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ASSOCIATION OF PLASTICS MANUFACTURERS IN EUROPE

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Plastics

An analysis of plastics consumption and recovery in Europe

Published Summer 2003

2001 & 2002

Plastics 2001 – 2002 headlines

- Total plastics consumption, including virgin polymers and recycled granulate, continued to increase, rising 6 per cent between 2000 and 2002. The main growth occurred in 2002 (+4.1 per cent), compared to 2 per cent growth between 2000 and 2001
- Per capita consumption of virgin plastics in Western Europe rose to 91 kg in 2001, increasing to 94.8 kg by 2002
- 38 per cent of total collectable plastics waste was recovered in 2002, up from 36 per cent in 2000. In tonnage terms, this represented an increase of 11 per cent
- Mechanical recycling of plastics waste increased by 22.5 per cent between 2000 and 2002 in tonnage terms. Mechanical recycling is the second largest recovery route after energy recovery in tonnage, with 13.3 per cent of total collectable plastics waste recovered this way. This growth was due to a substantial increase in packaging recycling while recycling of other types of plastics waste remained flat
- Energy was recovered from 4 688 000 tonnes of plastics waste in 2002, an increase of 6.3 per cent on 2000 figures and representing 23 per cent of the recovery of total collectable plastics waste
- Overall increased recovery meant that the amount of plastics going to landfill only increased slightly between 2000 and 2002 and is effectively being decoupled from the growth in consumption and associated waste generation. Volumes landfilled in 2002 are in fact estimated to be at the same level as 1996

Please note: Rounding of figures in this report (e.g. to nearest kilotonne or percentage point) may appear to cause slight differences in totals.
2002 data remains subject to a degree of estimation and it will not be fully confirmed until late 2003. The 2001 data is as accurate as possible and is based on fully confirmed figures.
The data for 2000 has been revised and verified since publication of the last report.

Contents

Plastics continued growth in difficult times

This is the thirteenth year in which APME has commissioned an annual survey of plastics consumption and recovery in the European market. This report is bigger than previous studies because it contains information for two years (2001 and 2002), and it has been expanded to include data from the ten East European Accession countries. The report has also been published later in the year than previous editions. This has allowed us to present the most up-to-date data, including statistics from the year immediately preceding publication, something never achieved before. It maintains its status as one of the few independent surveys which examines the complete lifetime of plastics – from consumption by processors through to material recovery at end-of-life. This latest report confirms that the demand for plastics has continued to rise across all industry sectors, despite the current economic downturn. It also shows that the amount of plastics recovered has continued to rise and is more than keeping pace with consumption.

Report in brief

Over the years, plastics have undergone a spectacular evolution in development and use. Today's almost infinitely versatile and affordable range of tailor-made materials helps designers meet the challenges of creativity with innovative technological solutions while minimising the impact on the environment.

Plastics are one of the most resource efficient and versatile materials available to society. As such, they make a significant contribution to the vital goals of sustainable development, which underpin the European Union's Thematic Strategies on Resource use and Recycling, as put forward in the Sixth Environmental Action Plan (6th EAP).

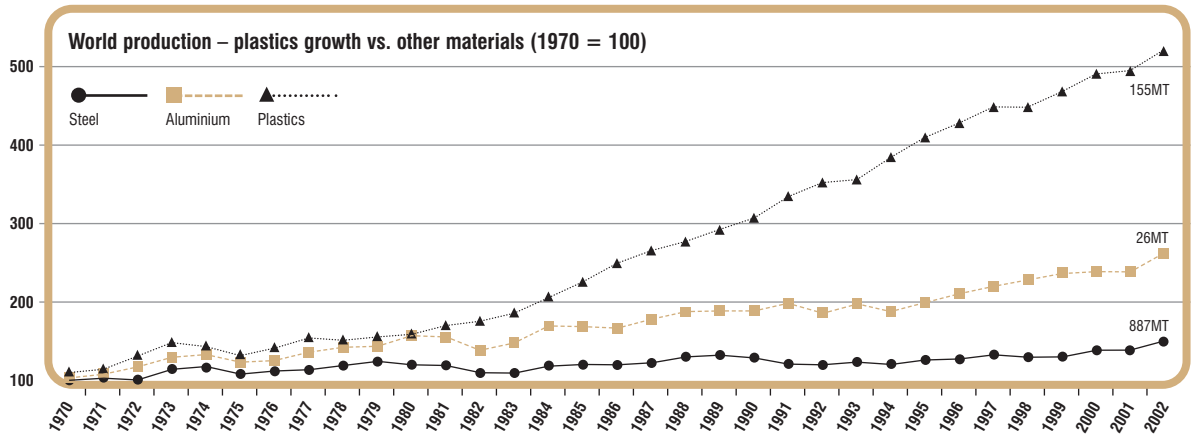
The European plastics industry is committed to facilitating improved resource efficiency as well as recovery and waste prevention techniques, through improved understanding and implementation of various recovery and recycling options. As this report shows, APME has been very active with a number of partners, looking at extending understanding and facilitating various recovery techniques to help meet the targets established in the European directives on Packaging and Packaging Waste (P&PW), End-of-life Vehicles (ELV) and Waste from Electrical and Electronic Equipment (WEEE).

For the industry, 2001 and 2002 have been challenging years with continuing consolidation within the industry and the global economic downturn taking its toll on all key market sectors. However, total plastics consumption in Western Europe continued to increase steadily despite this – to 38 123 000 tonnes in 2002, an increase of 6 per cent on 2000. This increase continues a trend that has been evident for many years and is a clear indication of the continuing popularity of plastics as a material.

End-of-life plastics recovery rose by almost 11 per cent between 2000 and 2002, with almost 7.7 million tonnes of plastics waste being given a second life through material recycling and energy recovery in 2002. This compares to just under seven million tonnes in 2000.

What is the 6th EAP?

The Sixth Environmental Action Programme, adopted in July 2002 is the European Union framework in the field of environmental policy. Entitled "Environment 2010: Our Future, Our Choice" (2001-2010), the programme identifies the following four priority areas: climate change, nature and bio-diversity, environment and health and the sustainable use of natural resources and waste. The document also sets out a number of approaches to achieve improvements in these areas including increased environmental awareness among citizens and the integration of environmental concerns into relevant policy areas. Plastics have a key role to play in meeting the objectives of the programme.



Source: SPMP – CIPAD – IISI – PECHINEY – PARDOS MARKETING

Plastics the material of choice for the 21st Century

Plastics are a major contributor to sustainable development, which is high on the policy agenda. Not only does their increased use bring economic and social benefits, but their significant contribution to environmental protection allows many objectives to be met. This may be surprising in that plastics are often perceived as not being particularly resource efficient because they are mainly derived from non-renewable energy sources, such as oil and gas. In reality, however, plastics products actually play a major role in reducing overall resource use.

When examining resource use, it is vital to consider all stages of the life cycle – from extraction and manufacture through the use phase, to end-of-life. Throughout this life cycle, plastics are unique in their ability to save resources. In fact, it is estimated that the use of plastics actually saves more oil than is used for their manufacture. For this reason they should be viewed as 'champions' of prevention or resource efficiency – key goals for resource and waste management.

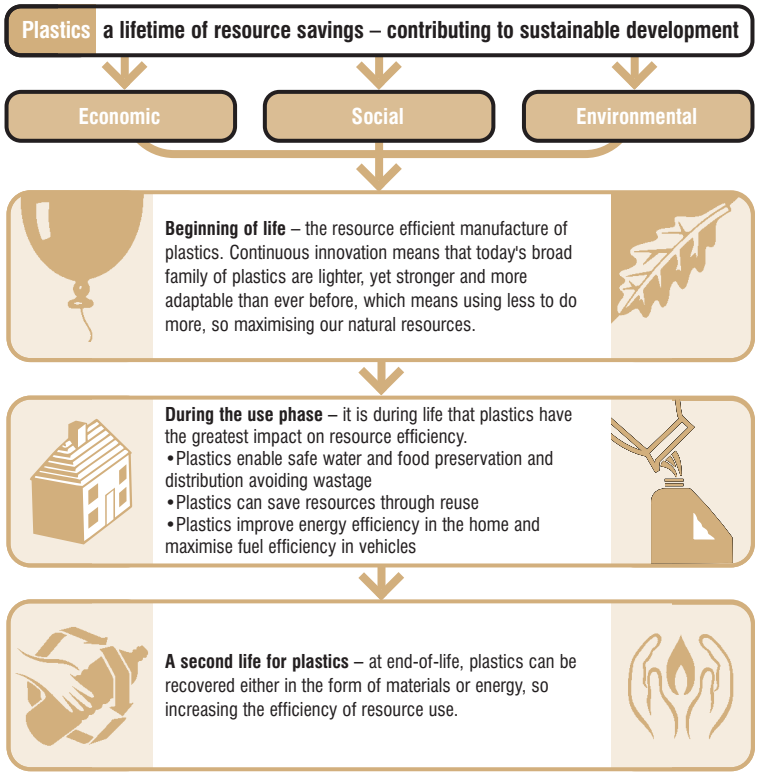
Constant research and technological advances mean that plastics are one of the most versatile, lightweight, resource-efficient materials available to society. Improved manufacturing processes, giving plastics materials improved processing and physical properties, have had a huge impact on the resource efficiency of plastics. So, too, have advances in recovery options at end-of-life, including the refinement of recycling options, the increase in energy recovery options from municipal solid waste (MSW) incineration and the development of high calorific alternative fuels. However, it is during the use phase that plastics products can be seen to have their greatest impact on resource efficiency.

The manufacture of plastics

The vast majority of plastics are made from feedstocks derived from oil or gas in large, efficient, world-scale petrochemical facilities. The feedstock for the manufacture of plastics only consumes a small fraction – four per cent – of the world's oil. Thanks to continuous innovations in material chemistry and process engineering, today's broad family of plastics are lighter (yet stronger and more adaptable) than ever before. This has opened up a huge range of uses for plastics yet at the same time means that, product for product, proportionally less of the world's oil supply and energy resources are being used in their manufacture – a fine example of the principle of 'using less to do more'.

