Solid Waste: Assessment, Monitoring and Remediation
Twardowska, Allen, Kettrup and Lacy (Editors)

II.1
Regulatory frameworks as an instrument of waste management strategies

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II.1.1. Introduction

Though over 25 years have passed since enactment of the first regulations on waste, the attempts to develop regionally and internationally harmonized waste management policies are still in progress. It is now clear that establishing a comprehensive system and creating adequate incentives for preventive management and proper cleanup worldwide have not yet been achieved. The best indicator of the quality of legislation is its efficiency. Law that has no proper or any enforcement mechanism is not worth the paper it is printed on. Such "paper law" can be exemplified in the environmental legislation of the former USSR and the countries under its influence. It can be summarized by a well-known sentence: "We have the best regulations in the world, unfortunately they do not work." The legislation that does not work is for sure the worst one and results in much greater harm than lack of regulations. Another imperfection of a waste legislation, common for the developed countries, comes from the too strong belief in the high level of public awareness as an instrument of proper control of waste disposal. This can result in "out of sight, out of mind" or "not in my backyard" practice, which leads to abortive solutions from the environmental and/or economic point of view. Nevertheless, public awareness is an extremely efficient support for safe waste management strategies.

This chapter is focused on the features and qualities of the legislation on waste and its efficiency, on efforts to reach this goal and results of these efforts.

II.1.2. Waste management practice in industrially developed countries

II.1.2.1. Terminology

The definition of "solid waste management" is similar in the US and EU legislation. According to RCRA (1976, 1984), this term means "the systematic administration of activities which provide for the collection, source separation, storage, transportation, transfer, processing, treatment and disposal of solid waste. The terms *solid waste planning, solid waste management* and *comprehensive planning* include planning or management

respecting resource recovery and resource conservation." Council Directive 91/156/EEC defines "waste management" as "collection, transport, recovery and disposal of waste, including the supervision of such operations and after-care of disposal sites."

Most of the basic legal terms related to solid waste management have been given in Chapter I and in the Appendices to that chapter, which provide excerpts from the EU and US legislation. A more detailed discussion of the European, OECD and Basel Convention terminology is based on the assumption, that in general, the US Federal laws and regulations are widely known, as they are discussed in numerous reference sources that are readily available for the reader outside USA. Some other legal terms related to waste management practice not defined in the previous chapters need to be given here, in particular the terms "solid waste management facility", "open dump", "landfill", "underground storage" and "treatment" being an integral part of the waste disposal practices.

The first two terms are defined in the RCRA (1976, 1984). The term *solid waste management facility* includes (A) any resource recovery system or component thereof, (B) any system, program, or facility for resource conservation, and (C) any facility for the collection, source separation, storage, transportation, transfer, processing, treatment or disposal of solid wastes, including hazardous wastes (HWs), whether such facility is associated with facilities generating such wastes or otherwise." The EU legal terminology relevant to this term comprises the major term "management" and derived terms "disposal", "recovery" and "collection" along with the lists of disposal operations and operations which may lead to recovery (Council Directive 91/156/EEC amending Directive 75/442/EEC on waste, Article I d, e, f, g, Annex IIA and IIB). These terms are given in Chapter I.1 and Appendix A to that chapter.

The term "open dump" means "any facility or site where solid waste is disposed off which is not a *sanitary landfill* which meets the criteria promulgated under section 4004 and which is not a facility for disposal of hazardous waste" (RCRA, 1976, 1984). This term is thus related entirely to solid wastes that are not HW and not a municipal waste.

In the EU legislation, the term "landfill" is of a more general character and is relevant to any solid waste, including HW and municipal waste, and to any form of storage, i.e. both onto or into land. According to the Council Directive 1999/31/EC (1999) on the landfill of waste, "*landfill* means a waste disposal site for the deposit of waste onto or into land (i.e. underground), including:

- internal waste disposal sites (i.e. landfill where a producer of waste is carrying out his own waste disposal at the place of production), and
- a permanent site (i.e. more than one year) which is used for temporary storage of waste but excluding:
  - facilities where waste is unloaded in order to permit its preparation for further transport for recovery, treatment or disposal elsewhere, and
  - storage of waste prior to recovery or treatment for a period less than three years as a general rule, or
  - storage of waste prior to disposal for a period less than one year."

According to the same Directive, the term "underground storage" means "a permanent waste storage facility in a deep geological cavity such as salt or potassium mine".

The term "treatment" means "the physical, thermal, chemical or biological processes, including sorting, that change the characteristics of the waste in order to reduce its volume or hazardous nature, facilitate its handling or enhance recovery".

II.1.2.2. General prerequisites, existing status of waste management and its efficiency

National, regional and global waste management strategies should be based on the harmonized, integrated and effective regulatory and legislative framework that addresses environmental safety and public health as a first priority and considers all the alternatives of waste stream minimization. There are three major prerequisites to ensure the implementation of legislation: (i) an effective enforcement procedure consisting of a sound, well-balanced system of charges, penalties and incentives; (ii) thorough legal liability of producer or holder for waste management in an environmentally safe way; and (iii) precise instruments of verification and effective audit of waste management practice, followed by execution of a law in a way that makes any attempts of evading or desisting from the juridical obligations highly unprofitable.

The legislation itself has to be clear, use unequivocal definitions and leave no doors open to differences in interpretation or to exemptions from the rule. Experience shows that producers will readily use any legislative gap to avoid extra costs of waste management. Quite often, the administration and legislative organs succumb to a massive pressure from industry and soften the regulations, e.g. by excluding some groups of potentially reusable waste materials from the category of "waste" simply by defining them as "secondary raw materials". An example of the consequences that can cause such playing on words was given in the introductory Chapter I.1 under the title "*Recyclable Waste* or *Secondary Raw Material*?". Artificial methods of reducing waste streams by just changing definitions are particularly popular in countries with a weak, unbalanced economy and a traditional low priority given to control of waste disposal practices. This approach is caused by a lack of recognition by governmental decision-makers and legislative bodies of the harm that inadequate management could cause to the human health and environment. In the Russian federation, Ukraine and other new states of the former USSR, the practice of constructing gigantic disposal sites and tailing waste ponds for open dumping of mining and ore processing waste has a long history. Despite numerous instances of severe pollution of surface and groundwater resources (Zoteev et al., 1999), the major standardization efforts are focused predominantly on the safety of these constructions from the standpoint of hydraulic engineering (Aksenov et al., 1999). The high-volume waste disposed off in huge unprotected sites is termed by the authors of national standards as "technogenic deposits". This tricky term is being applied to a high-volume disused waste potentially suitable for partial reuse and therefore considered as "non-waste" (Streltsov et al., 1999). Such a "terminological" way of waste stream minimization, though extremely cost-effective, bears many negative consequences to the environment and usually results in contamination of unprotected aquifers. This way of handling waste management problems is a rather adverse example of the legislative activity.

Pollution control in the different compartments of the environment works as connected vessels. Solution of a problem in one compartment immediately creates a new problem in another one. This requires an instant legislative reaction to a new situation, to get

a positive balance of pollution control in the environment as a whole. According to Congressional findings (RCRA, 1976, 1984), as a result of the Clean Air Act, the Water Pollution Control Act and other Federal and State Laws in the USA respecting public health and the environment, greater amounts of solid waste (in the form of sludge and other pollution treatment residues) have been generated. Similarly, inadequate and environmentally unsound practices for the disposal or use of solid waste have created greater amounts of air and water pollution and other problems for the environment and health. The same problems have been faced in the EU, other OECD member states and countries all over the world. In the past decades, as total and annual waste quantities increase, the availability of new disposal sites decrease and the cost of new disposal areas has risen significantly. Requirements for siting, constructing and managing disposal areas in the developed countries have become more stringent leading to a shortage of dumping sites and high costs of open dumping.

Consequently, open dumping has been recognized to be particularly harmful to health due to contamination of drinking water from underground and surface supplies and pollution of the air and land. A number of non-hazardous wastes were found to be sources of detrimental environmental impact lasting for decades. Land disposal, particularly landfill and surface impoundment, was found to be the least favored method for managing wastes, in particular hazardous ones, and also for waste that cannot be defined as inert. Simultaneously, solid waste was found to represent a potential source of usable material and/or energy. These findings gave rise to the enactment of RCRA (1976, 1984) and European Directives and Decisions on waste (EUR-Lex, 2003a,b), the objectives of which were to provide a legislative and regulatory basis for solid waste management strategies. This legislation, along with the already existing national one in developed countries, has created a framework within which enforcement procedures could be implemented. In view of the ultimate objectives of waste management strategies, besides safe solid waste disposal, minimization of HW generation, reducing the volume of waste stream and the volumes of waste requiring disposal should be ensured. The regulations on waste management should promote and enforce an application of the recovery and recycling of solid waste and environmentally safe disposal of the non-recoverable residues.

The available statistical data for the EU (EUROSTAT, 1997, 2000a,b,c, 2001a,b) and OECD (1998, 1999, 2001, 2002), though still incomplete and inconsistent, reflect the efficiency of these enforcement procedures, at least in waste recycling, municipal waste management, operating and capital costs of waste management and public opinion. These data show, on the one hand, general positive trends, and on the other hand an extreme diversity of efficiency of waste management strategies within the particular OECD and EU member countries, and the EU as a whole.

II.1.2.2.1. The EU waste management strategy

Facing the growth of waste generation by 10% a year, the EU has defined and is pursuing a general strategy aimed to reverse this trend, which has been addressed in the Council Resolution (1997), as well as in the document issued by the European Commission, Directorate General on Environment, Nuclear Safety and Civil Protection, and in other working and legislative documents focused on the most problematic issues concerning waste (EC DG ENV, 1999; EC-Environment; EUR-Lex, 2003a,b). In the EC DG ENV

(1999) document on EU waste management strategy, the major "P-principles" have been formulated, upon which EU approach to waste management is based: prevention, producer responsibility and polluter pays, precaution, and proximity. Based on these principles, the EU general strategy set out in 1996 a preferred hierarchy of waste management operations:

- prevention of waste (minimization and avoidance),
- recycling and reuse,
- optimum final disposal and improved monitoring.

The EU strategy has also stressed the need for:

- reduced waste movements and improved waste transport regulation;
- new and better waste management tools such as:
  - regulatory and economic instruments;
  - reliable and comparable statistics on waste;
  - waste management plans;
  - proper enforcement of legislation.

From the above, it can be seen that regulatory and economic instruments along with the reliable statistics on waste are considered of special importance in the EU waste management practice.

Waste prevention and minimization should receive the top priority in waste management plans. Complete or partial recycling (e.g. composting of municipal waste) has been found to be the way of waste reduction and conservation of natural resources. Recovering energy from waste material by using it as a fuel might also be considered as a solution. Neither waste landfilling nor incineration as the main alternative disposal method to landfill was found to be a perfect management option, both being potentially harmful to the environment and health. Recycling/composting also bears potential risks to human health and the environment (Table II.1.1). Therefore, the best option is to reduce the total amount of waste generated.

As particularly problematic waste in the European Community, the European Commission defined municipal waste, and also several constantly growing specific waste streams that require receiving special attention, among them packaging waste; end-of-life vehicles; batteries, electrical and electronic waste and hazardous household waste (EC DG ENV, 1999).

Packaging waste is estimated to form up to 50% of municipal waste in the EU, of this a relatively high total rate of 52.6% (for 11 of 15 EU member states, excluding Greece, Ireland, Luxembourg and Portugal) is being recovered. The EC Packaging Directive (1994) set the target recovery rate for this waste to 50–65% by weight, and recycling of 25–45%. The minimum recycling target aim, set for 12 EU member states to be fulfilled by 2001, was already exceeded in 1997 by 11 states, while the minimum recovery target of 50% was not yet achieved by Italy, Spain and UK (Table II.1.2). Nevertheless, packaging waste recycling/recovery rate in the EU-11 can be considered high compared to other OECD countries, as well as to three other EU member states (Greece, Ireland and Portugal) (Table II.1.3, Fig. II.1.1). This success was mainly due to high recycling rates for paper/cardboard and glass packaging, while recycling/recovery of other packaging waste such as plastics or metals was considerably lower for the majority of EU member states, at a similar waste generation per capita (Table II.1.4), among others due to difficulties with

Table II.1.1. Environmental impact of waste management options (after EC DG ENV, (1999).

