste management has set up the following targets:

- Prevention or reduction in the amounts of hazardous/non-hazardous household waste produced per capita
- Modernization and expansion of the collection and transport network
- Exploitation of the useful materials derived from the treatment of household waste
- Disposal in an environmental friendly way and restoration of unauthorized disposal sites

The following actions have been chosen in order to meet the standards set up by the waste management policy:

⇒ Promotion of efforts intended to reuse and recycle the materials
⇒ Utilization of the best available technologies and standardization of the collection network
⇒ Organization of sorting projects at the source and construction of recycling/composting and thermal treatments plants
⇒ Funding studies and expansion of the number of available sanitary landfills in an effort to cover completely the produced amounts of household waste
⇒ Restoration of previously uncontrolled disposal sites

3.2.2. *Recycling of Packaging and Packaging Materials*[5]

In Greece materials such as paper, glass, metals and plastics constitute the 37.5 % by weight of household waste, that is almost 1.5 million tons of recyclable materials.

In 70s the recycling process involved mainly municipal employees, peddlers, traders of used paper and few industries. However, many municipalities have recently designed and started recycling projects, which, nowadays, enjoy the participation of about 30 % of the total Greek population. A considerable number of schools, educational institutes, ecological societies and the Army promote and apply recycling programs, too. To all the above we may also add Municipal services, peddlers, small trading companies located nearby disposal sites. The recycling rates for paper, glass and aluminium cans in 1989 and 1997, respectively, can be read in fig. 3.2.2a The relative figure for plastics is about 5 % (0,5-1 % originates from household waste,) while packaging materials represent 20 % of municipal waste, that is almost 780.000 tons. The achieved recycling rates for plastics refer exclusively to industrial waste and tertiary packaging (e.g. films).

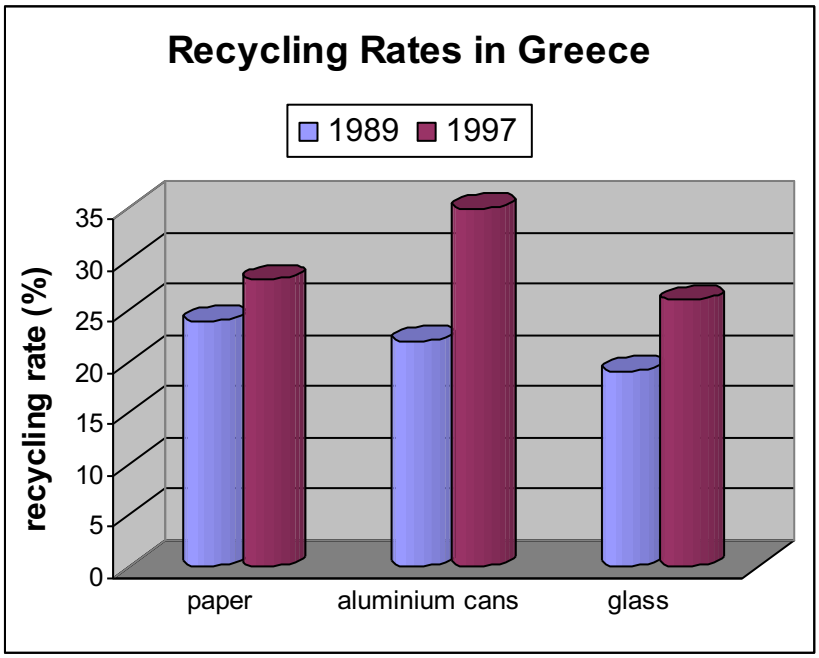


Fig. 3.2.2a. Recycling Rates in Greece in 1989 and 1997 [5]

The most important problem encountered in the recording of packaging materials and their recycling rates is the lack of data on the imported and exported products. To fill this gap a study was carried out under the authority of Ministry of Environment, Physical Planning and Public Works and co-financed by EC. Among the outcomes of this study an integrated database is expected which will provide information concerning the characteristics and evolution of packaging waste as well as the resulting risk by their use.

