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Chapter 2

WASTE GENERATION AND RELATED POLICIES: BROAD TRENDS OVER THE LAST TEN YEARS

By Soizick de Tilly[1]

1. Introduction

The primary purpose of this paper is to give an overview of the waste generation and management situation in the OECD countries during the past decade. It describes the broad trends and their impact on the environment, and the policies put into practice. Most of the findings are based on OECD Environmental Performance Reviews and Economic Surveys. We have chosen the most recent studies, giving preference to those which cover both the environment and the economy. The list of countries reviewed is contained in an annex.

However, the information contained in these reviews does not at the present time supply all the necessary data for an in-depth analysis and assessment of policy. Other studies carried out either by the OECD or by outside researchers or organisations have therefore also been used.

We then put forward some thoughts on the effectiveness of waste reduction policies and the conclusions that may be drawn.

2. The findings

2.1 Municipal waste generation

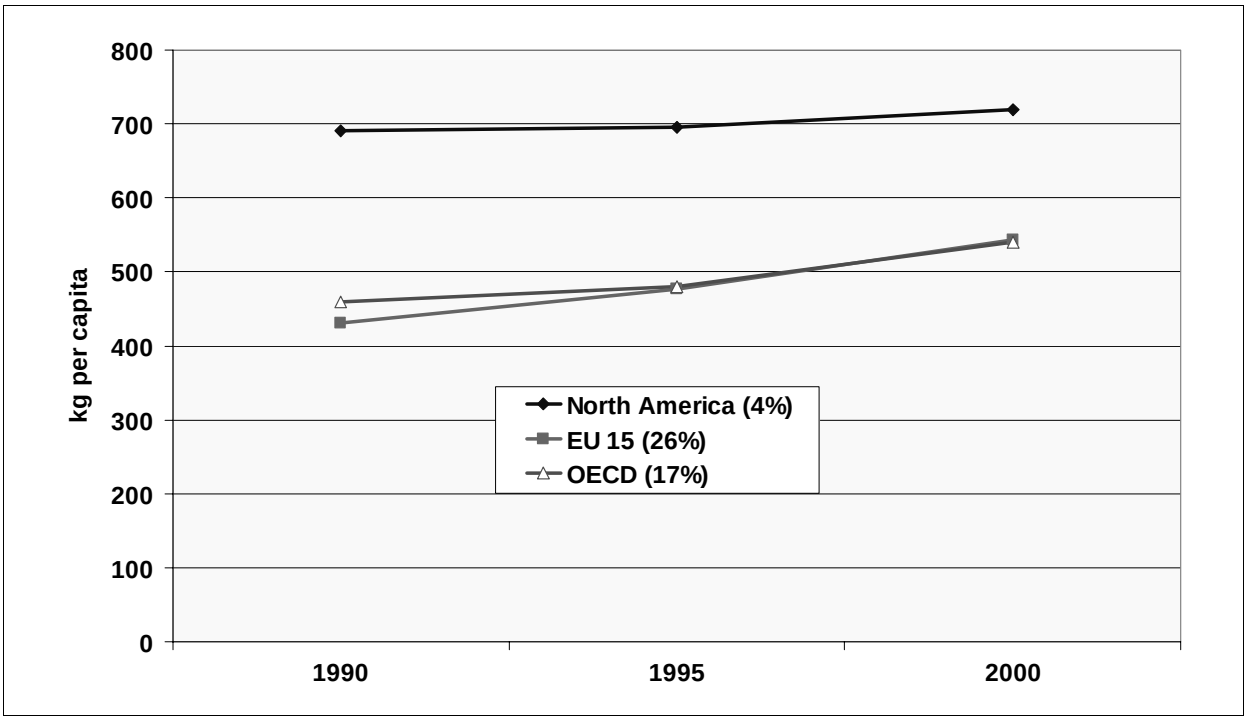
Municipal waste generation continued to rise in OECD countries between 1990 and 2000, not only in absolute terms but also on a per capita basis. This means that population growth is not the only cause of increased waste.

- Municipal waste generation increased by 14% over the period, from 530 to 605 million tonnes.
- Per capita, it increased from 509 to 540 kg on average, a rise of 6%.

The population of the OECD countries increased by 8% over the same period.

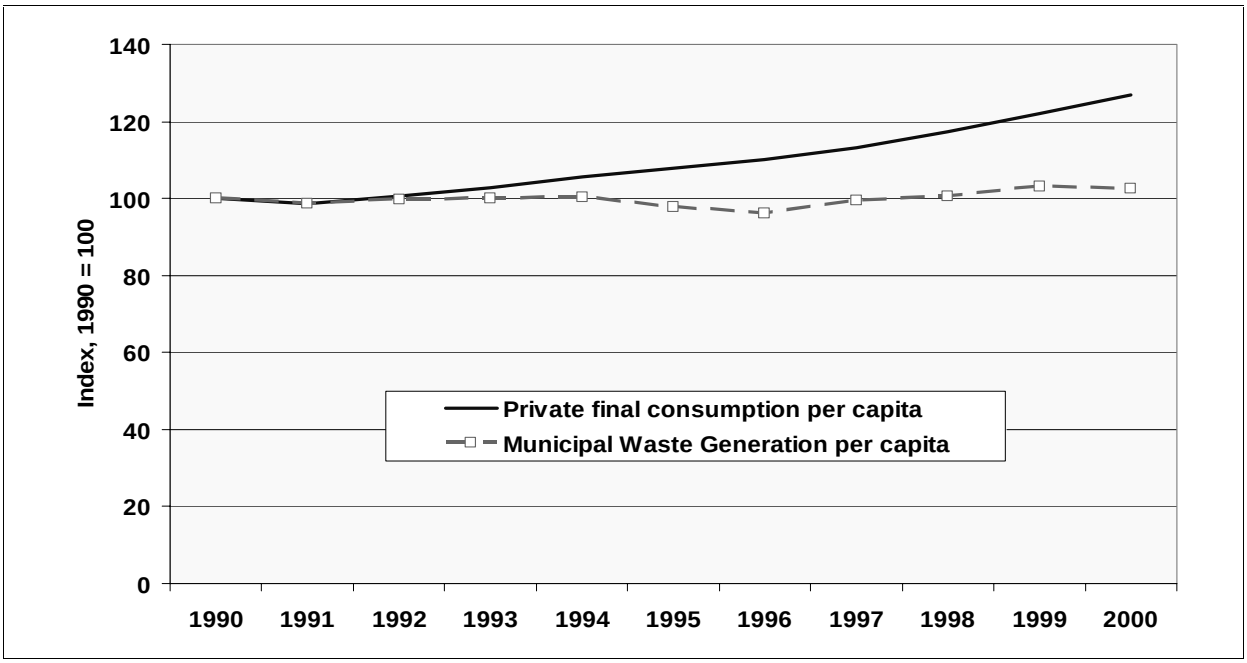
1. National Policies Division, OECD Environment Directorate. The opinions expressed in this chapter are those of the author and do not necessarily reflect the views of the OECD.

