7. Waste generation and management

Total waste quantities continue to increase in most European countries. Municipal waste arisings are large and continue to grow. The quantities of hazardous waste generated have decreased in many countries but increased in others in some cases due to changes in definitions. In western Europe and the 12 countries of eastern Europe, the Caucasus and central Asia (EECCA) manufacturing waste arisings have increased since the mid-1990s in most countries for which data are available, while in central and eastern Europe, the picture is less clear. Mining and quarrying waste is the largest single category of waste in Europe; data on quantities available from only a few countries indicate a general decrease, which is in line with a reduction in mining and quarrying activity. The quantity of waste from energy production depends on the fuel used, but some indication of quantities can be derived from the amount of electricity generated.

Total waste generation has been decoupled from economic growth in a limited number of countries. Agreed objectives to stabilise the generation of municipal waste in the European Union have not yet been met. Quantities are increasing in most western European countries and to a lesser extent in most central and eastern European countries and the countries of EECCA.

Landfilling remains the dominant waste disposal method. Recycling is increasing in western Europe, while the countries of central and eastern Europe and EECCA still have relatively low recycling rates. Initiatives to promote waste prevention and recycling and raise the safety standards for final disposal are considered to be the most effective options for minimising the environmental risks and costs associated with waste generation, treatment and disposal.

7.1. Introduction

Waste is an issue in every European country, and waste quantities are generally growing. Unfortunately, the lack of available and comparable data for many countries does not always allow reliable comprehensive assessment of waste-related issues.

Waste is generated by activities in all economic sectors and is generally regarded as an unavoidable by-product of economic activity (waste generated from inefficient production processes, low durability of goods and unsustainable consumption patterns). The generation of waste reflects a loss of materials and energy (see Figure 7.1 and Chapter 2.0), and imposes economic and environmental costs on society for its collection, treatment and disposal. Waste forms an increasing part of the total material flow through the economy and, particularly in western Europe (WE), is increasingly being considered in the context of material flows as a whole.

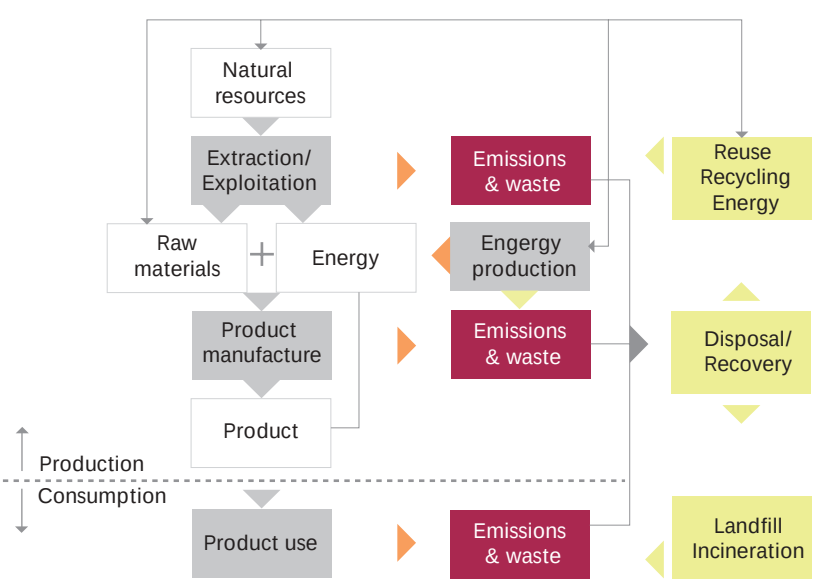
The impact of waste on the environment, resources and human health depends on its quantity and nature. Environmental pressures from the generation and management of waste include emissions to air (including greenhouse gases), water and soil, all with potential impacts on human health and nature. Most of the municipal waste in Europe is landfilled, leading to significant pressures on the environment, while too little is recycled.

7.2. Trends in waste generation

7.2.1. Total waste quantities

It is estimated that more than 3 000 million tonnes of waste are generated in Europe every year. This equals 3.8 tonnes/capita in

Waste flows Figure 7.1.



Source: Irish Environmental Protection Agency

WE, 4.4 tonnes in central and eastern Europe (CEE) and 6.3 tonnes in the countries of eastern Europe, the Caucasus and central Asia (EECCA) (Figure 7.2). Total waste quantities are continuing to increase in most WE and EECCA countries for which data are available. In CEE, the picture is more mixed: quantities are increasing in some countries (Czech Republic, Hungary, Poland) and decreasing in others (Estonia and the Slovak Republic). In general, limited data sets preclude an accurate assessment.

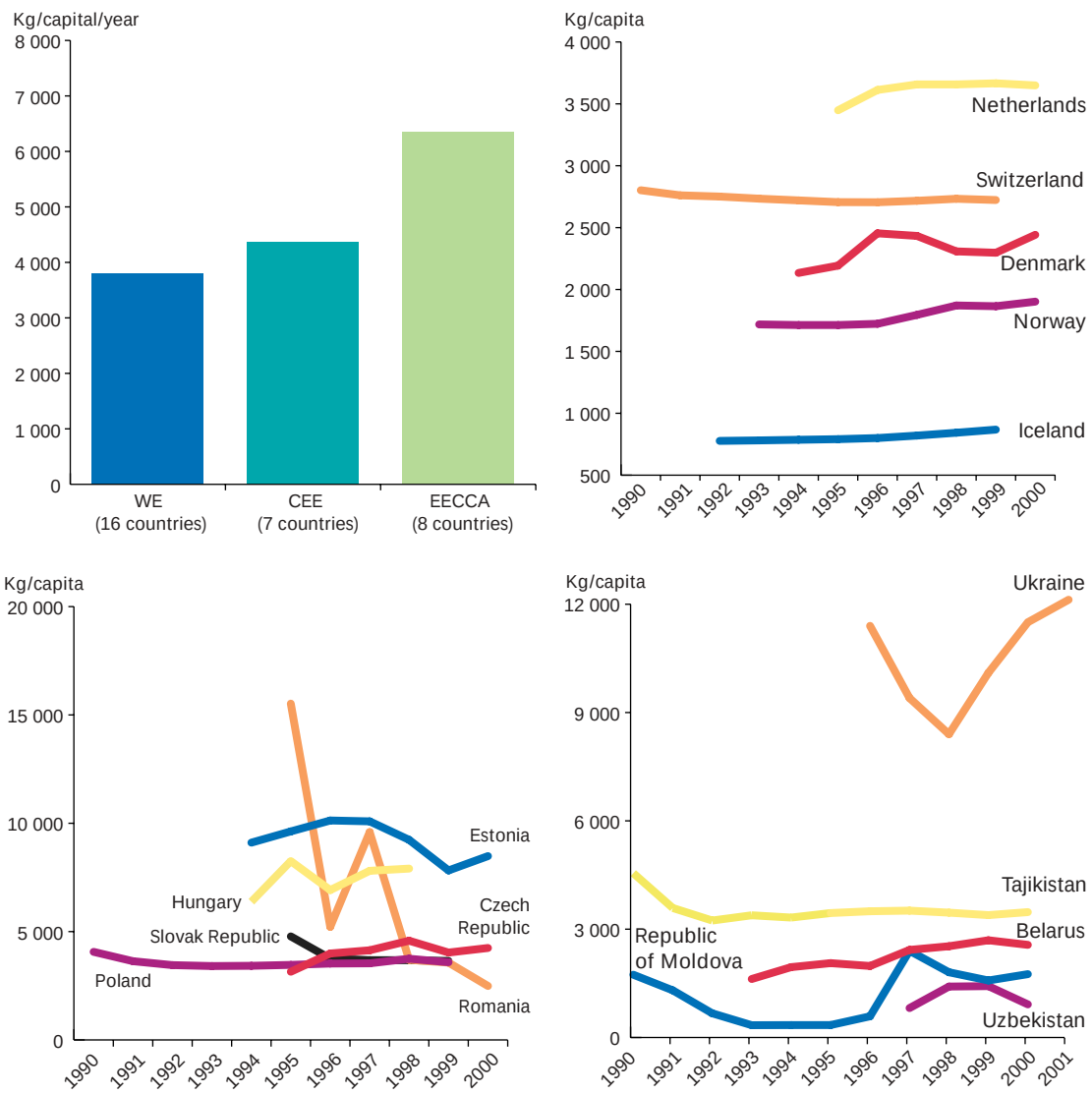
Waste per gross domestic product (GDP) per capita expresses the link between waste generation and economic activity per capita: high values mean more waste generated per unit of economic output per capita. Data for a limited number of WE countries (Denmark, the Netherlands and Switzerland) show a decoupling of waste from GDP (Figure 7.3). Of the four CEE countries for which adequate data exist, there are signs of decoupling in the Slovak Republic and Estonia (Figure 7.4). Of the four EECCA countries for which data exist, only Belarus and Tajikistan show an indication of decoupling (Figure 7.5). In some cases, the apparent decoupling may be associated with significant structural changes and industrial decline. However, without detailed knowledge of specific economies, the uncertainty associated with such an aggregated indicator precludes more reliable conclusions.