Environmental compartment	Waste management option				
	Landfill	Incineration[a]	Recycling	Composting	Transportation
Air	Emission of CH_4, CO_2, odors	Emission of SO_2, NO_x, HCl, HF, NMVOC, CO, CO_2, N_2O, dioxins, dibenzofurans, heavy metals (Zn, Pb, Cu, As, etc.)	Emissions of dust	Emission of CH_4, CO_2, odors	Emissions of dust, NO_x, SO_2, release of hazardous substances from accidental spills
Water	Leaching of salts, heavy metals, biodegradable and persistent organics to groundwater	Deposition of hazardous substances on surface water	Waste water discharges		Risk of surface water and groundwater contamination from accidental spills
Soil	Accumulation of hazardous substances in soil	Landfilling of slags, fly ash and scrap	Landfilling of final residues		Risk of soil contamination from accidental spills
Landscape	Soil occupancy, restriction on other land uses	Visual intrusion, restriction on other land uses	Visual intrusion	Soil occupancy, restriction on other land uses	Traffic

Ecosystems	Contamination and accumulation of toxic substances in the food chain	Contamination and accumulation of toxic substances in the food chain		Contamination and accumulation of toxic substances in the food chain	Risk of contamination from accidental spills
Urban areas	Exposure to hazardous substances	Exposure to hazardous substances	Noise		Risk of exposure to hazardous substances from accidental spills, traffic

[a]Emissions from high-performance incinerators are reduced to the environmentally safe level.

Table II.1.2. Total packaging consumption and achieved recycling and recovery rates in member states in 1997, including exports for recycling/recovery (after EC DGXI.E.3 (2001)).

Member state	Packaging put on the market		Recovery (%)			Targets (%)	
	1,000 t	kg/capita	Recycling	Energy recovery	Total	Recycling	Recovery
Austria	1.113	138.0	64.8	4.8	69.6	25	50
Belgium	1.356	133.0	62.3	n.a.	62.3	50	80[a]
Denmark[b]	971	184.0	48.7	38.0	86.7		
Finland[b]	417	81.2	41.8	12.2	54.1	42	61
France	11.069	189.2	41.0	14.5	55.5	25–45	50–65
							75[c]
Germany[d]	13.731	167.4	78.3	2.3	80.5	45	65
Greece[e]	780	74.4	n.a.	n.a.	n.a.		
Ireland[f]	683	186.9	n.a.	n.a.	14.8	25–45	50–65
Italy[g]	9.529	165.8	29.6	2.2	31.8	25–45	50–65
Luxembourg[h]	39	93.2	n.a.	n.a.	n.a.	45	55
Netherlands	2.745	176.3	55.2	22.4	77.6	45[i]	65
						65[j]	
Portugal[e]	1.012	101.9	n.a.	n.a.	n.a.		25[k]
						25[l]	50[l]
Spain	5.879	149.6	34.4	1.6		25–45	50–65
Sweden	923	104.4	57.9	7.2	36.0		
UK	7.755	131.7	31.3	3.2	65.1		58
EU-11 total	55.487	158.9	46.3	6.3	52.6		
EU-15 total	58.001	155.2					

n.a., data not available.
[a]Targets have to be achieved by 1999.
[b]Report contains no figures on energy recovery; the figures given in the table are calculated as difference between total recovery and total recycling.
[c]Target for household packaging waste to be achieved by the end of 2002.
[d]Data on energy recovery of paper/cardboard and plastic packaging are not available; data on exports of tinplate and paper/cardboard packaging are not or only partially available.
[e]Total consumption estimated on the basis of information from CEPI, APME, FEVE and own assumptions.
[f]National waste data report; data refer to 1998.
[g]Data on exported wood packaging not available.
[h]ECO Counsel Agency; data refer to 1996.
[i]Mandatory target to be achieved in 1998 defined in the packaging and packaging waste decree.
[j]Voluntary target defined in the Covenant II to be achieved by 2001.
[k]Target to be reached by 2002.
[l]Target to be reached by 2006.

identifying the markets for recovered/recycled materials. According to the EC DGXI.E.3 (2001) report, recycling/recovery rates were the lowest in those countries where landfilling was the predominant waste management option, while waste management strategies and enforcement instruments aiming at separate collection and recycling hardly existed. The achievement of high recycling/recovery rate thus appears to be based on the development

Table II.1.3. Rate of waste paper and glass recycling in the OECD and EU member states in 1980–1997* (after OECD, 1998; EUROSTAT, 2000a,b,c).

Countries	Paper (%)					Glass (%)				
	1980	1985	1990	1996[a]	Change since 1980	1980	1985	1990	1996[a]	Change since 1980
Canada[b]	20	23	28	33	13	12	12	–	17	5
Mexico[c]	–	–	2	2	–	–	–	4	4	–
USA[c]	27	27	34	35	8	5	8	20	24	20
Japan[d]	48	50	50	51	4	35	47	48	56	21
Korea	37	–	44	53	16	–	–	46	57	–
Australia	–	36	51	–	–	–	–	–	42	–
New Zealand	17	19	20	27	10	–	–	–	–	–
Austria	30	37	37	65 (***71***)	35 (***41***)	20	38	60	76 (***76***)	56
Belgium[e]	15	14	–	12 (***38***)	−3 (***18***)	33	42	55	66 (***66***)	33
Czech Republic	–	–	–	40	–	–	–	–	–	–
Denmark	26	31	35	44 (***52***)	18 (***26***)	8	19	35	66 (***71***)	58 (***63***)
Finland	35	39	41	57 (***39***)	22 (***4***)	10	21	36	63 (***63***)	53
France	30	35	34	38 (***41***)	8 (***11***)	20	26	29	50 (***50***)	30
Germany[f]	34	43	44	67 (***71***)	–	23	43	54	79 (***79***)	–
Greece[g]	22	25	28	19 (***31***)	−3 (***9***)	15	15	15	20 (***25***)	5 (***10***)
Hungary	33	42	53	49	16	–	–	–	–	–
Iceland	–	–	–	36	–	–	–	70	75	–
Ireland	–	10	–	12 (***17***)	–	8	7	23	46 (***29***)	38 (***21***)
Italy	–	25	27	29 (***31***)	–	20	25	48	53 (***53***)	33
Luxembourg	–	–	–		–	–	–	–	–	–
The Netherlands	46	50	50	77 (***69***)	32 (***23***)	17	49	67	81 (***81***)	64
Norway	22	21	25	41	20	–	–	22	75	–
Poland	34	34	46	13	−20	–	–	–	–	–
Portugal	38	37	41	37 (***39***)	−1 (***1***)	–	10	27	42 (***42***)	–
Spain	47	57	51	52 (***41***)	5 (− ***6***)	–	13	27	35 (***35***)	–
Sweden	34	–	43	54 (***66***)	20 (***32***)	–	20	44	72 (***72***)	–
Switzerland	35	39	49	67	32	36	46	65	89	53
Turkey	–	–	27	34	–	–	33	31	13	–
United Kingdom	32	29	35	37 (***40***)	5 (***8***)	5	12	21	22 (***27***)	17 (***22***)
EU mean[h]	31.5	33	37	43 (***46***)	13 (***15***)	18	24	38.5	55 (***55***)	39 (***39***)
OECD mean[h]	32	33	39	40	12	16	26	39	51	35

Data for 1996 reported by EUROSTAT (2000a,b,c) are ***bold italic***; *ratio of the amount recycled to the amount used (total production in the country + import − export).

[a]Or the last year for which the data are available.

[b]Data only for glass packaging.

[c]Recycling rates are based on the amounts of waste generated.

[d]Data for glass do not include returnable bottles.

[e]Including estimates.

[f]Data for the years 1980–1990 do not include the former GDR. Recycling rate is based on the total sales.

[g]Data do not include import and export.

[h]Estimates based on the available statistical data given in the respective columns (calculated by the authors).

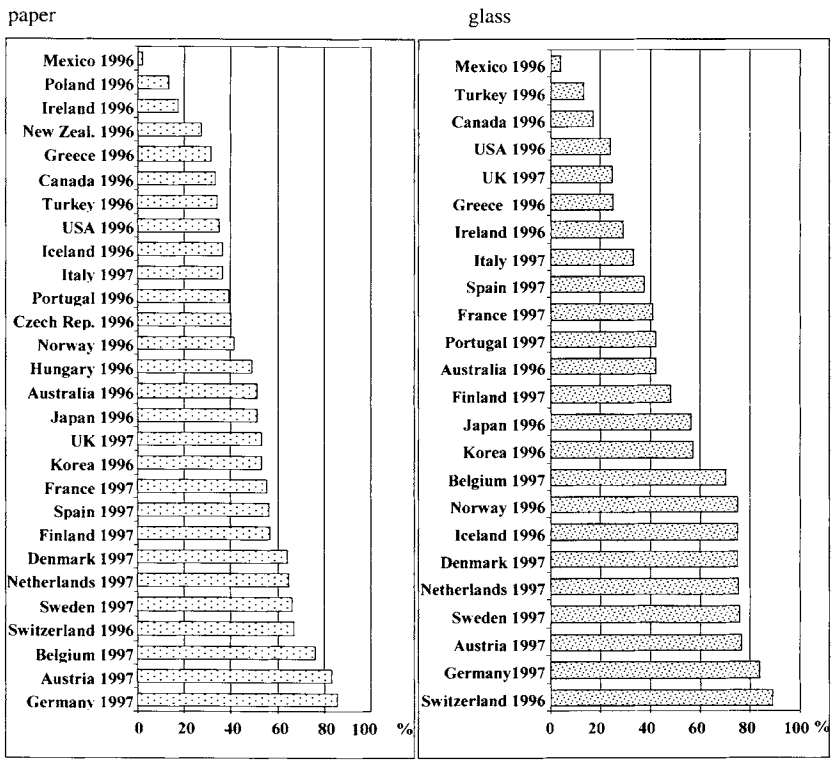

Figure II.1.1. Recycling of waste paper and glass in the OECD member states in 1996–1997, (after OECD, 1998 and EC DGXI.E.3, 2001).

of sound national (and internationally harmonized) waste management strategies that provide a legislative and regulatory framework within which efficient enforcement procedures can be implemented.

The study on the evaluation of costs and benefits for the achievement of reuse and recycling targets for the packaging materials has been recently subject to public discussion. Main elements of the working documents on waste batteries, as well as on electrical and electronic equipment include reduction of hazardous substances used in these products, establishment/improvement of collection and recovery/recycling systems and encouraging the producers' involvement in the recycling activity.

Proposals for the new EU legislation on waste management and disposal operations that reflect actual state of the art and technical progress, formulated by the European Commission in 1996–1999, and follow-up extensive regulatory activity resulted in the enactment of new updated Council Directives and Commission Decisions, among them Council Directive 1999/31/EC on the landfill of waste, Directive 2000/76/EC of the European Parliament on the incineration of waste; Directive 2000/53/EC on end-of-life vehicles (2000); Directives on waste electrical and electronic equipment 2002/95/EC and 2002/96/EC (2003), a number of additional recent regulations relevant to the EU packaging Directive adopted in 1994 and Council Directive on batteries and accumulators

Table II.1.4. Consumption of major kinds of packaging (kg/capita) and achieved recycling and recovery rates in member states and the EU in 1997* (after EC DGXI.E.3, 2001).