Figure 1. Municipal Waste per Capita
Unweighted averages



Source: OECD.

Figure 2. Municipal Waste Generation and Private Final Consumption
United States



Source : OECD.

This is the broad trend, but there have been some rare cases of a slowdown (USA, Japan) or a reduction in municipal waste generation (Korea, Germany), though we cannot be certain whether this

is due to a change in definition or a different way of calculating waste, as was the case with Germany in 1994.

Many factors influence the generation and type of waste, either positively or negatively, but in all events the outcome is increased waste generation, as we have seen. Some of these factors are as follows.

- Economic growth, coupled with enrichment of the population: higher incomes generally lead to higher consumption, for example of domestic appliances and electronic devices such as computers and mobile phones. In Italy, the regions with the highest standard of living produce more municipal waste per inhabitant:
  - Southern Italy (Molise region): 347 kg / inh., (average income per inhabitant: 12,000)
  - Northern Italy (Bologna region): 606 kg / inh., (average income per inhabitant: 20,400)
- Population growth and structure: studies (Van Houtven and Morris, 1999) have shown that households comprising young children and persons aged 25 to 64 produce more waste. However, ageing populations in OECD countries are likely to mean a corresponding reduction in waste generation.
- Growth in the number of households, linked both to growing populations and smaller households: the number of households in Finland increased by 71% between 1970 and 2000, but their size fell by 35% to a current level of 2.15 persons per household (Statistics Finland, 2002). One consequence is an increase in the number of small-unit food products and hence in the amount of packaging, thus increasing per capita waste generation.
- Growing urbanisation of the population: in general, urban dwellers have higher incomes than rural populations, generating greater consumption of goods and services in highly urbanised areas. However, waste collection and recycling are easier to organise in such areas. This may wrongly suggest higher levels of waste generation, whereas it actually reflects better waste management.
- The structure of consumption: the growth of the services and leisure sectors leads to dematerialisation. This in turn reduces the generation of certain types of waste but increases the generation of other types, such as computers; it also leads to the displacement of waste generation, as in the case of waste related to tourism.
- Socio-cultural habits: a more individualistic lifestyle leads to the multiplication of goods, such as cars and individual portions of food products. Less time spent on domestic tasks at home leads to greater consumption of ready-to-eat meals or home deliveries and hence to more food packaging. Socio-cultural habits, the sense of civic solidarity and "environmental awareness" vary considerably from one country to another. Scandinavians, more sensitive to environmental quality and protection, choose greener products which generate less waste and sort waste for recycling in a very disciplined way.

The variable and sometimes contradictory influence of these many factors on waste generation underlines how difficult it is to assess the determining driver(s) and to make forecasts. For example, OECD Economic Surveys suggest that a sharp rise in waste generation, as in Ireland or Korea, is due to high GDP growth and rising private final consumption (Ireland's GDP increased by 61% between 1995 and 2000, and municipal waste generation by 42 %.) Yet the correlation coefficient between the annual growth of private final consumption and municipal waste generation in OECD countries between 1990 and 2000 is only 0.18. Other studies carried out in the United States and Korea (Kinnaman and Fullerton, 1997; Hong, 1999, etc.) also show that municipal waste generation is relatively inelastic in relation to income.

The question remains open. We shall not linger here on the respective influence of the drivers for waste generation, which is debatable and could be the subject of a study in itself, but focus rather on the circumstances that have led to the introduction of different waste management policies.

Table 1. Growth of Municipal waste generation compared to that of some waste generation drivers (in %) between 1990 and 2000

	Municipal waste generation	Population	Gross Domestic Product	Private final consumption (1)
North America (2)	13	10	37	39
Asia-Pacific (3)	-11	5	25	25
OECD Europe	23	5	23	25
EU (15 countries)	26	3	23	23
OECD Total	**14**	**8**	**29**	**31**

(1) At 1995 price levels and purchasing power parities; estimates for East German, Hungary and the Slovak Republic in 1990.

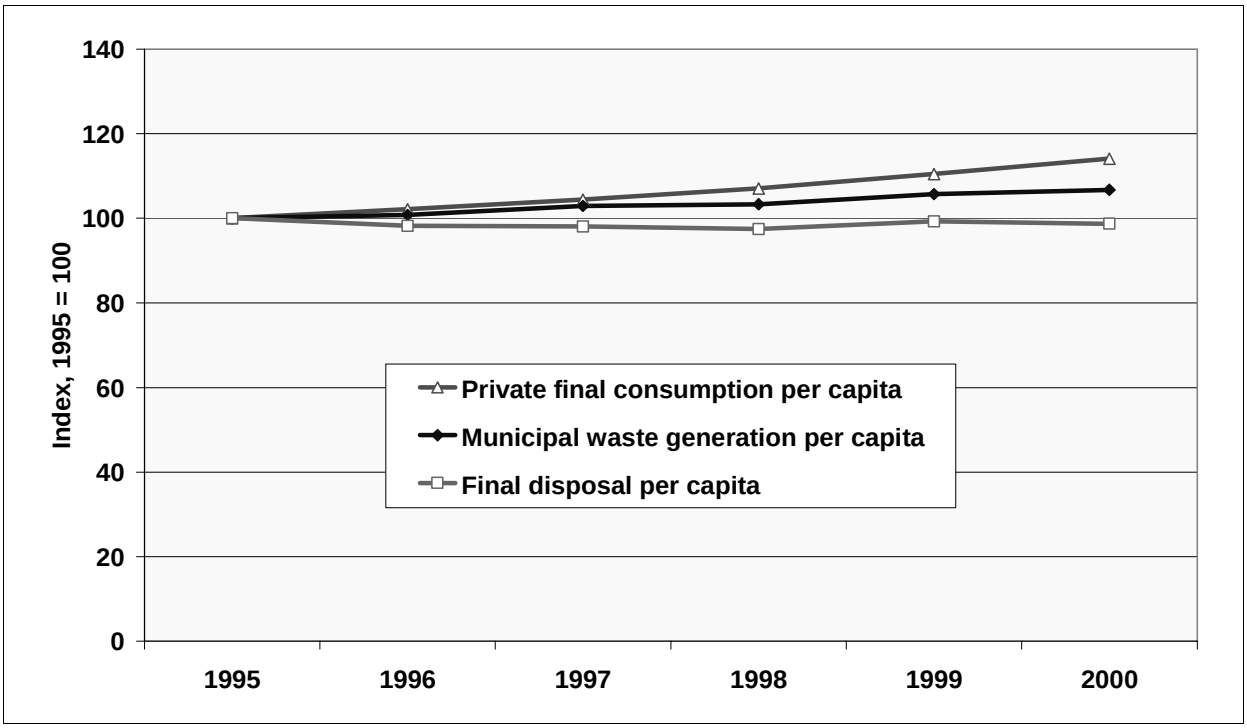
(2) Does not include Mexico.