Manufacturing industry, construction and demolition, mining and quarrying, and agriculture are the main sectors that contribute to waste generation (see Figure 7.6. and Sections 7.2.4, 7.2.7 and 7.2.5). Other important waste streams are municipal

Figure 7.2. **Total waste generation per capita in countries in Europe, 1990–2000**

Notes: Some WE and CEE countries and EECCA were not included due to lack of consistent time series. The figure for total waste generation for groups of countries is a highly aggregated indicator that can hide the waste generation profile of each country and consequently of Europe as a whole. Total waste includes all wastes generated and also includes materials which, in some countries, are not defined as wastes at all. Therefore interpreting total waste generation is difficult and policy decisions, especially for individual countries, should not be based on this indicator alone.

Source: Eurostat, 2000; EEA questionnaire (2002 — see Chapter 14)



waste (see Section 7.2.2), hazardous waste (see Section 7.2.3), waste from end-of-life vehicles (see Box 7.1), sewage sludge, packaging waste and waste from energy generation (see Section 7.2.6). Different definitions in different countries can make comparisons of total amounts of waste extremely difficult. Changing definitions within individual countries can make time-series analysis equally difficult except where detailed information is available.

Box 7.1. End-of-life vehicles

The number of end-of-life vehicles in western Europe is increasing as the number of cars increases. In EU accession countries, a total increase of 124 % in the number of scrapped cars is projected between 2000 and 2015. Reasons include the ageing and growing car stock.

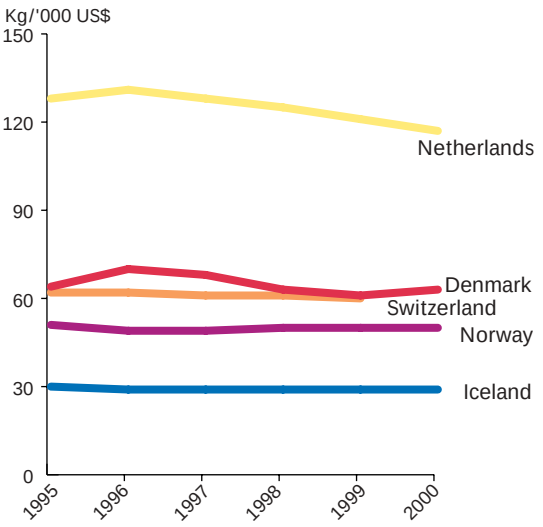
Cars contain materials such as lead, mercury, cadmium, hexavalent chromium and other environmentally harmful substances. About three quarters of a car by weight is steel and aluminium which is recycled. The rest, mainly plastics, is disposed of to landfills or by incineration. Cars also contain dangerous liquids (e.g. anti-freeze, brake fluid, oils) that are harmful to the environment if not disposed of properly.

The EU directive on end-of-life vehicles (Directive 2000/53/EC) has a strong focus on recovery, reuse and recycling. As a consequence, Member States will need to focus on improvements in the dismantling and shredder industry. By 2006, 80 % of an end-of-life vehicle is to be reused or recycled, with a projected 85 % by 2015. For recovery (including reuse and recycling) the targets are 85 % for 2006 and 95 % after 2015.

Illegal export of used cars from western Europe to central and eastern Europe is likely to cause major end-of-life vehicle waste problems in central and eastern European countries in the future.

Source: EEA, 2002a

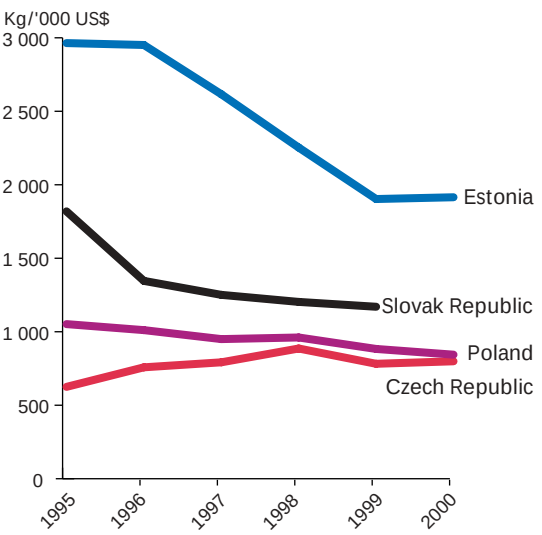
Waste per GDP per capita for selected western European countries — Figure 7.3.



Note: The definition of waste for the Netherlands includes wastes that are not included in other countries.

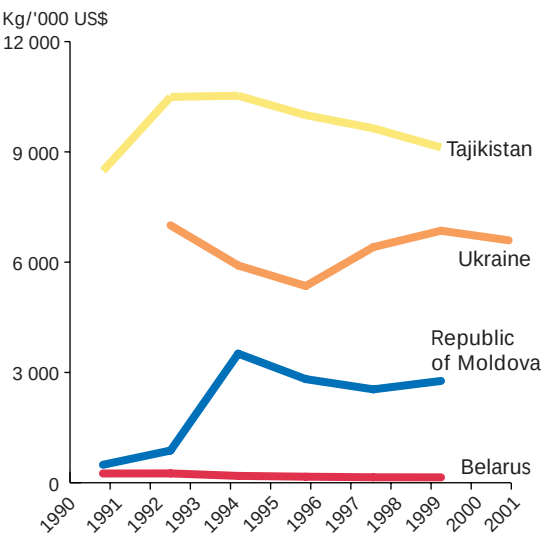
Source: Eurostat, 2002a

Waste per GDP per capita for selected central and eastern European countries — Figure 7.4.



Source: Eurostat, 2002a and information from Ministry of the Environment of the Slovak Republic, 2002; World Bank indicators on GDP in 1995 values from EEA data service

Waste per GDP per capita in selected eastern European, Caucasus and central Asian countries — Figure 7.5.

