

International Master in Sustainable Development 2007/2008

Module: Environmental Protection

WASTE MANAGEMENT

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LESSON 1: ANALYSIS OF PROBLEMS PRODUCED BY WASTE - CAUSES AND ORIGINS

1.1. - Introduction: Waste. Concept and classification

1.1.1. - Concept of waste

The continued development of modern societies, on both the industrial and economic front, has led to higher standards of living for humans; however, this has not come without a price. Humans now have to confront previously unheard of problems, such as, atmospheric, soil and water pollution.

The concept of waste can be explained in various ways, depending on the defining body.

- ✓ From morphological point of view, waste is a mix of chemical elements which follow different specific chemical cycles, such as the carbon and nitrogen cycles, etc.
- ✓ From an environmental point of view, the European Environmental Directive 75/442/EEC (European Economic Community), on Waste, amended by Directives 91/156/EEC, 91/692/EEC and by the Commission Decision 96/350/EC consider waste as any substance or object which the holder discards or intends to discard or is required to discard according to national regulations.

This is the main concept established in the Directive. It is however necessary to point out that, for legal purposes, the definition includes, in addition, the requirement of mentioned substances or objects to be considered as waste if they are included in the official waste list.

- ✓ From an economical point of view, the Organisation for Economic Cooperation and Development (OECD) defines waste as a material which generated from production and consumption, has not reached in the frame in which are produced, any economical

value, as there is no suitable technology to make use of them or any market of recovery products coming from them.

As the subject of this Module is environmental protection, this lesson is focused on environmental concepts and standards.

Waste standards and policies are designed to protect human health and the environment by replacing the “use and throw away” attitude toward waste disposal which was socially accepted until recent years.

The “use and throw away” attitude creates an abundance of waste that makes a serious environmental impact. The advent of reuse, recycling and recovering has cut down on waste and has created a market for recycled goods, which are becoming more economically profitable in recent years.

For these reasons the concept of waste is changing because something which becomes worthless to its first holder can have value to a second user as raw material.

Available technological treatments have a tremendous impact on the recycling industry in a given area, especially because technology is essential to transform waste into usable materials.

European Directive 75/442/EEC is the EU’s modern policy on waste classification. The old policy classified waste into two major groups: waste and hazardous waste. The new policy does not make this distinction, but has many specific regulations for how to treat different types of waste.

Focused on human health and environmental protection, the European Directive on Waste promotes:

- First of all waste prevention practice, that’s to reduce the amount of production and harmfulness of waste.
- Secondly, the reuse of them, whenever it is possible.

- Thirdly, the recycling.
- Finally, the energy recovering.

At the same time this Directive forbids the abandonment as well as dumping and uncontrolled disposal of waste. To conclude this general overview of this important Directive we should mention that it includes the standard identification and official denomination of the following items:

a) **“Categories of waste”**. These categories are identified by “Q”, as follows (e.g):

- “Off – specification products”:.....Q2
- “Products whose date for appropriate use has expired”....Q3
- “Materials contaminated or soiled as a result of planned actions (e. g) residues from cleaning operations , packing materials, containers, etc”..... Q5
- etc.

b) Activities considered **“Disposal operations”**: These activities are identified by “D”, as follows:

- Deposit into or onto land (e. g. landfill, etc).....D1
- Land treatment (e. g. biodegradation of liquid or sludgy discards in soils etc.).....D2

- Deep injection (e. g. injection of pumpable discards into wells, salt domes or naturally occurring repositories, etc).....D3

c) Activities considered **“Recovery operations”**: These activities are identified by “R”, as follows:

- Use principally as a fuel or other means to generate energy.....R1
- Solvent reclamation / regeneration.....R2
- Recycling /reclamation of organic substances which are not used as solvents (including composting and other biological transformation processes).....R3
- etc.

1.1.2. - Waste classification

Waste can be classified according to different criteria such as:

- Origin: Agricultural, mining, industrials, construction and demolition, municipal, etc.
- Location of production: household, sanitary, industrial, etc.
- Components: ferrous waste, non - ferrous waste, etc.
- Physical state: liquids, solids, gaseous waste
- Level of harm: hazardous, municipals, inert waste, etc.

Waste can fit into several of these categories at once, which creates many subdivisions of waste. Such methodology makes the classification process of waste very complex.

For the purpose of this lesson we will focus on only two major classification criteria:

A) **First criterion:** Origin

The main categories of waste are:

- ***Municipal waste:*** Waste from households, shops, offices and services, as well as non – hazardous waste which nature or compositions allow to assimilate them to waste produced at mentioned places or activities.
- ***Industrial waste:*** Both hazardous and non-hazardous wastes produced by the actions of industry.
- ***Construction and demolition waste (CDW):*** Waste resulting from construction, public works, demolitions, etc.
- ***Mining Waste:*** Waste from extractive industries, that is to say, waste resulting from the extraction, treatment and storage of mineral resources and the working of quarries.
- ***Sanitary waste:*** Waste resulting of healthcare, such as blood, tissues, needles, etc.
- ***Etc.***

B) **Second criterion:** Level of harm

Classified as follows:

- **Hazardous waste:** From a legal point of view, they are the waste which are included under this denomination in the lists of international or national regulations, as well as packaging in which they were contained. Conceptually, hazardous waste are waste composed of one or more substances that provide them with dangerous characteristics in enough quantity or concentration to serve as a risk to human health, natural resources or the environment.

Hazardous waste requires specific treatment and a continuous control during the production, transport and disposal. Therefore the disposal either at a sanitary sewage system, at municipal or inert landfills is forbidden. Hazardous waste require specific treatment and continuous control during production, transportation, and disposal. Disposal inside of sanitary sewage systems of municipal or inert landfills is strictly forbidden.

Examples of hazardous wastes include the following:

- Some chemical products.
 - Batteries.
 - Waste electrical and electronic equipment (WEEE).
 - etc.
- **Non- hazardous waste:** Waste not considered hazardous according to current regulations.

Non-hazardous waste includes the following subdivisions

- **Inert waste:** Waste that does not undergo relevant physical, chemical, or biological transformations.
- **Other Non – hazardous waste:** Every other waste that is not included at above mentioned categories, such as organic residues of food, paper,

cardboard, which, in general, resulting from regular, everyday “garbage bag” waste from the average home.

1.1.3. - European List of Waste.

One requirement of Directive 75/442/EEC is to establish a comprehensive list of hazardous waste. It is a harmonized list classified into subcategories based on the activities in which waste is produced, or the nature and or characteristics of waste. This method optimizes the possibility to reuse the different types of waste.

At the first level, there are 20 categories (chapters) of waste, in accordance with their origin. For example, Chapter 01 is called “Waste of prospecting and/or extraction of mining or quarries and physical or chemical treatment of minerals.”

Within each chapter, sub-chapters are established with more detailed classification of wastes according to their elemental origins. For example, 01 01 is called “Waste of extraction of minerals.”

Finally, at a third level are included the elemental waste, e.g.: 01 01 01 “Waste of extraction of metallic minerals”.

1.1.4. - Waste management

The concept of waste management encompasses all operations and activities which are carried out with the intention of curbing waste production.

According to Directive 75/442/EEC, on waste, waste management is:

- The collection
- Transport
- Recovery
- Disposal of waste

This also includes the supervision of the above operations and the after – care of disposal sites.

Collection is the gathering, segregation (sorting) or mixing of waste for transport purposes. Recovery is any process which aims to extract secondary materials or to employ waste as a source of energy; recovery could be recycling, re – use or reclamation or any other process for the same purpose (such as storage: “R – 13” of recovery operations). Disposal means the aforementioned activities included in standard identification and official denomination of Directive (such as: Deposit into or onto land - e.g. landfill - “D 1”, or Deep injection into wells, domes or naturally occurring repositories, “D 3”, etc.).

All mentioned management operations/activities must be performed without endangering the environment and human health, and without posing any risk to water, soil, air, animals and plants as well as without causing a nuisance through noise and odours and without adversely affecting the countryside or places of special interest.

Management of waste is founded on some “General Management Principles”, the main of which are:

- **Shared Responsibility**, of Public Administration, private companies and the citizens, in order to gear their behaviour toward waste reduction at the origin.
- **Polluter pays**. According to this principle, the cost of environmental management of waste must be defrayed by the producer of goods, because he is responsible for putting the goods out there in the first place.
- **Subsidize Principle**: Public Administration will only act on the management of waste when its goal cannot be reached by the concerned economical agents.

1.2. - ANALYSIS OF PROBLEMS PRODUCED BY WASTE, CAUSES AND ORIGINS.

1.2.1. - Development and economical growing and waste production.

Human activity is strongly linked to waste production. All societies have at one stage produced waste and still continue to do so

In the olden days, humans mostly consumed what was directly provided by the natural environment, and as such, there was little link for the production of harmful waste. However, economical development and growing of modern societies are generating a high increase in the quantities and harmfulness of waste.

Waste production thus became the measure of economic development. With that said, developing countries then came to be those countries which produce copious amounts of waste and it seems like developing countries are on the same path as waste production, a serious cause for concern.

Advanced societies are now attempting, as one of their main environmental goals, to break or stop the current link of waste production and economic development.