Member state	Cons. (kg/capita)	Paper/cardboard recovery (%)				Cons. (kg/capita)	Glass recovery (%)				Cons. (kg/capita)	Plastics recovery (%)				Cons. (kg/capita)	Metal recovery (%)				
		RC	ER	TR	Tg		RC	ER	TR	Tg		RC	ER	TR	Tg		RC	ER	TR	Tg	
																				Steel	Al
Austria	65.8	83.4	0.9	84.4	90	32.2	76.5	0.0	76.5	93	22.3	20.0	25.6	45.6	40	10.5	34.1	0.0	34.1	95	98
Belgium	53.8	76.0	n.a.	76.0		30.5	70.1	0.0	70.1		20.5	25.3	n.a.	25.3		11.8	70.3	0.0	70.3		
Denmark	87.8	64.1	30.9[a]	95.0	55	38.4	75.1	0.0	75.1	65	34.8	8.1	89.8[b]	97.9	15	11.0	15.8	0.0	15.8	15	15
Finland	47.4	56.5	16.4[a]	72.9	53	10.1	47.9	0.0	47.9	48	17.5	10.2	12.2[b]	22.4	45[c]	6.0	8.4	0.0	8.4	25	25
France	65.8	55.1	18.5	73.6		56.3	40.9	0.0	40.9		26.9	5.2	27.1	32.3		11.6	44.4	0.5	45.0		
Germany	66.4	85.5	n.a.	85.5	70[d]	45.7	83.9	0.0	83.9	75[d]	18.3	48.6[e]	n.a.	48.6	60[d]	13.7	82.0	n.a	82.0	70[d]	60[d]
Greece	30.2	n.a.	n.a.	n.a.		14.7	n.a.	n.a.	n.a.		20.9	n.a.	n.a.	n.a.		8.6	n.a.	n.a.	n.a.		
Ireland	82.2	n.a.	n.a.	14.9[f]	31	30.5	n.a.	n.a.	32.3[f]	45	46.2	n.a.	n.a.	2.6[f]	10	11.3	n.a.	n.a.	n.a.	5	25
Italy	56.5	36.3	3.1	39.4		39.1	33.4	0.0	33.4		30.9	9.6	6.1	15.6		7.9	5.5	0.0	5.5		
Luxembourg	28.6	n.a.	n.a.	n.a.		41.4	n.a.	n.a.	n.a.		16.7	n.a.	n.a.	n.a.		6.5	n.a.	n.a.	n.a.		
Netherlands	93.1	64.9	20.1	85.0	85[g]	30.1	75.5	0.0	75.5	90[g]	39.2	12.4	52.9	65.3	35[g]	13.9	67.1	0.0	67.1	80[g]	
Portugal	43.9	n.a.	n.a.	n.a		26.8	n.a.	n.a	n.a.		22.6	n.a.	n.a.	n.a.		8.6	n.a.	n.a.	n.a.		
Spain	57.4	56.0	1.1	57.1		35.6	37.3	0.0	37.3		30.9	6.7	5.3	12.0		8.7	22.6	1.3	23.8		
Sweden	59.5	66.2	8.4	74.5	40/65[h]	20.1	75.6	0.0	75.6	70	17.0	14.0	14.7	28.7	30[h]	7.9	45.4	0.0	45.4	70	70[h]
UK	51.5	53.0	7.9	60.9		30.3	24.7	0.0	24.7		23.0	8.8	0.0	8.8		13.7	26.1	0.2	26.2		
EU-11 total	61.8	59.0	7.5	66.5		39.9	52.2	0.0	52.2		25.3	15.5	14.2	29.7		11.4	46.0	0.2	46.3		
EU-15 total	60.6					38.8					25.3					11.2					

Cons., consumption; RC, recycling; ER, energy recovery; TR, total recovery; Tg, recycling targets for packaging materials; EU-11, total for 11 member states without Greece, Luxembourg, Ireland and Portugal; n.a., data not available; *recycling and recovery rates include packaging waste quantities exported for recycling/recovery.

[a]Data on energy recovery of paper/cardboard packaging are not available; the figures given in the table are calculated as the difference between total recovery and total recycling.

[b]Data on energy recovery of plastic packaging are not available; the figures given in the table are calculated as the difference between total recovery and total recycling.

[c]Target for plastics applies to recovery.

[d]Material-specific recycling targets apply to sales packaging.

[e]Recycling rate includes feedstock processes.

[f]National Waste Data Report; data refer to 1998.

[g]Voluntary target defined in the Covenant II to be achieved by 2001.

[h]Recycling target for: corrugated cardboard, 65%; paper/cardboard, 40%; aluminum drink containers, 90%; PET drink bottles, 90%.

of 1991; all these can be found in the EUR-Lex web site. The Biowaste Directive, Sewage Sludge Directive, new revised European legislation on batteries are well advanced and available as working documents (drafts), along with the reports on relevant events and studies in the continuously updated EC-Environment and EUR-Lex web sites.

Recently adopted EU legislation on waste tightens up environmental requirements for waste management options and defines more stringent standards for the design and operation of existing and new installations for waste management. Besides the waste streams discussed above, other studies initiated and supported by the European Commission have been carried out in order to develop new or review existing waste directives in compliance with the urgent need of tackling the rapidly growing waste generation and relevant environmental problems. The studied waste streams include PVC issues, as well as the management of bulk waste such as construction and demolition waste as well as the waste resulting from prospecting, extraction, treatment and storage of mineral resources.

To date, European action in the waste field has mainly taken the form of legislation, supported also by initiating and funding technical research, recycling industries, training, awareness-raising actions and exchange of good practice.

According to the statement of the European Commission (EC DG ENV, 1999; EC-Environment), the situation within the EU regarding waste management is still unsatisfactory due to the lack of complete coverage of the full EU territory with comprehensive waste management plans. To enforce drawing up such plans, the EC has initiated infringement procedures against 14 member states. Waste management planning that includes technical, organizational, economic and policy level aspects is considered by the European Commission to be a key part of the European legislation in the field of waste management and the basis of waste management strategies at local, regional and national levels. These plans are also to be an important instrument for awareness raising and citizens' participation in the field of waste management.

The growing waste problem requires solutions at local level, linked to larger management plans and in line with community waste strategy that has to assure sustainable environmental protection without distorting the European internal market. To improve the situation, EC formulated the need for shared actions that include consumers, business and local authorities. In general, these actions are to be based predominantly on awareness, partnership and providing means and provisions for separate collection of different waste.

Not negating or depreciating the role of public awareness and partnership in the consumer–producer–authority relation in the field of waste problem solution, it should be mentioned that this basis proposed by the EC for shared actions might considerably elongate achievement of the target if economic/financial instruments that have been pointed out as "new and better waste management tools" are not adequately considered in these relations.

Another aspect that has not been stressed enough in the EU approach to waste management, though also specified among "new and better tools" (EC DG ENV, 1999; EC-Environment, 2003), is a need of reliable and current waste management statistics. Without this tool, development of the consistent waste management plan that covers the full territory of the EU would be difficult to accomplish, if at all feasible. Enactment of Regulation (EC) No 2150/2002 on waste statistics and establishing a harmonized list of

wastes (Commission Decision 2000/532/EC, 2000) creates a good basis for obtaining comparable statistical data in the following years.

Public awareness plays an important role as an element of the EU waste management strategy and good practice, in particular, in showing preference for "green" products with little packaging, separate collection of waste or taking special care for disposing hazardous household waste and inducing/supporting local authorities in improvement of the local waste situation.

In the public opinion, in 1995, a general increase of perception of waste as a threat for the local environment was observed compared to 1988 (EUROSTAT, 1997). In the scale from 1 to 4, the threat from waste received 2.2 points as an average for the EU (1.8 in 1988), equal to the landscape damage, and higher than the decrease of drinking water quality (2.0), lack of green areas (2.0) and noise (2.1). Among the six factors, only the threat from air pollution was evaluated higher (2.3). This shows a sensitivity of the public opinion to waste management issues. In the different member states, the evaluation scale ranged from 1.3 points (Denmark) to 2.7 points (Italy). The lowest values were received from countries having low waste generation and good waste management practice (Denmark, Finland, The Netherlands), while the highest values were attributed to countries with problematic waste management (Italy 2.7, Greece and Spain 2.4). It is remarkable that in none of the EU member states the decrease of perception of waste as a threat to the environment was observed. This demonstrates a high level of public awareness as a whole and still unsatisfactory waste management practice in the eyes of the public opinion.

According to the same source of the statistical data (EUROSTAT, 2001a), the expenditure of the EU member states on waste management in 1997/1998 ranged from 3.2 (Greece) to 28% (UK) of the total budget for the environmental protection in industry and held mostly the third position after sewage management and air protection (Fig. II.1.2). The highest annual capital expenditure in the last decade of the 20th century on the integrated technologies of industrial waste management in eight EU member states ranged from 25.2 (UK) to 64.2% (Finland), while the latest available data for 1997–1998 accounted for 7.9 (Finland) to 33.7% (Portugal) of the total waste management expenditure that reflects the past and current status of waste disposal facilities modernization (Fig. II.1.3).

The total share of the environmental protection expenditure in GDP of the 11 EU member states (without Denmark, Spain, Italy and Luxembourg) and Switzerland in 1997–1999 ranged from 0.25 (Greece) to 2.12% (Austria), mean 1.20%. Of this, the mean expenditure in public sector accounted for 0.73% (from 0.16 to 1.55%) and in industry, 0.47% (from 0.09 to 0.77%). The relevant share of the environmental protection expenditures in four candidate countries (Czech Republic, Estonia, Hungary and Poland) in their GDP was higher, mean 1.68% (from 1.18% in Estonia to 2.39% in Poland), and showed prevalence in industrial sector (mean 1.00%, from 0.46% in Estonia to 1.49% in Poland) that reflects the efforts of these countries directed to improving the state of their environment, heavily impacted quite recently by the industry, mainly by primary production branches (EUROSTAT, 2001a).

II.1.2.2.2. Enforcement and supporting instruments in waste recycling and reuse

The level of paper and glass waste recycling in the OECD member states makes all the discussion about the distinction between "waste" and "non-waste" (see Chapter I.1)

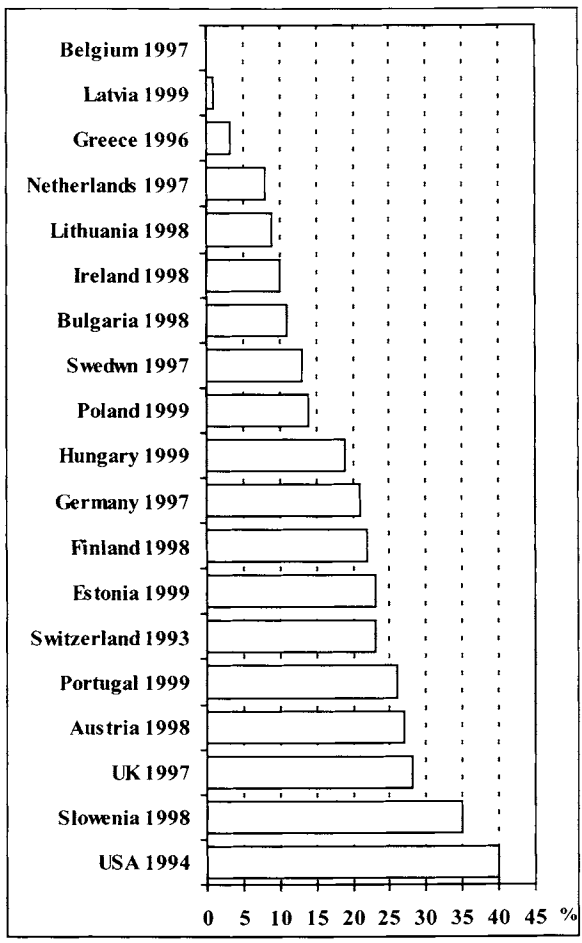

Figure II.1.2. Percentile of waste management in the total environmental protection expenditure (capital and operating costs) in industry in Europe and the USA (after EUROSTAT (2001a)). Data for Belgium comprise the capital costs only.

groundless. These materials, which are potentially thoroughly recyclable, are generally used by proponents of defining recyclable materials as "secondary raw material" or major arguments. The statistical data show that no OECD member state may boast of a thorough recycling of these materials. The rates of paper and glass recycling in 1996 ranged from 2 (Mexico) to 77% (The Netherlands) (mean 43%) and from 4 (Mexico) to 89% (Switzerland) (mean 55%), respectively (OECD, 1998). Data reported for 1996 by EUROSTAT (2000a,b) for paper recycling appear to differ significantly from those by OECD (1998), mostly in plus, though lower percentile also occurs. According to these data, the highest paper recycling rate achieved in the Netherlands, Austria and Germany did not exceed 69–71%, while the lowest one was 17% (Ireland) (Table II.1.3, Fig. II.1.1).

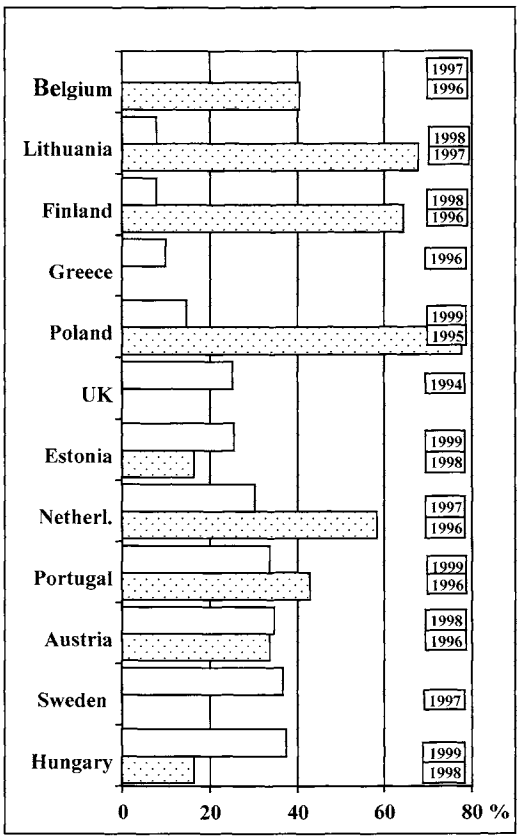

Figure II.1.3. The latest available and maximum rates of integrated technologies' capital costs in the total expenditure on the environmentally safe waste management in industry in the European Union and candidate countries in the last decade of the 20th century (after EUROSTAT, 2001a).