(3) Includes Japan, Korea, Australia and New Zealand; the negative rate is due to municipal waste generation in Korea which decreased by 45%.

Source: OECD.

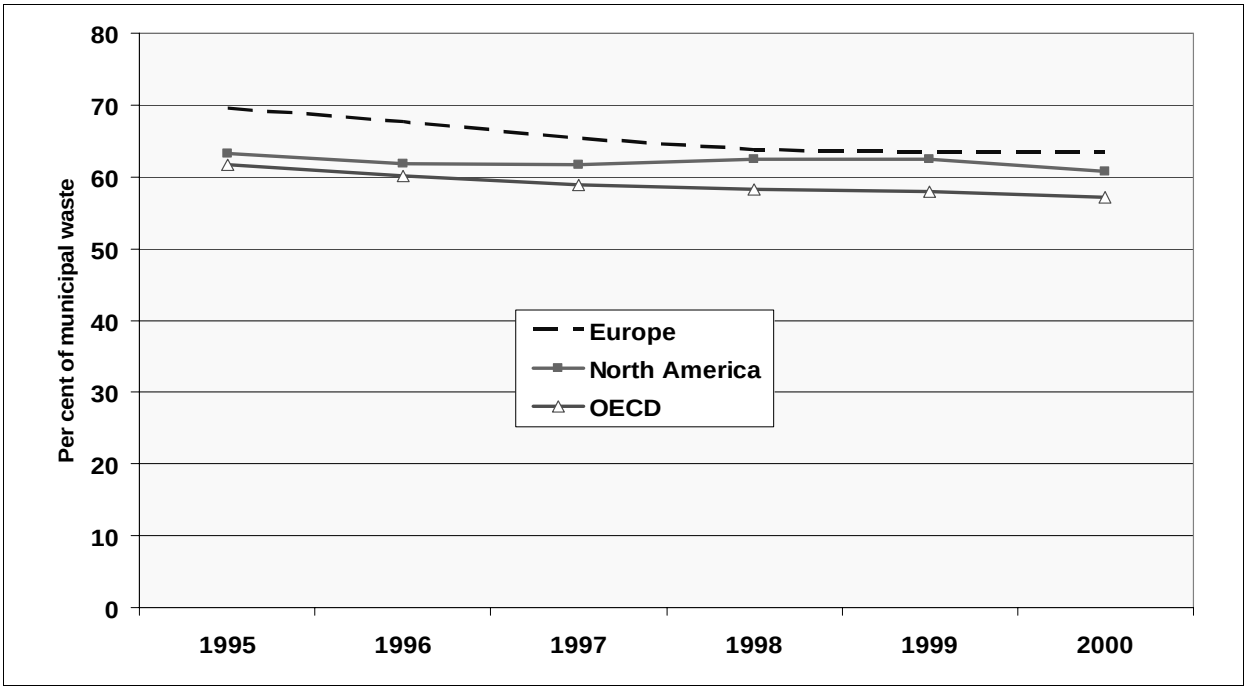
However, there is a slight decoupling between GDP growth or rising private final consumption and waste going to final disposal (landfill and incineration), which confirms the growing importance of the role of recycling and waste prevention.

Figure 3. Private Final Consumption, Municipal Waste Generation and Final Waste Disposal
OECD



Final waste disposal = Landfilling + Incineration without energy recovery
Source: OECD.

Figure 4. Share of Municipal Waste Destined for Disposal* in OECD Regions



* Final waste disposal = Landfilling + Incineration without energy recovery
Source: OECD.

2.2 Municipal waste management

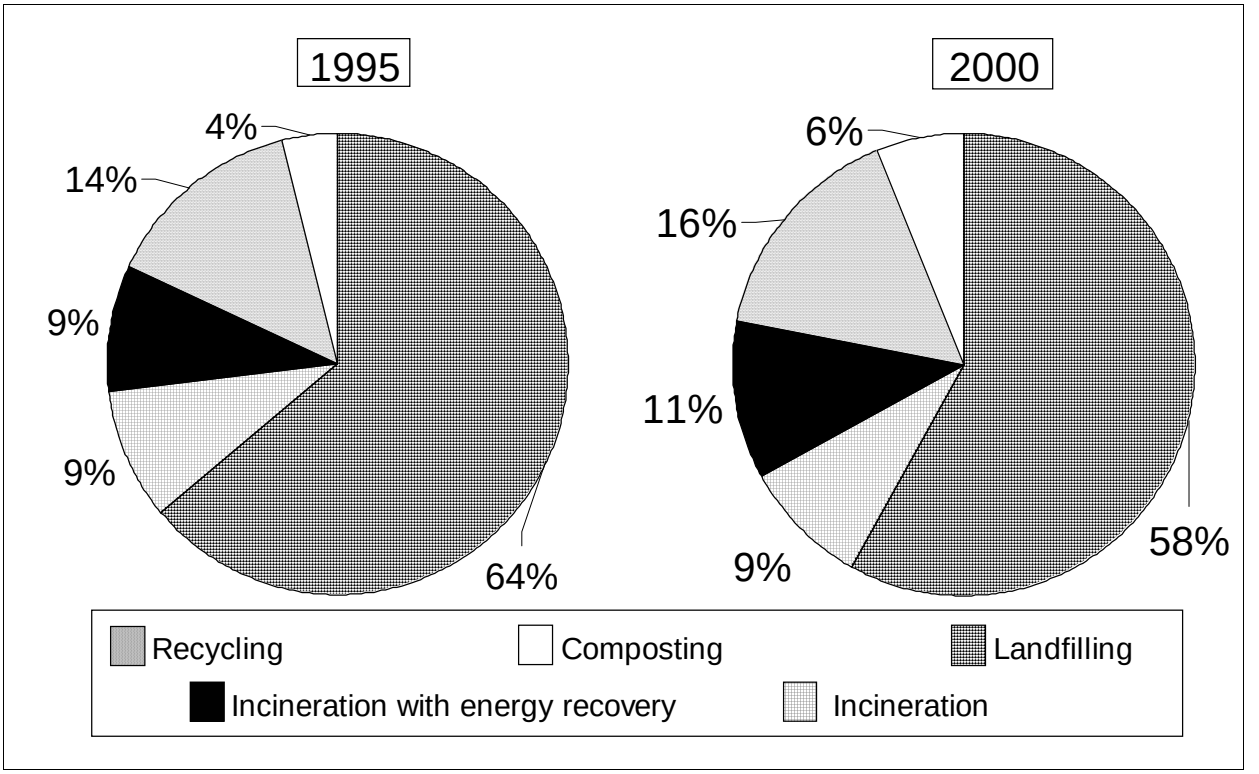
Although most waste is still put in landfills, this method of waste management is less and less prevalent and waste recovery[2] is increasing: municipal waste landfilling increased by only 2% between 1995 and 2000, while municipal waste generation increased by 10%.