Problems resulting from waste are really complex. On one hand, despite using modern technologies the amount of waste being reduced at industries, it is still not possible to stabilize the excess generation because at the same time the industrial production of goods are increasing and therefore the total amount of waste is increasing.

Waste production is a serious and very complex problem. Not even the use of modern technology can help curb this. Regardless of the use of sophisticated machinery, the fact that more and more goods are produced eventually leads to the production of increased amount of waste.

Paradoxically, the implementation of regulations to control waste management can sometimes lead to an increased amount of waste. For example, the construction and performance of

wastewater treatment plants (WWTP) helps reduce the contamination of water, but at the same time, leads to increased amounts of total sewage sludge.

The following table and graph show the growing total amount of the structural index of EU countries “Municipal waste generated”. They allow us to verify that, despite implementation of environmental regulations and, obviously, the increasing performance of waste management industries, the production of municipal waste grows more and more, mostly in the more industrialized countries.

This indicator presents the amount of municipal waste generated. It consists of waste collected by or on behalf of municipal authorities and disposed of through the waste management system. The bulk of this waste stream is from households, though "similar" wastes from sources such as commerce, offices and public institutions are included. For areas not covered by a municipal waste scheme an estimation has been made of the amount of waste generated. The quantity of waste generated is expressed in kg per capita per year.

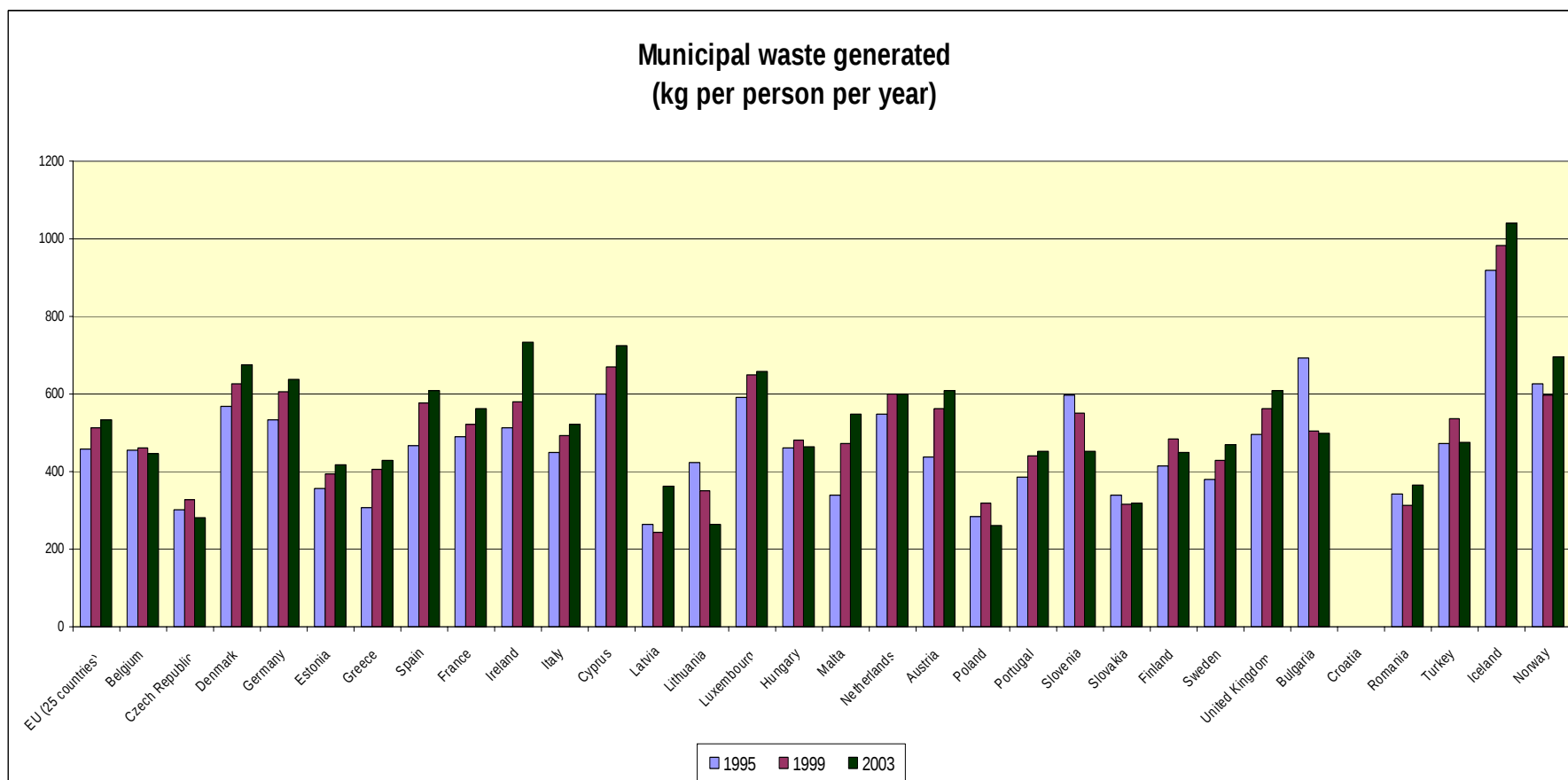
	1995	1996	1997	1998	1999	2000	2001	2002	2003
EU (25 countries)	457	470	485	487	513	520	520	531	534
EU (15 countries)	482	495	511	516	545	554	558	574	577
Euro-zone	481	494	509	513	543	553	555	570	573
Belgium	455	450	464	459	460	468	462	462	446
Czech Republic	302 ^(e)	310	318	293	327	334	273	279	280
Denmark	567	619	588	593	627	665	677	668	675
Germany	533	543	556	546	605	610	600	640	638
Estonia	357	383	406	383	394	440	372	406	418
Greece	306	344	372	388	405	408	417	422	428
Spain	467 ^(e)	492 ^(e)	517 ^(e)	530	576	595	595	588	609 ^(e)
France	489	500	511	522	523	532	545	557	561 ^(e)
Ireland	514	524 ^(e)	548 ^(e)	557	580 ^(e)	603	707	698	732 ^(e)

	1995	1996	1997	1998	1999	2000	2001	2002	2003
Italy	450	453	463	466	492	502	508	525	523 ^(e)
Cyprus	600	642	650	664	670	680	703	709	724
Latvia	263	263	254	247	244	270 ^(e)	302	369	362
Lithuania	424	400	421	443	350	309	300	288	263
Luxembourg	592	589	607	629	650	657	650	653 ^(e)	658 ^(e)
Hungary	460	468	487	484	482	445	451	457	463 ^(e)
Malta	338 ^(e)	350 ^(e)	361 ^(e)	385	473	483	550	474	549
Netherlands	549	563	590	593	599	616	612	615	599
Austria	438	517	532	532	563	581	578	611	610
Poland	285	301	315	306	319	316	287	272	260
Portugal	385	399	402	423	442	472	472	447	452
Slovenia	596	590 ^(e)	589 ^(e)	584	551 ^(e)	513 ^(e)	479	479	451
Slovakia	340	348	316	316	315	316	390	283	319 ^(e)
Finland	414 ^(e)	410 ^(e)	448	466	485	503	466	457	450
Sweden	380 ^(e)	397 ^(e)	416	431	428	428	442	468	471
United Kingdom	496	507	527	536	562	569	582	600	610
Bulgaria	693	616	577	495	503	516	505	500	499
Croatia	:	:	:	:	:	:	:	:	:
Romania	342	326	325	277	314	355	336	383	364 ^(e)
Turkey	472	501	530	533	536 ^(e)	500 ^(e)	474	479	474 ^(e)
Iceland	918	940	956	973	983	996	1006	1022	1040
Norway	626	632	619	647	596	615	635	677	696

(:) Not available

(e) Estimated value

Source: EUROSTAT



To summarize, the modern environmental policy encourages to establish measurements to obtain a bigger efficiency of natural resources because the available amount of them is finite. Therefore is necessary a suitable management of them as well as of the waste ones, by means of obtaining production and consumption models that are more sustainable, breaking the current link existing between the use of resources and waste production with growing economical rate and also in order to reach that the consumption of resources, both renewable and non - renewable do not exceed the capability of absorption by the environment.

1.2.2. - Human health and waste

It is not enough to manage the waste in a suitable way for the consumption of the natural resources; their production is also a concern to human health and this is another factor which international environmental regulation takes in to account.

International Environmental Organizations are aware of the relationship that exists between environmental degradation and an increase in waste, especially hazardous waste. Despite improvements in environmental regulations, the above relationship still leads to human illnesses.

However, this is not the sole precautionary measure; rules which limit or prohibit the use of known waste substances are also implemented. These rules serve to curb or lessen the harmful effects by waste substances which are carcinogenic or toxic by nature such it can be the case of Persistent Organic Pollutants (POP's).

Managing waste can also pose the risk of accidents or catastrophes. In some cases tailings are stored on heaps or in ponds where they are retained by means of dams. The collapse of dams or heaps may have serious impact on environment and human health and safety.

Examples of this are the accidents in the town of Aberfan (Wales), in 1966, the worst ever accident in the UK. The accident occurred due to the collapse of a heap of **inert waste** from a coal mine. It caused the death of 144 people, mainly children. Another example is the accident that occurred on 19 July in Stava (Trento, Italy), in which a fluorite tailings dam failed and

released 200,000 m³ of inert tailings; this resulted in the killing of 268 people and the destruction of 62 buildings.