Therefore, there is no rational basis for excluding these materials from the waste stream. It cannot be denied that many OECD countries have made significant progress in paper and glass recycling in the last two decades, though the range of recycling rates in various countries is still extremely wide. In 1997, recycling rates for paper in Germany reached 85.5% and in Austria 83.4%, while mean value for the EU-11 (without Greece, Luxembourg, Ireland and Portugal) accounted for 59.0%. The total maximum paper/cardboard recovery including energy recovery in the EU member states reached as high a level as 95% in Denmark due to a very high rate of the energy recovery, 85.5% in Germany and 84.4% in Austria, while mean value for the EU-11 was 66.5%. Maximum glass packaging recovery in 1997, entirely through recycling, reached 83.9% in Germany and 76.5% in Austria, at a mean value for the EU-11 that was as low as 52.2% (Table II.1.4, data after EC DGXI.E3, 2001). OECD (1998) reported the variable increase of paper recycling from 1980 to 1996 that ranged from 4 to 5% (Japan, UK, Spain) to 32–35% (Switzerland, The Netherlands, Austria). The increase of the rate of glass recycling in this period ranged from 5 (Canada, Greece) to 58–64% (Denmark, The Netherlands). Simultaneously, though,

four countries displayed in 1996 a decrease in the paper recycling rate, from − 1 (Portugal) to − 20% (Poland). Collapse of paper recycling in Poland was mainly due to the failure of a previous collecting system based on the paid individual delivery practice. A well-functioning free selective collection of wastepaper in the neighboring EU countries has made its import to Poland more cost-effective than the national collecting system. An attempt to save it by reducing the price for delivery resulted in a loss of interest by suppliers due to a negative balance of delivery costs and prices. The newly enacted regulations that impose highly restrictive disposal and annual charges for the landfilling of recoverable waste in parallel with financial encouraging of recovery through the product and disposal fees entailed on entrepreneurs, strongly back up this activity and result in fast improvement of this waste recovery in Poland, with the target level of 48% paper and 40% glass recycling (Polish Acts: on packaging and packaging waste, 2001; on the obligations of entrepreneurs on the selected waste management and on the product and deposit fees, 2003; on annual rates of packaging waste recycling and recovery, 2001; consecutive Directives of the Cabinet: of 22 December, 1998, on charges for waste disposal with amendments, last in 2000; of 9 October 2001 (*both repealed*); and on fees for use of the environment, 2003, currently in force).

This case is a good illustration of the fact that waste management is governed by the same economic rules as any other market. This fact should be strongly taken into consideration when selecting enforcement instruments if we want them to work well. The efficiency of these instruments can be easily proven by statistical data, provided no toying with the terminology masks the real status.

In the field of environment protection, a significant part of which is the waste management strategy, public attitude and level of awareness plays an important supporting role. Everyday life shows that appropriate waste management can be easily achieved by an adequate education within a general educational system coupled with organizational and investment efforts that can effectively utilize and enhance public enthusiasm. A well-working free separate collection system requires placing easily accessible well-marked aesthetic containers, precisely functioning container collection/emptying and transportation to the place of reuse, effective and environmentally friendly utilization of collected waste and finally thoroughly informing the public of their role in the waste management system. Any spoiling of public enthusiasm by the wrong functioning of further stages of waste processing results in a deep adverse psychological reaction and a fixed negative perception of the further collaboration with unreliable partners in the waste management chain.

The relatively low level of waste paper and glass recycling in the USA and Canada, which have all the conditions to ensure its implementation, shows that this process is not a self-acting one and needs establishment of adequate enforcement procedures. They should comprise well-balanced incentive and charge/penalty instruments applicable to any other potentially recyclable waste. This contradicts the ideas of proponents of reuse enhancement by expressly excluding certain categories of materials from the definition of waste. The optimum enforcement of waste reuse should thus be based on the "polluter pays" principle and a thorough legal and financial responsibility of a waste generator.

Waste disposal has to have direct economic consequences to make the legal definitions and regulations work properly in the implementation arena. Spectacular success of fly ash

utilization in Poland (see Chapter I.1) is a good example of a properly working enforcement mechanism, worthy of popularization. Waste management in Poland has been regulated by the Act (2001) on waste, which replaced the previous one of 1997 in compliance with the EU Framework Directive 75/442/EEC on waste amended by Council Directive 91/156/EEC (1991). Current enforcement instrument to this law is the Directive of the Cabinet (2003) on fees for economic use of the environment, which replaced the previous ones on charges for waste disposal (2000, 2001), which in turn replaced the earlier Directive (1993) on fees for economic use of the environment, in the part concerning waste, with amendments of 1994, 1995, 1996 and 1997 that consisted mainly in actualization of the payment rates per mass unit of disposed waste. In the currently valid directive, wastes are listed and coded according to the Regulation as regards the single waste list (2001) adopting European list of wastes (Commission Decision 2001/118/EC, 2001). The fees are divided in several categories according to the charge rates per mass unit for disposal of waste, the highest is over 19 times higher than the lowest one. The fee for placing waste at the disposal site comprises also charge for three years' waste storage at this site. These fees and charges are to encourage waste generators or holders to advance seeking opportunities for waste utilization, minimization of the waste stream generated during the production or rendering it harmless in a form other than disposal. The fees and charges for disposal are the highest with respect to HW, waste for which recovery/recycling is technically and technologically sound, commercially effective and environmentally safe, as well as for a thoroughly reusable non-hazardous waste. For ultimate waste, for which at least partial disposal is unavoidable, the charges are lower. The system of charges is directed to advancing waste utilization and stimulating technologies, which assure waste minimization. A well-substantiated regional enforcement system, which includes incentives, charges and penalties and is based on the term "waste", may thus greatly improve its utilization.

To be successful, the industry sectors involved in waste recycling or usable material/energy recovery from waste must not be thrown upon their own into hard competition with easily available natural resources. Being supported financially and organizationally by waste generators acting on the basis of cost/benefit calculations and encouraged by regulations and legislation executed by administration, they would significantly enhance their competitiveness and strengthen the position in the market and public perception. This finally gives desirable results in the minimization of a waste stream and conservation of valuable natural material and energy resources.

II.1.2.2.3. Implementation of waste management options

It is obvious that waste management strategies should consider storage and safe disposal of non-recoverable waste residues. In accordance with the general legal approach in the OECD countries, with the USA legislation articulated in the RCRA (1976, 1984) and Superfund (CERCLA, 1980) as well as with the EU law (Council Directive 75/442/EEC, 1975, amended by Council Directive 91/156/EEC, 1991), and national laws and regulations, waste must be disposed of without endangering human health and without the use of processes and methods likely to harm the environment. In practice, this implies the following major tasks:

- reduce landfilling waste onto land, ensure all required technical means for environmentally safe surface dumping or impoundment, provide permanent early-warning controls over environmental contamination in a dumping site, expedite instant corrective action in case of failure to meet criteria of environmental law;
- minimize or prohibit land disposal of HW, also in specially engineered landfills as the least favored method of managing HW;
- promote improved solid waste disposal techniques (e.g. incineration with energy recovery);
- provide waste treatment in order to reduce its volume or hazardous nature prior to disposal;
- select and expedite remedial actions in the contaminated sites that ensure meeting legal environmental standards.

With the goal of implementing these strategic tasks, a number of guidelines have been developed for waste characterization, short-term and long-term risk and environment impact assessment, site or facility design, construction, monitoring and remediation. Under RCRA (Subtitle C: Hazardous Waste Management) and Superfund law, US EPA has implemented regulations to provide "cradle to grave" management of HW. The program includes standards applicable to generators and transporters of HW and performance standards for permitting HW treatment, storage and disposal facilities. The standards establish the principal groundwater protection policies of the RCRA HW program. EPA has also established criteria for non-hazardous solid waste disposal under Subtitle D (State and Regional Solid Waste Plans), which are to be adopted and enforced by the states. In the EU, besides the Council Directive 1999/31/EU (1999) on the landfill of waste, national legislation and enforcement regulations, the CEN Standards on Waste Characterization are now in an advanced stage of development, partially already approved or to be approved by final votes in 2004 or later (CEN/TC 292, 2003). The basic presupposition at the disposal technique and site selection, designing and construction is that the effectiveness of the environmental protection and controls on it is a first priority. The least-cost analysis is to follow the level of effectiveness determined to be appropriate.

There are not many statistical data available to evaluate the efficiency of the disposal methods. Some idea about the general state of the art in the OECD and EU countries give the data on the municipal waste management (Table II.1.5, Fig. II.1.4) (EUROSTAT, 2001c; OECD, 2002). Waste generation per capita ranged in the OECD member states from 300–310 (Greece, Mexico) to 760 kg (USA) and in the EU from 300 (Greece) to 640–670 kg (Luxembourg, Denmark, Switzerland, Spain). It showed a regularly increasing trend reflecting generally the level of economic welfare (estimated average for OECD accounted for 560 kg and for the EU 520 kg per capita), and in two decades since 1980 increased to 33% in OECD and 40% in the EU. Waste management practice in different countries shows considerably higher diversity, with one general feature. In the majority of countries, landfilling remains the principal option for disposal of waste. A strong positive trend in the last decade is a high and still growing interest in reducing disposed municipal waste volume through recovery of useful materials (recycling) or energy (incineration) and composting (Table II.1.5). In several highly developed European countries, municipal waste reuse was $\geq$65%, up to almost 90%. EUROSTAT (2001c) reports significant increase of this form of municipal waste management in the EU

Table II.1.5. Municipal waste generation and management in the OECD, EU member and candidate countries (after OECD, 2002 and EUROSTAT, 2000b,c, 2001c).

Countries	Generation (kg/capita)			Waste management (% of total)						
	1980	1990	2000	Mid-1990s*			Year	1998–1999**		
				R/C	I	L		R/C	I	L
Canada[a]	510	640	–	19	6	75				
Mexico[b]	–	250	310	1		99				
USA[c]	600	740	760	27	16	57				
Japan[c]	380	410	410	4	69	27				
Korea[d]	510	710	360	24	4	72				
Australia[e]	700	690	–	–	–	–				
New Zealand[f]	660	–	–	–	–	–				
Austria[c]	–	420	560	38	14	48	1996	47	16	37
Belgium[g]	360	410	550	14	31	55	1998	50	24	26
Czech Republic[h]	250	310	330	–	–	99	1998	13	5	82
Denmark[i]	400	570	660	23	54	22	1998	36	53	11
Finland[j]	–	410	460	33	2	65	1997	0	5	95
France[k]	–	450	510	9	32	59	1998	14	27	59
Germany[l]	–	540	540	29	17	51	1993	9	21	70
Greece[m]		260	300	7	0	93	1997	8	0	92
Hungary	–	530	450	0	7	93	1999	0	8	92
Iceland	–	620	710	14	17	69	1999	9	8	83
Ireland[n]	190	510	560	8	0	92	1998	9	0	91
Italy	250	350	500	–	6	94	1999	16	6	77
Luxembourg[o]	350	580	640	28	43	28	1998	0	66	64
The Netherlands[p]	490	500	610	38	27	35	1999	80	0	20
Norway[r]	550	530	620	15	16	69	1998	26	12	62
Poland[s]	280	290	320	2	0	98	1999	2	0	98
Portugal[t]	200	300	450	12	0	88	1999	10	8	82
Spain	–	–	670	12	4	83	1999	27	10	63
Sweden[u]	300	370	450	19	42	39	1998	32	35	33
Switzerland	440	610	650	40	46	14	1999	38	41	21
Turkey[w]	270	360	390	2	2	81		–	–	–
United Kingdom[c]	–	470	560	7	9	83	1996	8	0	92
Slovakia[x]	370	300	320	(*13*)	(*10*)	(*77*)	1995	2	0	98
Russian Federation[g]	160	190	340	–	–	–		–	–	–
Bulgaria	–	(*536*)	(*436*)	–	–	(*85*)	1998	0	0	100
Estonia[c]	–	(*354*)	(*394*)	(*0*)	(*0*)	(*100*)	1999	0	0	100
Lithuania[u]	–	(*416*)	(*426*)	–	–	–	–	–	–	–
Latvia	–	(*262*)	(*252*)	–	–	(*100*)	1999	0	0	100
Romania	–	(*302*)	(*326*)	–	–	(*100*)	1999	0	0	100
Slovenia[y]	–	(*514*)	(*515*)	(*5*)	(*0*)	(*95*)	1998	17	8	75