There is also a broad and growing trend towards the incineration of municipal waste with energy recovery and the composting of moist organic waste.

Although these broad trends are valid for the OECD as a whole, each country has one or two predominant waste management methods, determined by its physical, economic and social characteristics and by its regulations. In the United States, for example, landfilling is the predominant waste disposal method, probably because land is plentiful and hence the cost is low. In densely populated countries like Japan, Denmark and the Netherlands, at least 50% of all waste is incinerated (78% in Japan) because these countries' incinerators benefit from economies of scale and incineration reduces the volume of household waste by 90%.

2. Recovery, according to the OECD definition [see all Council Acts relating to waste, especially Decision C(2001)107/FINAL], includes recycling, incineration with energy recovery and composting.

Figure 5. Municipal Waste Management in OECD Member Countries



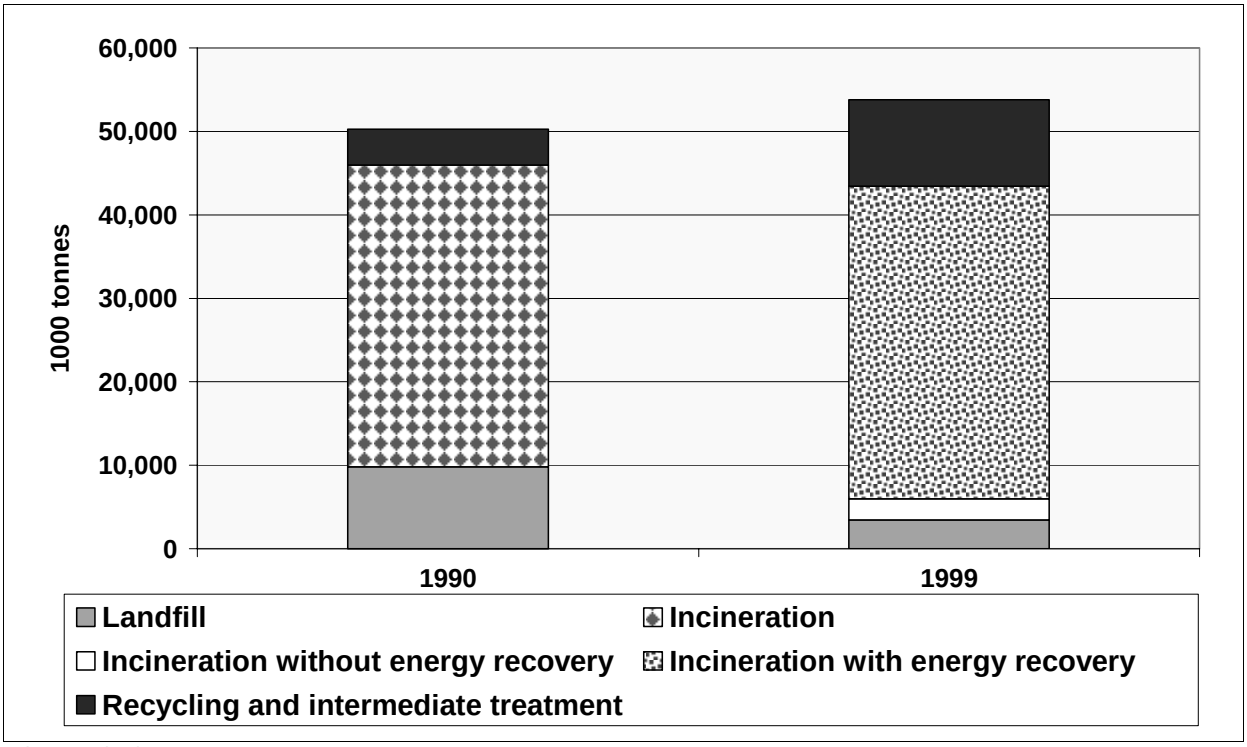
Source: OECD Environmental Data Compendium 2002, OECD Environmental Performance Reviews, OECD Economic Surveys, plus OECD Secretariat estimates.

There is also a broad trend towards improved recycling rates. Recycling rates differ according to the type of material: > 80% for metals, 35-40% for glass, 40-55% for paper and cardboard. Recycling rates differ considerably from one country to another: in Ireland, for example, 10% of paper and cardboard is recycled whereas the figure for Germany is 70%. All the Scandinavian countries have very high recycling rates, as do Belgium, Switzerland, Austria and Germany. The Mediterranean OECD countries (Greece, Portugal, Spain and Turkey) still have the lowest recycling rates, though they are rising fast.

It seems that once a certain level of recycling has been reached, the rate flattens out or even falls back slightly. This would mean that each country has a maximum recycling rate, beyond which technical and economic efficiency would no longer be achieved.