In order to promote recycling the Ministry of Environment, Physical Planning and Public Works has so far accomplished the following:

- Information programs in the context of environmental education for students and civilians
- Funding Municipal recycling programs at National level
- Co-funding of the construction of a recycling plant in one of the Ionian islands with nominal capacity 1450 tons/year (the sorting out will be carried out manually)
- Construction of a recycling center in Attica with capacity 1150 tons/day followed by the construction of smaller recycling units in various Municipalities all over the country

Objective - Actions

The national framework on the management of packaging and other similar materials sets specific recovery, recycling and re-use targets for all packaging waste, namely:

- Prevention of packaging waste formation
- Reduction in the quantities of packaging waste for final disposal by encouraging their re-use and utilization
- Recovery between 50-60 % of packaging waste
- Recycling 25-45 % of packaging waste
- Recycling at least 15 % of each material contained in packaging waste

To accomplish the aforementioned objectives the following action must be put forward:

⇒ Establishment of an Organization which will be responsible for the design and implementation of alternative management of packaging and packaging materials
⇒ Setting up of the requirements for the management of packaging materials
⇒ Determination of the responsibility of waste producer (the "polluter pays" principle)
⇒ Development of marking systems aimed at facilitating the identification of packaging materials and adapted to scientific and technical progress
⇒ Promotion and realization of sorting projects at the packaging waste source
⇒ Construction of Sorting, Recycling and Composting plants throughout the country
⇒ Establishment of a public information system at National level and encouragement of civilians' participation in waste management procedures
⇒ Encouragement of the active participation of the private sector through measures reinforcing the competitiveness of recycling companies and boosting activities in the sector
⇒ Drawing up regulatory measures and community legislation for those breaking the law

However, it is recognized that the viability of the project would require the active and continuous participation of civilians and the dynamic development of the recycled materials market carving up the way to a profitable recycling sector.

3.2.3. Sludge from Municipal/Household Sewage[5]

Sewage treatment and waste water reclamation generates its own solid waste in the form of sludge, the residual material that remains after the effluents have been treated. The existing sewage treatment plants in Greece serviced 55 % of the population in 1997 Primary treatment accounts for 33 % of the above figure, while secondary and tertiary treatment cover 14 % and 8 %, respectively. The number and capacity of sewage treatment plants have witnessed an increase during the last 5 years followed by a parallel increase in the amount of sludge produced. 86 Municipal Corporations have been established which operate 39 sewage treatment plants, while other 96 plants operate under the supervision of individual Municipalities and 3 larger plants (2 in Attica and 1 in Salonica) treat sewage from the 69,2 % of the serviced population. Evidently, the regions of Attica and Central Macedonia are responsible for the higher amounts of sewage sludge (see fig. 3.2.3a).

The management of sewage sludge is determined by the ordinances of joint cabinet decision 80568/4225/91, which determines the measures and requirements for the use of sludge in agriculture. The same joint cabinet decision lays down threshold values of heavy-metal concentrations in the sludge and in the soil as well as the necessary conditions for the issuing of permits by the competent authorities.

Sewage sludge is usually placed in municipal waste disposal sites, stored in proper sites provided by the sewage treatment plants and a smaller proportion finds agricultural use. It is worth mentioning that studies on the heavy-metal content of sludge conducted in different Greek sewage treatment plants do not reveal high toxicity levels.

Objective – Actions

The problems arising from sludge management are treated nowadays in the context of a national framework, especially in light of the operation of 56 new sewage treatment plants (now under construction), which will worsen things in the near future. Thus, the main objective involves the full exploitation of sludge carried out through co-fertilization with the organic refuse of household waste or from the ground up in agriculture. Finally, when the exploitation of sludge is not straightforward processing in order to provide high level of environmental and human health protection should precede the final disposal. The actions designed to meet the targets set by the framework include the operation of a composting unit with capacity 3650 tons of sludge as well as the construction of 3 more recycling-fertilizing plants to treat sludge originating from, Attica and Salonica region’s sewage sludge.