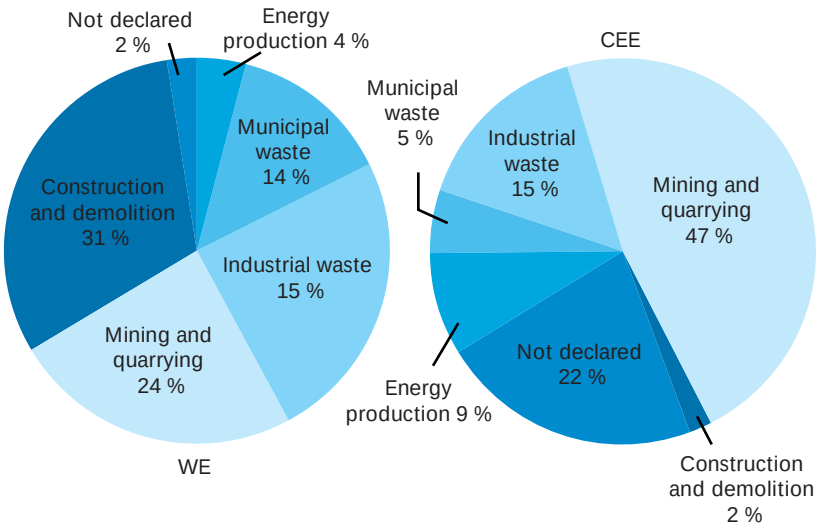


Source: EEA questionnaire (2002 — see Chapter 14); World Bank indicators on GDP in 1995 values from EEA data service

7.2.2. Municipal waste

Municipal waste arisings in Europe are large, and continue to increase (Figure 7.7). More than 306 million tonnes are estimated to be collected each year, an average of 415 kg/capita. The collection of municipal waste varies considerably between countries and lies in the range of 685 kg/capita (Iceland) to 105 kg/capita (Uzbekistan). Municipal waste accounts for approximately 14 % of total waste arisings in WE and 5 % in CEE. Landfilling is still the predominant treatment option in most countries throughout Europe.

Figure 7.6. **Total waste generation by sector in WE and CEE**

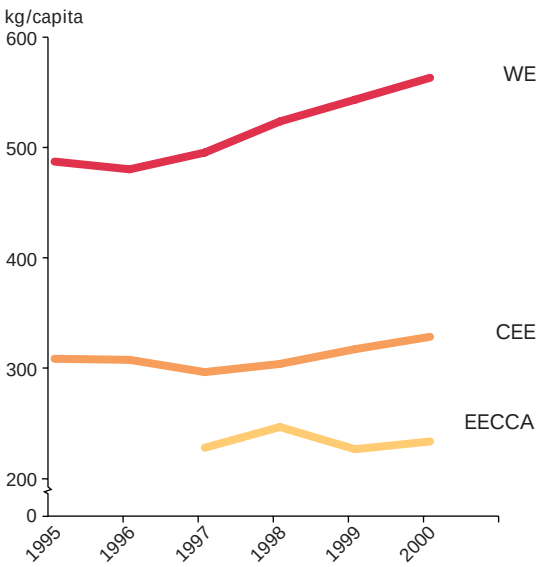


Notes: Figure for WE does not include Belgium, Iceland, Luxemburg, Norway, Sweden, Spain, Switzerland. Figure for CEE does not include Bulgaria, Czech Republic, Estonia, Hungary, Poland, Slovak Republic and Slovenia.
Source: Eurostat, 2002a

Figure 7.7. **Municipal waste collected in selected countries**

Notes: WE: Austria, Belgium, Denmark, France, Italy, Luxemburg, Netherlands, Portugal, Spain, Iceland, Norway and Switzerland. CEE: Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania and Croatia. EECCA: Belarus, Republic of Moldavia, Tajikistan, Turkmenistan, Ukraine and Uzbekistan.

Source: Eurostat, 2000; EEA questionnaire (2002 — see Chapter 14)



The fifth environment action programme (5EAP) of the European Community had set a target of stabilising municipal waste generation in the European Union (EU) at 1985 levels (300 kg/capita) by 2000. This target has been significantly exceeded in almost all countries, by 75–100 %. In the sixth environment action programme (6EAP) agreed in 2002, no quantitative waste targets have been included. The landfilling of municipal waste has decreased from 67 % in 1995 to 57 % in 1999 in EU countries, while composting and recycling rates have increased. Biodegradable municipal waste makes up approximately 60 % of the municipal waste stream in WE (see Box 7.2).

In CEE, municipal waste collection rates are lower than in WE, a result of different levels of economic resources and different consumption patterns and municipal waste disposal systems.

Many parts of CEE and EECCA, particularly rural areas, are not served by municipal waste collection systems. In CEE countries with available data, municipal waste generation, though currently lower than in other parts of Europe, is increasing. By comparison, the collection rates in EECCA appear to have been stable in recent years. In the Caucasus, it is reported that municipal waste landfills are often overloaded, improperly operated and maintained, and do not meet environmental and human health requirements (UNEP, 2002a). A similar situation is reported to a greater or lesser extent in several other CEE countries and EECCA (UNECE, 1995–2002). Illegal dumping of municipal waste, in particular in rural areas, is also common in many countries (UNEP, 2002a).

Box 7.2. Biodegradable municipal waste

In 1995, about 107 million tonnes of biodegradable municipal waste were generated in the EU and Norway, of which 66 % was landfilled.

Biodegradable municipal waste is generated by households and commercial activities and covers waste such as food, garden waste, paper and cardboard. Biodegradable municipal waste is a major contributor to the generation of leachate, landfill gas, odour and other nuisances in landfills. Alternative treatment methods such as composting or anaerobic digestion, if properly controlled, can eliminate or significantly reduce the polluting and emission potential of biodegradable waste.

The EU landfill directive imposes strict targets for the reduction of biodegradable municipal waste that may be disposed of to landfill, namely a reduction to 35 % by 2016 of the amounts going to landfill, taking 1995 as the starting point. Source separation, separate collection, more incineration, more composting and limits and bans on landfilling are among the key instruments needed to reach this target.

Source: EEA, 2001a

7.2.3. Hazardous waste

Hazardous waste is broadly defined as any waste that possesses one or more of 15 hazardous characteristics e.g. flammable, corrosive, infectious, eco-toxic. However, the definition of hazardous waste is not uniform in all countries. Consequently, direct comparison between countries may be questionable since total amounts can be made up of different waste types.

Hazardous waste generally makes up less than 1 % of all waste generated in Europe. However, due to the dangerous substances it contains, it presents a serious risk to the environment and human health if not managed and treated safely. Several EU countries report hazardous waste recovery rates (generally by separate collection and recovery as by-products) in excess of 40 %. In other regions, the situation is less clear but several countries report unsatisfactory disposal of hazardous waste.

Since the mid-1990s, overall quantities of hazardous waste generated per capita have dramatically changed in some WE countries (e.g. 62 % increase in Austria; 57 % decrease in Denmark); changes in definitions of hazardous waste might explain these trends (Figure 7.8). In Ukraine, hazardous waste generation decreased by 38 % between 1996 and 2000; in the Russian Federation, quantities increased by 32 % between 1996 and 1999. By contrast, in some CEE countries, overall quantities generated per capita have decreased substantially since the mid-1990s.

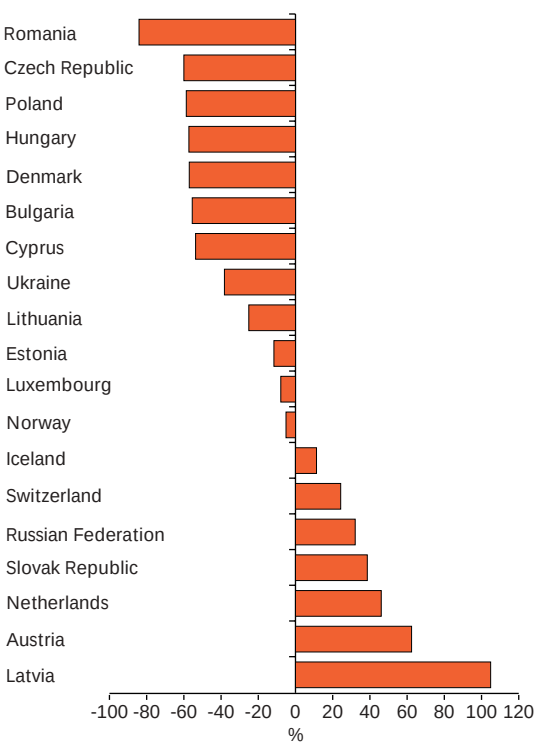
A limited number of economic sectors contribute substantially to hazardous waste generation, manufacturing industry being the main source. Hazardous waste is generally the subject of special legislation. It requires special management arrangements which require hazardous and non-hazardous waste to be kept separate and treated differently. Studies (EEA, 1999a; EEA, 2001b) have shown that a large proportion of hazardous waste in most WE countries consists of a relatively small number of waste types (typically 75 % of hazardous waste generated consists of 20 principal types — based on the EU hazardous waste list containing 236 codes for hazardous waste types). The major types differ from one country to another; examples include slag and fly ash from waste incineration, spent solvents and lead batteries. Similarly, in many CEE countries and EECCA, hazardous waste generation is often dominated by a relatively small number of sources. This means that hazardous waste management, prevention or recycling programmes can be focused on the sources responsible for the generation of the majority of hazardous waste, thus allowing the maximum return on investment and effort.