The reduction in the weight of plastics is particularly noticeable in packaging – the sector which uses most plastics in Europe. Around 50 per cent of Europe's goods are now packaged using plastics, yet these same plastics by weight account for less than 20 per cent of all packaging produced. In fact, there has been a 28 per cent decrease in the average weight of plastics used per packaged article over a recent 10 year period. This represents a reduction of some 1.8 million tonnes – a figure almost as high as the tonnage being recycled. It has been calculated that without plastics, overall packaging weight would increase by 291 per cent. An impressive contribution to resource efficiency and to the prevention of packaging waste.

As for the manufacturing process itself, the European plastics industry has made great advances to ensure cleaner production, the reduction of energy consumption and limitations in harmful emissions to air and water.



Over a 10-year period from 1988 – 1997, the weight of the average plastics package was reduced by 28 per cent. A good example of this is seen in the switch from shrink to stretch film packaging on pallets filled with drinks cartons by one of the Europe's largest fruit juice producers, based in the Netherlands. This move reduced the amount of packaging waste that needs to be recycled by 80 tonnes per year. In Europe as a whole, the average reduction in weight of pallet film was 70 per cent over ten years.

This ongoing improvement is thanks to innovation in catalyst development and process technologies, which saves resources while enhancing product performance.

A lifetime of resource savings

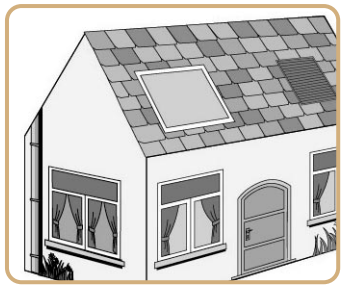
Plastics are now used in countless applications, from cars to packaging, medical equipment to mobile phones and buildings. It is this 'use' phase of plastics which has the greatest impact on resource efficiency.

A recent APME-commissioned study looked into the environmental and economic benefits of plastics products across their whole life cycle in each

Some examples to illustrate the dramatic impact of using this 'material of choice':

1. Improving energy efficiency in the home

In northern European countries, almost one quarter of total energy consumption is used for domestic heating. However, thanks to the insulating properties of plastics, this can be reduced considerably. Energy is conserved through plastics building insulation made from expanded polystyrene or polyurethane foam, while plastic window frames also help reduce heat loss. In a typical house, it is estimated that the energy equivalent to that needed to produce the insulation initially is saved after only one year of use. The CO_2 reduction in the same period is two to five times higher compared to the CO_2 emissions from its production.



2. Better fuel consumption

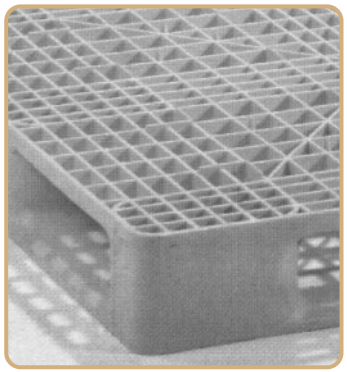
Increasingly lighter, stronger plastics are helping automotive designers meet the twin challenges of performance and minimising impact on the environment. It is estimated that 100 kg of lightweight plastics have typically replaced 200-300 kg of conventional materials in today's vehicles – saving around 12 million tonnes of oil and reducing by 30 million tonnes of CO_2 emissions per year across Europe.

3. Saving resources by reuse

Further savings of resources during use can be achieved where reuse proves to be beneficial to the environment and many plastics packages are increasingly being designed in ways that make this possible. For example, the number of reusable plastic pallets, crates and boxes used in food distribution and the medical sector has grown rapidly. These rigid units have the additional benefit of giving products greater protection, which reduces costs and saves energy.

4. Preserving other resources

In addition to direct energy savings, plastics help save other valuable resources in the course of their lifetime. For example, they play a vital role in preserving and distributing essential food and water economically and reliably to a growing world population. In areas of the world where water is scarce, conservation and irrigation systems help retain water and distribute it.
Plastics cost-effectiveness, ease of transportation, assembly and durability make them the material of choice for these applications. March 2003 saw the launch of a joint initiative between APME and the international charity WaterAid, to raise enough money to provide thousands of people in Africa with clean water and basic sanitation.



In the same vein, food waste in Europe is also kept low – just 1-2 per cent – due in part to plastics packaging, which accounts for about 60 per cent of all food packaging. In regions of the world where modern packaging is not readily available, as much as 30-50 per cent of food is wasted.

5. New energy sources

Alternative and renewable sources of energy such as wave, wind and solar power all contribute to resource preservation. Plastics are integral to the design of environmental technologies, such as solar panels and wind turbines – and in this way help minimise resource depletion. For example, the Enercon E-112, with a blade length of 52 metres and a tower 120 metres high, is the world largest windmill. Built using epoxy resins, it can produce a power output of 4.5 mega watts – enough for the daily needs of 15 000 people.

Meanwhile, fuel cell technology may radically alter the way we power our vehicles in the future. Plastics play a crucial role here as well. Several different polymer applications will be involved in the construction of efficient, affordable automotive fuel cells. Hybrid systems which use a combination of power sources are already coming onto the market. The new technologies employed call for new engineering solutions, presenting important challenges for construction materials such as plastics.

major application sector and compared them to products made from alternative materials. Although such studies are highly dependent on the boundary conditions chosen, the results give us confidence that plastics generally provide advantages or are equivalent in overall environmental terms compared to the use of other materials.

An expanded study with a focus on energy is now under way, with initial indications that the whole range of plastics applications result in energy savings of up to 40 per cent compared to using alternative materials.

A second life for plastics

Plastics are usually made from oil products which represent an important potential source of energy even after the end-of-life 'use' phase. At end-of-life, plastics products can be recovered either in the form of materials or energy, thus extending further the overall efficiency of resource use.

Mechanical recycling is preferred when homogeneous waste streams are available which can substitute virgin plastics on close to a 1:1 basis, as energy savings here are the greatest. APME has conducted much research in this area, including groundbreaking studies during the late 90s covering the estimation of the recycling potential in Europe, identifying best practices in recycling and assessing the eco-efficiency of various recovery options.

Further understanding of the potential of recycling comes from ongoing work and cooperation with partners such as the Association of Cities and Regions for Recycling (*see page 13*), and with recyclers, manufacturers and NGOs at key events such as Identiplast (*see page 13*), where the latest technologies for both recycling and other recovery options are reviewed.

Where mechanical recycling is not sensible – for example, with mixed or contaminated waste streams – other recovery routes are to be preferred. Energy recovery – whether from municipal waste incineration or through the preparation of alternative fuels using end-of-life plastics – offers the possibility to replace traditional energy sources, thereby contributing to the security of supply as well as resource efficiency. It has been estimated that the use of waste plastics which cannot be sensibly recycled is equivalent to more than 17M tons of coal, or 15 per cent of solid coal imports into the EU.

Over the last 11 years, recovery of plastics waste has risen by over 50 per cent, from 22 per cent in 1993 to 38 per cent in 2002 through a combination of recycling, energy recovery and feedstock recycling. There is still much to do but real progress continues to be made, which makes a significant contribution to overall resource efficiency.

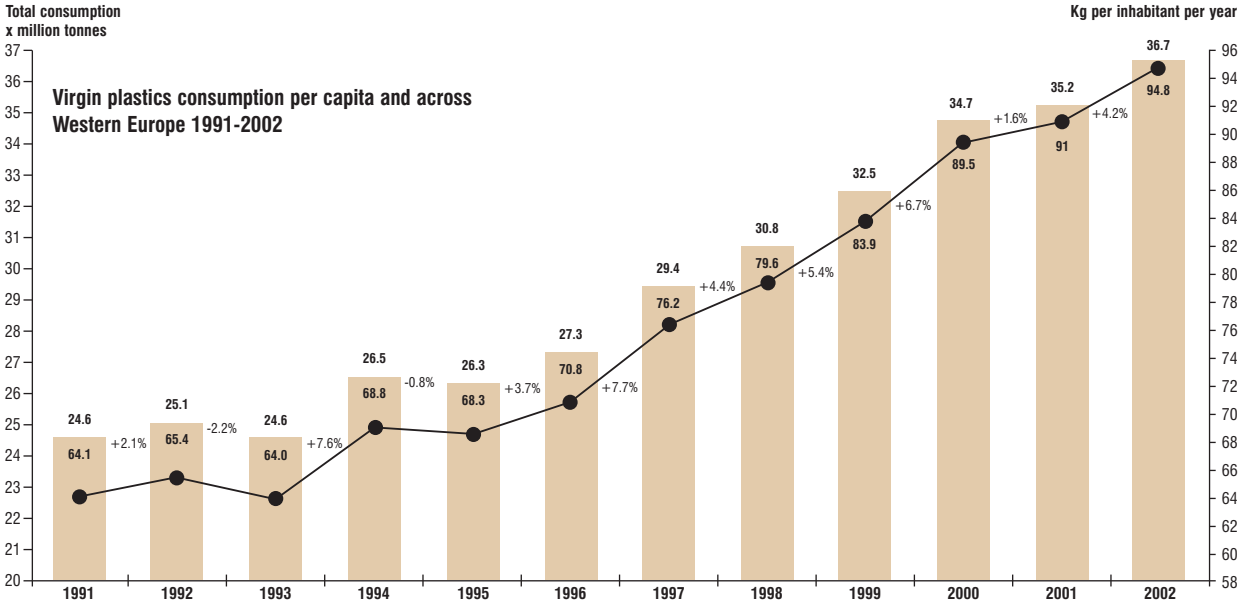
Consumption in Western Europe

Plastics processors' consumption by country, Western Europe 2001 (x 1 000 tonnes/year)

	Trend 2000/2001	% compared to the total	
Austria	-0.7%	1.9%	681
Belgium	-1.8%	3.6%	1 316
Denmark	-0.8%	1.6%	568
Finland	1.6%	1.2%	441
France	-0.9%	11.9%	4 367
Germany	3.8%	30.1%	11 009
Greece	8.1%	1.3%	463
Ireland	10.5%	0.6%	238
Italy	3.9%	18.7%	6 860
The Netherlands	3.4%	3.9%	1 412
Portugal	4.1%	1.6%	596
Spain	2.3%	8.9%	3 243
Sweden	2.1%	1.8%	649
United Kingdom	-1.3%	10.7%	3 903
Total EU	1.6%	97.6%	35 746
Norway	0.9%	0.8%	291
Switzerland	-0.7%	1.6%	574
2001 Western Europe	2.0%	100.0%	36 612
2002 Western Europe	*4.1%*	*100.0%*	*2002 38 123*

In 2002, the consumption of polymers for plastics applications in Western Europe was 38 123 000 tonnes, an increase of 4.1 per cent from 2001 and a total increase in consumption of 6 per cent from 2000. Each individual in the region consumed on average 94.8 kg of virgin plastics in 2002, up from 89.5 kg in 2000.