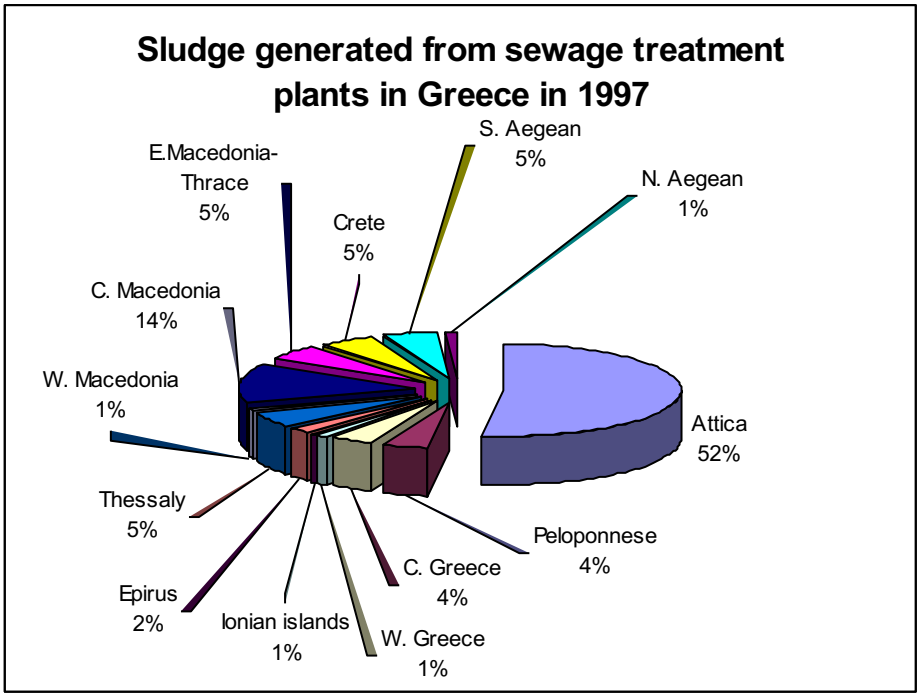


Fig. 3.2.3a. Sludge generated from Greek sewage treatment plants in 1997 [5].

3.2.*4. End of Life Vehicles*[5]

The total number of vehicles in Greece amounted to 3.279.330 in 1997 with the composition described analytically in Table 3.2.4a. Certainly, the highest percentage belongs to cars whose number has witnessed a 67 % increase within a10 year period (1998-1997, see fig. 3.2.4a)

TABLE 3.2.4a. Number of vehicles in Greece in 1997 [5]	
VEHICLE TYPE	
Cars	2.401.414
Light Trucks	666.584
Heavy Trucks	185.427
Buses	25.905
TOTAL	**3.279.330**