The above accidents show that human safety and health are not only threatened by the actual waste itself, but also by the management of it.

But the risk can also be produced by the dangerous nature of the waste components. And this is illustrated by the following accidents: On 1998, in Aznalcollar (Spain), a collapse of a dam of dangerous tailings produced the release into the Guadiamar River of 2 million m³ of tailings and 4 million m³ of water contaminated by heavy metals in an area close to the Doñana Natural Park in South Andalusia. Similar accidents also occurred at Baia Mare and Baia Borsa (Romania) in 2000.

In Baia Mare a tailings pond burst led to approximately 100,000 m³ of waste containing up to 120 tonnes of cyanide and heavy metals being released into the Lapus River, then travelling down stream into the Somes and Tisda Rivers into Hungary before entering the Danube. In Baia Borsa 20,000 tonnes of tailings were released into the Novat River, a tributary of the Viseu and Tisa Rivers.

1.2.3. - Awareness Citizen.

As we have mentioned above an increase in waste production is due to the consumption behaviour of citizens.

Therefore another area which requires special environmental attention is the development of prevention measures by means of global waste reduction, which can be achieved by implementing prevention strategies and also by resorting to more sustainable consumption models. The first step to success for this model would be getting the citizens to collaborate in the reduction of the production of waste.

Providing information to the citizens on reusing, recycling and on other useful daily life waste practices would prove a core component of the prevention model. We can mention, as an example, composting of some organic waste resulting from domestic food and gardening.

It should also be mentioned that awareness of citizens to collaborate in the reduction of waste would result in a drastic decrease on the number of accidents and illnesses.

The first condition to promote this awareness is to provide enough information on environmental actions which can impact on health and daily activities of the citizens.

At the same time current environmental policy gives potentially affected citizen by some environmental actions an important capability of early participation in process of making decisions.

Such as the cases of information mechanisms to the citizens included into procedures for the evaluation of application for operation permits for some industries and management of waste facilities.

So, current regulation requires that the public shall be informed, by public notices or other appropriate means, such as electronic media where available, of relevant items early in the procedure for granting a permit.

These items are (e. g.):

- The application for a permit.
- Details of the competent authorities responsible for taking the decision.
- Details of the time schedule for transmitting comments or questions.
- Indication of the times and places where the relevant information will be made available.

1.2.4. - Minimization.

Waste minimization focuses on the reduction of productive processes of industries that are waste producing. Minimization includes measuring the organization and operation of such industries to reduce to suitable economical and technical levels the quantity and harm of products and polluted elements. That is to say, there is a strong focus on reducing environmental waste and emissions in industries such as sewage which require treatment before disposal.

In general, Minimization can be categorized by an effort to **reduce waste at its origin**, **recycle** materials that are recyclable, and **recover** usable substances and resources contained in mentioned sub products or waste.

- ❖ **Reduction at the origin** of the production of sub products or waste includes the implementation of suitable operative practices, the optimization of such processes, and the advent of changing technologies to aid this process, and the modification of products, such as substituting less harmful raw materials for more harmful ones at the outset of production.
- ❖ **Recycling of sub products** is the process of using a used product as a raw material in the production of a new product. Recycling involves varying levels of treatment and processes to prepare the raw material for reuse. Recycling has economic implications, and can require the support of intermediate companies and favourable market conditions to make it profitable.

Directly reusing products is included in the concept of recycling.

- ❖ **Recovery** is the process of attaining the valuable substances and/or resources inside sub products or waste by means of extraction processes. These materials are then used for other purposes. Examples include precious metals extracted from catalysers, and energy extracted from the incineration of sludges.

The purpose of this lesson is to present important concepts of Minimization, but not to say that these concepts are only strongly linked to Waste Management. In other words, this lesson's

purpose is to stress Minimization as “a philosophy,” or “a general criterion” considered by Management of organizations. The observation and execution of Minimization principles is a responsibility of the governing departments of these corporations and also involve the job of workers.

Minimization is considered an environmental priority to solve waste related problems, while at the same time it is considered to be a brilliant opportunity to reduce production costs, increase competitiveness, and improve the condition of the environment.

Mostly for the following reasons:

- Waste regulation is a problem that always requires immediate attention. Often, minimization is the only option for the Waste Management industry to fulfil requirements, due to:
 - In some cases, complete disposal of waste in a suitable manner is technically impossible.
 - Some options of disposal have been forbidden to particular substances or the disposal procedures are very sophisticated or expensive.
 - In many cases, public opposition prevents the advent of new Waste Management facilities, and the only available management facilities are in foreign countries, which is a very unprofitable situation. Also, regulations on transboundary transport of waste complicate the process of using foreign Waste Management facilities.
- Government controls on companies in terms of fulfilling the requirements of regulation grow stronger each day, often leaving companies penalized or under litigation for not performing the duties they are responsible for.

- New taxes for new technological systems for treatment and disposal create rising costs in Waste Management. On the other hand, Minimization saves costs relating to production, consumption, and disposal, and thus can increase profits.
- Minimization improves the image of companies in the public eye by showing a concern for the planet and mankind.
- Finally, Minimization often creates higher quality products with a higher degree of efficiency. The result is an improvement in productivity.

In summary: Companies have the possibility to fulfil the enforced legal requirements related to their production and waste taking advantage of excellent possibilities that minimization methodology provides.

1.2.5. - The Role of Public Administrations.

Responsibility of Public Administration is not only focused upon issue regulation, the control of this fulfilment, to evaluate of application of permits and surveillance activities, etc.

Public Administrations are responsible to create harmony and a balance between individual consumers and public and private enterprises, based on the aims and objectives of the modern environmental policy. They also aim to keep all parties informed about the most economical and environment friendly processes and products so as to achieve sturdy and sustainable consumption patterns.

The Sixth Community Environment Action Programme states that in order to achieve the aforementioned aims, should promote ecological policies and criteria in the procurement procedures taking into consideration environmental characteristics and providing guidelines on the best available practices.

LESSON 2: CURRENT WASTE MANAGEMENT

2.1. - Sustainability.

2.1.1. - European policies on environment

European policies on environment have been laid down on the Environment Actions Programmes. The Fifth Environment Action Programme “Towards Sustainability” (1992 – 2000) helped to establish “Sustainability” as one of the main aims of the European Union.

“Sustainability” is a principle prevailing all European strategies on environment. The Programme also established the decision to integrate environmental dimension into all European policies, as well as the European strategy of management of waste. This strategy is based on the following concepts and activities:

1st Prevention.

2nd Reuse

3rd Recycling

4th Recovery

5th Disposal in landfill

Prevention means minimization / diminution of quantities and / or harmfulness of raw materials and waste resulting from products.

Reuse is the reintroduction into commercial flows of used products and waste that do not undergo any relevant treatment.

Recycling means to use contained inside products and waste as raw materials in the productive cycle when it is technically, environmentally suitable and economically feasible (e.g. composting of municipal waste in order to obtain a material by means of fermenting organic waste from some types of waste, such us: municipal waste, sewage sludge, garden waste, etc.).

Recovery is to take advantage of all usable contents within the waste and to reintroduce them into the production cycle; in particular, energy recovery means to take advantage of energy

within the waste and alter it to use as steam or electricity; according to these definitions, recycling is included in the recovery concept.

Finally, disposal in landfill is the disposal of the worthless fraction of waste in a technically suitable site to guarantee that negative impacts do not occur for the environment nor human and animal health.

The Fifth Programme ended on 31 December 2000. The main conclusions reached by its implementation were: a) Despite decreased levels of contamination in certain, environmental problems still remained, and b) The Programme did not, ultimately, stop deterioration of environment.

For these reasons the Programme established a new proposal: To overcome the sole legislative strategy and to create a general strategy approach.

The Sixth Environment Action Programme, “Environment 2010: Our future, our choice” (2001 – 2010), started with the following proposals: First of all, to improve and increase results of existing regulation; and secondly, to improve collaboration with companies and to increase information available to citizens and consumers.

2.1.2. - European policies on waste.

The European policies on waste are founded in the three main principles:

- Sustainability of resources.
- Prevention on waste production, and
- Sustainability of management of resources and waste.

To define “Sustainability of resources” it is necessary to distinguish “renewable resource” and “non- renewable resource”. A “renewable resource” it is sustainable when its consumption always remains below its capability of renewal.

However, a non – renewable resource is renewable when its consumption is lower than the capability of its substitution.