Virgin plastics consumption per capita and across Western Europe 1991-2002



The figures for 1999 and 2000 have been revised in accordance with updated data.

Data in this graph refer to consumption of virgin plastics in plastics applications.

Plastics consumption data generally refer to the final market of plastics products consumed by end-users in Western Europe. They may include recycled polymers but exclude non-plastics applications. Fibres, strappings, coatings, woodbondings, elastomers and composite packaging such as LDPE film in cartons for liquid food are considered as non-plastics applications. Furthermore, these data do not take into account the import/export flows of empty and filled packaging.

Consumption in Western Europe

Consumption of thermoplastics in Western Europe 2000-2002

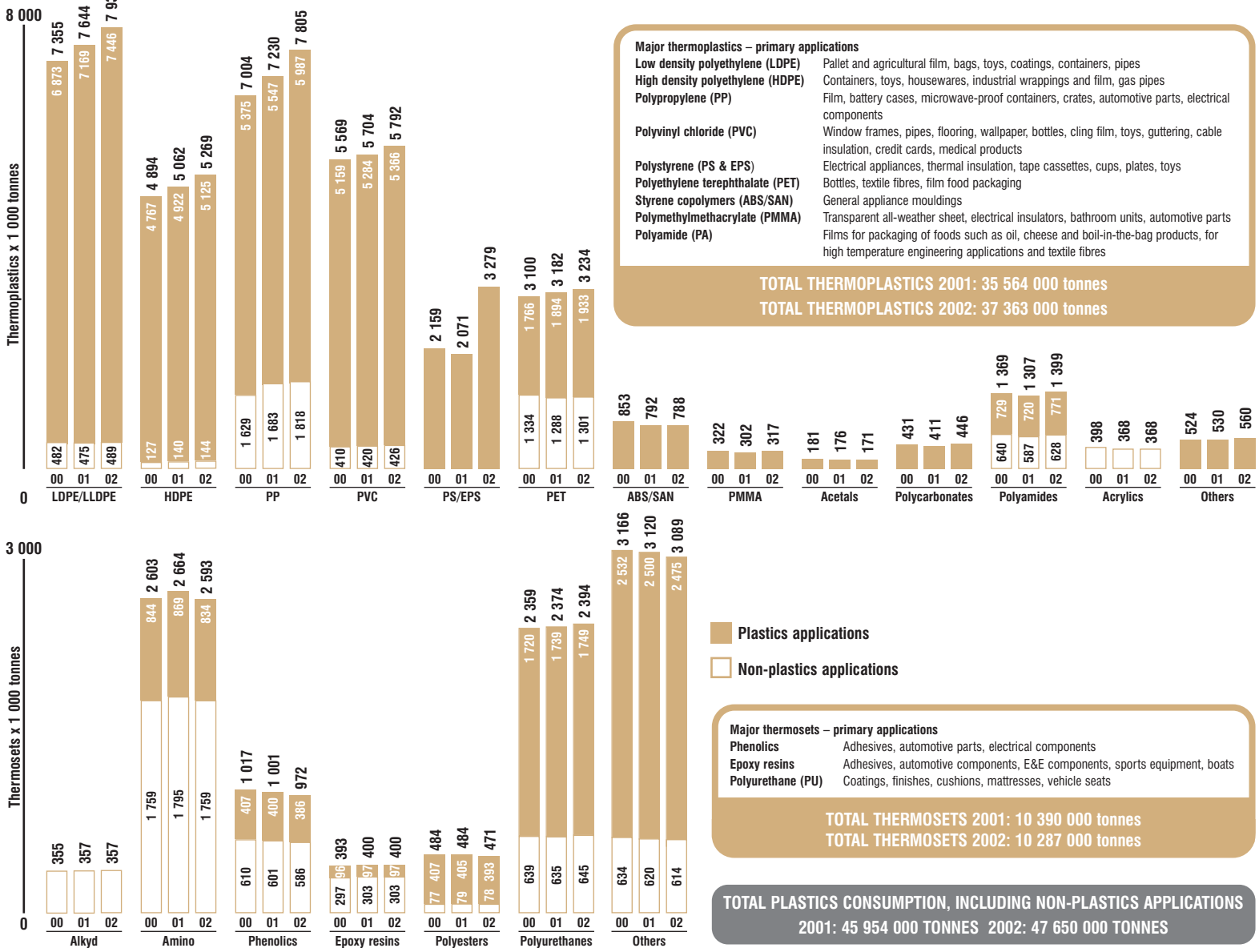
The total demand for thermoplastics across all applications rose by a total of 9.2 per cent across two years – from 34 159 000 in 2000 to 37 363 000 in 2002. Thermoplastics are not only used in the manufacture of many typical plastics applications, such as packaging and automotive parts, but also in non-plastics applications such as textile fibres and coatings. Non-plastics applications accounted for 13.9 per cent of all thermoplastics consumed.

In 2002 the large-volume, thermoplastic families of polyethylene (PE), polypropylene (PP), polyvinyl chloride (PVC), polystyrene (PS & EPS) and polyethylene terephthalate (PET) represented 78 per cent of total plastics consumption in typical plastics applications. Many of these demonstrated substantial growth, in particular PP with 11.4 per cent higher volumes, followed by LLDPE with a 7.9 per cent increase, and HDPE 7.7 per cent. However, PVC demand was relatively flat, particularly between 2001 and 2002.

Consumption of thermosets in Western Europe 2000-2002

The total demand for thermosets shrunk by just under one per cent in 2002 to 10 287 000 tonnes, compared with 10 376 000 tonnes in 2000. Demand for these polymers in non-plastics applications such as adhesives is stagnant. Demand for these polymers in plastics applications has decreased by 1.2 per cent over two years.

The proportions of thermosets used for plastics applications remained steady at 58 per cent.



Major thermoplastics – primary applications	
Low density polyethylene (LDPE)	Pallet and agricultural film, bags, toys, coatings, containers, pipes
High density polyethylene (HDPE)	Containers, toys, housewares, industrial wrappings and film, gas pipes
Polypropylene (PP)	Film, battery cases, microwave-proof containers, crates, automotive parts, electrical components
Polyvinyl chloride (PVC)	Window frames, pipes, flooring, wallpaper, bottles, cling film, toys, guttering, cable insulation, credit cards, medical products
Polystyrene (PS & EPS)	Electrical appliances, thermal insulation, tape cassettes, cups, plates, toys
Polyethylene terephthalate (PET)	Bottles, textile fibres, film food packaging
Styrene copolymers (ABS/SAN)	General appliance mouldings
Polymethylmethacrylate (PMMA)	Transparent all-weather sheet, electrical insulators, bathroom units, automotive parts
Polyamide (PA)	Films for packaging of foods such as oil, cheese and boil-in-the-bag products, for high temperature engineering applications and textile fibres

TOTAL THERMOPLASTICS 2001: 35 564 000 tonnes
TOTAL THERMOPLASTICS 2002: 37 363 000 tonnes

Plastics applications

Non-plastics applications

Major thermosets – primary applications	
Phenolics	Adhesives, automotive parts, electrical components
Epoxy resins	Adhesives, automotive components, E&E components, sports equipment, boats
Polyurethane (PU)	Coatings, finishes, cushions, mattresses, vehicle seats

TOTAL THERMOSETS 2001: 10 390 000 tonnes
TOTAL THERMOSETS 2002: 10 287 000 tonnes

TOTAL PLASTICS CONSUMPTION, INCLUDING NON-PLASTICS APPLICATIONS
2001: 45 954 000 TONNES 2002: 47 650 000 TONNES

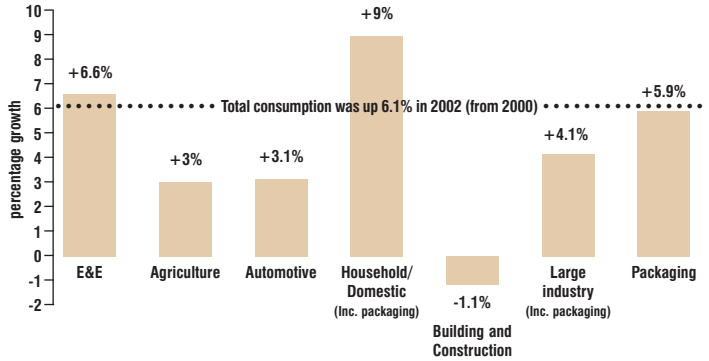
Consumption by industry sector

Demand for plastics remained strong across all industry sectors in 2002, continuing the growth trend and with no particular changes in relative consumption patterns. The packaging sector continues to be the major consumer of plastics. However, the building and construction sector, although still the third largest user of plastics at 18 per cent in 2002, showed a slight decrease of -1.1 per cent between 2000 to 2002. Despite this flat growth rate, which can be attributed to the general economic downturn, there were positive signs of recovery in this sector in 2002 and there is some hope that this may indicate the beginnings of a broader economic upturn.