(*continued*)

Countries	Generation (kg/capita)			Waste management (% of total)						
	1980	1990	2000	Mid-1990s*			Year	1998–1999**		
				R/C	I	L		R/C	I	L
North America	500	620	660	*16*	*7*	*77*				
OECD[z]	420	500	560	*17*	*18*	*65*				
EU	370	420	520	*20*	*19*	*61*				
EU Assessing Countries[aa]	–	*(362)*	*(375)*			*(94)*				

Waste generation: Source: OECD (2002); (a) data for 1990 and 2000 are related to 1992 and 1998; (b) data for 1990 are related to 1991; (c) data for 2000 are related to 1999; (d) data for 1980 are related to 1985; (e) data for 1980 and 1990 are related to 1978 and 1992; (f) data for1980, 1990 and 2000 are related to 1982, average of 1986–1991 and 1999, respectively; (g) estimate; (h) data for 1990 and 2000 are related to 1987 and 1996; (i) data for 1990 are related to 1995, data on household waste for 1980 are related to 1985; (j) data for 1990 are related to 1994, estimates on household waste; (k) data for 1990 and 2000 are related to 1989 and 1999; (l) data for 1998; (m) data for 2000 are related to 2001; (n) data for 1990 are related to 1995, data for 2000 are related to 1998; (o) data for 1990 are related to 1992, data for 2000 are related to 1999; (p) data for 1980 are related to 1981; (r) data for 1990 are related to 1992; (s) data are related to collected waste, data for 1985 comprise liquid waste from containers and other tanks; (t) data are related also to Azores and Madera Islands; (x) data for 1980 and 1990 are related to 1987 and 1992, respectively; (u) data for 2000 are related to 1998; (w) data for 1990 and 2000 are related to 1989 and 1998; (y) data for 2000 are related to 1995; (w) estimates based on studies of different towns; (z) data do not comprise former GDR, Czech Republic, Slovakia, Hungary, Poland and Korea; data after EUROSTAT (2000b,c) are bold italic in parenthesis. *Waste management*: R/C, recycling + composting; I, incineration; L, landfilling; (*) Source: OECD (1998); (**) Source: EUROSTAT (2001c). *Mean values*: [aa]estimates (italic) based on the available data given in the respective columns (calculated by the authors).

member states. According to this source, the leading position in 1998–1999 was held by Denmark, the Netherlands and Switzerland (80–90%), Sweden, Belgium and Austria (over 75%), France, Luxembourg and Spain ($\geq$35%). Municipal waste composting continues to develop successfully in the EU member states (more information on composting and separate collection issues in view of the EU waste management strategy can be found in the Chapter VI.2 of this book).

This proves a substantial potential for municipal waste reuse, provided the selective collection of waste is adequately organized. A relatively high level of waste recycling and composting in North America (19% in Canada, 27% in the USA in mid-1990s) shows a good progress in this field. In a number of countries with weaker economies, the level of this attractive method of waste management is still low (from 0 to $<$10%), and greater progress is needed.

Another option for municipal waste management, which shows significant progress as a result of the implementation of waste management strategy in the developed countries, is incineration (see also Chapter VI.3 of this book). The preferences in the choice of this method of disposal are highly varied. In the most developed countries with a limited availability of land, it is used either as a predominant option (Japan, Luxembourg), or to a differing extent supported by a developed recycling/composting practice (Denmark, Switzerland, Sweden). In the EU, 24 (Belgium) to 66% (Luxembourg) of municipal waste was incinerated in 1998–1999, resulting in a significant reduction of landfilling. In the

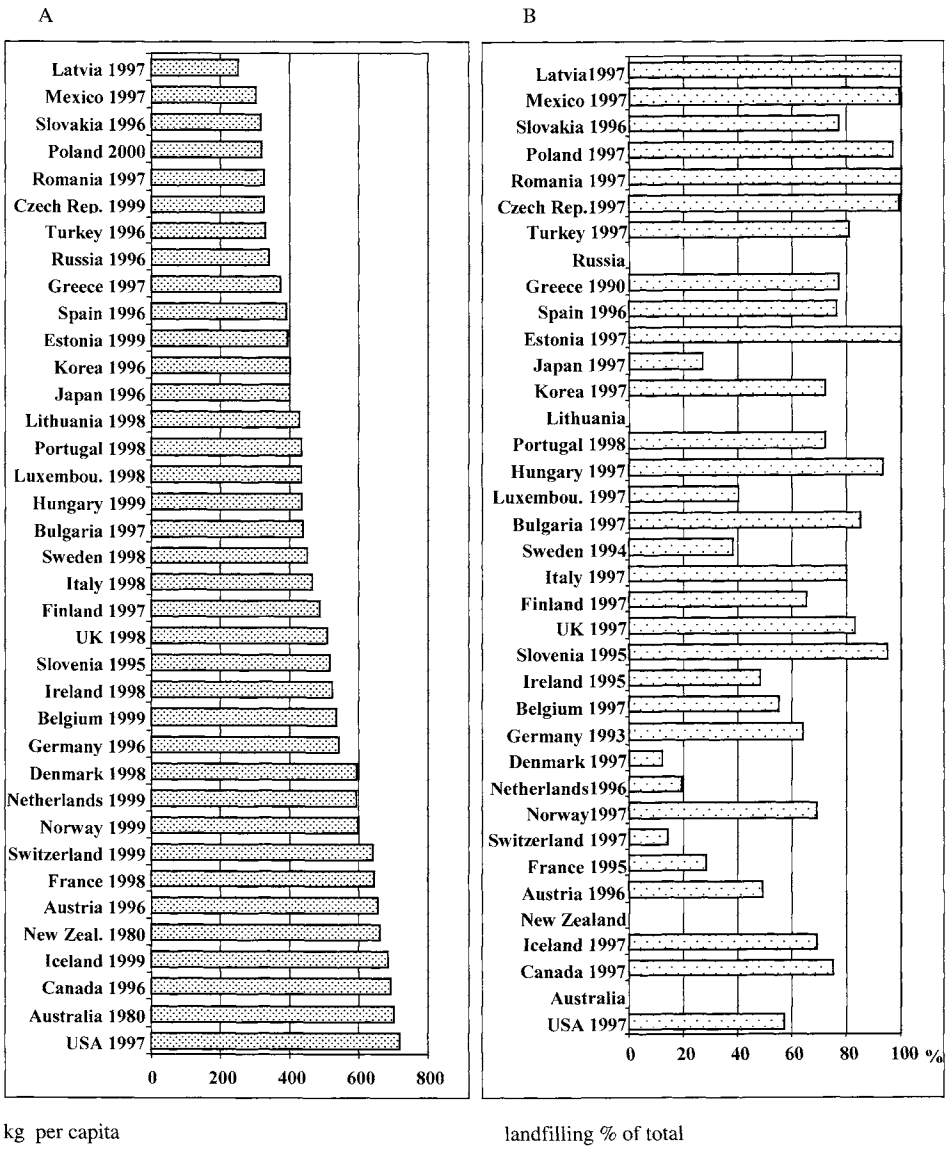

Figure II.1.4. Municipal waste generation and disposal in the OECD member states (after OECD, 1998, 1999 and EUROSTAT (2000a,b,c, 2001b)). Total amount exported for recycling: 3,959,974 t. Total amount imported for recycling: 4,481,983 t.

Netherlands, Belgium and Austria, recycling/composting was the major waste management practice (80, 50 and 47%, respectively).

The data from the beginning of the last decade of the 20th century report that over 70% of municipal wastes in North America and Western Europe were landfilled with little or no treatment (UNEP, 1992). Compared to these data, the present fast, though unequal progress is encouraging, considering the dramatic increase of the amount of municipal

waste per capita (Table II.1.5, Fig. II.1.4) (EUROSTAT, 2000b,c, 2001c; OECD, 2002). The latest available data show that the most frequent landfilling rates in the EU member states range roughly from 60 to 80% (e.g. Germany, Portugal) but can also be as high as 95–98% (Finland, Greece, UK). In the mid-1990s, the mean value for North America was 77%; of this in the USA it was 57%. According to the data derived from EUROSTAT (2001a), the mean value for landfilling municipal waste in the EU and associated countries in 1998–1999 accounted for 61% and ranged from 11 (Denmark) to 72–80% (Portugal, Spain, Greece, Italy). The countries where only a minor part of waste is landfilled (below 50%) have reached this level of reduction due to a concerted use of recycling, composting and incineration. These countries include Denmark (11%), Switzerland (21%), The Netherlands (20%), Sweden (33 %), Belgium (26%) and Austria (37%) and in non-EU countries, also Japan (27%), all have problems with land available for landfill siting. Of these countries, only Japan reached this low level of disposal onto land almost entirely due to incineration.

It should be underlined that non-hazardous waste disposal in adequately constructed and protected sites following the environmental regulations is also one of the options for municipal waste and remains the preferred method in a number of highly developed countries. It is accepted by the national policies and often influenced by a long-term expertise of environmental lobby groups, e.g. firms involved in safe landfilling coupled with production of usable energy (UK, Italy, Ireland). Also in economically weaker countries (Mexico, Czech Republic, Poland, Hungary and other Central and South European countries, Turkey, Greece, Portugal, Spain), landfilling predominates, being regarded as a cost-effective and environmentally safe method of disposal provided all the required protection measures are undertaken.

It has been recognized long ago (RCRA, 1976, 1984) that certain classes of land disposal facilities, in particular open dumps (landfills) and surface impoundments, are not capable of assuring long-term containment of certain waste, in particular large volume and HWs. Remedial actions in emergency cases are likely to be expensive, complex and time-consuming. In the USA, cleanup costs of the past mistakes are estimated at 10–100 times higher than the adequate controls on HW management (UNEP, 1992).

To solve waste management problems and develop a waste management strategy, besides paying particular attention to the proper management of HW, which constitute only 1.3% and municipal waste, which account for 9.0% of the total waste stream in the EU (see Chapter I.2, Tables I.2.1 and I.2.5), it is essential to manage properly the bulk of high-volume so-called "non-hazardous" waste, only a small part of them being inert waste. Long-term behavior of anthropogenic waste material exposed to atmospheric conditions, including material that is considered non-hazardous, is often difficult to predict precisely using general geochemical computer models (e.g. WATEQ 4F, MINTEQ, PHREEQC), so that in case of a false-negative prognosis, a substantial risk to human health and environment from the disposed wastes may occur in the long run. In the US and EU regulatory framework and regulations on waste, as well as in the respective guidelines, the general procedure, comprising environmental impact assessment (EIA), site design and construction in an environmentally safe way in the operational and post-closure stage, and local monitoring networks for detection and subsequent interception or remediation of contaminants before they degrade the ambient environment is to be followed.

II.1.2.3. Remediation and restoration of contaminated sites

In addition to designing and constructing new facilities receiving solid waste, already existing old and more recent facilities that are improperly performing so that they may pose risks to humans and the ambient environment are of concern. The historical development of industrialization in Europe and North America based on mining and metallurgy, followed by chemical industry, resulted in the creation of HW dumping sites in thickly populated areas. In the Central European countries, the problem of improperly constructed and managed dumping sites of solid waste from different industries existed until the end of the Soviet influence. Since the beginning of transformations of political and economical systems towards democracy and free market economy, most of these countries in their legislation on waste adopted the EU regulatory framework and developed adequate control and enforcement mechanisms. The unprotected dumping sites, both abandoned and partially still under operation, created a severe problem in the recent past, which is to be solved in the future. Effective implementation and enforcement of controls is greatly supported by well-trained enforcement administration and a high level of public awareness. The major difficulty in implementation of large-scale remediation and restoration programs is a weaker economical condition of a number of large industries and state budgets. Due to these limitations, the waste management strategies are focused on the proper operation of waste sites or optimum performance of current waste management practice, while the remediation and restoration of the old contaminated sites, where the polluter is frequently not available, is limited to the worst cases.

In the area of the former USSR (Russian Federation, Ukraine, Byelorussia and other new states) and in many developing countries the problem of improperly designed and constructed and badly managed hazardous and other solid waste sites is still a current practice, intensified by a poor economic status.