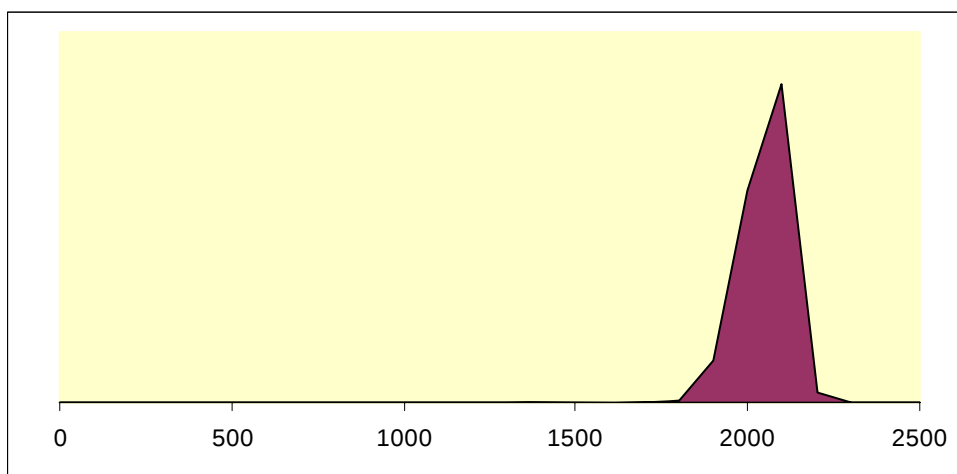
Regarding prevention on waste production, waste production is sustainable when its production is lower than the capability of absorption of them by the system.

In relation to the sustainability of management of resources and waste, the following graphs show the difficult current situation both on resources and waste and they allow us to conclude the necessity to conserve the resources as well as waste production in countries of European Union (kg per person per year).

NECESSITY TO CONSERVE RESOURCES

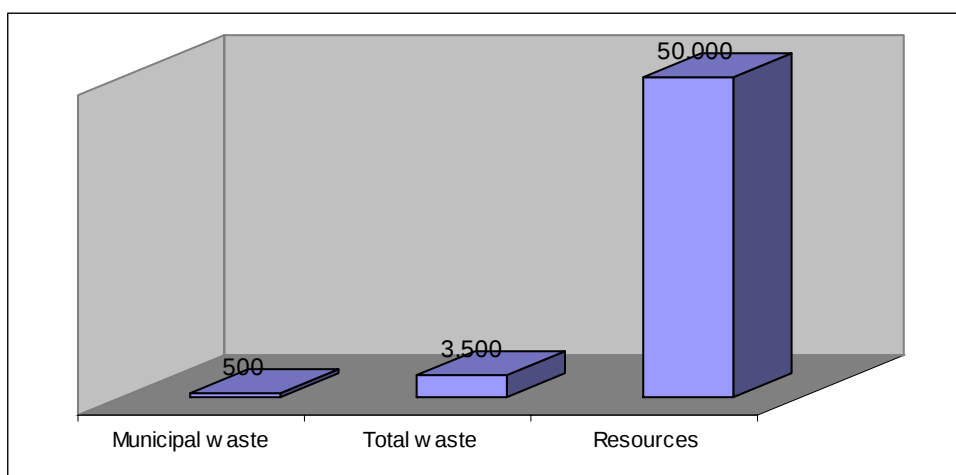
OIL PRODUCTION

FROM YEAR 0 TO YEAR 2,500



RESOURCES CONSUMPTION AND WASTE PRODUCTION IN E.U.

(kg per person per year)



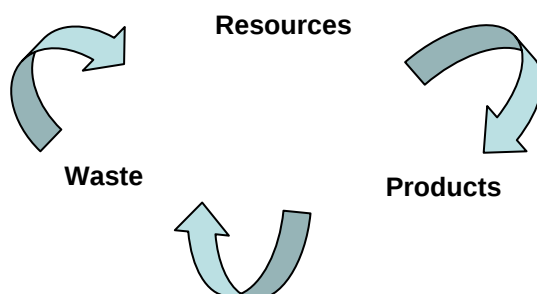
On the other hand, an aim of the Sixth Community Environment Action Programme, is to reach “better resource efficiency and resource and waste management to bring about more sustainable production and consumption patterns, thereby decoupling the use of resources and the generation of waste from the rate of economic growth and aiming to ensure that the consumption of renewable and non – renewable resources does not exceed the carrying capacity of the environment”.

Reaching the mentioned aim is necessary to implement the sustainability conditions to ensure “non – contamination” which is required in order to guarantee that the waste cycle, the material cycle and the energy cycle are completed.

The waste cycle: As it is exposed at Lesson 1, waste, from a morphological point of view, is a mix of chemical elements which follow different specific chemical cycles, such as the carbon cycle, the nitrogen cycle, etc. Therefore, as much waste is produced as many cycles of chemicals elements are accumulated.

The Nature has its own solution to complete the chemicals cycles but sometimes such solution is too slow. That's the reason why the society has implemented "waste treatments" to speed up the breakdown of harmful chemicals, understanding by "waste treatment" a local and artificial acceleration of the cycle of one element toward an inert state which allows nature to continue the cycle and complete it without adverse impacts.

The material cycle: In the material cycle the input is the raw materials, that is, the resources, and the output is the products. Making use of resources means to complete the cycle of materials, converting resources into products, products into waste and waste back into resources.



The energy cycle: In the energy cycle the input is the external fuel and the output is the energy. The energy is used to achieve sustainability of materials and waste cycling. It is not possible to reduce the amount of energy used and maintain the same level of efficiency in waste cycling.

Current situation of cycles with regard to sustainability are strongly conditioned by the fact of modern society requires the continuous growth of cycles; therefore sustainability conditions must be implemented to decrease raw material and external fuel input to the system.

2.2. - Waste recovery.

It is possible to get waste recovery relying on waste cycling taking advantage of the reusing and recycling of materials and as well as some news technologies enable sustainable energy production from the waste cycle.

The new trend on waste recovery, by means of the performance of the "Hierarchy Principle" to achieve reuse and recycling of waste, is the implementation of "Integrated Waste Management" methodology.

This methodology includes a tailor – made management for each particular case (waste and / or location); to perform and to emphasize every step of hierarchy principle according to local and specific conditions for each particular waste, and the criterion of only “the ultimate waste” will be disposed in landfill. (“Ultimate waste” means the waste that remains after all of the usable contents have been taken out).

For the purpose of this Lesson this concept is explained focusing on new trends of management of two types of waste, Municipal waste and Industrial waste, as follows.

2.2.1. - Municipal waste management.

According to the already mentioned definition, Municipal waste (MW) is “waste from households, shops, offices and services, as well as Non – Hazardous waste due to its nature or composition being similar to waste produced at mentioned places or activities.

Types of components of Municipal waste are: Organic matter; paper – cardboard; plastic; ferrous metals; non – ferrous metals; woods; glass; others.

Reuse of MW: Current reuse of this waste is mostly performed for glass packages (bottles) produced by industries related to the manufacturing of beer, water, wine, etc.

Recycling of MW: Gathering and recycling of components of MW are performed by two main procedures: The installation of containers and specific gathering of recyclable waste (paper, cardboard and glass) and the treatment of it in classification and composting plants.

Final disposal of MW: In past years, MW was disposed in landfills, but this practice created several problems such as: Numerous uncontrolled landfills, which produced serious sanitary problems and environmental contamination; many of them did not have official permits and did not maintain ecological conditions; they did not allow recycling nor recovery of materials such as packages; very few citizens were aware of the danger to public health caused by these uncontrolled landfills. Despite these facts there was strong social opposition to build installations for management of MW.

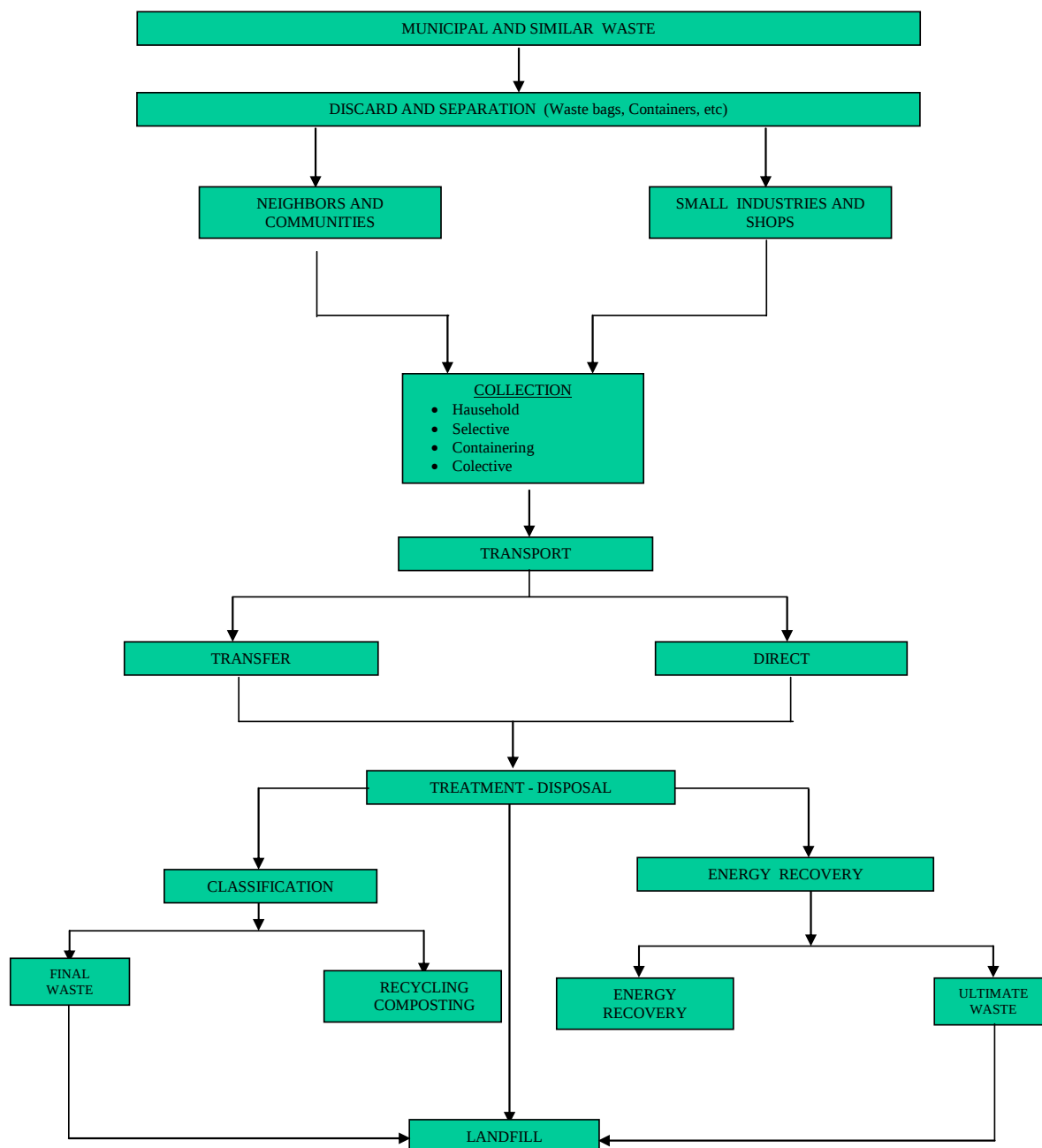
Current management of MW:

To solve the aforementioned problems, current management of MW is based on the following aims: Decreasing the quantity and harmfulness of MW; to implement selective collection; increasing the reuse, recycling and recovery of MW, waste packaging in particular; to perform, when it is possible, the backfitting of current management infrastructures, to fulfil the Directive 1999/31/EC, of 26 of April 1999, on the landfill of waste; to dispose in landfill only the components of waste that cannot be recovered and to recover organic matter by means of composting and / or energy recovery.

Process of management of MW. Chart flow

Current management of MW is performed according to the following chart flow:

MUNICIPAL WASTE MANAGEMENT



In summary: Conceptually it is important to emphasize that the main activities of integrated management of municipal waste must, at least, include: A selective initial collection separate to the organic matter from the fraction of waste to be recycled; a separation of the fraction of waste to energy recovery and the pre-treatment of remaining waste before its disposal in landfill.

2.2.2. Industrial waste management.

According to the already mentioned definition, Industrial waste (IW) is a waste produced by the actions of industry. Types of IW are Inert IW; Non – Hazardous IW and Hazardous IW.

Usually specific waste , such as: post – consumer tyres, construction and demolition waste, spent batteries, etc. *are* not classified as IW due to a large portion of this specific waste resulting from non – industrial consumption activities and because the management of this waste is performed according to specific programmes, regulations and systems.

Inert Industrial Waste.

This is the industrial waste that does not undergo relevant physical, chemical or biological transformations. This characteristic can be due to the natural origin of the waste or to the processes of waste treatment.

Non – Hazardous industrial waste.

This waste results from some industrial, production and/or service activity that is not classified as hazardous in the current regulation.

Waste excluded from the scope of this definition of waste includes that which is generated in the industries but does not directly result from their operations nor their productive processes. Non – Hazardous industrial waste can be similar to household waste, municipal waste, etc. Such waste is managed by municipal systems, according to general and common regulation. (there is no specific legislation)

Hazardous Industrial Waste (HIW).

Hazardous Industrial Waste is industrial waste which is under the denomination of “Hazardous” in the lists of international or national regulations.

In recent years the industrialized countries have become concerned with managing the suitable disposal of waste in order to protect human health and environment. The large increasing of water, air and soil contamination, as well as some accidents and catastrophes related with the performance of some industries and installations of management of waste have facilitated the citizens' awareness in this matter.

Development of legislation and technology for treatment and disposal of this type of waste since the 1970's has mostly been due to the studies and initiatives developed by international organizations, such as: **NATO** (North Atlantic Treaty Organization), Committee for Challenge of Modern Society. **OECD**, (Organization for Economic Cooperation and Development), Waste Management Committee. **WHO** (World Health Organization) and **UNEP** (United Nations Environment Programme).

Based on these studies and initiatives the most industrialized countries issued specific regulations on environmental protection, such as: The Federal Republic of Germany and Denmark, in 1972; France and USA, in 1976, etc.

At the same time, these industrialized countries developed a great technology for the treatment and disposal of almost all the hazardous waste produced; therefore, new profitable industrial activity has arisen in this matter; also a new specialized service: “Hazardous waste management”.

Nowadays, international and national authorities enforce strong controls over production, treatment, and disposal conditions of this waste as well as over the fulfilment of requirements imposed in the permits of management, transport, etc.

Activities of IW Management

As we can remember the activities of waste management are: Collection; transport; recovery (including storage of waste); disposal; supervision of such operations, and after – care of disposal sites. For the purpose of this lesson we will focus on the management of hazardous industrial waste.

A) Previous activities to management.

First of all, note that in these activities the production of waste is not included: Actual production of waste is not an activity of management: It is the problem. However, according to current regulations, the producer must start the management of waste in his facility, by means of the following activities:

A.1) Segregation (sorting): In order to avoid the mixing of waste, which is a problem because of: The incompatibility of some different waste, due to the possibility of increasing the dangerous characteristics in waste in comparison with initial components; or because of economic reasons because the cost of destruction and mixing of waste is usually bigger than the cost of the separate destruction of its components or, finally, because of legal reasons due to mixing of waste is forbidden by regulation.

A.2) Characterization in the factory: The producer / holder of waste is he who has the best knowledge of the composition, physical – chemical characteristics, and harmfulness of his waste.

A.3) Previous storage in the factory: Especially important is the storage of industrial waste in suitable conditions and places. Storage of hazardous waste is performed, according to their particular type, in different kinds of standardized containers.

B) Collection.

Industrial hazardous waste can be collected by: The producer, or a Public Administration or an authorized collector.

C) Transport.

Transport of hazardous industrial waste must fulfil very specific regulations.

The producer is responsible to verify all these requirements, such as: The vehicle is authorized to transport dangerous materials and it is provided all necessary identifications and other required elements; the specific documentation to carry out this type of transport (such as: controlling and monitoring documents, documentation of safety of the waste), etc.

D) Treatment and disposal.

According to what we have already learned at lesson 1 classical procedures of management do not avoid production of waste.

Therefore, it is necessary to reduce it at the origin instead of only controlling it, that is, it is necessary to implement minimization methodology. However, despite the fact that minimization reduces the amount of wastes, it is not enough to eliminate it completely. That's why waste treatment must be carried out as well.

Treatment is defined as: The physical, thermal, chemical or biological processes (including sorting), that change the characteristics of waste in order to reduce its volume or hazardous nature, facilitate its handling or enhance the recovery.

Disposal is any procedure of landfill or waste destruction without causing negative impacts on the environment or human health.

Activities of treatment of Hazardous Industrial Waste.

“Classical” treatments are: Physical – chemical treatment plant; landfill for hazardous waste (HWL) and incineration.

a) Physical treatments of industrial hazardous waste:

They are mostly used to perform the separation (sorting) of different phases and/or components of the waste. This sorting enables relevant reduction of the waste volume, mostly when the dangerous component is contained into only one phase of the waste. Physical treatments are mainly used for water and industrial sewage sludge treatments; they include operations such as: centrifugation, distillation, filtering, etc.

b) Chemical treatments of Industrial Hazardous Waste.