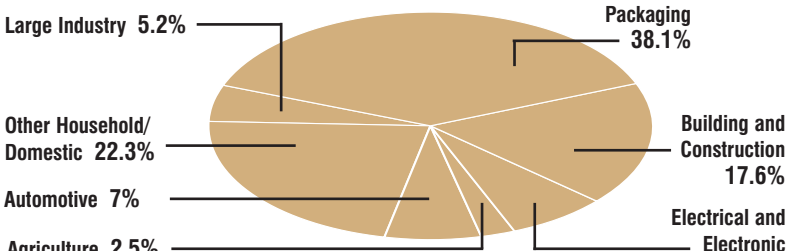
Packaging

The packaging sector remained the largest consumer of plastics in 2001-2002, accounting for 14 525 000 tonnes, or 38.1 per cent of all plastics consumed. Packaging also saw high growth rates between 2000 and 2001 at just over 3 per cent. This is because plastics packaging continues to be the material of choice for packaging, increasingly substituting other materials because they are light weight, flexible and easy to process. Over 50 per cent of all Europe's goods are now packaged in plastics, yet by weight these plastics only account for 17 per cent of all packaging. Thanks to continuing technological development by the plastics industry, plastics continue to do more with less. In fact, in a recent 10 year period, plastics packaging for a given unit has seen an average decrease in weight of 28 per cent. This means that thanks to their resource efficiency, although plastics rank first among packaging materials in terms of units sold, they are only third if judged on weight.

Growth in plastics consumption by sector (Tonnes) 2000-2002



Plastics consumption by industry sector Western Europe 2002



TOTAL CONSUMPTION, WESTERN EUROPE 38 123 000 TONNES

Agriculture

Although agricultural plastics account for just 2.5 per cent, 953 000 tonnes, of the total plastics consumed in Europe in 2002, they have a pivotal role to play in this sector. Plastics-based irrigation and drainage systems provide effective solutions to crop growing. For example, in the Almeria region of Southern Spain, plastics-based irrigation systems, greenhouses and films have helped boost horticultural output three-fold. Plastics' growth between 2000 and 2002 in this sector was 3 per cent.

Building & Construction

From insulation to piping, window frames to interior design, plastics are a key fabrication choice in the building and construction sector, providing durability and an aesthetically pleasing finish. This is reflected in the data showing that B&C consumed 6 710 000 tonnes of plastics in 2002 and accounted for 17.6 per cent of total consumption of plastics in Western Europe, making it the third largest user after the household and domestic and packaging sectors. However, there was a slight average decrease in plastics consumption between 2000 to 2002, which was due to the negative effects of the broader economic downturn. Data from 2002 indicates that there are some positive signs of recovery in this sector in 2002, which is hopefully indicative of a broader economic upturn.

Automotive

The demands on the automotive industry are a challenge for designers. Motorists want high performance cars combined with reliability, safety, comfort, style, competitive pricing, fuel efficiency and, increasingly, reassurance about the impact on the environment. With their unique combination of properties, the new generation of lightweight plastics is one family of materials rising to the challenge – and this is reflected in the volume of plastics being used in the automotive sector. Not only are plastics in the vanguard of innovative new automotive designs (Daimler Benz's Smart is a fine example), but it is estimated that plastics' light weight contributes to a 10 per cent per year reduction in passenger car fuel consumption across Europe. 2002 saw growth in the sector of 3.1 per cent to 2 669 000 tonnes.

Electrical & Electronic

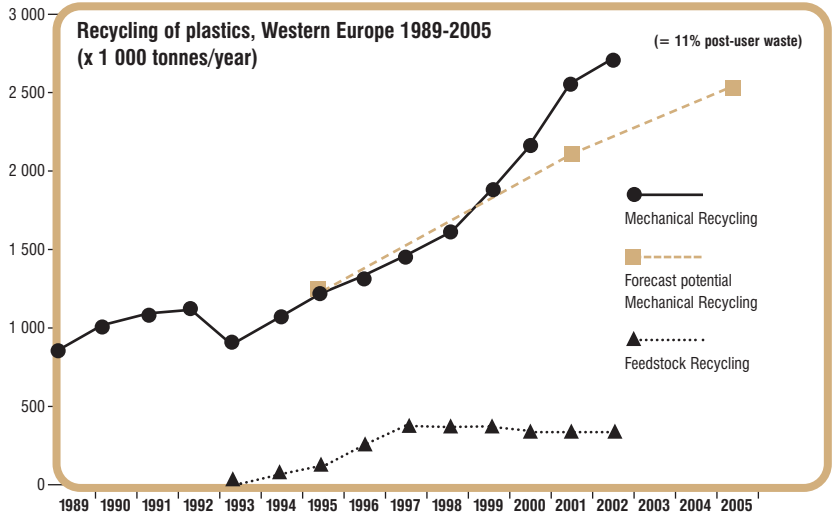
Many of today's new technical innovations capitalise on the latest types of plastics – and as a result devices are becoming smaller and lighter. However, this also means that while the number of E&E applications continues to increase, the weight of plastics used in each unit, as in packaging, tends to decrease. In 2001 and 2002, 2 783 000 tonnes of plastics were used by the E&E sector, up by 4.8 per cent on 2000.

Plastics waste management maximising diversion from landfill

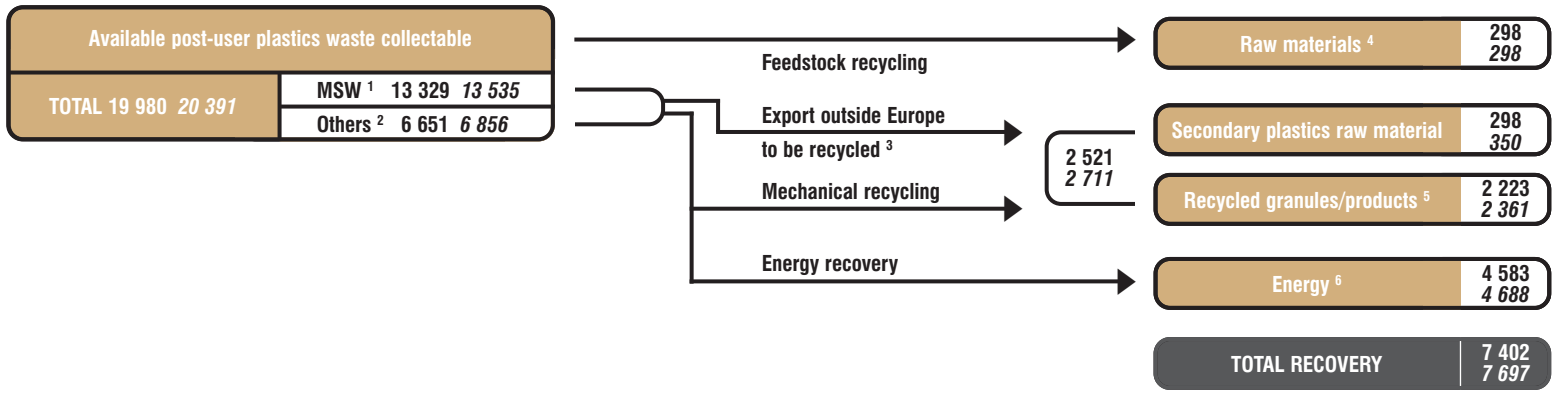
This year's research shows that between 2000 and 2002, the recovery of plastics waste has more than kept pace with the increase in consumption. Good progress was made in the collection for mechanical recycling, which saw a massive 22.5 per cent increase between 2000 and 2002, while energy recovery rose by 6.3 per cent.

- **Total recovery of waste from all plastics applications was 38 per cent in 2002**
- **Total recovery of plastics packaging waste increased to 49.4 per cent in 2001, driven by mechanical recycling**
- **The proportion of plastics recovered rose by 2 percentage points from 2000, more than keeping pace with consumption**

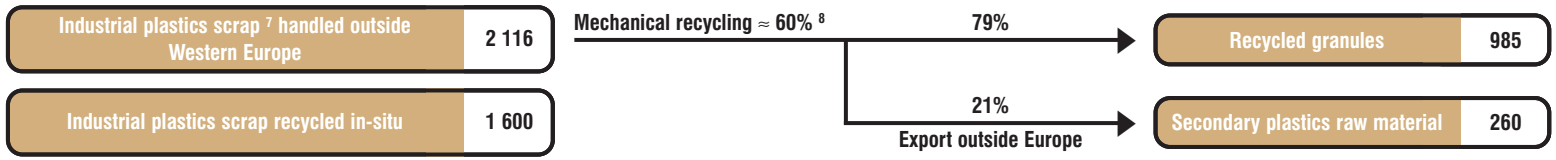
It is increasingly accepted that the single most effective environmental measure in relation to waste is its diversion from landfill. However, some EU Member States still have more than 80 per cent dependence on landfill. Such a loss of resources and impact on the environment is no longer acceptable and this is reflected in the EU Landfill Directive (1999) which obliges Member States to progressively reduce the amount of waste going to landfill to 35 per cent of 1995 levels within 15 years.



Plastics waste recovery in 2001 – breakdown by recovery route (x 1 000 tonnes/year) ***2002 data shown in italics***



Only 2001 data available here



1 Households and assimilated **2** Distribution and industry **3** Mainly to Asia **4** Methanol, Syngas **5** 85% granules, 15% plastic products **6** Of which 150/200 000 tonnes energy recovered in cement kilns **7** Processing, filling, assembling, installing, polymerisation
8 40% is not mechanically recycled but goes to cement kilns and municipal incinerators

The European plastics industry is committed to promoting recovery and minimising waste lost to landfill through a combination of waste management options. Based on the findings of exhaustive research plus the practical experience gained from the implementation of the Packaging and Packaging Waste Directive, it is clear that neither recycling nor energy recovery options alone can be sufficient – both are needed to achieve the most effective, eco-efficient, waste management solution.

The basic challenge for plastics is for waste recovery to keep pace with growing consumption. In 2001 and 2002, thanks to improving collection and separation infrastructures, this was achieved and more,

Plastics waste management maximising diversion from landfill

ensuring that a decreasing amount of this valuable resource was lost to landfill and the negative impact on the environment was reduced.

Although post-user plastics waste generation increased by 5.4 per cent between 2000 and 2002 to 20 391 000 tonnes, progress in recovery, and in particular recycling, greatly improved, ensuring an 11 per cent rise in recovery and an overall proportional rise of 2 per cent more plastics waste recovered in 2002. As a result, the amount going to landfill in 2002 rose only slightly and is estimated to be similar to the quantities landfilled in 1996.