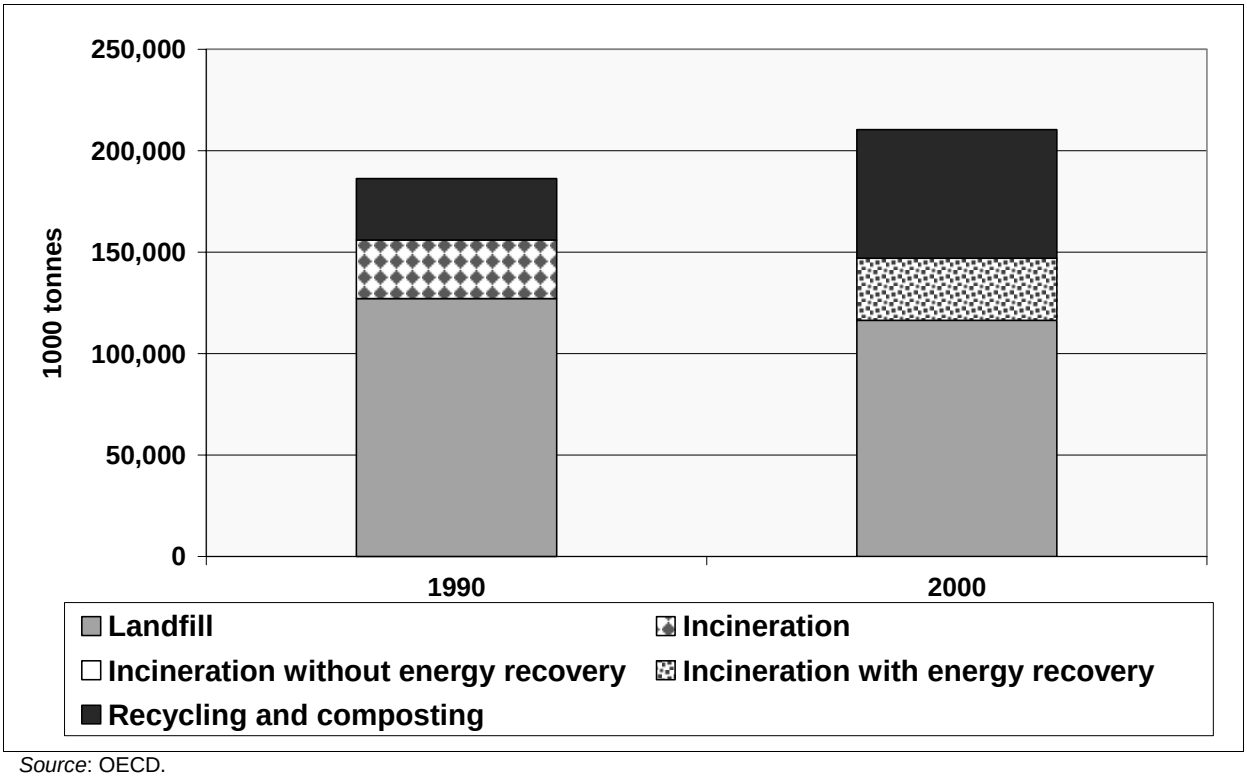
Broadly speaking, municipal waste generation is rising steadily (it is forecast to reach 640 kg/inh. for the OECD as a whole by 2020), despite all efforts to prevent waste generation and increase waste recovery in relation to disposal.

Figure 6. Municipal Waste Management - Japan



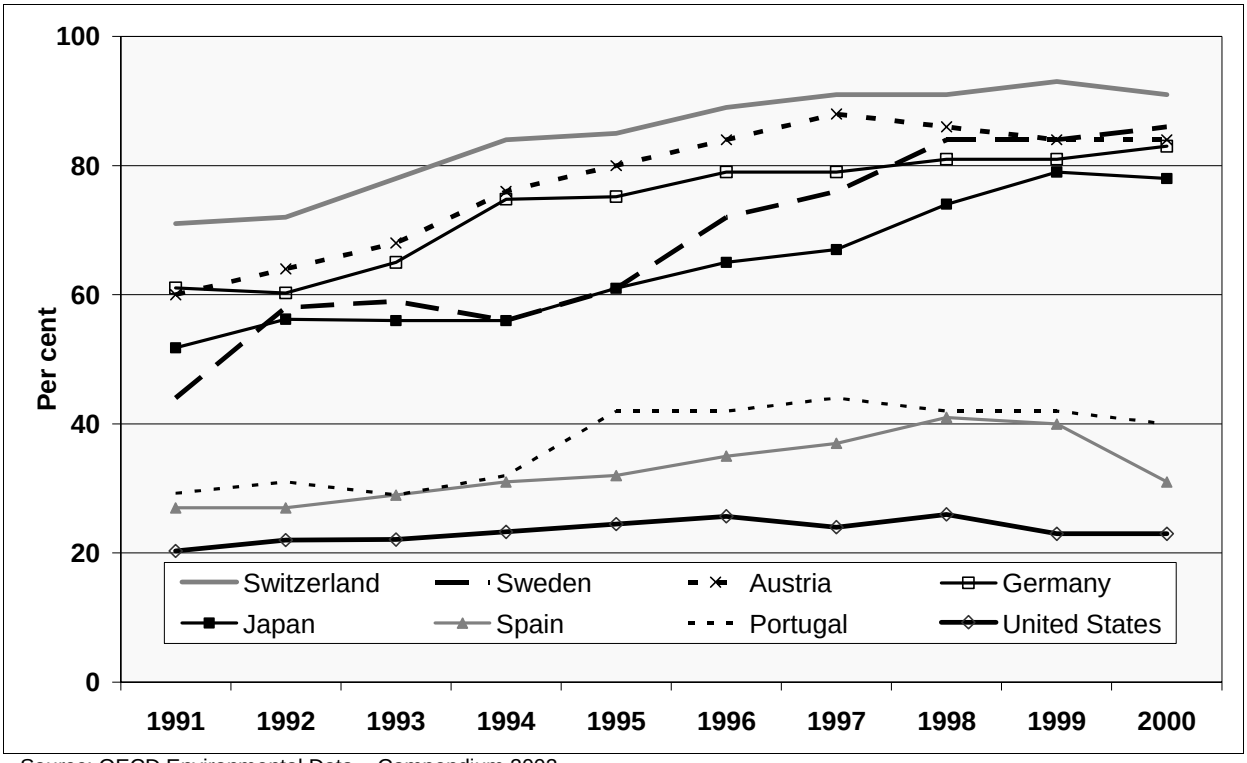
Source: OECD.