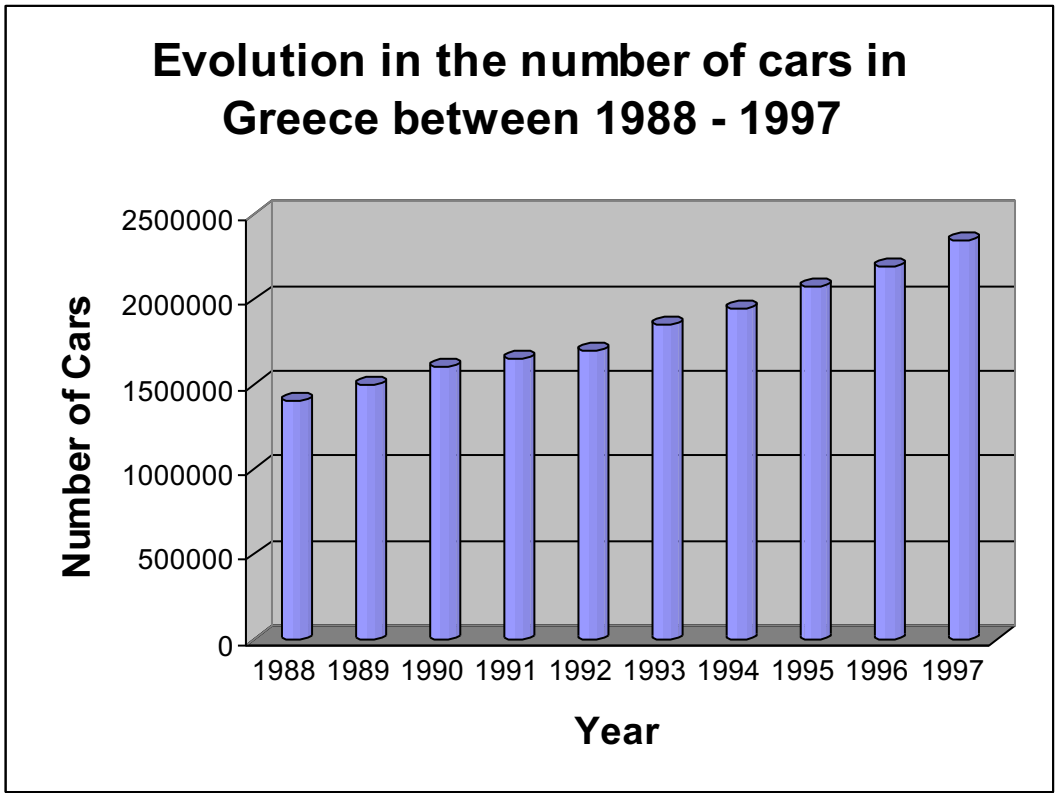


Fig. 3.2.4a. Development of the number of cars in Greece between 1988 and 1997 [5].

The rate of cars withdrawal every year in Greece varies between 0,6 - 0,8 % of the total amount of vehicles with the average lifetime of new technology and "conventional" cars estimated to be 4,5 and 13,2 years, respectively. These rather small rates can be easily explained if one considers the fact that most of the old cars have been withdrawn since 1991 and 1992 as a result of specific motives backed by the Greek Government. Almost 46.3 % of them come from the broad district of Athens and the remainder 53.7 % from the rest of the country.

The common management policy on out of use cars includes their collection either by public or individuals. These latter dismantle and take advantage of any useful or valuable parts (back of cars, seats, oils, motor parts) and sell the remainder either for recycling or scrap. Deserted cars are treated in the context of joint cabinet decision 69728/824/96, which determines the collection and management framework.

Objective – Actions

The national framework on end of life vehicles sets target harmonized with EC legislation and anticipates the establishment of an Organization responsible for the alternative treatment of various materials and end of life vehicles. In this context the development of alternative management projects is favoured including measures for the re-use, recovery, recycling and public awareness.

3.2.5. Used Tyres[5]

In just over a decade (1987-1998) the quantity of used tyres has experienced a 70 % increase fuelled by the corresponding increase in the numbers of vehicles into circulation (fig. 3.2.5a). The broader Athens district contributes 55 % of the total 43000 tons of tyres withdrawn nowadays from the various types of vehicles (cars, trucks, motorcycles).