In several WE countries, recovery has become the dominant hazardous waste management option, while in most other countries disposal by landfilling and incineration without energy recovery are widely used. In many countries, hazardous waste has to be stabilised before disposal, for example by physico-chemical treatment in order to meet the acceptance criteria for landfills. However, treatment methods are often poorly defined, or sometimes undeclared, and this leads to difficulties in comparing practices in different countries (Figure 7.9). For example, defining recovery operations such as 'incineration with energy recovery' and 'recovery of materials' in one group of countries does not allow an accurate comparison with hazardous waste treatment in other countries.

A relatively minor hazardous waste stream in most countries, healthcare waste is a cause of concern in terms of its potential to cause infection, injury and pollution (see Chapter

Percentage change in hazardous waste generation in 19 European countries in the period 1995–2000 or latest year available

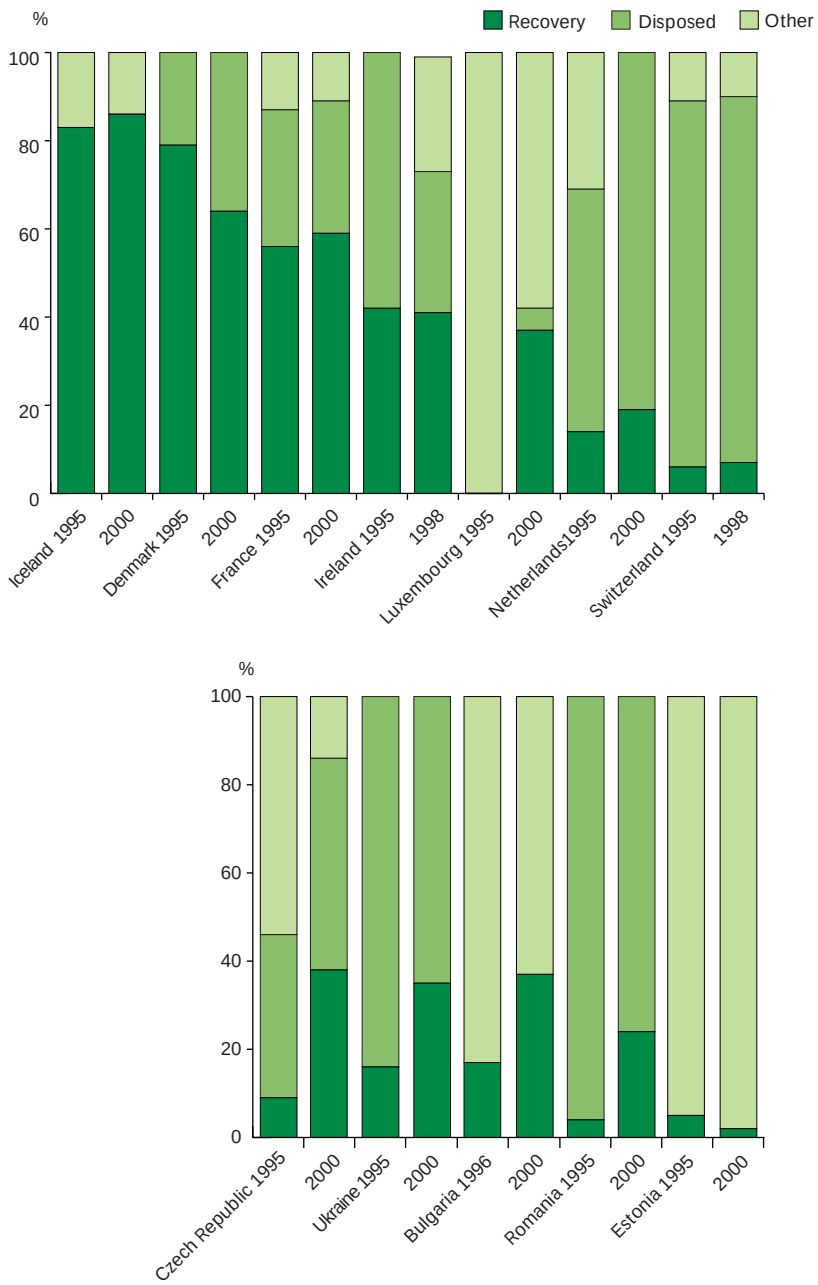
Figure 7.8.



Notes: Includes only countries with at least four years of data. The graph is based on per capita estimates and the population changes 1995-2000 should be taken in to account.

Sources: Eurostat, 2002a; EEA questionnaire (2002 — see Chapter 14)

Figure 7.9. **Hazardous waste management methods in selected countries (1995–2000 or latest year available)**



Notes: 'Recovery' includes: incineration with energy recovery, recycling, composting and other recovery methods. 'Other' treatment methods include: physico-chemical or biological treatment, permanent storage, release into water bodies and unspecified or not declared.

Sources: Eurostat, 2002a; EEA questionnaire (2002 — see Chapter 14)

12, section 12.3.4). In many countries, hazardous healthcare waste (needles, used dressings etc.) is not separated from municipal waste, and this can present an increased environmental risk in the proximity of landfills and other disposal facilities. As with other categories of waste, and hazardous waste in general, the establishment of a national policy, a legal framework, the training of personnel and the raising of public awareness are essential elements of successful healthcare waste management (WHO, 1999).

In the Caucasus, it is reported that known hazardous waste disposal sites are overloaded and not adequately isolated from the environment, posing risks to the environment and human health. Because of the lack of sound law enforcement and monitoring systems there is a risk of the area becoming a 'haven' for international trading in hazardous waste (UNEP, 2002a). Although all the EECCA countries (except Kazahkstan and Tajikistan) are parties to the Basel convention (1989), many lack the national capacity as well as finances to fulfil commitments made under the convention. International assistance and regional cooperation are key to achieving effective waste management and environmental protection. Several CEE and EECCA countries report improved information on or definition of hazardous waste as a result of implementing the provisions of the Basel convention.

7.2.4. Waste from manufacturing industries

Approximately 740 million tonnes of waste are generated by the manufacturing industry in Europe every year. In WE and EECCA, manufacturing waste arisings have increased since the mid-1990s in most countries for which data are available. In EECCA, the increase followed a period in the early 1990s of drastic decline in industrial activity, and therefore in industrial wastes, after the disintegration of the USSR. In CEE, the picture is less clear, and some countries, including the Czech Republic, Hungary, Romania and the Slovak Republic, have produced decreasing quantities of such waste. As with many other waste categories, manufacturing waste is not defined consistently in different countries, making comparisons difficult (Figure 7.10).

The range of industrial wastes generated is as broad as the manufacturing industries that generate them, and as the waste management options used — which combine recycling, recovery and disposal techniques. Small and medium-sized enterprises, as well as some large enterprises, do not always have the expertise or the resources to ensure that the management of their waste does not have environmental impacts.