Figure 7. Municipal Waste Management - USA



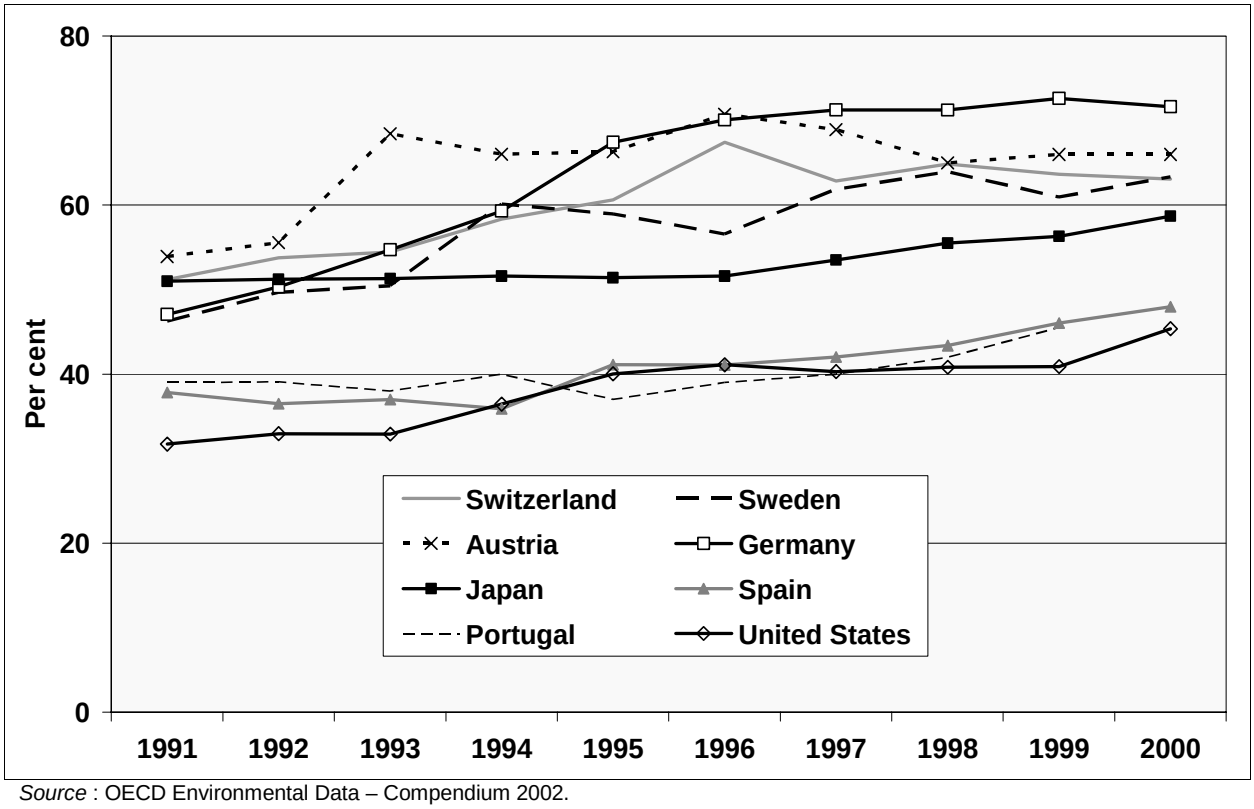
Source: OECD.

Figure 8. Glass Waste Recycling Rates



Source: OECD Environmental Data – Compendium 2002.

Figure 9. Paper and Cardboard Waste Recycling Rates



Source : OECD Environmental Data – Compendium 2002.

2.3 Industrial waste generation

Industrial waste generation is linked to economic growth and hence to GDP. For example, Korea, which has experienced rapid growth over the last decade, has seen a corresponding rise in industrial waste generation. In Ireland, the volume of ordinary industrial waste increased by 56% between 1995 and 1998. Industrial waste as a proportion of total waste naturally varies according to each country's industrial structure, the industries which produce the most waste being the chemical, pulp and paper and iron and steel industries.

Unfortunately, as industrial waste is generally managed at source by the industry itself and as information on the subject is regarded as confidential, data are difficult to obtain.

2.4 Hazardous waste generation

Hazardous waste is estimated to account for 3-4% of total waste on average. The characteristics of hazardous waste, produced mainly by industry, are the same as for industrial waste: generation increases in line with GDP growth, and the amount of hazardous waste produced varies enormously from one country to another according to their industrial structure. The lack of data on the subject and differences in definitions make it difficult to give any assessment for all OECD countries as a whole.

3. The environmental impacts of waste management

Waste has many impacts on the environment. They occur throughout the product life-cycle, from production through consumption to disposal; they are caused by a number of different players (humans, animals) and activities (eating, travelling, transporting, working, etc.) that are extremely varied in both type and location; and they affect many areas, such as water, air, vegetation, landscape, human health, etc. The range of impacts resulting from waste generation is therefore extremely wide in both space and time and this greatly complicates government action, as we shall see.

Broadly speaking, environmental impacts in the OECD countries have diminished over the last ten years, for various reasons:

- extensive regulation, especially concerning landfills and standards for incinerator emissions. This is particular true of Europe as a result of EU directives on landfill, incineration, the management of certain waste flows such as electrical and electronic waste, end-of-life vehicles, the content in certain materials of dangerous substances such as lead, mercury and cadmium, etc.
- the development of highly efficient technologies in areas such as the control of incinerator emissions, especially dioxins (for example, dioxin emissions in the United Kingdom fell by 90% between 1990 and 1997), recycling, the health and safety characteristics of landfill sites (methane emissions from landfills are falling in most countries since most sites have gas recovery systems).

However, problems still remain.

- In many cases, disposal capacity is insufficient, as with incinerators in the UK and Germany, and landfill sites in Japan, Ireland and Germany (see OECD Environmental Performance Reviews and Economic Surveys). The problem is all the more difficult to solve insofar as many plants and landfill sites prefer to close rather than meet new standards. It is

compounded by increasingly prevalent NIMBY[3] attitudes, preventing any further expansion of disposal capacity. This leads in turn to higher prices for waste disposal and exports of waste to neighbouring countries.

- In other countries, in contrast, the availability of disposal capacity (such as incinerators in the Netherlands) encourages maximum use in order to amortise the investment, increasing movements of waste and the environmental impacts of transporting it. This situation may run counter to recycling policies.

- Emission regulations and standards are often not complied with. Unauthorised dumps and sites that do not meet the technical requirements may spring up, as in Italy and Ireland (OECD Environmental Performance Reviews of Italy in 2002 and Ireland in 2000, and OECD Economic Survey of Ireland in 2001). Incinerators may exceed air pollution limits, as with dioxins and furans in France (see "Aménagement du territoire et environnement – Politiques et indicateurs", IFEN – DATAR, France 2000). Groundwater pollution may also exceed authorised levels, often due to leachate from landfills. Non-compliance may partly be explained by the lack or inadequacy of environmental monitoring and penalties and by higher taxes on landfill and final disposal or the introduction of "pay-as-you-throw" taxes, based on the weight of waste produced (Kinnaman and Fullerton, Horton).