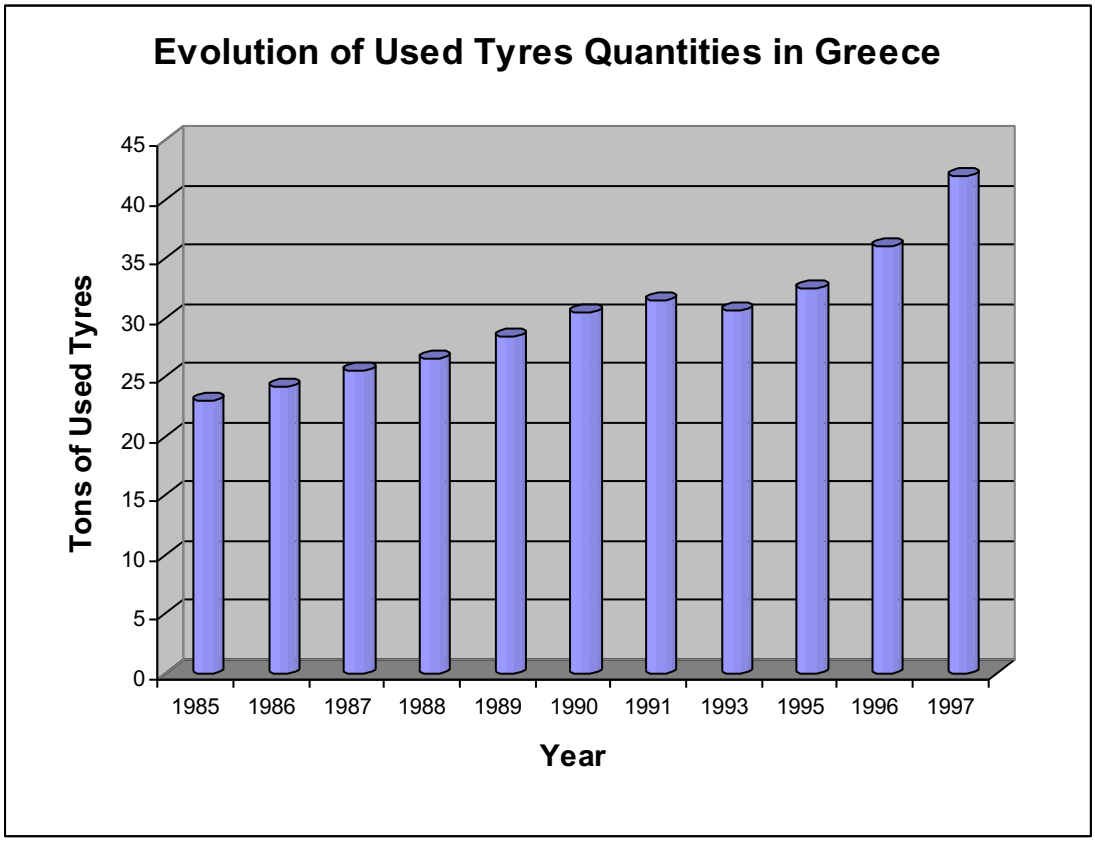


Fig. 3.2.5a. Evolution in the amount of used tyres in Greece between 1985 and 1997 [5].

At present the used tyres are collected from the enterprises that provide vehicle servicing which also carry out the sorting out of those that can be re-treated (3 % of the total amount). Old and worn-out tyres are landfilled together with bulky household/municipal waste except a small fraction, which are stored in specific sites or disposed of inappropriately.

Objective – Actions

The main objectives of the National Framework on tyres aims to:

- increase the lifetime of tyres a fact which will eventually lead to a parallel reduction in the number of withdrawn tyres
- increase the percentages of retreated tyres from 3 % to 20 %
- promote the alternative use of tyres (for instance in various constructions)
- improve the recycling rates and the energy production out of tyres
- minimize the quantities that are disposed of

The former objectives have been considered attainable through actions such as promotional campaigns that reinforce public awareness, establishment of infrastructure assisting re-use, recycling and energy recovery projects.

3.2.6. Construction & Demolition Waste (C & DW)

This general term covers a wide variety of materials with the most obvious classes being[9]:

(i) Waste derived from total or partial demolition of buildings or/and public works.
(ii) Waste came from the construction of buildings or/and public works
(iii) Soil, rocks and vegetation derived from excavations of public and other works

Most C&DW had traditionally been landfilled in the same landfills as were used to dispose of municipal solid waste in volumes roughly equal in last few years. The term core C&DW is commonly known as the mix of materials obtained when a building or a piece of civil engineering infrastructure is demolished, such as concrete, bricks, tiles, glass, plastics, metals and insulation materials. According to the estimation of Eurostat core C&DW alone amount to around 180 million tons each year[10] (see table 3.2.6a). From this only about 28 % is re-used or recycled with the remaining 72 % being either incinerated or landfilled. This raises the quantity of non-reused or recycled core C&DW amounts to around 130 million tons. Adding construction waste and excavated soil and rock to this figure more than doubles the total weight and volume of material to be managed. Moreover, the nature of today's demolition waste is directly influenced by the building techniques and materials, which were in vogue when the buildings being demolished today were built. The nature and volumes of demolition waste arisings also reflect the solidity and flexibility (and therefore the life expectation) of the structures themselves, as much as the investments of housing, industry and the service sector of previous years.