Risks to humans from toxic materials in contaminated sites derive from contaminated groundwater and airborne particulates and from direct or indirect exposure to contaminated soils. For many sites, radioactivity, explosion and fire are also major risks. Most of these sites also release toxic substances to various ecosystems through direct contact, leaching or runoff. Groundwater contamination at these sites has been the most difficult technical issue and represents a large part of cleanup costs. Groundwater contamination is perceived by the public as a major health issue and may present high risks at specific sites. It is also of concern because it degrades a natural resource and reduces its future uses. A recent NAS study estimated groundwater cleanup costs in the USA of up to US $1 trillion over the next 30 years, and concluded that existing technologies are generally not capable of effectively addressing the problem. Enactment of RCRA in 1976, the Superfund cleanup law in 1980, with the follow-up amendments, RCRA in 1984 and SARA in 1986 in the USA created a legislative basis for HW management practices, but at the same time revealed shortcomings of these programs. Extremely high costs of cleanup to a pristine condition and the low level of implementation of the current Superfund law results in the fact that of over 1200 Superfund sites, less than 1/6 had been cleaned up in the USA by 1994 (Reagan et al., 1994), and not much more progress has been achieved up to now. Besides the facilities receiving HW, other old facilities for solid waste disposal appeared to create a substantial contamination problem for groundwater, which since the 1980s, has loomed as a major environmental issue. In the mid-1970s, US EPA and the state

administrations became increasingly concerned that all waste disposal landfills, including those receiving non-hazardous waste under RCRA, may pose a threat to groundwater quality. There were 93,000 such landfills estimated in the USA. Of these, 75,000 were classified as industrial, and another 18,500 were municipal landfills. These sites invariably had anthropogenic surface impoundments that were problematic with respect to groundwater contamination. Most of them were unlined. About 40% of these facilities were located over unprotected aquifers currently or potentially used as a source of drinking water. Due to the lack of general knowledge, groundwater protection was not taken into consideration when these facilities were sited and constructed (EPA, 1984).

The European approach concerning sanitation requirements of old contaminated sites considers the realistic need of a quality-safe evaluation of such areas in order to take into account both interests of the environment and nature on one side and economy and industry on the other. In practice, this means that the site investigation, risk assessment and selection of remedial concepts is to be use- and site-specific, in accordance with criteria dictated by the defined protection objectives, which are determined by further use of the decontaminated area and corresponding human sensitivities. This approach applies to the presupposition that in the designing of the remedial concept, the required level of environment protection effectiveness is to be established first, and then the least-cost method of achieving it has to be determined (Twardowska et al., 1999). Evaluating the required method to achieve the desired level of effectiveness already involves the least-cost analysis, considering the cleanup to the not a pristine, but to the site- and use-specific level dictated by the sustainable development premises. This makes the cleanup program much more realistic and harmonized with the actual industrial and economic development of the region. Nevertheless, the costs of remedial actions are still very high, which results in the gradual evolving and implementing of cleanup programs.

II.1.2.4. Monitoring

Characterization and monitoring of toxic materials and pollutants released from waste and their pathways in all compartments of the environment are essential parts of the implementation and enforcement side of all waste disposal strategies. Without efficient and cost-effective monitoring technologies it is not possible to either initiate the most appropriate waste management/disposal and remediation activity or determine whether an actual decrease of risk can be achieved by either control or pollution prevention approaches. Effective monitoring used as a benchmark for residual risk reduction is essential in the waste management strategy. As an instrument of an actual short-term and long-term risk assessment from the solid waste disposal facility in an operational and post-closure stage, monitoring networks are utilized both in North America and in the EU countries in non-hazardous and HW sites screening and characterization. The comprehensive life cycle monitoring of landfills (both of solid and HW) is also included in the site characterization and evaluation of lining and cover (capping) performance, as well as in post-closure and remediation strategies. Monitoring thus plays an essential role in the implementation and enforcement procedures of the legislative framework. In the last decade, great advances have been made in the science and

technology associated with early warning monitoring of recoverable groundwater resources. Advanced cost-effective equipment and technologies, standardized techniques and expert systems to assist environment protection regulations of RCRA and Superfund in the USA and to support respective national and the EU legislation on waste have been developed (some of these issues are addressed in Chapter IV of this book). Further, fast advances in this field will create new opportunities for data collection and analysis related to waste management.

II.1.3. Waste management legislation and its implementation in the developing countries and new post-communist states

II.1.3.1. Major issues of solid waste disposal

II.1.3.1.1. Waste management issues in the developing countries

Developing countries face special problems in implementing waste management programs. They include generally poor control of pollution, lack of financial resources, shortage of trained resource personnel with technical and managerial skills and a low level of public awareness. Particularly severe problems and challenges have been created by rapid growth of urbanization and industrialization, not balanced by adequate environmental protection strategies, including the field of waste management. At the beginning of the last decade, UNEP pointed out instances of exporting extremely HW from developed countries to developing ones, which had neither the facilities nor the technical expertise to deal with (UNEP, 1992). These practices have been caused by the increased stringency of requirements for siting, constructing and managing waste disposal areas, stricter controls over waste disposal, in particular HW, and adequately increased costs of waste management that decrease the profits and competitiveness of the manufacturers in the internal and international markets. These practices are banned by international regulations (OECD Council Decisions (88)90 and C(92)39 Final; Basel Convention, 1989, in force since 1992) and are therefore considered illegal. These regulations have been supported by a number of EU regulations enacted since 1988 concerning transfrontier movements of HW to third countries, among them Council Resolution of 21.12.1988 (1989); Council Decision 97/640/EC (1997); Council Regulation (EEC) No 259/93 (1993) on shipments of waste within, into and out of the European Community, as well as Council Regulation (EC) No 1420/1999 (1999) establishing common rules and procedures to apply to shipments to certain non-OECD countries of certain types of waste. All these legal documents, along with decisions concerning the reporting obligations of the member states (1999/412/EC), and determining the control procedures under this Regulation (EC No 1547/1999) can be downloaded from the EU web site EUR-Lex (2003a). In face of the controls set out on the transfrontier movement of HWs, another trend, which successfully avoids these bans, appears to be much more dangerous. This trend is the massive shifting of production plants by manufacturers, in particular by international companies, from the native countries, where high labor costs along with stringent safety and environmental

regulations profoundly increase costs, to the developing countries. There they fully and legally use all the opportunities created by cheap labor, low safety requirements and either lack of legislative frameworks or weak and poorly executed legislation concerning waste management. In most cases, the fast industrialization of developing countries is due to the growing activity of such producers, who unrestrictedly use cheap solutions for dangerous waste materials disposal in these countries, usually landfilling them without any control. The rapid imported technological developments, proliferation of new materials and particularly HW do not meet the adequate level of development in the legislative, economical and educational arena. This may bring about unpredictably dramatic irreversible and long-term consequences to human health and the environment in these countries, which are usually rich in rare and extremely valuable species. Only occasionally is international public opinion shocked by emergency cases with great loss of life (e.g. the Bhopal case in India). Long-term environmental impact, in particular deterioration of groundwater resources and risk for human health from waste disposal sites, remains hidden from view. In these countries, governments, local administration and the common public concern themselves only rarely with HW being disposed off in unlined open dumps. Few know or really understand how seriously their health and resources have been compromised. The otherwise proper conclusion derived by UNEP (1992) that developing countries should move quickly to implement controls over waste disposal to avoid high cleanup costs in the future has no realistic basis to be actualized, though the increasing role of the Basel Convention in controlling illegal traffic of HWs, its activity focused on achievement of environmentally sound management of HWs (ESM) in developing countries through establishing the regional and sub-regional centers for training and technology transfer regarding the management of HWs and other wastes and the minimization of their generation, assistance in implementation of a model national legislation on the management of HWs, development and harmonization of national legislation, as well as improvement in national reporting and transmission of information, results in a visibly increasing awareness of parties to the Basel Convention towards the introduction and implementation of ESM. Nevertheless, in many cases national legislative frameworks of developing countries, if they are already enacted and exist, are not able to solve the problems posed by waste disposal, due to inadequate enforcement mechanisms. At this stage, the developing countries cannot be left on their own, and urgently need the harmonized support and assistance of the international legislative bodies to solve the environmental aspects of importing industrial investments into their countries, including waste management and in particular HW disposal. The international enactment of the environmental laws concerning export of industrial/ technological investments would also prevent international companies from using the disparity in standards set for waste disposal across the world and looking for countries where the environmental laws are the least stringent and enforced. Usually, the developing countries with the weakest economies, legislation and a low general educational level appear to be the most attractive targets for the import of technologies with savings on the costs of environmental protection. These countries are not prepared to solve the problems now, as imported new technologies are not harmonized with their natural development course and they will not also be able to bear the highly increased costs of remediation in future, considering that the USA and EU countries fail in attempts to implement their cleanup programs.

II.1.3.1.2. Waste management issues in the new states of the former USSR

The waste management problems in the new states that emerged from the former USSR are of different nature than those of the developing countries. The new states of the former USSR represent a rather high industrial and educational level and poor economic status (UNDP et al., 2000). They already have profound and often still not thoroughly understood environmental problems with the gigantic uncontrolled, unlined open dumps and impoundments, which resulted from their own unbalanced industrial development (Aksenov et al., 1999; Kitchilin and Ginzburg, 1999; Logatchev, 1999; Streltzov et al., 1999; Zoteev et al, 1999). These countries may also suffer further environmental damage due to their present bad economic situations, poor status of environmental legislation and actual lack of implementation and enforcement mechanisms. The attempts to mask the environmental problems in the Russian Federation are coupled with the lowest capital expenditure per capita for pollution abatement and control, which in 1996 accounted for US $11, 14 times lower than in Germany and over 5 times lower than in Poland. The optimistic situation is a systematically increasing trend, 10-fold compared to only US $1 in 1992 (OECD, 1998), as well as an enactment on 26 June 1998 of a Federal Law "On Wastes of Production and Consumption" in Russian Federation and recently also of the similar laws in several other new states that emerged from the former USSR (SBC, 2001a,b, 2002).

II.1.3.1.3. Common needs

It seems clear that developing countries and new states urgently need national control strategies, which provide legislation on waste, and a regulatory framework within which realistic enforcement procedures can be implemented. Some developing countries try to adopt legislative acts from the developed countries, producing in this way the most dangerous type of legislation, which is the "paper law" with a set of wishful thinking that cannot be implemented. Controls cannot be enforced if a choice of adequate facilities for treatment, disposal and recycling is not available, where there is no mechanism of collection and handling waste from small producers and households, where there are no properly trained enforcement officers, plant operators and managers, and where a legal enforcement procedure is not armed with an adequate incentive/penalty mechanism which exerts desirable effect on waste generators and holders. Waste control strategies in the developing countries should thus be carefully adjusted to the current conditions in each country and consider entirely and solely the realistic options which would work properly, without any gap between legislation and implementation.

In the case of import of industrial investments by foreign or international companies, also as joint venture with a local industry, in the waste management area, foreign/ international investors should follow the harmonized regulations to be evolved by the international legislative bodies similar to those for transboundary movement of waste by the OECD Council Decision C(92)39 Final and Basel Convention (1989, 1992). Now is the last moment when we can prevent severe and irreversible damage of the environment in the great part of the world resulting from the import of technologies while using the

least-cost choices in waste management because of the inadequate laws of developing countries. Experience shows that waste management practice follows the path of least regulatory control and least cost. It should be kept strongly in mind that "we could not expect firms to invest in technologies and to compete against unrestricted land disposal practices where cost alone is allowed to dictate the choice of management method and where a lack of proper regulation indirectly subsidizes the status quo" (Fortuna, 1989). These words written by a principal architect of the 1984 RCRA Amendments almost two decades ago are still fresh and applicable. We also should not expect developing countries to cope alone with the problem that overwhelms their abilities and to harmonize their regulations worldwide. The enactment of unequivocal international regulations on waste management related to the import of investments would greatly support developing countries in their efforts to establish national systems of waste disposal controls.

II.1.3.2. Waste disposal control options, pollution prevention, and information sources for industries in developing nations

According to the recommendations of UNEP (1992), "governments should establish a national system of waste disposal controls including legislation and regulatory framework, implementation and enforcement procedures, meaningful information on waste sources, and adequate facilities." It also seems clear that the legislative bodies must not create paper laws that cannot be implemented under the specific conditions of a given country. The major prerequisite is that the law must work, and therefore the analysis of different realistic applicable options, which can give the best environmental and public health effect, should be performed. Below, various alternative administrative waste control options, advantages and disadvantages are presented for consideration. These options include (1) no controls, (2) mandatory controls, (3) administrative control by industry, (4) individual control by industry, (5) collective control by industry, (6) joint administrative control by government and industry and (7) administrative control by government. Three alternative levels of control are addressed: (1) specified standard, voluntary compliance; (2) low standards, mandatory compliance; and (3) high standards, staged mandatory compliance. Options include ambient standards, discharge standards, prohibitions, disposal charges, licenses/permits, warrants, zoning and subsidies. This section briefly covers the advantages and disadvantages of four industrial waste control strategies: (l) cleaner fuels and raw materials, (2) improved production processes, (3) waste reclamation, recycling/reuse and (4) "end-of-pipe" treatment for suspensions.