- Poor waste management in the past can create an inherited burden. In several countries, unsupervised landfills have led to the long-term contamination of soil and groundwater. The costs of restoring the environment are very high and for that reason sometimes have to be assumed by central government, as is the case in Spain. This report merely touches on the matter without going into any more detail, since soil contamination is a related issue which deserves to be treated separately.

- The cost of managing waste, whether locally or nationally, is generally hard to evaluate. Consequently, local authorities set waste management prices that do not reflect the environmental externalities and fail to provide a coherent basis for the use of the different potential methods of waste management.

4. Measures and policies

The governments of OECD countries have introduced a certain number of measures and policies in an attempt to reduce the environmental impacts and costs connected with rising waste generation.

- <u>Waste management planning is on the increase</u>, generally at national, regional and local level. This includes forecasting the quantities of waste produced, collected and treated, setting objectives such as recycling rates for certain materials, and financing waste management. These plans all give priority to preventing and reducing waste generation through recovery; disposal by incineration or landfilling is a least desirable solution of last resort from a public health and environmental standpoint.

- Almost all the OECD countries now apply the principle of <u>extended producer responsibility (EPR)</u> for a certain number of products that pose end-of-life problems either because of their volume or because they contain dangerous substances. Producers, importers and distributors are generally required to organise the collection and recycling of these end-of-life products. Increasingly, they are getting together to sub-contract their obligation to specialist private organisations that cooperate with local authorities in organising the collection, sorting and

3. "Not In My Back Yard", meaning that local populations refuse to allow polluting facilities to be located nearby.

recovery of materials. Collection and recovery rates everywhere have since improved considerably. The types of waste to which EPR applies are practically the same in all OECD countries: packaging, electrical and electronic waste, used tyres, used oils, batteries, end-of-life vehicles and batteries.

- Economic instruments are increasingly being used to internalise the costs of waste management and the environmental impacts of waste. These costs are passed on to economic agents, especially consumers, for example through taxes or charges on purchase (deposit refund systems) designed to finance the disposal or recovery and recycling of end-of-life products. End users who return the used product (end-of-life vehicle, used oil, electrical appliances, batteries, etc.) to approved centres can reclaim the tax or charge. The instruments most widely used in waste management are charges for the collection of household waste calculated either by weight or at a flat rate (per person, per household or according to the habitable surface area) and taxes on tipping or incineration. The level of these taxes, and hence their deterrent effect, can be adjusted to direct waste flows towards other, more environmentally desirable methods of disposal.

- The control and monitoring of hazardous waste, from generation through transport to final disposal, have been stepped up both within countries and outside their borders. In the Slovak Republic, for example, an information system tracks all hazardous waste by origin, quantity and method of disposal. In Japan, there is a tracking system for used oils, residual acids and bases, hospital waste and asbestos, and in Germany for all hazardous waste.

- Internationally, there has been a realisation of the need to cooperate in order to ensure better management of international movements of waste, reflected in:

  - the introduction of international systems to control exports and imports of waste (OECD decisions, European regulations, Basel Convention) and greater efforts to combat the illegal movement and disposal of waste. This can sometimes represent very substantial amounts of money, as in Italy, where in 1999 the value of the illegal traffic in waste was estimated at 6 billion euros (Environmental Performance Review, Italy – OECD 2002);

  - agreements seeking to ensure environment-friendly waste management, like the London Dumping Convention and the 1996 Protocol to the London Convention which prohibits the dumping and incineration of waste at sea.

- The infrastructure needed to treat waste is improving. The capacity to treat certain types of hazardous waste, such as PCBs, is being commissioned or adjusted at national level with the aim of achieving self-sufficiency in order to comply with certain principles of a political nature, especially at European level. From the standpoint of economic efficiency, however, such policies are open to question since they imply repeat large-scale investment and run counter to the achievement of economies of scale. Systems are being set up to collect environmentally harmful waste produced in isolated and limited quantities, such as hazardous household waste, lead batteries, used oils, etc.

- Administrative structures are being reorganised to cut costs and ensure more efficient management. In Japan, France and Denmark, for example, local authorities are getting together for the provision of waste removal and treatment services, generating economies of scale.

- More ecological waste management methods are being developed. In Ireland, for example, a ban was introduced in 1999 on discharging sewage sludge into the sea and better slurry spreading practices have been introduced. Increasingly, landfills may accept only inert or pre-treated waste; other forms of waste, like organic waste, inflammable materials and old tyres, are refused. New and cleaner waste treatment technologies are being developed, such as the automatic sorting of metals, batteries and plastics. New incinerators, whether for household

or hazardous waste, must comply with very strict limits on atmospheric emissions, especially of dust, hydrogen chloride and fluoride, sulphur dioxide, heavy metals, dioxins and furans, etc.

5. Conclusions

It is very difficult to draw an accurate and precise picture of the situation and trends in the generation of different types of waste because of the lack of reliable, comparable data.

- Definitions have changed: the terms "waste" and "hazardous" vary over time as regulations have changed, creating series breaks (in Germany, Ireland, the Slovak Republic, etc.) and suggesting enormous increases or the decoupling of waste generation and economic growth. This factor makes forecasting all the more difficult.

- The most detailed and reliable data concern municipal waste, which accounts for only a small proportion of total waste generation – approx. 14% – and is generally not hazardous by nature.

- There is very little information on which to base an assessment of the economic efficiency of the various instruments and types of approach, according to whether they are voluntary or coercive and the level at which they are implemented (national / federal, regional, local).

Economic efficiency takes second place to environmental effectiveness as the principal concern in framing environmental policy. In addition, populations strongly oppose waste management solutions like incineration and landfill that they regard as a local and environmental nuisance even though they cost less. Under pressure from public opinion, governments therefore introduce recovery policies that prove to be much more expensive. That is the case with the EPR systems for packaging introduced in Germany and Sweden: their economic efficiency is far from optimal, but their results in terms of meeting recycling objectives are highly satisfactory. Preference is given to waste management methods which are not necessarily rational from an economic point of view. For example, the marginal cost of recycling a ton of packaging waste in Sweden is reckoned to be 250, compared with 160 for incineration and 130 for landfilling (Economic Survey, Sweden – OECD 2001). A recent cost-benefit analysis by the Danish Environmental Protection Agency ("Should household food waste be burned or recovered?", 2003) showed that it costs more to compost organic waste than to incinerate it; moreover, the environmental benefit in comparison with incineration is very small. Questions are increasingly being asked about the recycling of certain materials, like plastics, and studies advance "optimum" recycling rates that are much lower than those currently being practised. Inefficient management in economic terms may well pose problems of long-term viability. The question of a better allocation of resources may also be raised, and it is all the more relevant in that these so-called "environmental" waste management methods benefit from subsidies.