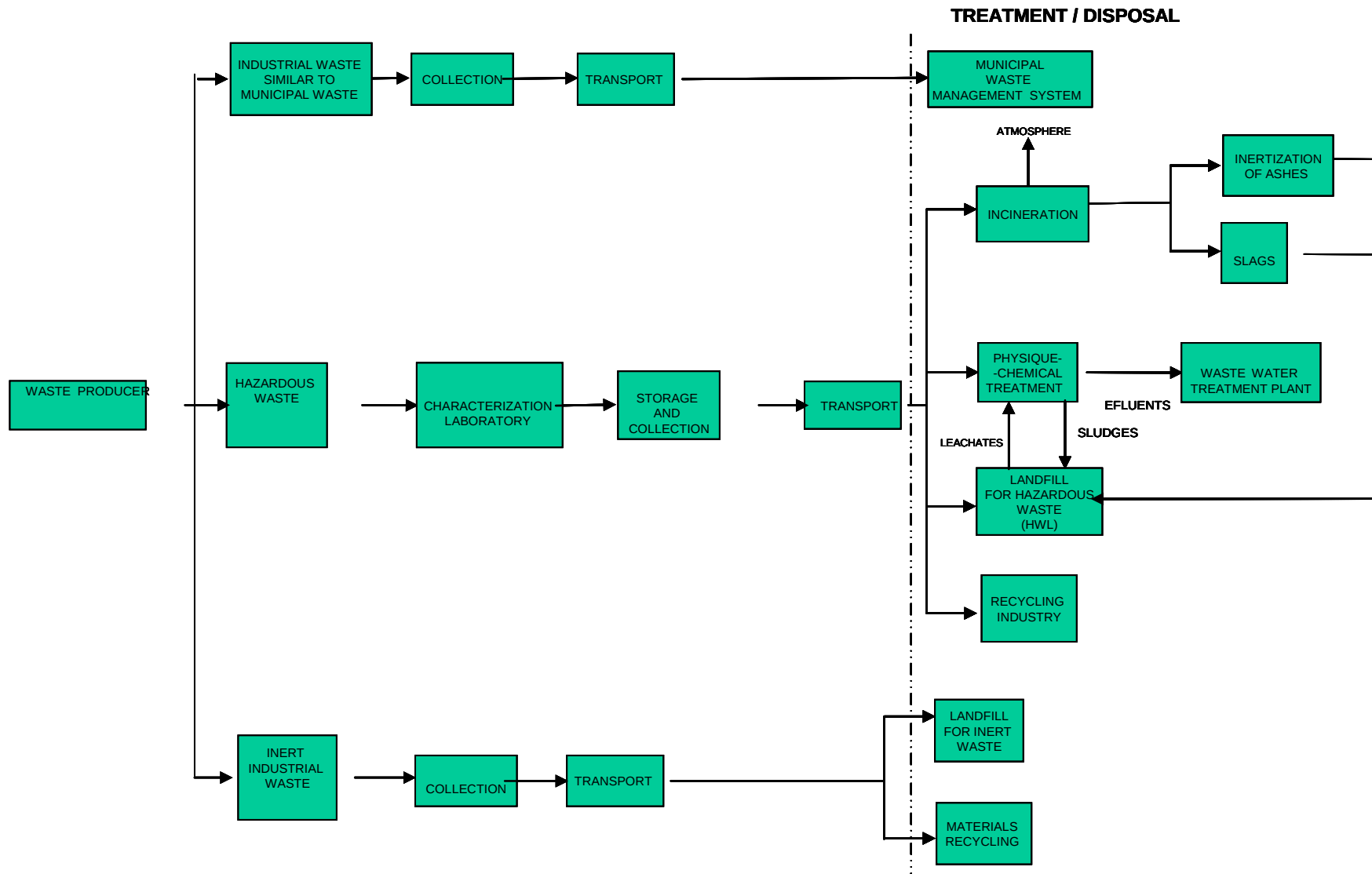
Numerous chemical processes are employed in this type of treatment. Of these numerous chemical processes which are used, two general categories can be established: Treatments to destroy the waste (e.g. destruction of cyanides) and treatments which only reduces the mobility of the dangerous components of the waste (e.g. heavy metals).

Chemical treatments include processes such as: oxidation, chemical reduction catalysis, etc.

c) Other treatments of industrial hazardous waste.

These are treatments such as: Solidification and stabilization; biological treatments; deposit into or onto land (e.g.: landfill) etc. Industrial Waste Management can be summarized in the following chart flow:

INDUSTRIAL WASTE MANAGEMENT



2.3. - The ecologist movement

The construction and performance of waste management and treatment facilities have come under fire from ecologist movements, who are questioning their effectiveness or efficiency.

Two opposing scenarios are raised by these movements: a) The performance of these facilities has a negative impact on recycling and the reduction of waste at the origin. This is due to the fact that industries are not interested in waste reduction at the origin because they think waste treatments are efficient enough in curbing the problem; and b) actually (the ecologists say) the treatment facilities only transfer the contamination from a reception area to another; incineration plants are particularly held responsible because of the emission which they release into the atmosphere, water and ashes.

Both of them have some valid points.

It is true that incineration plants have negative effects; but it is also true that current available technology allows us to solve those effects, although with an increase in the cost of management.

Some ecologist groups from Central Europe are setting out their opposition mainly to plants of ultimate treatments (incineration plants and landfills), fighting to promote the implementation of the minimization methodology. This is a logical policy in countries where there is an excess of supply of treatment facilities; however it is not a suitable position to apply to countries which do not have many waste facilities of ultimate treatments, especially incineration plants.

2.4. - Environmental education.

The problems produced by waste can be summarized by one major fact: there is not a suitable environmental education of the citizens. These only realize the importance of environmental protection when we are made aware or when we are victims of an ecological disaster.

Regarding waste, the behaviour of the population is often paradoxical and contradictory: citizens are more and more concerned by the industrial waste impact, but at the same time we have at home – without special surveillance – hazardous waste, such as: post – consumer paints, expired medications, etc.

We should realize that the harmfulness of waste is not only due to its dangerous components but also due to the unsuitable way it is used and managed. With regards to public opinion on the treatment of waste, we should take into consideration that the problem is not the activity of treatments themselves, but the uncontrolled disposal and the abandonment or the unsuitable use of it.

2.5. - Conclusion.

In general, is it possible to conclude that in order to solve the aforementioned problems on management of waste it is necessary to build and operate environmental facilities together with the implementation of minimization methodology and awareness of citizens.

2.6. - Life – Cycle Assessment (LCA):

2.6.1. - Concept of LCA

Life – Cycle Assessment (LCA) is a process that is used to evaluate the resource consumption and environmental burdens associated with a product, process or activity.

The LCA encompasses: The identification and quantification of energy and material usage as well as the environmental releases across all stages of the life cycle, the assessment of the impact of this energy and material uses and releases to the environment, and the evaluation and implementation of opportunities to effective environmental improvement.

In other words, LCA is a tool which is based on the gathering and evaluation (according to systematic procedures) of inputs and outputs of raw materials, energy and waste and emissions.

2.6.2. - Methodology of LCA

Methodology of LCA (“*cradle to grave*”) includes four main phases:

1.- Aim’s definition and scope, such as: Definition of production to consider (e.g.:1kw/h in electricity production); definition and evaluation of inputs for different applicable technologies and consideration of different types of impacts and definition of scope, e.g: From mining extraction (oil) (cradle) to production of 1 kw hour (grave).

2. - Analysis of inventory, performing the identification of linked environmental burden and the balance of inputs of material and energy and output of waste and emission streams.

3. - Impact Assessment. In this phase the interpretation and assessment of every input and output flow and its relative contribution to each one of categories of environmental impact is considered.

Finally the impacts are categorized (in our example of electricity production, 12 categories of impact).

4. - Interpretation of results. This phase includes the consideration of all achieved information from the aforementioned phases and the quantification of environmental damages produced by every technology linked to every category of impact.

As a result of this last activity the assigning to every technology the corresponding negative ECO – points; these ECO – points allow the comparison of different technologies.

The assignation of ECO-points and the comparison of the different technologies are problematic because such assignation is always subjective. It is therefore necessary to lean towards the levels of standardization; that’s why several organizations, such as “ the Society of Environmental Toxicology & Chemistry” (SETAC), are working on this standardization.

LCA should be taken into account during the design phase of new products, or during the re – design of existing ones.

Finally we must point out that, despite the above mentioned difficulties, LCA is a very useful tool in reaching better products and more suitable manufacturing processes from an environmental point of view.

LESSON 3: PLANNING ON WASTE MANAGEMENT

3.1. - The Sixth Environment Action Programme.

3.1.1. - Introduction.

As it was covered in Lesson 2, on 22 July 2002, The European Parliament and The Council, taken into consideration the results and conclusions of the Fifth Environment Action Program, issued the Decision nº 1600/2002/EC laying down “The Sixth Community Environment Action Program: Environment 2010: Our future, Our choice”.

The main purpose of this new Program is to identify environmental problems and how they got started.

3.1.2. - Objective

The fundamental objective of the Programme is to define the priorities and objectives of community environmental policy up to 2010 and beyond and to describe the measures to be taken to help implement the European Union's sustainable development strategy.

3.1.3. - Strategic actions

The **Programme** proposes five main strategic actions:

Improving the implementation of existing legislation; integrating environmental concerns into other policies; working closer with the market; empowering people as private citizens and helping them to change behaviour and taking into account the environment in land-use planning and management decisions.

3.1.4. - Specific measurements

Specific measurements are proposed for each of these actions, as follows:

- a) To improve the implementation of legislation: Support for the IMPEL (Implementation of European Legislation on Environment) network and its extension to the candidate countries (nowadays, Member states); reporting on the implementation of environmental law; to publish the good and bad results on the implementation of environmental regulation; the improvement of environmental standards of inspection; to take initiatives to combat environmental crimes and pursuing action in the European Court to ensure implementation of legislation.
- b) **To integrate environmental concerns into other policies:** Establishing additional integration mechanisms; implementing the Treaty requirements on integration and **the** further development of indicators to monitor the integration process.
- c) Working in partnership with business could involve : Encouraging a wider uptake of the Community's Eco-Management and Audit Scheme (EMAS); encouraging companies to publish their performance and to comply with environmental requirements; introducing company environmental performance reward schemes; encouraging voluntary commitments; establishing an integrated product policy; promoting the use and evaluating the effectiveness of the eco- label scheme ; the promotion of green procurement and the adoption of legislation on environmental liability .
- d) To empower citizens and change behaviour, the following actions can be implemented: Helping citizens to benchmark and to improve their environmental performance and improving the quality of information on the environment.
- e) To take account of the environment in land-use planning and management: Publishing a communication on the importance of integrating the environment into land-use planning and management; improving the implementation of the Environmental Impact Assessment Directive; spreading best practice and fostering the exchange of experience on sustainable development, including urban development, sustainable development in Community regional policy; boosting agri-environmental measures within the Common Agricultural Policy and developing active partnership for sustainable tourism.