TABLE 3.2.6a. Construction & demolition waste arisings together with percentages of recycling and landfill[10].

MEMBER STATE	CORE C&DW ARISINGS (million tons, rounded)	% RE-USED OR RECYCLED	% INCINERATED OR LANDFILLED
Germany	59	17	83
UK	30	45	55
France	24	15	85
Italy	20	9	91
Spain	13	< 5	> 95
Netherlands	11	90	10
Belgium	7	87	13
Austria	5	41	59
Portugal	3	< 5	> 95
Denmark	3	81	19
GREECE	2	< 5	> 95
Sweeden	2	21	79
Finland	1	45	55
Ireland	1	< 5	> 95
Luxemburg	0	(n/a)	(n/a)
EU-15	**180**	**28**	**72**

(n/a)=non-available

The countries that present the best percentages in environmental management of core C&DW are the Netherlands (90 %) and Denmark (81 %). On the other hand, there members like Greece, Spain, Portugal and Ireland with re-use or recycling rates less than 5 %. Specifically, the volumes of inert C&DW exhibit incremental trends in Greece in the order of 5 % from 1991 to 1996 (see fig. 3.2.6a and Table 3.2.6b for the contribution of the various Greek regions)

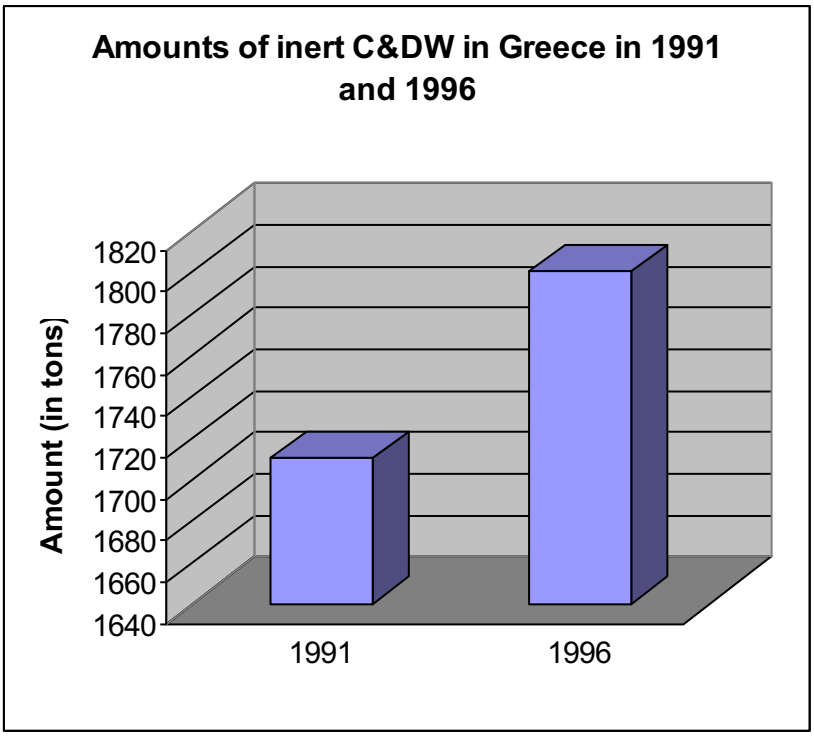


Fig. 3.2.6a. Amounts (in tons) of inert C&DW in Greece in 1991 and 1996[5].