How much does waste management cost and who should pay? The major problem at present is that the evaluation is still very vague. Where waste is concerned, given the number of players involved throughout the product life-cycle, it is particularly difficult to identify polluters in accordance with the polluter-pays principle (PPP). Few cost-benefit analyses have been made of the real and total costs (including externalities) of waste management, especially recycling, because such studies are both complex and expensive. Broadly speaking, and at first sight, recycling seems to be "greener" but also more expensive than incineration and landfilling. Consequently, recycling receives support from governments that favour it as a solution. However, internalising the environmental and social costs could call this preconception into question. In addition, the way in which public authorities set more or less arbitrary and uniform charges for municipal waste collection is unsatisfactory in several respects:

- first, the charges are not generally high enough to cover local authorities' waste management costs and do not include the external costs, even though they are borne by the local community;

- second, they do not create any incentive for citizens to reduce their own waste generation or to recycle, since those who create the waste are not aware of and have no responsibility for the costs they generate for society. Most citizens have no idea of the charge they have to pay for household waste collection: in Vienna, only 8% of inhabitants were aware of it.

That is why PPP – i.e., taxation according to the weight of household weight produced – would seem to be the most effective method from several points of view, because it places responsibility with the producer of the waste.

- In environmental terms, it generally goes hand in hand with a 15-30% increase in recycling and a sharp fall in landfilling (Miranda and Aldy, 1996, Kinnaman and Fullerton, 1996).

- In economic terms, collection and treatment costs are adjusted according to the weight treated. The result is a drop in the volume of waste to be collected and treated, generating lower costs for local authorities. However, this fall is partly or even entirely wiped out (Fullerton and Kinnaman, 1996) by the higher costs of administering the system.

- It is also the fairest solution, since the cost of the service is individual and billed according to use.

The drawback of this method of taxation, called "pay as you throw" (PAYT) in the United States, is that it often leads to the illegal disposal of waste by unauthorised tipping and incineration (Kinnaman and Fullerton, 1996 and 2000, Horton, 1996). Although the generator of the waste disposes of it at least cost, the disposal has a significant environmental impact and implies social and rehabilitation costs borne by the community as a whole. In order to limit such side-effects, regulations backed up by penalties and waste tracking systems may prove necessary, as has been the case in Korea, Japan and Germany.

What are the most ecologically and environmentally efficient solutions, bearing in mind the extreme variety of factors that, in all countries, influence waste management, whether physical conditions (climate, surface area, population density, extent of urbanisation, etc.), demographics (age pyramid), social and cultural features (lifestyles, consumption, behaviour) or economic factors (standard of living, structure of economic activity)? Is the arbitrary definition of a hierarchy of waste management methods, which all waste policies recommend, valid in all cases? Waste management costs vary enormously from one country to another, and even from one region to another within the same country, depending on local conditions. Consequently, shouldn't the arbitrary and uniform definition of recycling quotas by international legislation be adapted according to the circumstances (regional, local, social and cultural differences)? Some countries try to link charges to related externalities: in Austria, for example, the landfill tax depends on the risk potential of the waste and the facilities of the landfill site.

In a nutshell:

- a very complex situation,
- full of contradictions,
- full of shadowy areas,
- in which a uniform approach may well be prejudicial to environmental and economic efficiency.

6. Avenues for further research:

1. Better knowledge of the facts (quantities of waste produced, recycled, composted, incinerated with or without energy recovery, put in landfills, exported, imported, by type, by origin, treatment capacity, treatment costs, etc.) is essential in order to monitor how the situation develops and frame effective waste management policies.

2. Detailed cost-benefit analysis would certainly provide better information about externalities and make it possible to adjust waste management policies in such a way as to optimise their environmental effectiveness and economic efficiency. However, given the difficulties of carrying out such studies, mentioned above, we should not take a wait-and-see attitude or refrain from acting on the grounds that we do not know enough or that it costs too much, especially as waste generation is continuing to rise.

3. We must find the lever or levers which can be used to reduce waste generation, especially municipal waste generation. As we have seen, it is difficult to identify these levers and assess their importance, and it is not easy to see how governments could go against broad demographic, social and cultural trends which are not susceptible to policy intervention. The aim must be rather to control their effects on waste generation and waste management and find the most effective instruments, i.e. those most liable to influence the behaviour not only of consumers but also of product designers and producers.

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FOREWORD

Waste generation and waste management receive increasing attention among policy makers. On the one hand, waste causes environmental problems, both if it is handled properly and - especially - if it is mishandled, e.g. through illegal dumping. On the other hand, both waste recovery and final disposal can involve significant financial costs for public authorities, waste handlers and for households. Unfortunately, under existing policy frameworks, both producers and households often lack proper incentives to reduce the amounts of waste being generated, and to ensure that the waste which is generated cause limited adverse environmental impacts. Some countries have adopted ambitious targets in the waste area, but the costs of achieving them through the instruments chosen is sometimes high. It is therefore important to carefully assess the costs and benefits of waste-related policies.

The OECD has for many years been working on waste-related issues, in later years primarily through its Working Group on Waste Prevention and Recycling (WGWPR). The work has inter alia focused on transboundary movements of waste, and on defining environmentally sound management of waste.

In the elaboration of the 2003-2004 work program of WGWPR on waste issues, it was felt that it could be useful for the OECD to place more emphasis on issues related to the "economics of waste". In order to take stock of recent research findings on such issues, and to help the selection of topics on which the OECD could usefully do additional work, a workshop on the economic of waste was held 14-15 October 2003 in Paris. The workshop brought together leading academics, civil servants working on waste-related topics and representatives of the business community (selected by the Business and Industry Advisory Committee to the OECD, BIAC) and environmental NGOs.

This book contains eight papers that were presented at the workshop - revised to take into account relevant comments made and questions raised in the subsequent discussions. In addition to these papers, two more papers were presented at the workshop: David Fitzsimons of the consultancy firm Oakdene Hollins, Aylesbury Bucks, United Kingdom, had written a paper on "Improving Markets for Used Lubricating Oils", while Nick Johnstone of OECD, Environment Directorate, had addressed "Market Failures and Barriers in Secondary Material Markets". While this book would have benefited greatly from the inclusion of these two papers, it has instead been decided to issue them separately, along with two other papers, all presenting findings of a recent OECD project on the functioning of secondary material markets.

The OECD wishes to thank Denmark and France for financial contributions that allowed the workshop to take place.

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