Manufacturing waste consists of food, wood, paper, chemical, non-metallic mineral, basic metal and other waste. A comparison of WE and CEE countries shows that WE generates

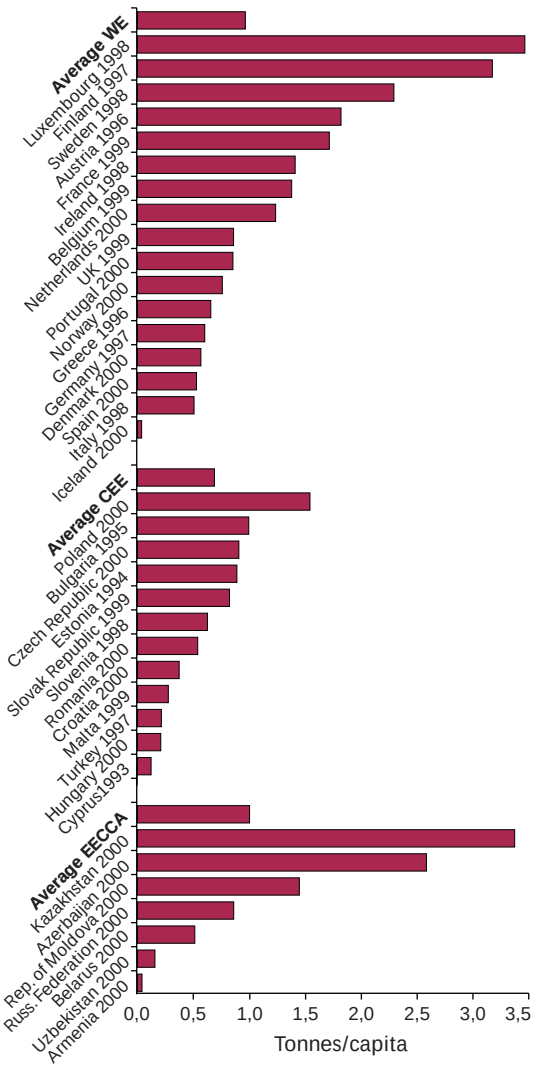
most food, wood, paper, non-metallic and other manufacturing waste. The differences in the composition of manufacturing waste are probably influenced by the strong representation of paper industries in some reporting countries. CEE countries generate most manufacturing waste from chemical, iron and steel industries. In 1998, the main contributor to manufacturing waste in five CEE countries was the basic metals industry (contributing about 50 %). In WE, no dominant industry can be identified, but in five reporting countries the food, wood and paper industry each accounted for about 20 % in 1998. A comparison of manufacturing waste generated in selected CEE countries from 1995 to 1998 (Figure 7.11) shows that the contribution to the generation of manufacturing waste increased from 50 % to 59 %.

In EECCA, the oil industry and mineral resources extraction are major generators of industrial waste (UNEP, 2002a).

Manufacturing industry can play a central role in reducing the amount of waste generated by:

- incorporating life-cycle analysis in the design and manufacture of goods and services;
- promoting sustainable use of materials and energy;
- eliminating or reducing the use of substances or materials hazardous to health or to the environment.

Manufacturing waste generation per capita in European countries — Figure 7.10.



Note: Consistent use of a standardised statistical classification of economic activity in defining manufacturing activities would help to eliminate differences in national definitions of manufacturing waste. For example: International Standard Industrial Classification of All Economic Activities, Third Revision, (ISIC, Rev.3), UNSD Statistical Classifications Section, http://unstats.un.org/unsd/class/family/famlist1.htm

Sources: Eurostat, 2002a; EEA questionnaire (2002 — see Chapter 14); updated data for Estonia

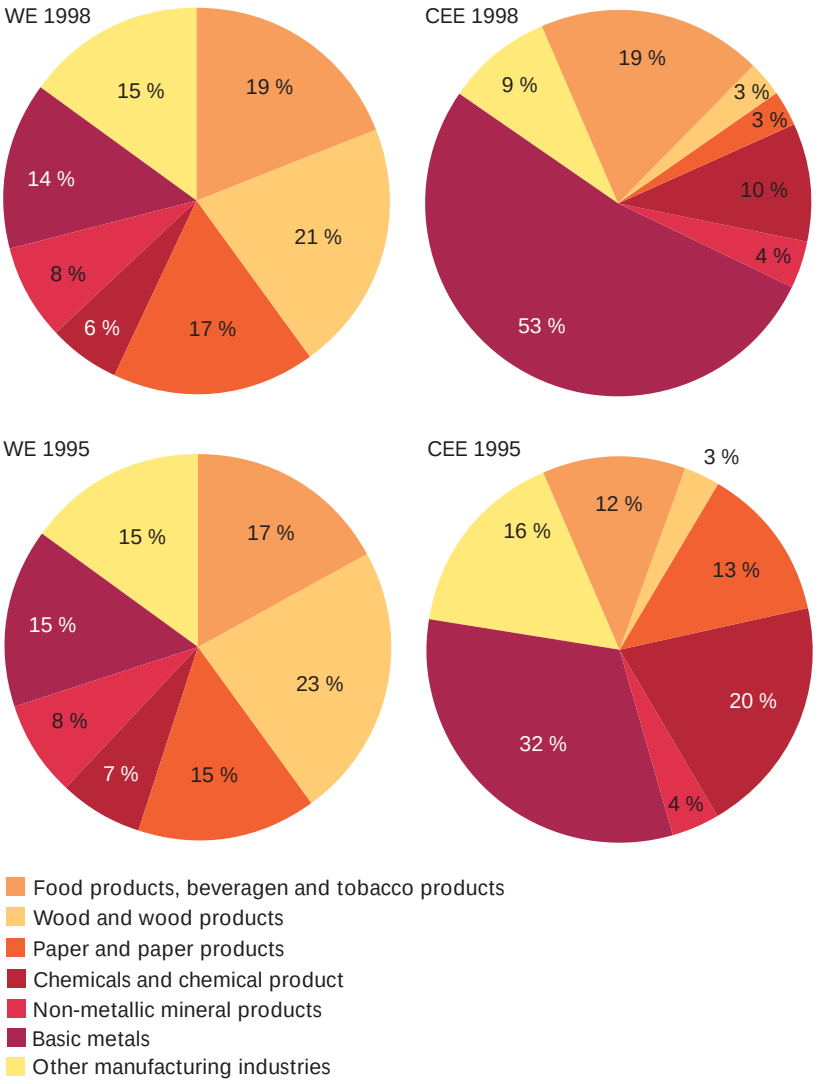
7.2.5. Waste from mining and quarrying

Mining and quarrying waste is the largest single category of waste in Europe, accounting for more than 20 % of all waste generated. Quantities are generally decreasing in the United Kingdom, Poland and Romania. It is assumed that decreasing waste generation in these countries has resulted from a reduction in the level of mining and quarrying activity.

The disposal of mining waste can take up large areas of land and, unless properly managed, can result in detrimental impacts on air, water and soil quality. Recent uncontrolled releases from mining and tailings waste management facilities highlight the potential risks associated with poor waste management in this sector. In response, the EU has proposed initiatives that are designed to improve mining waste management, including a proposed directive on the management of waste from the extractive industry (quarrying and mining) and a reference document on best available techniques in the management of tailings and waste rock from mining.