The presented options include both the simplest like "no controls" and the most sophisticated ones, which have high capital and operating costs, need well-trained operators, managers and enforcement officers, and require well-equipped pollution control and monitoring systems and a high common life standard, level of education and public awareness. In general, the choice of option should be strictly adequate for the implementation/enforcement ability of the country. The "paper law" that is ignored due to the lack of means to execute it is more depraving than no law at all. Also all "voluntary compliance" options have a destructive effect and thus cannot be recommended.

Advantages and disadvantages of alternative industrial waste administrative control options.

Option	Advantages	Disadvantages
No controls	Popular with industry Short-term industrial growth No capital expenditures No regulatory agencies	Encourages uncontrolled use No incentive to reduce pollution Probable degradation of resources and public health. High capital costs are subsequently encountered
Mandatory controls	Prevents resources' waste Reduced contamination Prevents adverse effects Allows planning of resource use Increased employment due to construction and management of control devices and programs	Diverts capital Increases prices. Forced closing of inefficient plants
Administrative control by industry	Experts in control	Unrealistic to expect industry to police itself Industrial welfare takes precedence over public health
Individual control by industry	Compliance adjusted to achieve minimum loss	Unfair to small industries No control over dispersed industries
Collective control by industry	Considerable cost savings Group of experts control situation Avoids duplication	Needs legal incentives
Joint administrative control by government and industry	Best potential of technical and administrative personnel Equitable internal plant and external land control Mandatory compliance with some industrial control Total environmental, industrial and resource control	New administration required, tends to create dissension Results in debates and compromises caused by conflicting interests
Administrative control by government	Represents society Administrative apparatus already exists Enforceable incentives and penalties insure compliance Enables total resource control Better ultimate quality of life Traditional separation of government and industry	Unpopular with industry Potentially higher short-term cost Political infighting with possible increases in bureaucracy

Advantages and disadvantages of alternative levels of waste control.

Option	Advantages	Disadvantages
Specified standards, voluntary compliance	Simple No red tape or constraints No public effort required Minimum opposition from industry	Almost completely ineffective Politically damaging if public realizes its failure Politically damaging if public realizes its failure Allows virtually unchecked natural resource exploitation and waste disposal
Low standards, mandatory compliance	Achieves some degree of pollution control Least objectionable to industry	Cost of implementation and administration Slows some waste of resources Environmental deterioration remains unchecked
High standards, staged mandatory compliance	Environmental deterioration checked or prevented Maximum long-term resource economic conservation	Industrial opposition Capital costs may be large Costs for administration, requires technical personnel

Advantages and disadvantages of selected regulatory strategies.

Option	Advantages	Disadvantages
Ambient standards	Allows range of alternatives A basis for a comprehensive control program Monitoring indicates when levels are dangerous	Requires monitoring of the environment Encourages increased pollution in clean areas
Discharge standards (uniform)	Relates directly to environmental quality Simple program which can be the basis for other programs Definite pollution limits Direct, effective guideline for safe discharges	Requires administration and enforcement Industries may not be able to meet the standards Variable standards may be more equitable Ignores cost effectiveness Enforcement requires individual firms to be monitored

(*continued*)

Option	Advantages	Disadvantages
Prohibitions	Stops further pollution Simple administration and monitoring Necessary for toxic wastes	May cause permanent or temporary closings
Disposal charges	Costs are internalized Decision-making is decentralized Least-cost method of control which relies on market stimulation	Industrial opposition Some delay inequities inevitable Relating the charge to pollution is difficult Low disposal charges may become an accepted cost
Licenses	Prevents operation of polluting plants Enforces compliance before pollution occurs Encourages periodic review	Requires monitoring to ensure compliance
Warrants	Controls ambient quality by limiting number and quality	Awards favor financially strong firms Other firms may be forced to close Restricts industrial development rather than encouraging better waste management
Zoning	Forces industry to locate in suitable areas Protects sensitive areas Allows separation of industrial and municipal waste Economical, effective treatment and control Simple enforcement	Can supplement need for treatment or pollution controls Permitted area may be uneconomical Development of zoning difficult
Subsidies	Cost of cleanup not a burden to any one society Bases problem for smaller industries Easy to administer	Difficult to determine optimum payment Contrary to the "polluter pays" principle Increased taxes possible Does not encourage cost efficiency Imposes burden on government No incentive to use most cost-effective treatment, equipment or method Encourages end-of-line treatment rather than process change and recovery methods

Advantages and disadvantages of industrial strategies to control pollution.

Option	Advantages	Disadvantages
Cleaner fuel/raw materials	Reduces pollution through prevention Reduces need for waste treatment Less costly and more effective than treatment methods	Substitutes may be in short supply, more costly and/or less suitable
Improved production processes	Conserves limited resources Reduces pollution through prevention Reduces need for waste treatment More effective manufacturing methods also can reduce polluting waste	Processes which reduce pollution may increase costs or reduce efficiency Additional costs may be higher than those of waste treatment
Waste reclamation (recovery, recycling, reuse, by-product use)	Conserves limited resources Increases public relations May reduce costs, pay for itself or return a profit Eliminates need for permits Eliminates need for monitoring Eliminates need for reporting	May be more expensive than waste treatment Not technically or economically feasible for all pollutants
End-of-pipe liquid waste treatment	Conventional treatment methods readily available for most pollutants Effluent waste collectively treated in municipal or industrial waste treatment systems Technology well developed	Residues remaining after treatment need disposal Pollution only reduced, not eliminated Can be expensive if retrofitting is necessary Waste resources

Advantages and disadvantages of solid waste disposal methods.

Option	Advantages	Disadvantages
Ocean and lake dumping	Usually cheap and easy	Contaminates fish and aquatic plant life Introduces toxic pollutants into the food chain Unsightly and damaging to tourist trade Lake dumping may endanger drinking water supply

(*continued*)

Option	Advantages	Disadvantages
Open land dumping	Usually cheap and easy	May contaminate air and water (surface and groundwater) Harbors disease-carrying rodents, insects and micro-organisms Unsightly and odorous Source of toxic leachates
Open burning	Usually cheap and easy	Causes air contamination Odorous and unsightly
Sanitary landfilling	Accepts most types of waste Produces little air pollution and odor Less groundwater pollution than open burning and dumping Can be used for land reclamation Minimizes hazards caused by organic wastes Economical and easy to operate	Nearby residents may object Requires careful maintenance Completed landfills continue to settle and can produce methane gas and toxic leachates for many years Soil cover material may be difficult or costly to acquire
Incinerating	Requires little land Process is rapid Does not require long hauling	Causes air pollution, some possibly toxic if the most advanced technology is not used Unsuitable for many wastes, needs selection or selective collecting Residues require disposal Pollution control and heat recovery systems are very costly Nearby residents usually object Usually located close to solid waste sources and therefore tends to affect larger populations than other disposal methods

Experience shows that regulatory strategies based on prohibitions are also not effective and do not encourage industries to seek optimum solutions for waste management, if the only enforcement instrument is the threat of closure. Usually, as this measure adversely affects the employees not responsible for posing pollution or health hazards, closing is applied in emergency cases, when severe damage to the environment or human health has already occurred. It does not have any preventive or discouraging effect, as such cases are relatively rare. Thus, this regulatory instrument may be considered as "close to none".

For the developing countries, the method of small but firm steps forward in setting and enforcement of staged national waste management law based on the thorough ability of execution at the current stage of development seems to be the best option, e.g. lower standards and mandatory compliance may be a legally accepted level of control if high standards cannot be achieved or controlled.

The principle of financial responsibility of waste generators or holders for its disposal has proven to be the most effective enforcement instrument. It assures the best and instant response through seeking ways to minimize waste production by improvement of technology, waste recycling and reuse, or render them less hazardous. The charges for waste disposal can be used for providing the necessary equipment, training of enforcement officers and environmental education, as well as improving the environment in the communities (e.g. construction of environmentally safe sanitary landfills or organizing proper waste collection systems). The application of this instrument should be given high priority because of its link to sustainable development, i.e. to a mutual support of a clean environment and economic growth. The system of charges must be well thought over, to relate adequately the charge to the level of hazard posed by waste and its reuse or recycling properties. The charges have to encourage better waste management and cannot be either too high to sustain nor too low to become an accepted cost.

An important part of a sound waste management strategy in developing countries, similar to that in the developed states, is a two-way communication with the public and a direct community involvement in all aspects of the environmental decision making process supported by free access to reliable information about sources and levels of environmental pollution and hazards from the waste disposed off in the community.

Foreign companies siting industrial plants in developing countries and called here "import of industries", with respect to waste management, in particular HW disposal, are to follow stringent regulations of developed countries, e.g. based on the EEC Council Directive 91/689/EEC (1991) or the RCRA and adequate guidelines, to be imposed on them by the competent international bodies (OECD Council, Basel Convention). These companies are to bear all the capital and running costs of the waste disposal facilities, which have to meet the stringent international regulatory requirements, as well as financial and legal responsibility for their proper management. They have to establish monitoring to provide information about the effectiveness of environment protection measures at the disposal sites and to eventually track the concentration and impact of toxic substance releases to the environment. If required, they have to undertake corrective remedial actions to intercept pollution and eliminate hazard to the environment and human health. The compliance with international regulations is to be supervised by the bodies that enacted the regulation in cooperation with the national governmental administrative apparatus in the host country where the plant is sited. This way, the environmentally controlled import of industries to the developing countries due to high expertise and technical/technological abilities of the international companies can become an effective instrument of sustainable development, instead of posing threat to the environment of the host nations.

Through collaboration of international and governmental sectors, this optimized waste management strategy should assure the achievement of the required level of sustainable development that is required for both the environmental protection and economic growth of the developing countries.

II.1.4. Effect of international regulations on the control of the transboundary movement of hazardous waste

As has been shown above, in some areas national legislation is not able to solve the broader problems posed by waste disposal. In these cases, their effort is or should be supported by the international conventions. An international mechanism to control transfrontier movement of waste destined for recovery operations within the OECD area has been implemented on the basis of the OECD Council Decision OECD C(92)39/Final. According to the available recent data (OECD, 1998), export/import of HW within this area was almost totally balanced and accounted for 1170.5 thousand tons (export) and 1174.1 thousand tons (import) that comprised 0.4% of the total generated amount. Import exceeded export for 8.5 thousand tons, which is a negligible part of the total HW stream. Within the EU area, import exceeded export by 231.7 thousand tons and accounted for 1021.3 thousand tons (see Table I.2.4, Chapter I.2). The amount exported comprised 2.7% and imported 3.4% of the total amount of HW generated. The biggest waste importers are France, Belgium and Mexico; the biggest exporters are Germany, Luxembourg and the USA. The export accounts for 100% of waste generated in Luxembourg, 5.7% of the total waste stream in Germany and only 0.07% of HW generated in the USA (the USA appears to produce 79.2% of the total OECD HW stream and over 7 times more than the European Union, which illustrates the scale and importance of the HW management in this country). Within the OECD countries, information concerning HW generation and transboundary movement has been greatly improved. The directions of major waste import to the most developed EU countries, which are well prepared regulatory, technically and technologically for environmentally safe waste reuse and disposal, indicates that in the OECD area transboundary movement of HW is effectively controlled by the OECD regulations.

The Basel Convention (1989/1992) is aimed at limiting the international shipment of HW, in particular from OECD countries to non-OECD countries. In 1989, it was ratified by over 100 countries and the European Economic Community (EEC), and in 1992 entered into force. By June 2002, the Basel Convention was ratified by 151 parties. The Basel Convention provides the major international regulations that protect against the unrestricted import of HW to the developing nations, which have neither facilities nor expertise in dealing with it (more information about the Basel Convention and its implementation is given in Chapter II.2). The analysis of generation, export and import of HWs and other wastes by Y-codes carried out by the Secretariat of the Basel Convention for the years 1993–1999 on the basis of data provided by 18 of 101 parties of the Convention for 1993 and by 36 of 151 parties for 1999 that gave some rough idea about the structure, use and disposal of the imported/exported HWs and other wastes, has been presented in Chapter I.2. Of these HWs, only seven are ultimate solids, the rest represents solvents, solutions, emulsions and mixtures, which reflects the difference in definitions of HW: according to the RCRA, HW must be solids (though the interpretation of this term shows that in many cases a waste often is not an ultimate solid – see Appendix A to Chapter I.2), while there is no such criterion in the Basel Convention or the EU list of waste (Commission Decision 2001/118/EC, 2001, amending Decision 2000/532/EC, 2000; Basel Convention, 1989/1992 as of July 1999). The major part of the transboundary movement of HW among all reporting parties in 1999 was reported to be used for

recycling operations (49% of total amount exported and 71% of total amount imported) (Fig. II.1.5). Most of the exported and imported HW shipped for recycling operations was going for recycling/reclamation of metals and metal compounds R4, other inorganic materials R5 and catalysts R8. The next highest amounts of exported HW were directed for solvents reclamation/regeneration R2, recycling/reclamation of organic substances R3 and regeneration of acids or bases R6, and in lesser amounts for generating energy R1. The remaining minor amounts were distributed among seven different operations. A high percentage of imported wastes was recycled by unspecified operations (Fig. II.1.6).