TABLE 3.2.6b. C&DW volumes per Region for the years 1991 and 1996 in Greece[5].		
REGION	**1991**	**1996**
East Macedonia-Thrace	93	66
Central Macedonia	295	278
W. Macedonia	89	32
Thessaly	102	131
Epirus	82	71
Ionian islands	34	66
West Greece	105	112
Central Greece	82	96
Peloponnese	83	109
Attica	590	639
North Aegean islands	33	45
South Aegean islands	50	74
Crete	80	90
TOTAL	**1718**	**1809**

The management of C&DW in Greece is still in its infancy lacking of an appropriate collection and utilization system. Still, certain wastes such as electrical wires, insulating materials, frames, glasses and other debris are used in other constructions, while the rest of them end up in sanitary or open disposal sites. In the case of Attica, for instance, the restoration of 6 quarries is carried out with waste derived from big infrastructure works. It is, therefore, obvious, that any project designed to tackle the problem of C&DW by increasing the re-use and recycling rates should rely on the development of a complete collection, sorting and exploitation framework.

3.2.7. Vegetable Waste[5]

Fig. 3.2.7a demonstrate the volumes of vegetable waste (fruits) disposed of in landfills between 1995-1997.

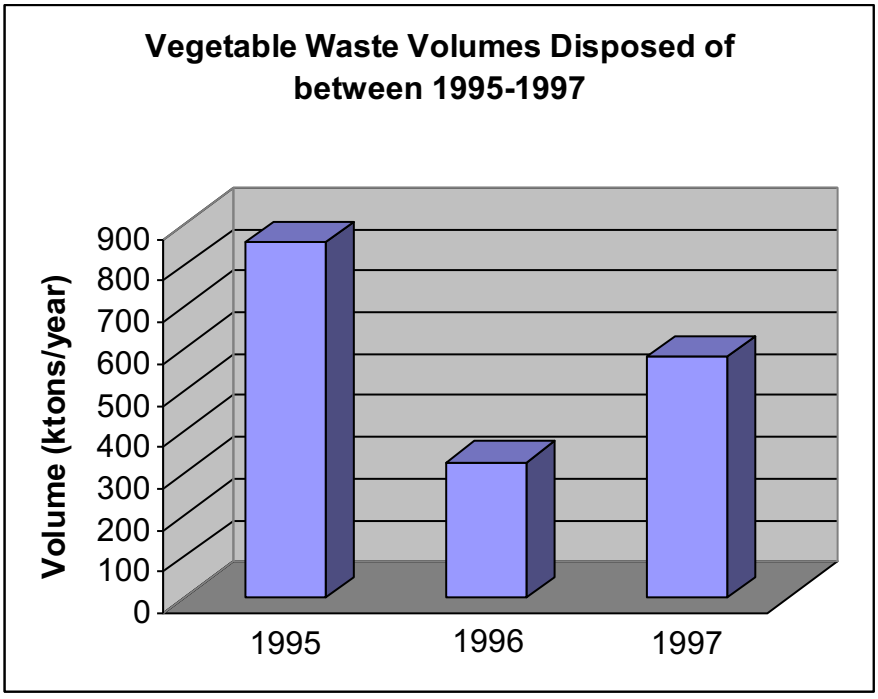


Fig. 3.2.7a. Volumes of Vegetable waste disposed of in Greece between 1995 and 1997 [5].

The fluctuation observed on the volumes of vegetable waste can be accounted for by the EU policy on the production of fruits and the demand levels of the corresponding market. The volumes are expected to be even smaller in the future.

It is worth mentioning that the above values correspond to waste disposed of in open or unauthorized landfills. However, there are two sanitary landfills under construction in the regions of Arta and Evros with nominal capacities 15000 and 1.500 tons/year, respectively.

In the context of the national management policy on vegetable waste the biodegradation or the final disposal in sanitary landfills is anticipated.

3.2.8. Stock Farm Waste[5]

The average production of waste out of stock farm processes consisting primarily of animal debris sums up to 7000 ktons/year with 74.3 % being used as organic fertilizers. The national waste management strategy suggests their full exploitation incorporating at the same time all the necessary measures in order to avoid the ensuing risk of water pollution.