In many European countries, waste from mining and quarrying is not subject to environmental or waste management legislation. Consequently, information on waste quantities and management is scarce and the quality of data poor. A surrogate indicator (domestic extraction of fossil fuels and construction materials) is proposed to illustrate the scale of waste generation by mining and quarrying. Most mining and quarrying results in the extraction of material that is not used directly but is stored for later use, landfilled or otherwise disposed of. For example, fossil fuel extraction results

Figure 7.11. **Manufacturing waste profiles in selected countries in western Europe and central and eastern Europe**



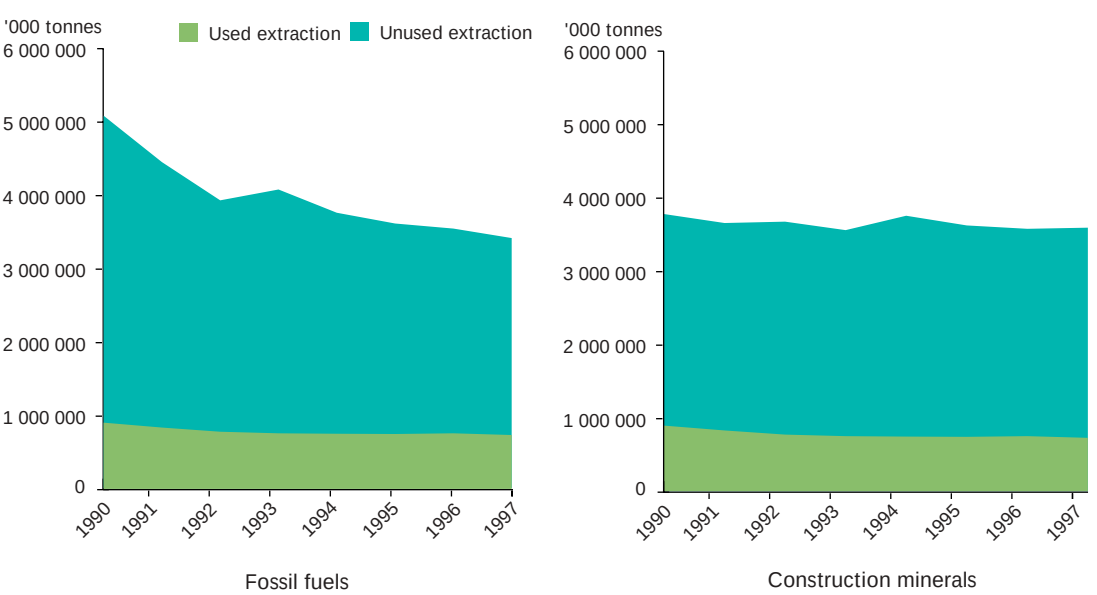
Notes: The figure for western Europe only contains data from Ireland, the Netherlands, Portugal, Sweden and Finland. The figure for CEE only contains data from Czech Republic, Hungary, Poland, Romania and Slovak Republic.

Source: Eurostat, 2000

in up to 80 % of unused material. In contrast construction minerals extraction results in less than 20 % of unused material. Different mining and quarrying activities result in varying but significant quantities of unused material, of varying nature and potential hazard. Data for the EU show that domestic extraction of fossil fuels and construction materials (Figure 7.12) is decreasing and so, therefore, is the amount of unused material extracted (i.e. hidden flows). As illustrated in Chapter 2.0, the natural resources used in WE are increasingly being imported from countries outside the EU, e.g. increasing import of fossil fuels from EECCA, with consequent increased arisings of unused material in those countries.

Figure 7.12. **Domestic extraction of fossil fuels and construction minerals, EU**

Source: Eurostat, 2002b



7.2.6. Waste from electricity production
The quantity of waste from energy transformation depends on the fuel used, but some indication of quantities can be derived from the amount of electricity generated (see Chapter 2.1).

Hydroelectric and gas-fired power stations generate no solid waste. Coal-fired power stations generate large quantities of bottom ash and fly ash. During the 1990s, the EU generated 50 million tonnes/year of coal ash of which, in those countries which reported, about 75 % was recycled (varying from 70 % to 98 %) (EEA, 2002b). Nuclear power generation results in waste that requires specialised and expensive management (see Box 7.3). A shift to cleaner (e.g. natural gas) and renewable sources of energy will result in reduced waste quantities. However, there is very little information on waste generation from power stations in Europe. Instead, for illustrative purposes, the relative use of various energy sources can be used as a surrogate indicator for waste types and quantities: coal and other fossil fuels produce the largest amounts of waste residues (e.g. fly ash).

7.2.7. Waste from construction and demolition
Waste generated from construction and demolition activities, including the renovation of old buildings, accounts for about 32 % of all waste generated in WE and a declared share of 2 % in CEE (the reasons for the difference are unclear — poor reporting in CEE may be a factor). Construction and demolition waste may contain dangerous substances, such as asbestos, which may be present in significant proportions when old buildings are demolished or renovated.

The generation of construction and demolition waste in WE generally increased during the 1990s: per capita generation increased in seven countries, remained constant in four and decreased in four (EEA, 2002b). In CEE, quantities have increased since 1995 in four of the five countries for which there are data. Time series are not available for EECCA.

In many countries, construction and demolition waste is mainly disposed of to landfill, despite its suitability for recycling. Some WE countries such as Germany, Denmark and the Netherlands, have achieved up to 90 % recycling of construction and demolition waste. Special initiatives were needed in each of these countries to drive up the recycling rate: in Denmark, the introduction of landfill tax in the late 1980s and its enforcement in the 1990s motivated the recycling of demolition waste.

Many components of construction and demolition waste are readily recyclable and have the potential to replace up to 10 % of virgin raw materials. In order to promote the sustainable use of raw materials, the possibilities for recycling the components of construction and demolition waste should be exploited.

Box 7. 3. Waste from nuclear electricity generation

In general, the quantities of radioactive waste generated annually are very small compared with the quantities of hazardous waste and other non-radioactive waste. Due to its special nature, however, the management of nuclear waste is normally considered separately from other wastes.

Various wastes arise at each stage in the nuclear fuel cycle, classified in terms of their radioactivity content and, for the most highly radioactive wastes, their rate of heat generation. Some wastes which have low to medium levels of radioactivity and which lose their radioactivity relatively rapidly as a result of natural decay are generally disposed of, following studies of long-term safety, in engineered repositories constructed at or near the surface, for example in Finland, France, Sweden and the United Kingdom. Other wastes that are not suitable for disposal at or near the surface are normally held in specially built interim storage facilities that provide containment consistent with the hazard presented by the radioactive content.

In most European countries the favoured long-term solution for the wastes with the longest-lived radioactivity is deep geological disposal. Progress towards this objective has been slow, mainly because of societal concerns: the one deep disposal facility licensed to date, in Germany, will not operate in the foreseeable future. Site identification, characterisation and safety assessment programmes for the disposal of long-lived and heat-generating wastes are well advanced in a number of European countries. A site has been chosen in Finland, underground investigations are under way at a site in France, and the programme in Sweden is on track to select and develop a site in 2008.

In the case of decommissioning of nuclear reactors and installations, there are two main strategies. Immediate dismantling involves the cleaning and/or dismantling of all contaminated and radioactive components and structures, which are then packaged and transported to a waste disposal or storage site. This may take five or more years. Deferred dismantling involves making the plant structure safe for protective storage for an extended period of time (from 10 up to 150 years), including securing the part of the plant containing radioactive materials. The aim of deferred dismantling is that the radioactivity will decay so that the total radioactivity will be approximately 1 000 times less than its original level after 50 years of storage. When the radioactivity has decayed sufficiently the reactor will be decontaminated and dismantled as for immediate dismantling.

Sources: IAEA, 1994, 1996 and 1999; NEA, 2000

7.3. Waste management

7.3.1. Trends in waste management
One of the barriers to the establishment of improved waste management planning, monitoring and enforcement in many parts of Europe, including WE, is the lack of sound, reliable, comparable and available data. Reliable data are essential for the long-term prevention of illegal and polluting disposals

and the use of unreliable data can lead to poor policy-making decisions and the establishment of inappropriate waste management infrastructure. The data in this chapter are often of poor quality, reliability, comparability and availability. Consequently, it is difficult to establish a full picture of waste generation and management in Europe.

The preceding sections have shown that, with waste arisings growing in almost all regions of Europe, there is significant scope for improvement. Waste prevention should be the primary initiative since reducing the generation of waste at source reduces the need for collection and treatment and the associated costs and environmental impacts. Furthermore, natural resources and materials are saved, bearing in mind that waste is 'wasted' raw material.