3.1.5. - Areas for action

The Programme determines the following four areas for action: Climate change; biodiversity; environment and health and sustainable management of resources and waste.

A) Climate change: In this area the Programme tries to reduce greenhouse gases to a level that will not cause unnatural variations of the earth's climate. In the short term, the aim is to achieve the objectives of the Kyoto Protocol, (e.g. to reduce greenhouse gas emissions by 8% by 2008-2012 compared to 1990 levels as well as in the longer term, by 2020 it will be necessary to reduce these emissions by 20 to 40% by means of an effective international agreement).

Particular measurements to achieve the targets on climate change are: The integration of climate change objectives into various community policies, in particular energy policy and transport policy; the reduction of greenhouse gases by means of specific measures to improve energy efficiency, to make increased use of renewable energy sources, to promote agreements with industry and to make energy savings; the establishment of an EU-Wide emissions trading scheme; the improvement of information given to citizens on climate change and preparing society for the impact of climate change.

B) Nature and biodiversity: The objective in this area is to protect and restore the structure and functioning of natural systems and stop the loss of biodiversity both in the European Union and on a global scale.

C) Environment and health: In this field the Programme tries to achieve a quality of the environment which does not give rise to significant impacts on human health.

D) Management of natural resources and waste: The target of the programme is to ensure that the consumption of renewable and non-renewable resources does not exceed the carrying capacity of the environment and to achieve a decoupling of resource use from economic growth through significantly improved resource efficiency and the reduction of waste.

With regard to waste, the specific target is to reduce the quantity going to final disposal by 20% by 2010 and 50% by 2050.

The actions to be undertaken to implement this area of action are the following: The development of a strategy for the sustainable management of resources by laying down priorities and reducing consumption; the taxation of resource use; the removal of subsidies that encourage the overuse of resources; the integration of resource efficiency considerations into integrated product policy, eco-labelling schemes, environmental assessment schemes, etc.; establishing a strategy for the recycling of waste; the improvement of existing waste management schemes and investment in quantitative and qualitative prevention; the integration of waste prevention into the integrated product policy and the community strategy on chemicals.

3.2. - Integrated Pollution Prevention and Control (IPPC).

This important matter is under regulation of Council Directive 96/61/EC, of 24 September 1996.

3.2.1. - Objective

Its objective is to prevent or minimize emissions to air, water and soil, as well as waste, from industrial and agricultural installations in the community, with a view to achieving a high level of environmental protection.

Integrated pollution prevention and control for highly polluting industrial and agricultural activities, as defined in its Annex I (energy industries, production and processing of metals, mineral industry, chemical industry, waste management, livestock farming, etc.).

The Directive defines the basic obligations to be met by all the industrial installations concerned, whether new or existing. These basic obligations cover a list of measures for tackling (fighting) discharges into water, air and soil and for tackling waste, wastage of water and energy, and environmental accidents.

They serve as the basis for drawing up operating licences or permits for the installations concerned.

At the same time the Directive determines a procedure for applying for, issuing and updating operating permits and lays down minimum requirements to be included in any such permit (compliance with the basic obligations, emission limit values for pollutants, monitoring of discharges, minimization of long-distance or transboundary pollution).

A transitional period (30 October 1999 - 30 October 2007) is determined, during which existing installations can be brought into conformity with the requirements of the directive.

The Member states are responsible for inspecting industrial installations and ensuring they comply with the Directive. An exchange of information on best available techniques (serving as a basis for emission limit values) is organised between the commission, the Member states and the industries concerned. Reports on the implementation of the Directive are drawn up every three years.

3.2.2. - Main concepts.

Main target: The main target of the Directive is to achieve a high level of protection of the environment taken as a whole.

Some mentioned activities listed in Annex I:

1. Energy industries.
 - 1.1. Combustion installations with a rated thermal input exceeding 50 mw.
 - 1.2. Mineral oil and gas refineries
 - 1.3. Coke ovens
 - 1.4. Coal gasification and liquification plants
2. Production and processing of metals.
 - 2.1. Metal ore (including sulphide ore) roasting or sintering installations.
 - 2.2. Installations for the production of pig iron or steel (primary or secondary fusion) including continuous casting, with a capacity exceeding 2.5 tonnes per hour.
 - 2.3. Installations for the processing of ferrous metals.

3. Mineral industry.

- 3.1. Installations for the production of cement clinker in rotary kilns with a production capacity exceeding 500 tonnes per day or lime in rotary kilns with a production capacity exceeding 50 tonnes per day or in other furnaces with a production capacity exceeding 50 tonnes per day.

4. Chemical industry.

4.1. Chemical installations for the production of basic organic chemicals, such as:

- (a) Simple hydrocarbons (linear or cyclic saturated or unsaturated, aliphatic or aromatic).
- (b) Oxygen-containing hydrocarbons such as alcohols, aldehydes, ketones, carboxylic acids, esters, acetates, ethers, peroxides, epoxy resins.

5. Waste management.

Without prejudice of article 11 of Directive 75/442/eec or article 3 of council directive 91/689/eec of 12 December 1991 on hazardous waste (2):

- 5.1. Installations for the disposal or recovery of hazardous waste as defined in the list referred to in article 1 (4) of directive 91/689/eec, as defined in annexes ii a and ii b (operations r1, r5, r6, r8 and r9) to directive 75/442/eec and in council directive 75/439/eec of 16 June 1975 on the disposal of waste oils (3), with a capacity exceeding 10 tonnes per day.
- 5.2. Installations for the incineration of municipal waste defined in the Council Directive 89/369/EEC, of 8 June 1989, on the prevention of air pollution from new municipal waste incineration plants and Council Directive 89/429/EEC of 21 June 1989 on the reduction of air pollution from existing municipal waste incineration plants with a capacity exceeding 3 tonnes per hour.
- 5.3. Installations for the disposal of non-hazardous waste as defined in Annex II a to Directive 75/442/EEC with a capacity exceeding 50 tonnes per day.
- 5.4. Landfills receiving more than 10 tonnes per day or with a total capacity exceeding 25 000 tonnes, excluding landfills of inert waste.

6. Other activities

6.1. Industrial plants for the production of:

- (a) Pulp from timber or other fibrous materials
- (b) Paper and board with a production capacity exceeding 20 tonnes per day

3.2.3. - Other concepts

Pollution: Shall mean the direct or indirect introduction as a result of human activity, of substances, vibrations, heat or noise into the air, water or land which may be harmful to human health or the quality of the environment, resulting in damage to material property, or impair or interfere with amenities and other legitimate uses of the environment.

Best Available Techniques: Shall mean the most effective and advanced stage in the development of activities and their methods of operation which indicate the practical suitability of particular techniques for providing in principle the basis for emission limit values designed to prevent and, where that is not practicable, generally to reduce emissions and the impact on the environment as a whole.

Access to information and public participation in the permit procedure: Shall mean the right of public to participate on such procedure.

3.3. - Planning on waste management

To fulfil the requirements of waste regulation Member states drawing up and enforce National Plans on Management for each particular waste. e.g : National Plan of municipal waste, National Plan of sewage sludge; National Plan of post- consumer tyres, National Plan of end-of – life vehicles, etc.

For the purpose of this lesson, and as an example, the Spanish National Plan of Post-Consumer Tyres 2001-2006 is following exposed.

This Plan issued to facilitate the performance of post –consumer tyres in Spain.

The following picture shows storage for post- consumer tyres recycling in Westley CA. USA
(Courtesy of National Geographic. Published at Vol-186, nº 1 July 1994, devoted to “Recycling of Waste”).



The Spanish National Plan of Post-Consumer Tyres 2001-2006

3.3.1. - Introduction

According to latest statistical data, in Spain 297,683 tonnes of post-consumer tyres have arisen in 2003. The disposal routes have been: Retreading 42,092 t (14.14 %); recycling 27,143 t (9.12 %); energy recovery 35,000 t (11.76 %); landfill 180,950 t (60.79 %) and, finally, 12,498 t (4.20 %) to export.

This data shows the high percentage of landfill, which constitutes particular difficulty taking into account that, in accordance with 1999/31/EEC Directive on the landfill of waste, transposed to national regulations through Decree 1481/2001, the landfill of whole post-consumer tyres is banned from 16th July of 2003.

To encourage the management of post consumer-tyres the Spanish Administration implemented regulatory instruments and mechanisms discussed in this presentation.

3.3.2. - National regulation

Regarding post-consumer tyres, the main legal instrument is the Spanish Law 10/1998 on Waste. This law applies to the production and management of all kinds of waste, excluding from its scope radioactive waste, gaseous effluents emitted into the atmosphere, waste waters and emissions to the sea from ships and airships, which are covered by other legislation.

The aim of this Law is to prevent the production of waste, to establish the legal frame to regulate this production and management and, in accordance to the Hierarchy Principle, to encourage its reduction, reuse, recycling and other types of valorisation.

At the same time, Autonomous (Regional) Governments enforce their own regulations, keeping coherence with national regulation, in particular with the aforementioned Law.

So far, regional governments of the Basc Country, Valencian Region, Castilla - León, and the Local Government of Mallorca Island have enforced regulations on post-consumer tyres. The Government of Aragón has drawn up a draft, which is under a review process.