Mechanical recycling – the material reprocessing of waste plastics by physical means into plastics products

Mechanical recycling is the European plastics industry's preferred recovery technique, provided plastics recyclate can replace virgin plastics on close to a 1:1 ratio. Between 2000 and 2002 there was a 22.5 per cent increase in the amount of post-use plastics waste recovered through mechanical recycling, from 2 213 000 tonnes in 2000 to 2 711 000 tonnes in 2002. This represented 13.3 per cent (up from 11.4 per cent in 2000) of total collectable plastics waste and resulted in a significant growth in the quantity of recyclate. The increase was due to improvements in packaging waste recycling. France, Italy and Spain improved their waste management systems and strongly expanded their packaging waste collection activity. Increasing quantities of collected waste was also exported *(see page 15)*.

The graph on page 8 indicates that the mechanical recycling of post-user waste throughout Western Europe has continued to increase year on year since 1993. At first sight it would appear that the initial forecast of a level of a potential of around 11 per cent of collectable waste is being comfortably exceeded. However, it should be noted that the original study, carried out jointly by TN Sofres and TNO in 1997, assumed there would be no export of waste outside Europe and that all the recycled material would be used in European markets. Correcting for the waste exports in fact brings the trend much closer to the original forecast. The availability of end-markets for plastics recyclate has been recognised as an important factor for the long term sustainability of high rates of plastics recycling. This is in contrast to other materials, for example paper, where appropriate end markets are not a limiting factor.

Looking specifically at the targets set by the European Packaging Directive, an average of 23.3 per cent of post-user packaging waste was mechanically and feedstock recycled across Western Europe in 2001, up from 21.3 per cent in 2000. In particular, progress has been made in Spain, United Kingdom, Norway, Italy and Denmark, pushing up the overall average.

A few countries did not meet the minimum 2001 target of 15 per cent of post-user plastics packaging waste to be recycled (Portugal, Greece and Ireland had been given longer to meet these targets).

If, as expected, the recycling target for packaging plastics is raised to 22.5 per cent by 2006 or 2008, this will mean a challenging increase in overall tonnage recycled, as the target applies to each individual member state. In fact compared to the situation in 2001, more than 0.5M tonnes (or around +30 per cent) additional quantities will have to be recycled.

Feedstock recycling – material reprocessing of waste plastics by conversion into basic chemicals, monomers for plastics or hydrocarbon feedstock.

The amount of post-user plastics waste sent for feedstock recycling levelled out and actually decreased between 2000 and 2001 by 0.9 per cent. As a whole, the development of feedstock recycling – where waste plastics are broken down into their basic chemical building blocks for making into new compounds including new plastics – has not progressed. Feedstock recycling has in principle great potential to boost plastics waste recovery levels, however in practice the amount of waste treated this way has not changed significantly since 1997. While a number of companies have successfully developed and demonstrated technologies, many of which can process mixed plastics streams, actual implementation is currently limited to Germany. Investments in new installations have been hindered by a combination of logistical and economic factors, as well as progress being made with other eco-efficient energy recovery technologies.

With the right conditions, other areas of feedstock recycling could also be developed – such as the de-polymerisation of PET or the treatment of PVC to make the production of new plastics.

Energy recovery

In 2002, 4 688 000 tonnes of post-user plastics waste was reclaimed through energy recovery in Western Europe. This represented 23 per cent of total collectable plastics waste. Because plastics are derived from oil, this gives them an overall calorific value equivalent to or greater than coal. This means that post-use plastics' energy value can be recovered via combustion in order to give that oil a second life.

Switzerland and Denmark recovered the most plastics waste via energy recovery in 2002 with each recovering 69 per cent. France continued its recent trend and recovered the most plastics waste via this route in tonnage terms in 2002.

Completing the recovery picture 1993-2002 (x 1 000 tonnes)

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Total plastics waste	**16 211**	**17 505**	**16 056**	**16 871**	**16 975**	**18 457**	**19 166**	**19 341**	**19 980**	**20 391**
Mechanical recycling	915	1 057	1 222	1 320	1 455	1 614	1 888	2 213	2 521	2 711
Feedstock recycling	0	51	99	251	334	361	346	329	298	298
Energy recovery	2 425	2 348	2 698	2 496	2 575	3 834	3 949	4 411	4 583	4 688
Total plastics waste recovered	**21%**	**20%**	**26%**	**25%**	**26%**	**31%**	**32%**	**36%**	**37%**	**38%**

While year-on-year figures give a clear indication of overall trends, the scope of data used has changed and there have been improvements in methodology. Although Figures have been re-evaluated to take such changes into account, comparisons between years should be treated with care.

Plastics waste in perspective

Despite the huge demand for plastics across all industry sectors, they continue to account for less than one per cent of total waste by weight. While total waste stood at almost 2 649 million tonnes in 2001, post-user plastics contributed just 20 million tonnes of this – 0.75 per cent. The sector breakdown of this plastics waste has remained broadly constant over time.

Total waste by sector, (all materials included), Western Europe 2001 (x millions of tonnes/% by weight)

Sector	x million tonnes	% by weight
Agriculture	1 041	39.3
Distribution & Industry	353	13.3
Building & Construction	449	17
Municipal Solid Waste	205	7.8
Automotive	15	0.6
Electrical & Electronic	7	0.25
Others (Mines, sludges, energy production)	557	21.8

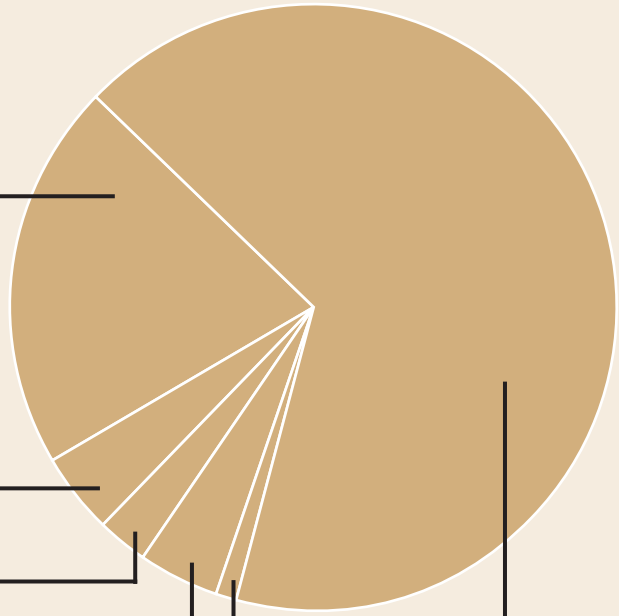
TOTAL WASTE 2 649 MILLION TONNES

of which total proportion of plastics

<1%

TOTAL POST-USER PLASTICS WASTE 19 980 000 TONNES

Total post-user collectable plastics waste by sector, Western Europe 2001
(x 1 000 tonnes/% by weight)



DISTRIBUTION & INDUSTRY (4 130) 20.6%

ELECTRICAL & ELECTRONIC (854) 4.3%

BUILDING & CONSTRUCTION (530) 2.7%

AUTOMOTIVE (851) 4.3%

MUNICIPAL SOLID WASTE (13 329) 66.7%

AGRICULTURE (286) 1.1%

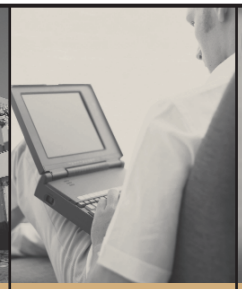
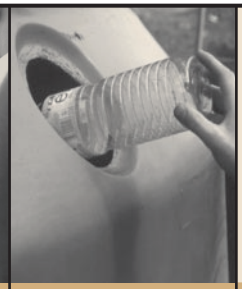
Plastics recovery in action

Mainly as a result of improving packaging collection systems and municipal incineration facilities, the highest quantities of plastics waste were recovered from municipal solid waste (MSW) – with a total of 5 190 000 tonnes in 2001. However, in proportional terms the most fruitful sectors are distribution and industry and agriculture. This chart shows that continued commitment to minimise the loss of valuable resources at end-of-life has ensured that plastics recovery has more than kept pace with consumption. While feedstock recycling rates have remained flat with 298 000 tonnes being recovered, mechanical recycling increased by 14 per cent between 2000 and 2001, to 2 521 000 tonnes – this is mainly due to improvements in packaging waste recycling including increased exports. Energy recovery remains the largest recovery route of collectable plastics waste in Europe at 4 583 000 in 2001, an increase of nearly 4 per cent on 2000. This is mainly achieved by utilising the energy from MSW incineration.

Breakdown by recovery route and by end-use sector, Western Europe 2001 (x 1 000 tonnes)





	Agriculture	Automotive	Building and Construction	Distribution and Industry	Electrical and Electronic	Municipal Solid Waste	TOTAL
Total available plastics waste collectable	**286**	**851**	**530**	**4 130**	**854**	**13 329**	**19 980**
Landfill and incineration*	125	755	472	2 271	816	8 139	**12 578**
Energy recovery	0	35	0	441	4	4 103	**4 583**
Feedstock recycling	0	0	0	0	0	298	**298**
Mechanical recycling within Europe	147	61	58	1 193	32	732	**2 223**
Mechanical recycling for export	14	0	0	225	2	57	**298**
% total recovery as a proportion of end-use waste	**56.3%**	**11.3%**	**10.4%**	**45%**	**4.4%**	**38.9%**	**37%**

*Without energy recovery

Managing plastics waste by sector

The case studies examined over the next two pages highlight the ways in which the industry is striving to maximise the resource efficiency of plastics through a range of pan-European initiatives and partnerships. Recovery of plastics waste naturally varies by application sector – both in terms of quantity and method of recovery. APME is involved with a number of partners and projects including some EU co-funded initiatives to further knowledge and facilitate appropriate recovery systems throughout Europe and across the various sectors. These include partnerships with ACRR (Association of Cities and Regions for Recycling), ASSURRE (Association for the Sustainable Use and Recovery of Resources in Europe), plus a number of proposals involving research and development into recycling in which APME is involved as a partner.

Packaging

Plastics are used to package more products than any other material, which is why in 2001 and 2002, the packaging sector was once again the largest consumer of plastics. Continuing technological innovation has improved efficiencies in plastics packaging, to the extent that the weight of packaging for a given article has been reduced by 28 per cent over a recent ten year period. At the same time, plastics have increasingly substituted more traditional materials, such as glass and metals, which goes someway to explain the 9.4 per cent growth in plastics consumption between 2000 and 2002.