Disposal operations comprised 11% of the total amount exported and 27% of the total amount of wastes imported. Predominant disposal operation for exported wastes was declared to be incineration, while most of imported waste was reported to be directed to landfilling, in lesser amounts to incineration and landfilling in the specially engineered landfills; other disposal operations comprised minor amounts of waste (Fig. II.1.7)

The statistical data obtained by SBC from the reporting parties display substantial inconsistencies: (i) there is 1766 thousand tons (22% of total) discrepancy between export and import; (ii) of the total amount exported, 3251 thousand tons, i.e. 40% of total, was directed to unspecified operations; (iii) there are striking differences between the amounts of exported and imported wastes directed for different recycling/disposal operations as declared by the reporting parties.

The incompleteness of information and difficulties in obtaining accurate data require that the charts, which have been presented above, have to be considered with a great deal of caution. This shows that the level of protection that has been reached in the control of shipment of HWs between the OECD member states is still far from being achieved by the parties of the Basel Convention. The diversity of the general development, lack of a reliable or any information on waste generation and on trends in the quantity and

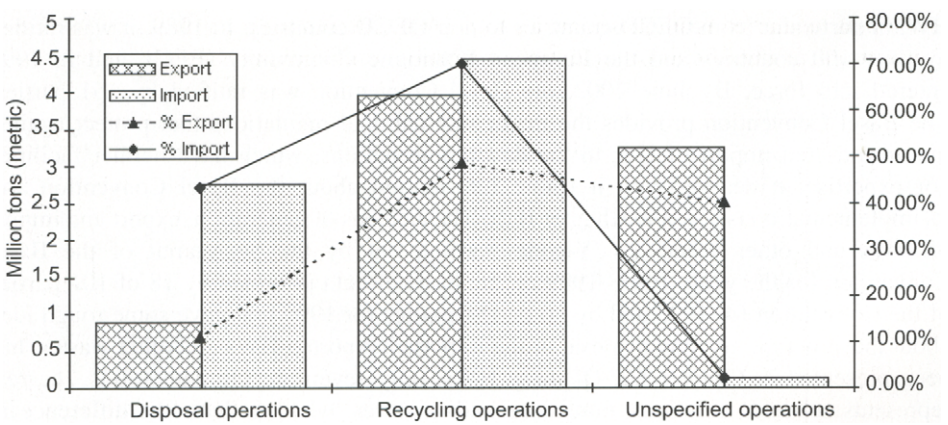

Figure II.1.5. Transboundary movement of hazardous wastes and other wastes by operations among all reporting parties in 1999 (after SBC, 2001b). Explanation of R-codes (Annex IVB of the Basel Convention – see Chapter II.2, Appendix A): R1 – generating energy; R2, R3, R6 – solvents, organic substances, acids or bases; R4, R5, R8 – metals, other inorganics, catalysts; R7, R10, R11, R13 – residual materials; R9 – re-refining/other reuse of used oil; R – mixed R operations. Total amount exported: 8,104,960 t. Total amount imported: 6,338,474 t.

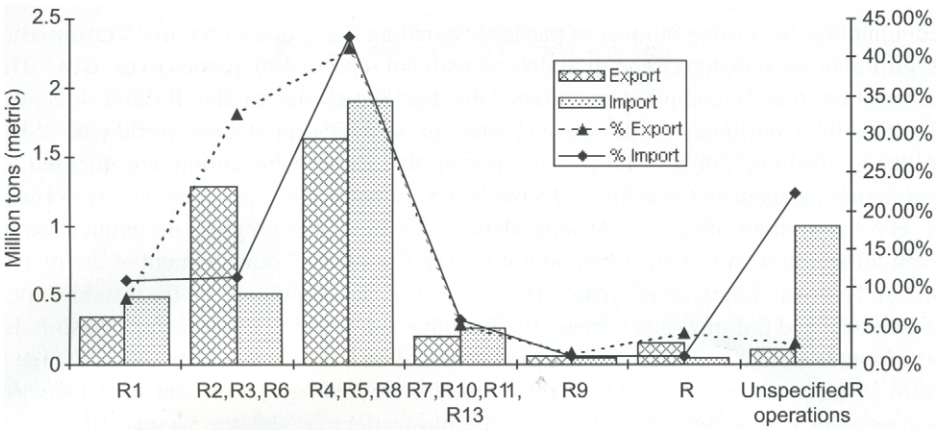

Figure II.1.6. Transboundary movement of hazardous wastes and other wastes for recycling among all reporting parties in 1999 (after SBC. 2001b). Explanation of D-codes (Annex IVA of the Basel Convention – see Chapter II.2, Appendix A): D1, D2, D4 – landfill, land treatment, surface impoundment; D3, D12 – deep injection, underground storage; D5 – specially engineered landfill; D8 – biological treatment; D9 – physico-chemical treatment; D10 – incineration on land; D13, D14, D15 – blending, repackaging, interim storage, the amounts for mixed D wastes are not included because of their negligible value. Exports for mixed D operations: 2200 t; imports for mixed D operations is not included because of its negligible value: 6.2 t. There was no import for unspecified D operations. Total amount exported for disposal: 893,649 t. Total amount imported for disposal: 1,727,591 t.

composition of waste streams, disparity in terminology, legislative framework and the regulatory/enforcement mechanisms create significant difficulties in controls of transboundary waste movement between the OECD and the developing countries. Nevertheless, the considerable progress in the control of transboundary HW shipment to developing countries is unquestionable, to a great extent due to activities of the Basel Convention in the field of statistics, reporting and transmission of information.

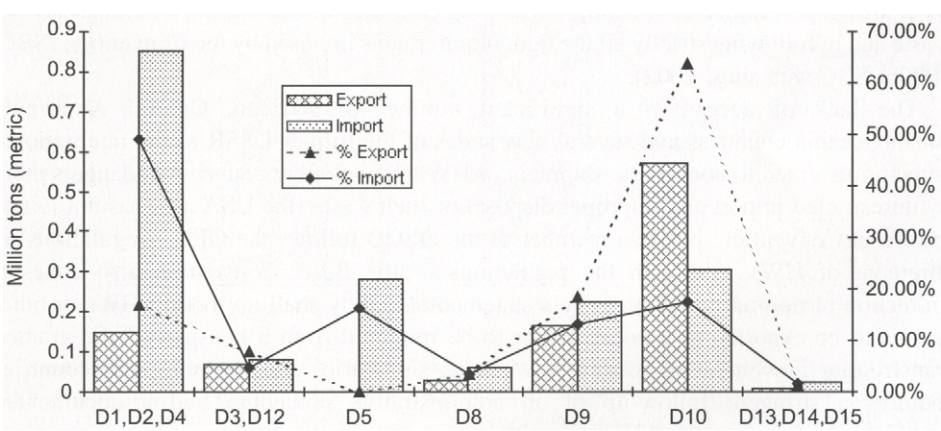

Figure II.1.7. Transboundary movement of hazardous wastes and other wastes for disposal among all reporting parties in 1999 (after SBC, 2001b).

Continuously increasing number of parties responding to the questionnaire "Transmission of Information" reflects a trend in improved national reporting by parties to the SBC. This information that is compiled and issued by the Secretariat of the Basel Convention significantly contributes to the development of statistics on wastes worldwide (SBC, 2000a,b, 2001a,b, 2002). Many activities of the Basel Convention are focused on optimizing mechanisms to achieve the major aim of control of transboundary movements of HWs and their disposal. Among these activities, the progress in unification of terminology on waste, characterization of hazard from waste, development of the revised Model National Legislation (SBC, 1995) and the developments in the establishment of Regional and Sub-regional Centers for Training and Technology Transfer, transmission of information on transboundary waste movement under the Convention and exchange of information between parties of the Convention on national legislation, statistics and waste management practice can be considered the most effective and spectacular ones (SBC, 1996; Basel Convention Statistics, 2002; Basel Convention Publications, 2002).

The revised version of the Model National Legislation developed by the Convention (SBC, 1995) provides assistance to states to take appropriate legal, administrative and other measures to implement and enforce the provisions of the Basel Convention. It comprises the elements for inclusion in legislation for the management of HWs and a draft model national law on the control of transboundary movements of HWs and other wastes and their disposal (SBC Legal Working Group, 2002 update).

The elements for inclusion in legislation on the management of HWs and other wastes specify the aim, the authority responsible for implementation of a law in this regard and its obligation, as well as the control of the management and monitoring of the generation of HWs and other wastes. The model national law on the control of the transboundary movements of HWs and other wastes and their disposal sets out the aim of the national legislation, defines relevant terms, provides for the establishment of a regulatory authority and addresses export, import, transit and illegal traffic issues in HWs and other wastes. The aforementioned activity of the Basel Convention tends thus to harmonize national laws and definitions related to waste management and the transboundary movement of HW and other waste. It is aimed at assisting developing countries in elaborating a national law on waste and in following strictly all the tight requirements imposed by the Convention (SBC, 2000b; SBC web sites, 2002).

The lack of access of a significant number of African, Central American, Asian/Oceania countries and several new states of the former USSR to the international convention aimed to control the shipment of HW to developing countries endangers them by unrestricted import and improper disposal of such waste (the USA also has not joined the Basel Convention, but as a member of the OECD follows the OECD regulations on shipment of HW). Although the regulations of the Basel Convention also consider protection of non-party countries by a statement, "a party shall not permit HWs or other wastes to be exported to a non-party or to be imported from a non-party," the granted transfrontier movement of wastes between its signatories and the non-party countries requires a stringent follow-up of an administrative procedure and a documented justification of the exporting country of the necessity of export and a proper management of waste by the importing country (for more information about the Basel Convention, see Chapter II.2 of this book).

II.1.5. Conclusions

Despite the substantial, though uneven progress in waste management in the last decade, in particular in the EU and the OECD member states, the harmonization of waste terminology, completeness and reliability of statistics, the level of minimization of a waste stream through reuse/recycling and reduction of a waste disposal in landfills on land still cannot be considered satisfactory. A relatively low mean level of reuse of such thoroughly recyclable waste materials as paper and glass in the OECD area makes groundless the suggestions to exclude recyclable waste materials from the definition of waste.

The unrealistic legislation on waste along with weak enforcement mechanisms and the "import of industries" by international companies, which use a lack of proper regulations for choosing the cheapest waste management solutions, results in open uncontrolled dumping of hazardous and other wastes and gives rise to current and future pollution problems in the developing countries. The staged waste management strategies, which provide for a legislative and regulatory/enforcement framework, carefully adjusted to execution ability along with setting international regulations over waste management in "imported industries" by a Convention similar to the Basel Convention, would create effective instruments for the sustainable development of these countries.

While OECD regulations seem to significantly improve the control over the transfrontier movement of HW within the OECD, the Basel Convention faces bigger problems with providing the same protection to developing countries. Besides generally poor control of pollution, weak economies and shortage of trained technical, managerial and enforcement personnel, the disparity in national definitions and the difficulties in obtaining accurate data from the developing countries – signatories of the Convention – have a generally lower efficiency of controls over transboundary movement of waste and a scarcity of reliable information about the quantity and composition of waste streams between the parties and non-parties of the Convention. The activities of the Basel Convention in providing tools for evaluating the hazard posed by wastes, developing and spreading the revised model national legislation on waste management and establishing regional centers for training and technology transfer are aimed to achieve harmonized legal basis in the signatory countries for adequate progress in the environmentally safe waste management at the national and global level. Still existing substantial discrepancies between national and international waste management regulations and directives bring about an urgent need for a better integration and harmonization of policies as a prerequisite of an integrated regional and global strategy focused on the environment protection and conservation of the natural resources and energy. This should be considered as a first priority task in the field of waste management.

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