The second main document is the Decree 1383/2002, on the Management of End-of-Life Vehicles, dated 20th December 2002. It contains specific requirements to regulate the management of Post-consumer tyres removed from these vehicles.

The third important document is the above mentioned Decree 1481/2001, on Landfill, approved on 27th December 2001.

As presented, this Decree bans, with some exceptions, the deposit in landfill sites of whole post-consumer tyres from 16th July 2003 onward, and shredded post-consumer tyres from 16th July 2006 onward. However, bicycle tyres and tyres bigger than 1,400 millimetres diameter, are excluded and can continue to be landfilled.

The above mentioned Law 10/1998, in relation to waste management planning, requires the issue of specific National Plans for each particular waste whose contents must take into account the requirements of corresponding specific Regional Plans of Waste issued by the Autonomous Governments. Among these National Plans, the one corresponding to post-consumer tyres is included.

3.3.3- The Spanish National Plan of Post-Consumer Tyres

The National Government approved on 5th October 2001 the National Plan of Post-Consumer Tyres for the period 2001-2006. The main points are discussed in the next paragraphs.

A) Management Principles.

First of all, the Plan contains the Management Principles, the most important of them is the Hierarchy Principle, as mentioned above, in order to prevent, to reuse as much as possible, to recycle the wastes with no possibility of reuse, and to valorise recovering energy from the waste neither reused nor recycling.

The Plan emphasizes that landfill should not be taken into account in order to fulfil the Directive 1999/31/EC requirements.

On the other hand, the Plan lays down specific targets and the measures to reach them.

B) Ecological Objectives

Objectives to reach in the period 2001-2006:

- a) Valorisation of 100% of shredded post-consumer tyres arising before 2007.
- b) From 1st January 2006 onward, to forbid disposal and incineration of shredded post-consumer tyres without energy recovery.
- c) Decreasing 5% in weight of arisings.
- d) Retreading, at least, 20% in weight of arisings before 1st January 2007.
- e) Valorisation, other than retreading, of 65% in weight before 1st January 2005 of arisings of car tyres.
- f) Recycling 25% in weight before 1st January 2007 of arisings of car tyres. This percentage will be reviewed in the current year 2003, taking into account the new technological possibilities of recycling.
- g) Recycling of, at least, 25% in weight of arisings of truck tyres. This percentage will be reviewed in 2004 taking into account the new technological possibilities of recycling.
- h) To perform a statistical analysis of the data on post consumer-tyres and their management to incorporate into the National Inventory of Waste.

Bicycles tyres and those with a diameter bigger than 1,400 millimetres, are not included under the scope of these objectives.

C) Instruments

In order to reach the defined targets the Plan lays down the following instrumental measures:

First, in collaboration with Regional Governments, to determine the landfill sites at which to dispose the shredded post-consumer tyres until 16th July 2006. At the moment, 20 to 30 strategically located landfill sites throughout the Country are under consideration because their geographical situations would allow optimizing the transport to valorisation facilities

Second, the Plan requires the design and implementation of an economic model to co-finance the management activities based on the Principles of Producers' Responsibility and Shared Responsibility.

Third, it has also been established that there will be a General Management Agreement with the industrial stakeholders as well as a system of economical grants for Research, Development and Implementation of new technical possibilities such as extending tyre life, reuse and recycling.

Fourth, a very important measure is to prioritise the use of materials resultant from recycling in civil engineering projects. In this respect, an important task of the responsible authorities is to include this requirement in the corresponding Terms of Reference (TOR) of contracts.

Fifth, and particularly important to the public at large, it will provide a system of economic grants for programmes to raise the awareness of citizens in order to promote the improvement of reuse and recycling. Other education programmes will be designed for specialist personnel.

Finally the Plan includes, as another instrument, economic grants to develop and implement an information and data base system on the environmentally sound management of post-consumer tyres.

D) Financing of investment mechanisms.

The total budget of the Plan is 80,836,128.04€ for the period 2001-2006. This amount is composed by the following items: Prevention, that is, to promote retreading, 8,414,169.46€; size reduction facilities to produce recycled materials, 14,424,290.5€; energy recovery facilities, 36,060,726.26€; research and development and implementation programmes, 12,020,242.1 €; activities for citizens' awareness raising and the education of specialist personnel, 8,414,169.46€; and to design, implement and improve information and data base systems, 1,502,530.26€.

The financial mechanisms are specified in the Plan separately for public and private investments for the facilities of prevention and recycling; research, development and implementation programmes; and raising citizens' awareness, as follows:

- Public investments for prevention and recycling facilities will be shared by stakeholders, grants from Public Administrations and Community Funds (Cohesion Funds and FEDER).

- Private investments for prevention and recycling facilities will be shared by stakeholders, grants from Public Administrations and from the part of the general State budget that targets and encourages business activities and/or economic development in different geographic areas, country-wide.
- Research, development and implementation programmes financing will be shared by the stakeholders, Regional Administrations and the State's Central Administration.
- Citizens' awareness raising activities, the education of specialist personnel and statistical control, will also be shared by the stakeholders and Public Administrations as mentioned above.

E) Control and review of Plan

Control of the Plan's targets is carried out by the Ministry of the Environment in collaboration with Regional Governments.

The Plan must be reviewed every two years. The activities that will be covered in the first review, which should be issued in October, 2003, are now starting up. The aim of the reviews is to include newly issued regulations and, according to the results of the experiences, to modify, if necessary, the initial targets.

f) Implementation of Plan

In order to implement the Plan an "ad hoc" Working Group is performing analyses and studies and preparing reports as background to advise and to provide specific recommendations to environmental authorities, at both Central and Regional government level.

Representatives of the industrial sector, environmental engineering companies, research institutions, the Municipal and Provinces Spanish Federation, Regional Governments and the Ministry of the Environment are members of this Working Group. They are organized into seven "Task Forces", as follows: to update the statistics on post-consumer tyres; reduction and reuse; Recycling; energy recovery; landfill; management and financing and, finally, citizens' awareness raising and the education of specialist personnel.

f.1) Current status of the work

- The task force to update statistics, whose chairman is a representative of the manufacturers, is now performing consultations with the industrial sector about manufacturing and management both new and post-consumer tyres in order to collect data to review the plan and to include them in the Information System of Waste, mentioned earlier.
- Retreaders are giving valuable information to the Task Force on reduction and reuse. First results indicate that in Spain retreads are mainly used by trucks and industrial vehicles. Unfortunately, the use of retreads in cars is not a popular practice in Spain.

- The Task Force on Recycling activities has been given special importance. They are focused, mainly, on the different uses of recycled materials other than retreading, as well as on describing the current situation in Spain and identifying the necessary actions to promote their development.

The Chairman of this Task Force is a very well qualified civil engineer at the Road Studies Centre, a research institution of Ministry of Public Works. Members are representatives of research laboratories of construction both official and private industry, well known managers of recycling industry, manufacturers and environmental engineering companies.

In particular among all of the ongoing activities, one of the most important is the preparation of a Dossier describing the different uses of recycled materials and classifying them according to their level of use in Spain.

Uses already implemented are sport facilities and safety pavements; floor coverings, industrial rubber goods, such as products for the automotive industry, injection moulding applications, rubber soles, etc.

Uses under development are components of bitumen products for road construction; waterproofing and protection sheets, etc.

Potential undeveloped applications are their use in embankments, drainage elements of walls, elements for acoustic insulation, etc.

For each particular application, the content of this Dossier is:

- Description of use of Post-consumer tyres materials in the application.
 - Advantages to use such materials in the application.
 - Disadvantages, if any, to use these materials in the application.
 - Quantity used, identifying the data sources.
 - Actions to be taken, mainly by the Administration, to encourage the use in the application.
- Activities of the Energy Recovery Task Force are being carried out with the participation of members of the cement industry, the main users in Spain, and representatives of electricity generation facilities. The Best Available Technologies are currently being analysed.
- The Landfill Task Force is currently involved in developing specific measurements set in order to fulfil the requirements mentioned in Directive 1999/31/EC and Spanish Decree 1481/2001 both of which concern the landfill of waste. In particular the group is in the process of analysing and studying the design characteristics for special areas or cells to deposit shredded post-consumer tyres until 16th July 2006. Issues being studied include fire protection, physical security, accessibility requirements, etc.

- The work being carried out by the Management and Financing Task Force is of critical importance. This Task Force involved in the design and performance of an economic model of co-financing the management of post-consumer tyres, as it is required under Law 10/1998, on Waste. This Law sets the producers' obligations to implement Organized Systems of Waste Management.

Different models have been available and, finally the Integrated Systems of Management have been chosen; in this System the financing is carried out based on funds created with the payments by the manufacturers at the beginning, that is, when the new tyres are put on the market.

- The Citizens' Awareness Raising Task Force and the Education of Specialist Personnel is studying and evaluating different advertising campaigns in order to improve driving, the control of air pressure of in service tyres, as well as training courses for workers at tyre removal garages, recycling facilities, landfill employees, etc.

Finally, in relation to the activities of the Working Group the high interest of all involved sectors must be emphasized: the Spanish Administration, Industrial stakeholders, Consulting and Engineering companies, specialized press, etc. The regulatory activities of Spanish Regional and General Administrations must also be acknowledged.