3.2.7. Non-Hazardous Industrial Waste[5]

The Greek industry sector consisting of several large-scale units and more numerous light and medium-size ones generate (solid) waste, which have been classified as non-hazardous according to the European Waste Catalogue. These industrial units include:

- Food and beverage industry
- Olive oil presses
- Paper production industry
- (Primary & Secondary) Metal industry
- Plastics industry
- Inorganic fertilizers industry
- Glass industry
- Wood industry
- Construction industry
- Electric power plants
- Mining

Among the former branches sulfur mining, aluminum-ferronickel and steel production plants, fertilizers production and electric power plants present particular interest mainly because of the huge amounts of waste they generate as shown in the following Table 3.2.7a[5].

TABLE 3.2.7a. Volumes of the most important waste generating industrial activities in Greece (1997)

INDUSTRIAL ACTIVITY	WASTE TYPE	VOLUME
Sulfur Mining	Wastes originating from metal separation process	500,000 tons/year
Aluminum production	Red Sludge	1,100,000 m^3/year
Ferronickel production (Fe 75 % - Ni 25 %)	Slag	1,500,000 tons/year
Steel production	Slag	115,000 tons/year
Chemical fertilizers	Phosphorus by-products	1,000,000 tons/year
Amianthus extraction and processing	Extraction wastes	2,000,000 tons/year
	Residues from the process of amianthus fibers separation	3,900,000 tons/year
Electric power plants	(fly-liquid) Ash	9,320,000 tons/year
	Sludge	170,000 tons/year

Non-hazardous industrial wastes are treated in Greece according to joint cabinet decision 69728/824/96 providing the requirements for the:

- Prevention or reduction of the produced quantities and their danger supporting the implementation of innovative and clean viable technologies
- Exploitation of the waste by recycling, re-use or any other process aiming at producing secondary materials
- Energy production out of waste

The former joint cabinet decision also anticipates that the cost of waste management should be borne by the producer. The latter will hand over his waste either to licensed establishments (public or private) or will carry out their management himself in a way, which reduces as far as possible the ensuing risks for the public health and the environment. Moreover, the producer is responsible for the restoration of disposal sites in their previous status.

The most common waste management practices followed by industries include:

- Recycling
- Energy production out of waste
- Disposal-storage in sites
- Final disposal in sanitary or open landfills

Objectives – Actions

The National Framework on the management of non-hazardous industrial waste has set up targets the summarized below:

- Recording of the qualities/quantities of the generated wastes as well as of their management practices on an ongoing basis
- Reduction in the volume and the danger emanating from non-hazardous industrial waste
- Improvement of exploitation rates of waste
- Progressive elimination of waste disposed of in unauthorized landfills

The following types of actions have been identified in order to meet the targets set up by the National framework:

⇒ Development of a potential marking system aimed at facilitating the full exploitation of the data collected so far. (*Today, this project is under construction with the Ministry of Environment, Physical Planning and Planning Works being the competent authority*).

⇒ Prevention of waste production on site through the implementation of clean-innovative technologies

⇒ Development of measures in favour of the best available techniques concerning waste management

⇒ Supporting of actions undertaken by the private sector towards the improvement of (non-hazardous) waste utilization

4. EMPLOYMENT STRUCTURE AND POTENTIAL OF LABOUR FORCE

The rather insufficiently systematic waste management results in the absence of companies involved in the whole recycling procedure (that is, collection, sorting out, recycling). Thus, waste collection is carried out mostly by local authorities through bins for paper, glass, aluminium or individuals (especially in the case of metals or oil waste). For example, the Association O.T.A. of greater Thessalonika area first began a paper-recycling program in 1998.

The waste sorting out as well as the transportation is carried out by private companies or individuals working on a family business scale, while the final processing is taken over by companies with the appropriate facilities, which finally make use of the recycled products. Some of these companies involved somehow in the procedure will be examined by corresponding case studies.

The sector suffers from poor professionalisation because the employees (and/or employers) coming from the workforce, in general, lack any special qualifications, even though most managers or directors hold University degrees. Consequently, there is a tremendous need for initial as well as continuing vocational training (at least on a regular and systematic basis), especially, in cases where a demanding waste sorting is required (e.g. plastics).

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