Compared to traditional materials such as glass and metals, plastics packaging represents something of a challenge in terms of mechanical recycling due to the composition and diversity of plastics used and the fact that waste is often dirty and/or contaminated. The table on the right which shows the plastics packaging waste recycling breakdown for 2001 by country. Although most countries have increased their plastics packaging recycling rates, challenges still remain for them to meet the minimum recycling targets. This is due to a number of factors including geography and demography that can have a significant impact on availability of an economic source of plastics waste. Nevertheless, in terms of the total recovery of plastics packaging waste in Europe, comparing recovery in 2001 to 2000, the rate increased from 46.9 per cent in 2000 (updated data) to 49.4 per cent in 2001, as a result of increased mechanical recycling.

Automotive

The presence of some large, homogeneous waste streams from this sector (for example, bumpers and batteries) means that, compared to other plastics components, the potential for mechanical recycling is somewhat greater, due to easier dismantling and separation. In fact, battery recycling is now a mature activity and for about 80 per cent of the batteries discarded (for new cars and for spare) plastic is mechanically recycled. However, except for 8 to 9 kilotonnes of bumpers, the recycling of other car parts appears to be difficult to develop. Even for bumpers, the filler content, the high proportion of painted bumpers and the wide spectrum of densities make manual sorting very difficult. Developments are continuing to assess the potential of various treatment and recovery options for plastics contained in the light shredder fraction, as it is expected that the largest proportion of plastics will be found here.

It is estimated that just over 11 per cent of automotive plastics waste was recovered both from repair shops and end-of-life vehicles in 2001. Some 61 000 tonnes of this was recycled, mainly PP from batteries and bumpers – in line with the findings of the TNO/APME report, *Best Practices for the Mechanical Recycling of Post-User Plastics*. This is because large single polymer parts are easier to dismantle and recycle, while smaller, multi-polymer parts present a greater challenge. Differences in performance by country also remained, with recycling rates over 10 per cent being found only in Austria, France, Germany and The Netherlands.

Plastics packaging waste recycling, 2001

Mechanical recycling rate, %	Country
> 20%	Austria, Belgium, Germany, The Netherlands
15 – 20%	Spain, Denmark, Italy, UK
10 – 15%	Sweden, Finland, France, Ireland
5 – 10%	–
0 – 5%	Portugal Greece

TOTAL MECHANICAL RECYCLING (MR) IN 2001 = 2 156 000 TONNES (20.6% rate)

TOTAL ADDITIONAL MR TONNAGE NEEDED BY 2006 FOR 22.5% PROPOSED TARGET BY COUNTRY	0.5M (+30%)

Recycling rates as estimated here are measured as a percentage of collectable waste. This in general tends to result in higher figures than if rates were calculated as a percentage of packaging put on the market.

Electrical & Electronic

The closely integrated nature of E&E products such as mobile telephones, TVs and VCRs means that glass, plastics and metals are frequently combined with one another, making waste treatment difficult. Plastics are never the key driver for recovery – it is the precious metals or hazardous materials (for example, lead in cathode ray tubes) contained in the equipment. Plastics that are recovered from items such as mobile phones can be used as a source of energy. For larger equipment, such as refrigerators, the same shredding equipment as end-of-life vehicles (ELVs) is used. The possibility of dismantling some parts for recycling prior to shredding can also be considered but a recent eco-efficiency study indicates that such options may be limited.

The fact that E&E recovery is still an industry under development adds to the challenges facing this sector, and means that the total recovery, as a proportion of end-use plastics waste, stood at around 5 per cent in 2001 – equivalent to 38 000 tonnes.

It is forecast that the theoretical collectable plastics waste in WEEE (waste E&E equipment) will grow to some 1.1 million tonnes by 2005 (source SOFRES 2000). A recent independent European study commissioned by APME and carried out by TNO examined waste treatment scenarios for plastics from end-of-life electrical and E&E (with a specific emphasis on the plastics fraction). It

is explained that E&E equipment consists of a number of materials, which means that plastics cannot be considered on their own when looking at the best recovery options. Therefore, depending on what is being recycled, the elimination of hazardous substances or recycling of precious metals can dominate the eco-efficiency score of end-of-life processing of E&E equipment. If these are the main driving forces for dismantling (and homogeneous plastic streams are obtained) then mechanical recycling may be a suitable option when market outlets exist.

case study

APME and ECVM (European Council of Vinyl Manufacturers) are involved in a joint study with ACRR (Association of Cities and Regions for Recycling) aimed at assessing the potential for increasing the recycling of plastics in building, construction and demolition. The project is focusing on a collective of municipalities in both Porto and Catalonia. It aims to build on best practices with the intention to roll out the findings to other municipalities to increase recycling from this sector.

Building & Construction

The B&C sector offers some scope for mechanical recycling, due to the concentration of larger, single polymer applications such as pipes and window frames. However, collection and separation of materials is the challenge and APME is currently assessing the true potential in this area – in particular for PVC products. As a result, 2001 data shows that 10.4 per cent of collectable building and construction waste was recycled for a second life. At a national level, Denmark, Finland, Germany, The Netherlands, Sweden and the UK exceeded this rate; Sweden achieved an impressive 55 per cent, and Germany 22 per cent. While there is currently little legislation in this area, there are a number of voluntary schemes targeting specific products such as window frames and pipes, which, as single polymer items, are the most practical candidates for recycling.

Agriculture

Although not a large user of plastics, this sector offers potential for mechanical recycling, particularly of agricultural film used in greenhouse and dry climate areas. These films are extensively collected and, in general, the recycling activity is economically viable. Therefore, although situations contrast from one country to another, overall high recovery rates were achieved in this sector during 2001 – 56 per cent for Western Europe.

case study

APME is working through ASSURRE (the Association for the Sustainable Use and Recovery of Resources in Europe) and other partners in an EU-funded project entitled 'Waste to Energy – Isles'. The project, which is due for completion in 2003, is concerned with developing an integrated approach to resource management, including recycling, focusing in particular on implementing energy-from-waste recovery options. Its focus is on 12 island communities stretching from northern to southern Europe, all of which are at different stages of development and sophistication. There are a broad range of scenarios in these communities. Some have only basic recovery infrastructure, while others claim to be totally sustainable. The project provides advice on technologies and strategies to help assess the viability of energy recovery in these different communities.

Seven countries achieved rates of over 50 per cent – Denmark, Finland, Ireland, Italy, The Netherlands, Spain and Norway. There is no European legislation affecting agricultural plastics – and most of these schemes are voluntary. The success in this sector reflects the importance of a regular, easily accessible supply of large quantities of homogeneous plastics waste and suitable end markets, which make plastics economically attractive to recover.

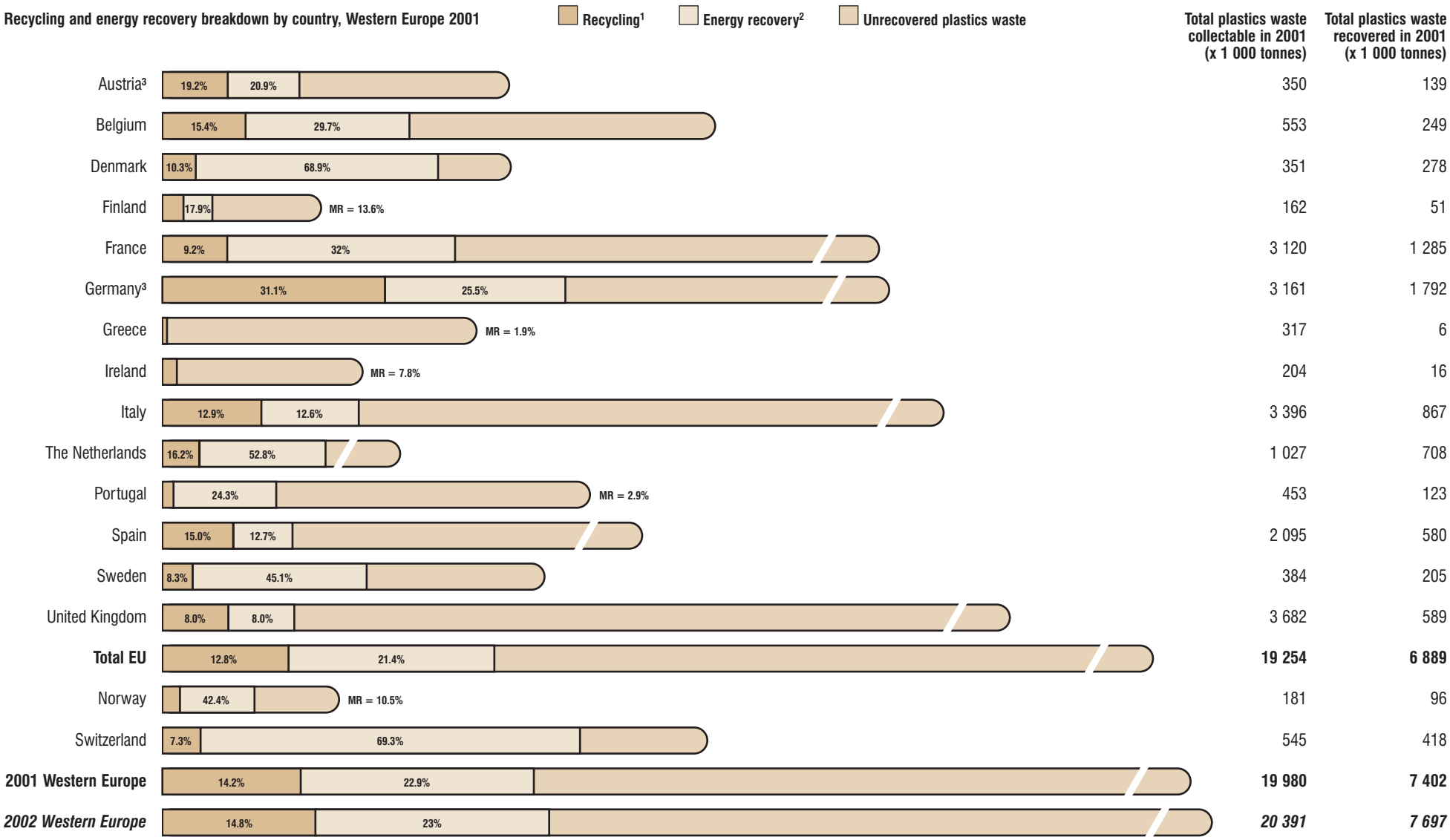
identiPlast

Automatic identific
sorting and separat
plastics from dif
waste streams

case study

The European plastics industry's commitment to the development and implementation of various recycling options inspired the 4th biennial Identiplast conference, which took place in April 2003 and was hosted by APME over two days. The conference, which has become a landmark in the plastics world, brought together an international audience from four world regions including associates from North America and Japan, to identify the opportunities of plastics recycling through the sharing of information and best practices. The event – renowned for the quality of its speakers, drew an impressive array of plastics producers, convertors, recyclers, recycling compliance organisations, equipment developers, OEM's, academic institutes, media and EU Commission representatives to discuss the latest challenges, opportunities and technologies in the field of plastics recycling. The programme built on the success of previous conferences. It included a broad range of the latest developments in plastics separation and sorting technologies, equipment and practical experiences from various countries. The conference provided a platform for the European plastics industry to highlight technological progress, while simultaneously demonstrating the commitment of the global plastics industry to facilitate plastics recycling.