A study (EEA, 2000) concluded that three principal impacts of landfill and incineration were significant at the global level because of their potential for transboundary migration: organic micro-pollutants (dioxins and furans), greenhouse gases (methane) and volatile heavy metals. Other emissions from incinerators (hydrogen chloride, heavy metals and salts) and landfill sites (nitrogen, ammonia, organic compounds and heavy metals), if uncontrolled, have the potential to cause severe contamination problems due to the dangerous substances contained and emitted. Minimisation of waste generation, reduction in the hazardous constituents of waste, especially those with the potential to cause adverse impacts on environmental quality and health, and adequate management of residual wastes are therefore the major challenges to be tackled in future years if these impacts are to be avoided.

Prevention

Waste prevention translates into a need to design materials, goods and services in such a way that their manufacture, use, reuse, recycling and end-of-life disposal results in the least possible generation of waste. Particularly in growing economies, waste prevention is a heavy challenge in order to achieve decoupling of waste generation from economic growth. However, waste prevention is only one element in the broader concept of cleaner production which has been promoted by the United Nations Environment Programme (UNEP) for some 15 years (UNEP, 2002b). As an additional approach, cleaner consumption has recently been promoted in tandem with cleaner production as a key to achieving sustainable development (WSSD, 2002) through the adoption of a preventive approach to the entire product life cycle, incorporating design, manufacture, use and disposal. Cleaner production and consumption policies and initiatives are supported and coordinated worldwide by national cleaner production centres and international and regional conferences and roundtables. Many policies, tools, instruments and activities are available to governments for the promotion and implementation of cleaner production and consumption policies.

Recycling

Figures for recycling are rather discouraging. The rate of recycling in many countries throughout Europe is minimal. In relatively few WE countries, recycling of some waste streams has increased considerably during the past decade. In the EU, recycling (including composting) of municipal waste was 11 % during 1985-90 (EEA, 1999b), increasing to 21 % in 1995 and 29 % in 2000 (Eurostat, 2002). By comparison, in the eight EU accession countries where data exist, an average municipal waste recycling rate of 8.6 % was reported during the period 1998-2001. Among the EECCA countries, Ukraine has a total recycling rate of 10–12 %, Belarus 14–15 % (industrial waste only) and Uzbekistan 6–15 % (UNECE, 1995–2002).

There is thus plenty of scope for increasing the level of recycling in almost all European countries. A major challenge is to establish new and, to some extent, more comprehensive collection and recycling schemes. For some waste streams (e.g. construction and demolition waste) solutions may be fairly straightforward, while others (e.g. waste from electrical and electronic equipment) may demand a more complex system. There is a large potential for cooperation between countries especially in CEE and EECCA. Perhaps a greater challenge will be the development of sound and sustainable markets for recycled materials and products that will ensure the long-term viability of recycling systems. Technical and economic restrictions will need to be overcome in order to further stimulate the recycling of waste streams such as municipal and plastic waste. The creation of market opportunities and increased public acceptance is expected to dramatically increase the composting of separately collected green or biodegradable municipal waste in WE.

Incineration

Incineration with energy recovery is another option to avoid landfilling. In WE, 17 % of municipal waste was incinerated in 1995 and 18 % in 1999 (EEA, 1999b; Eurostat, 2002a), and in CEE 2.3 % and 6 % (Figure 7.13). No quantitative information is available for the EECCA countries. The operation of sub-standard incinerators is widely reported in CEE and EECCA. Three Balkan countries report the incineration of hospital waste though not all with flue-gas cleaning. In one case, a second-hand incinerator for hospital waste was obtained under 'bilateral cooperation', but without any pollution abatement. Obviously, in such a case, a balance must be struck between the need to separate hazardous hospital waste from municipal waste and the need to avoid environmental pollution in the incineration of hospital waste.

Landfilling

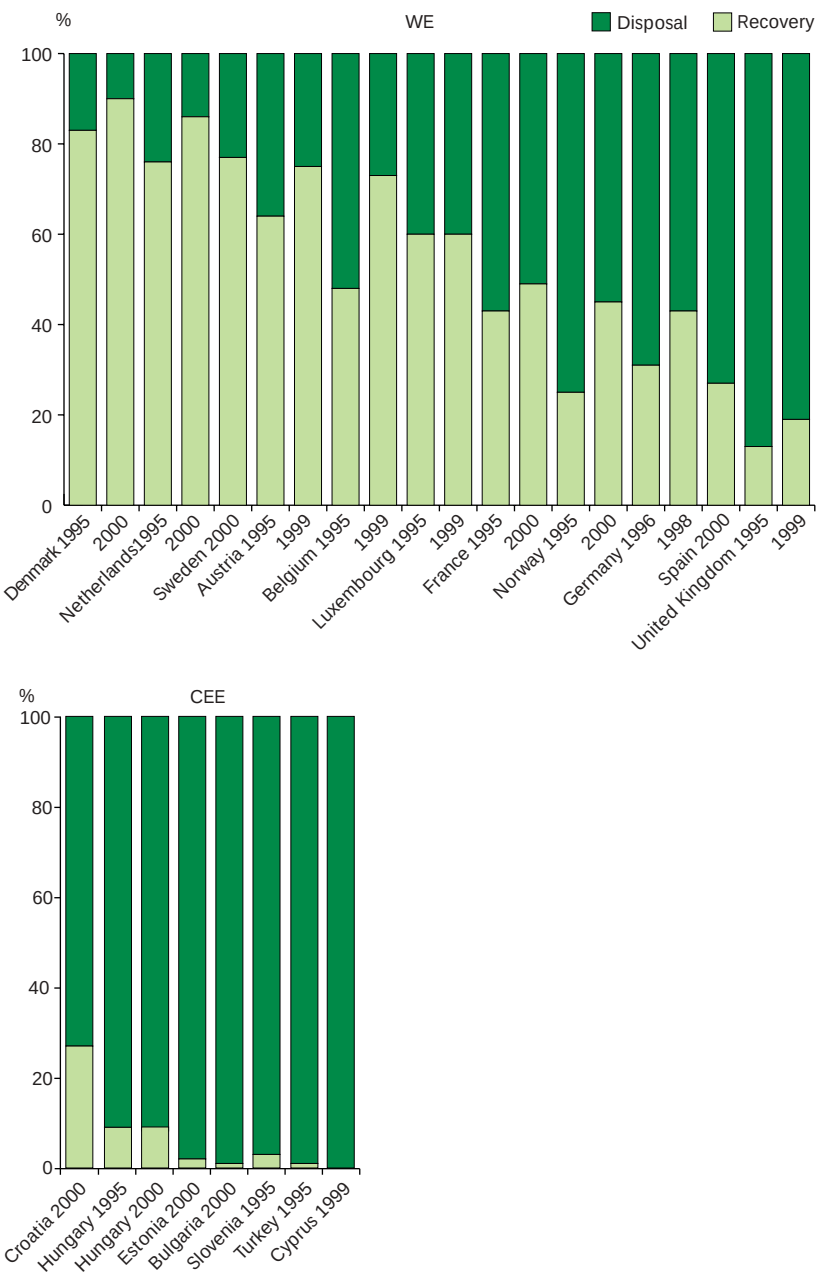
Landfilling is the lowest ranking waste management option in the waste hierarchy, but remains the dominant method used in Europe. One of the reasons could be the reluctance of public opinion to accept incineration as a safe treatment/disposal option, as well as local conditions which eventually prohibit the sustainability of operation of incineration plants (i.e. geographical constraints, long transport routes). Some 57 % of municipal waste in WE and 83.7 % in CEE was landfilled in 1999 (DHV CR, 2001). Little quantitative information on landfilling is available for EECCA, but it is clear that it is by far the most-used option. In the environmental outlook for the Caucasus (UNEP, 2002a), the situation is described as: 'overloaded, improperly managed and maintained municipal waste landfills that do not meet minimum health and environmental standards'.