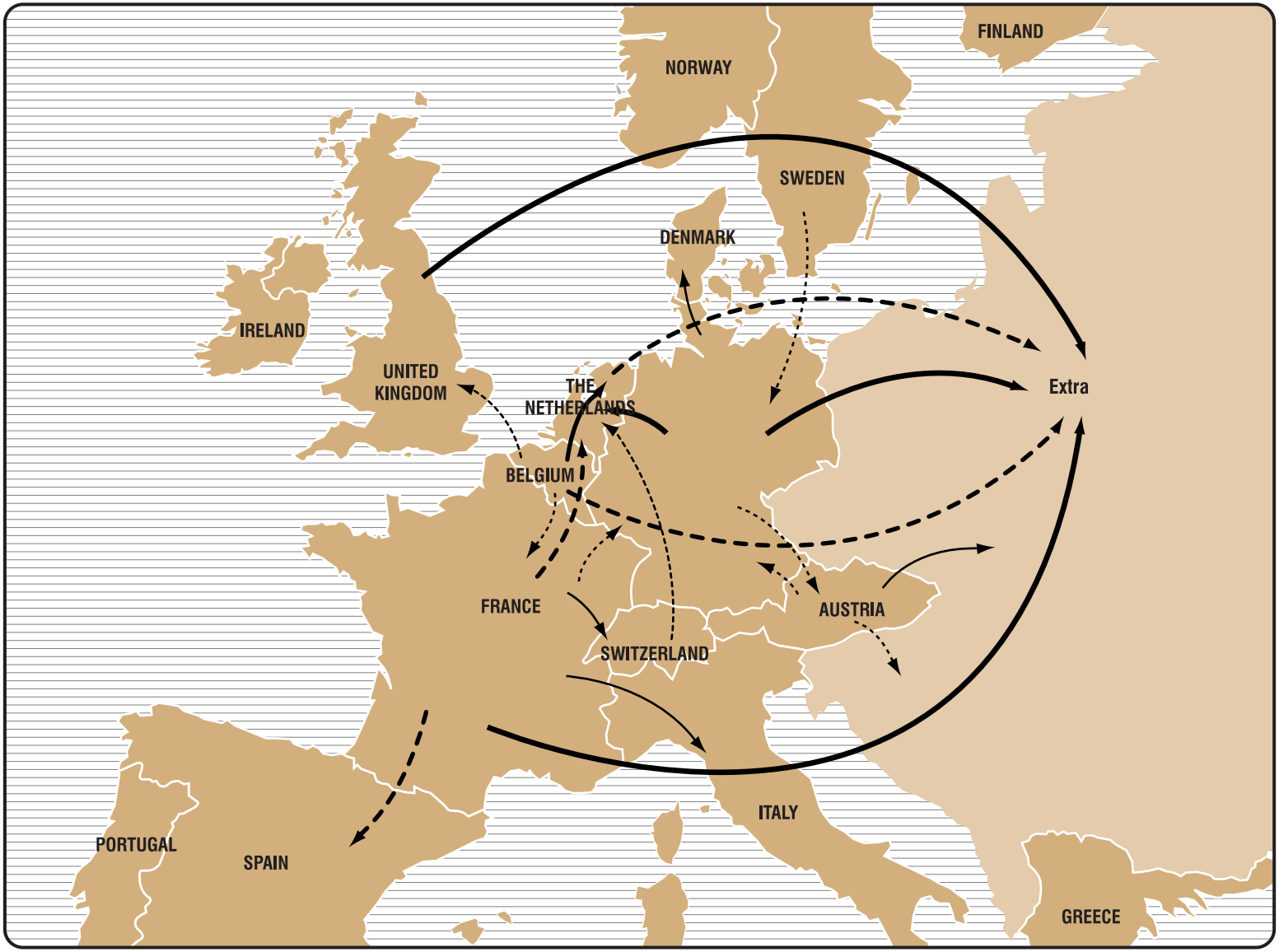
An overview of recovery in Western Europe



1 Recycling ratio = (local waste recycled + waste exported to be recycled)/waste collectable **2** Energy recovery ratio = energy recovery/waste collectable **3** Recycling in Austria and Germany includes feedstock recycling **4** For clarity all figures are rounded to nearest 1 000

Trade in post-user plastics waste 2001

Two opposite trends can be observed between 2000 and 2002: intra-EU plastics waste shipments decreased by 21.4 per cent, while plastics waste for export outside Western Europe increased by 54.4 per cent. In other words a significant part of the former intra-EU trade flows have been re-orientated towards non-EU markets, particularly Asia. This is due to economically attractive waste reprocessing deals outside Europe. However, while exports of post-user plastics waste outside Western Europe have increased further in 2002, there appears to be some levelling off.

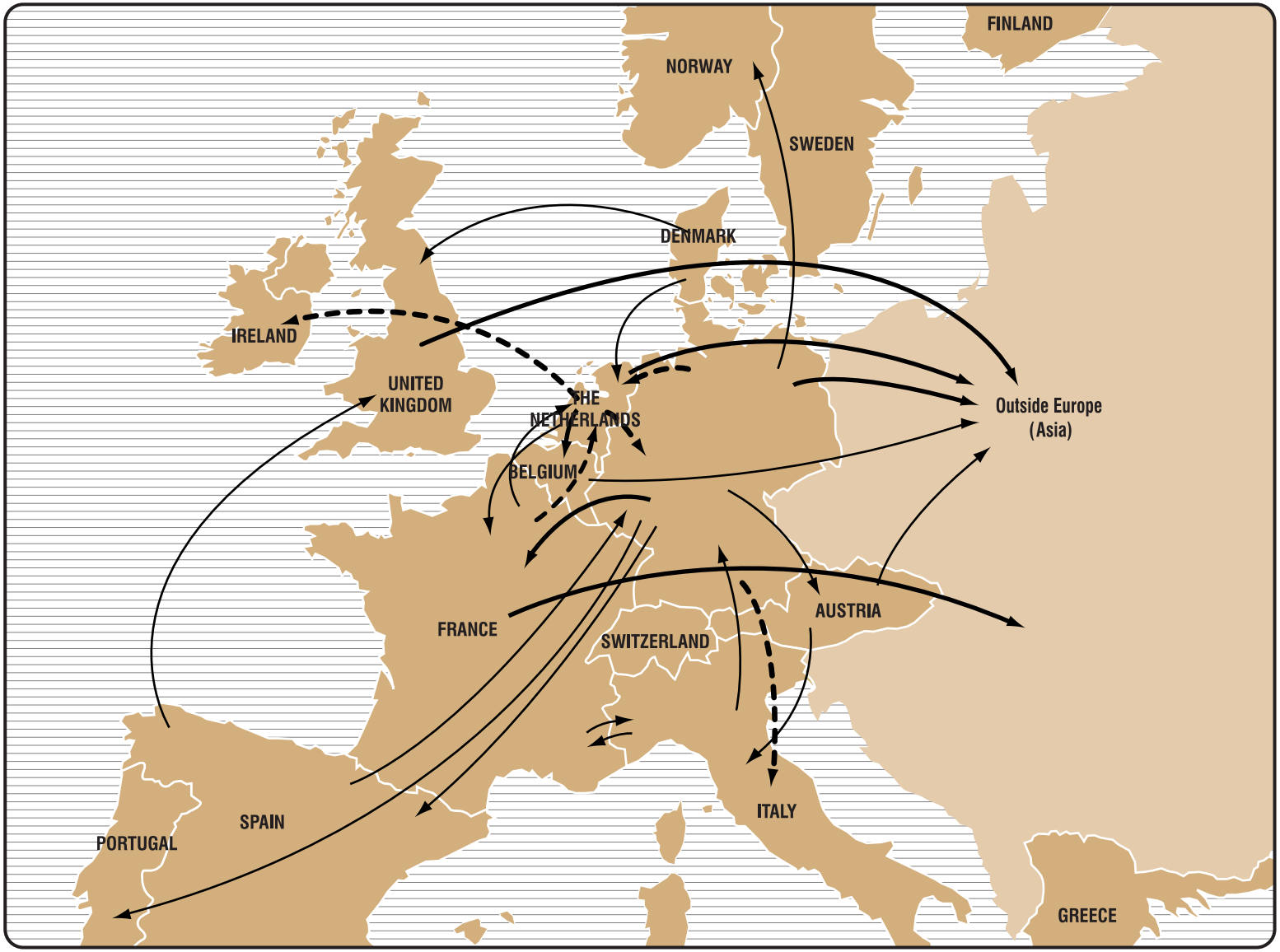


2001 Streams

- 3 – 5kt/year
- 5 – 15kt/year
- 15 – 25kt/year
- 25+kt/year

Trade in granulate from post-user plastics waste 2001

In addition to the intra-EU trade of recycled granulate across national boundaries, there continued to be substantial trade in granulate being exported outside Europe. This was due to the better price and demand in end user markets outside Europe.