Thus, to meet the waste hierarchy, wastes should be diverted away from landfill to higher-ranking management options. It should however be noted that in many CEE and EECCA countries, landfill capacity is unavailable and waste, including hazardous waste, is accumulating pending the availability of treatment or disposal options. In many instances, hazardous waste is stored under unsatisfactory conditions resulting in increased risks of industrial accidents, health impacts and environmental contamination. Estonia and Latvia have, however, demonstrated some success in this regard by establishing safe storage for large quantities of obsolete pesticides, although the question of disposal remains.

Another challenge for the future is to raise the standards of landfills and close improperly managed and maintained sites. In the EU Member States and accession countries, compliance with the EU directive on the landfill of waste (Directive 1999/31/EC) is expected to significantly reduce the potential for environmental pollution from landfills. The directive imposes stringent operational and technical requirements on landfilling and requires a reduction in the quantity of various waste streams entering landfills as well as treatment of all waste

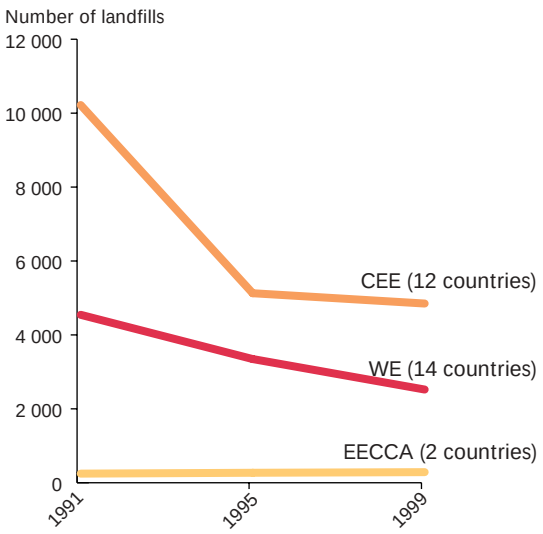
Municipal waste management in selected countries of western Europe and central and eastern Europe, 1995 and latest year available

Figure 7.13.



Note: Countries are sorted according to recovery rate obtained in year 2000 or latest year with information available.
Source: Eurostat, 2002a

Figure 7.14. **Number of landfill sites in Europe, 1990–99**



Notes: Due to lack of data reference years are partly combined (1990/91, 1997, 1998/99). If data for both combined years are available, the data of the later year are used. Data for the Slovak Republic on all landfills and registered dumps are included for the years 1993 to 1995, after which the dumps were closed or redefined as landfills. In the Slovak Republic, the number of dumps and landfills decreased from 8 372 in 1993 to 6 068 in 1995 to 568 landfills in 1998 to 156 landfills in 2002. Countries: WE: Austria, Belgium, Finland, France, Ireland, Italy, Luxembourg, Portugal, Spain, Sweden, the Netherlands, Iceland, Norway, Switzerland. CEE: Croatia, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovak Republic, Turkey. EECCA: Belarus, Tajikistan.

Sources: Eurostat, 2002a; EEA, 1995; EEA, 1998; Austrian Federal Waste Management Plans 1992, 1995, 1998, 2001; EEA questionnaire (2002 — see Chapter 14); Ministry of Environment of the Slovak Republic

Box 7.4. Levies on the landfill of waste

A tax on the landfill of waste has become a widely used instrument and is now in use in nine western Europe countries. The tax has been applied for several reasons, including the stimulation of waste reduction, reuse and recycling; to raise revenue; and to internalise landfill costs. More than EUR 1.7 billion is raised each year in western Europe (Kirk McClure Morton, 2001). While the influence of landfill taxes on reducing the generation of some waste streams (e.g. municipal waste) is questionable, landfill taxes do provide price signals which should stimulate the adoption of more sustainable waste management practices.

The purpose of the tax, its design and its level vary from country to country.

- The general purpose is to internalise the environmental costs of final disposal of waste. In some countries, environmental tax revenues are used to offset revenues from other, distorting, taxes, for example on labour, in the framework of ecological fiscal reform (e.g. the Netherlands and Denmark); others use the revenue to support the remediation of contaminated sites (Austria and Switzerland).
- The level of the tax varies greatly, from EUR 79 per tonne in the Netherlands to EUR 15 per tonne in Finland.
- The tax may depend on the kind of waste being landfilled (e.g. United Kingdom and Italy) or may apply to all waste consigned to landfill (e.g. Sweden and Norway).
- Only two countries introduced the tax before 1990, the rest in the period 1993-2000.

Sources: OECD/EU, 2002; EEA-ETC/WMF

prior to landfill. Data for WE and CEE show that the number of landfills decreased significantly up to 1999 (Figure 7.14).

7.3.2. Review of policies

According to EU legislation (Directive 75/442/EEC), all Member States are required to produce one or more waste management plans. These must relate in particular to the type, quantity and origin of waste; its recovery or disposal; general technical requirements; special arrangements for particular wastes; and suitable disposal sites or installations.

Twelve EU countries have national waste management plans or strategies and three countries have prepared regional plans. The elements of national waste management plans have been provided for by many CEE countries, generally as part of the accession process (DHV CR, 2001). Several other CEE and EECCA countries have formulated waste management plans and programmes; however, the general lack of resources is commonly quoted as a significant barrier to their satisfactory and timely implementation (UNECE, 1995–2002).

The EU directive on waste (Directive 75/442/EEC) requires Member States to establish an integrated and adequate network of disposal installations. This may be done in cooperation with other Member States. The network must enable the Community as a whole to become self-sufficient in waste disposal, and must reflect the fact that certain wastes, particularly hazardous waste, may not be generated in one country in sufficient quantities to warrant the establishment of a dedicated disposal facility in that country.

Command-and-control measures are widely used in all European countries especially for hazardous waste management. For non-hazardous waste, the use of economic or market-based instruments is on the increase in WE and CEE countries. An important aspect is to make the polluters (i.e. the enterprises or households generating the waste) aware of the costs of their actions and to provide opportunities for alternative options. The costs are usually recovered through user charges that reflect the cost of collection and treatment of wastes, and through taxes. 'Pay-as-you-throw' schemes are gaining ground in several countries.

In WE countries, producer responsibility has been implemented for various waste streams

such as packaging, batteries, waste from electrical and electronic equipment, paper and tyres. Voluntary agreements between authorities and industry have also been set up to some extent (e.g. end-of-life vehicles, construction and demolition waste).

The most commonly used instruments in CEE are user charges for the collection, transportation and treatment of municipal waste, and waste disposal charges (DHV CR, 2001; REC, 2001). Several countries have introduced deposit-refund systems on beverage containers and product charges on batteries. Many of the instruments have been relatively recently introduced due to the EU accession process and any assessment of their efficacy at this stage would be speculative.

Most EECCA countries operate various waste management and user taxes; however, the effectiveness of these instruments is generally limited (OECD, 2000). A centrally controlled deposit-refund system which used to exist for the collection and reuse of glass bottles has been abandoned in all the EECCA countries except Belarus, although privately operated systems have emerged in several other EECCA countries. Resistance from industry stifled attempts to introduce user charges on packaging in Georgia and Ukraine. In overall terms, the Organisation for Economic Co-operation and Development (OECD) recommended a 'comprehensive reform of economic instruments for environmental protection in the EECCA in the context of achieving priority objectives and targets of environmental policies.'

Economic instruments should serve not only to indicate and penalise undesirable waste management practices, but also to complement, encourage or reward desirable practices, namely waste prevention, minimisation, reuse, recycling and recovery (see Box 7.4.). However, the possible adverse impacts of incentives should also be taken into account when designing economic instruments. If the user charge or tax is too high, or an increase too abrupt, the risk of illegal dumping will increase.

Perhaps the greater challenge is the development of sound and sustainable markets for recycled materials and products that will ensure the long-term viability of recycling systems. Technical and economic restrictions will need to be overcome in order to further stimulate the recycling of waste streams such as municipal and plastic waste. For compostable municipal wastes, a major step forward would be the creation of market opportunities and increased public acceptance of the use of compost.

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