2001 Streams

- 5 – 15kt/year
- 15 – 25kt/year
- 25+kt/year

Consumption in EU Accession Countries

For the first time, this report details consumption and recovery figures for the 12 countries due to join the EU in the coming years. These countries – Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia, Cyprus, Malta – represent some 105 million inhabitants, 21 per cent of the enlarged EU zone.

Data from these countries will be analysed and reported on an annual basis, allowing the mapping of trends in these countries over a period of time. It should be stressed that the data for these countries, as shown in this first expanded report, is necessarily not as complete as for other countries. Data covers the period up to 2001 although not all countries have data up to that date.

However, clear patterns and comparisons with other countries are visible even at this stage.

Plastics consumption

Plastics processors' consumption across the 12 countries in 2001 totalled 3.7 million tonnes, averaging out at 35 kg per head of population (compared to 91 kg in Western Europe). The potential for future growth is high.

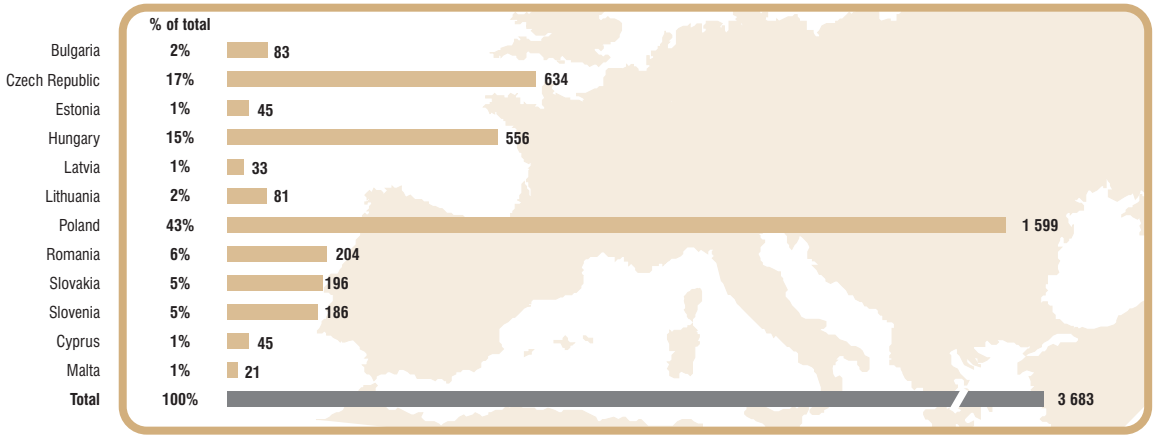
Significant growth was noted in the Czech Republic (30 per cent), Hungary (9 per cent) and Poland (9 per cent) on the previous year, driven primarily by growth in PET and PP applications. Poland is the largest consumer overall with 43 per cent of the total, and appears to be the sole country producing engineering plastics. However, small quantities are produced elsewhere.

A key growth area is packaging. Per capita consumption stands at 70-85 kg per head (compared to 180 kg in Western Europe) but the proportion of plastics within that total is increasing considerably, due to the development of distribution centres, PET bottles and the latest development in pharmaceutical and cosmetic packaging and fast food. Growth in PVC (5 per cent) is also strong due to the continued boom in the construction sector.

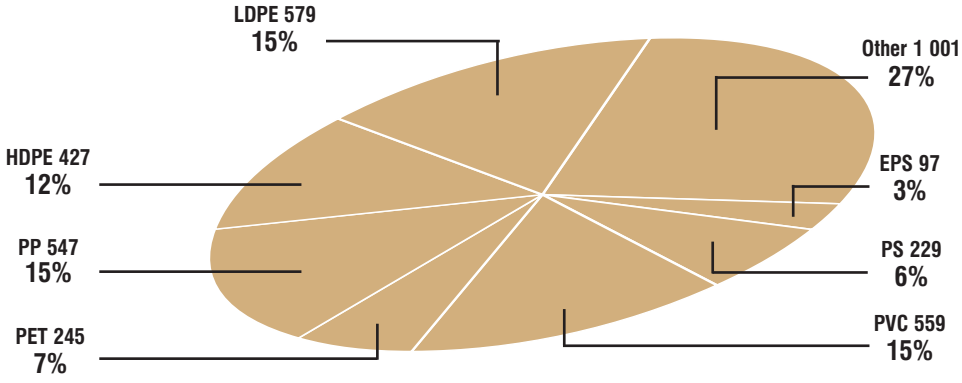
Reliable data on waste and recovery is particularly difficult to obtain across all countries. However, in general it can be stated that collection and recovery schemes remain in their infancy in most countries although some advances have been made in the Czech Republic, Poland and Slovakia since the mid 90s, and more recently, in the Baltic States.

Total waste from the 12 countries, across sectors is estimated at 424 070 000 tonnes per annum, of which MSW accounts for just over 37 000 000 tonnes (8.7 per cent), slightly ahead of the proportion in Western Europe. Plastics waste, as in Western Europe, accounts for under 1 per cent by weight of total waste generated.

Plastics processors' consumption by country, Accession countries, 2001 (x 1 000 tonnes/year)



Plastic consumption by polymer, Accession countries, 2001 (x 1 000 tonnes/year)



TOTAL **3 683 000 TONNES**

Plastics waste, collection and recovery in EU Accession Countries

Evaluation of the MSW fractions, Accession countries, 2001 (x 1 000 tonnes)

	Total MSW (all materials)	Of which		MSW per capita (kg/year/hab.)
		Household and assimilated	Bulky waste and other	
Bulgaria	3 300	2 013	1 287	402
Czech Republic	3 400	2 400	1 000	333
Estonia	633	570	63	452
Hungary	4 300	2 537	1 763	430
Latvia	780	515	265	325
Lithuania	1 236	1 236	0	334
Poland	13 500	9 315	4 185	350
Romania	6 600	5 412	1 188	295
Slovakia	1 650	1 056	594	311
Slovenia	1080	886	194	540
Cyprus	369	306	63	461
Malta	188	105	83	470
TOTAL	37 036	26 351	10 685	351

OF WHICH PLASTICS CONSTITUTES 6 – 11% BY WEIGHT (3m TONNES)

Plastics packaging mechanical recycling in Accession countries, 2001

	Plastics packaging waste (household + distribution) (x1000 tonnes)	Mechanical recycling (%)	Comments
Bulgaria	143	Probably very low	
Czech Republic	98	6 to 7%	A structured plastics recycling activity has emerged. About 20-30 per cent of one-way PET bottles are collected and sorted. Through Eko-Kom and recyclers (the main one being SILON), they are recycled, mainly into fibres
Latvia	26	n.a.	Some facilities exist for PE recycling, but these are not currently operating at full capacity or on any significant scale
Lithuania	47	9%	14 ktonnes of post-user, of which 11 ktonnes imported
Poland	454	8 to 9%	RekoPol claims a 3.5 per cent plastics recycling rate at the end of 2001. This is coherent with another source indicating that municipalities have collected about 17 ktonnes of plastics packaging waste for mechanical recycling (RekoPol) in 2000. According to non-official data, about 90 ktonnes of plastics waste was mechanically recycled in 2001. However, this volume probably includes a majority of processors waste. As a whole, the total volume of plastics packaging recycled was about 40 ktonnes
Romania	348	2 to 3%	Only 1 to 2 per cent of plastics packaging is recovered by scavengers. However, in the last two years some private economic entities have initiated a sustained collection of packaging cardboard waste and PET bottles from large generating sources. Collected materials are exported to Hungary, Bulgaria, Italy, China or Korea
Slovakia	55	3%	2 to 3 ktonnes recycled
Slovenia	52	3%	

Collection

Collection and recovery of plastics suffers along with other materials due to the limited collection infrastructure noted above. However, there are pockets of activity. In particular, Poland has seen growth in the collection of packaging waste in its big cities over the last five years and the country as a whole now has organised waste collection covering 90 per cent of its inhabitants.

A significant barrier to recovery exists across the region in the form of fly tipping – leading to around 10 per cent of all MSW being uncollectable in urban areas. In rural areas the problem is still worse, with the figure rising to 20-50 per cent.

As a whole, around 80 per cent of all waste is landfilled.

Recovery

Recovery levels overall remain low – largely due to a previous lack of political pressure and high cost – and is based mainly on plastics waste imports. However, some countries, such as Poland and the Czech Republic have set up recovery infrastructures which are starting to have some effect.

In terms of mechanical recycling, plastics packaging waste is the chief sector activity, primarily led by PET bottle recycling. Structured systems have been set up in Poland and the Czech Republic, mainly recycling into fibres.

ELV recycling remains undeveloped, despite an ageing vehicle profile across the region and the fact that the number of scrapped cars increased 50 per cent between 1995 and 2001.

Figures for the specific energy recovery of plastics are not available. However, energy recovery as a whole remains low with around 2 per cent of MSW recovered in this way. Again, there are prominent exceptions. Slovakia registers a 15 per cent rate of recovery in this way, Hungary 8 per cent (although the central incinerator is likely to close soon) and the Czech Republic 5 per cent (around 100kt of plastics waste were recovered in 1999 through co-incineration in cement plants).

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Note: Those references marked (*) are available and downloadable from the APME Web site: www.apme.org

APME represents the polymer-producing industry at European level. Its membership today includes around 50 companies representing well over 90 per cent of Europe's polymer production, with a turnover of more than 29 billion euro. Combined with the European polymer converting industry and the machinery manufacturers, the plastics industry represents a major contributor to Europe's economic strength employing well over one and a half million people and generating sales in excess of 159 billion euro.

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APME
ASSOCIATION OF PLASTICS MANUFACTURERS IN EUROPE

Data for the report in was collected through numerous contacts: plastics manufacturers (18), plastics manufacturers associations (25), professional associations (38), Ministries of the Environment (22), environment agencies (21), waste management associations (75), plastics recyclers (30), waste collectors (15), incinerator plants (5), cement kiln groups (5), coal fired plants (2) and other players involved in plastics recovery in the major European countries (consultants, magazines, associations, - (50)). As a whole, around 500 companies were contacted to update the survey. APME and AJI-EUROPE Consulting would like to thank all contributors for their generous help.

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