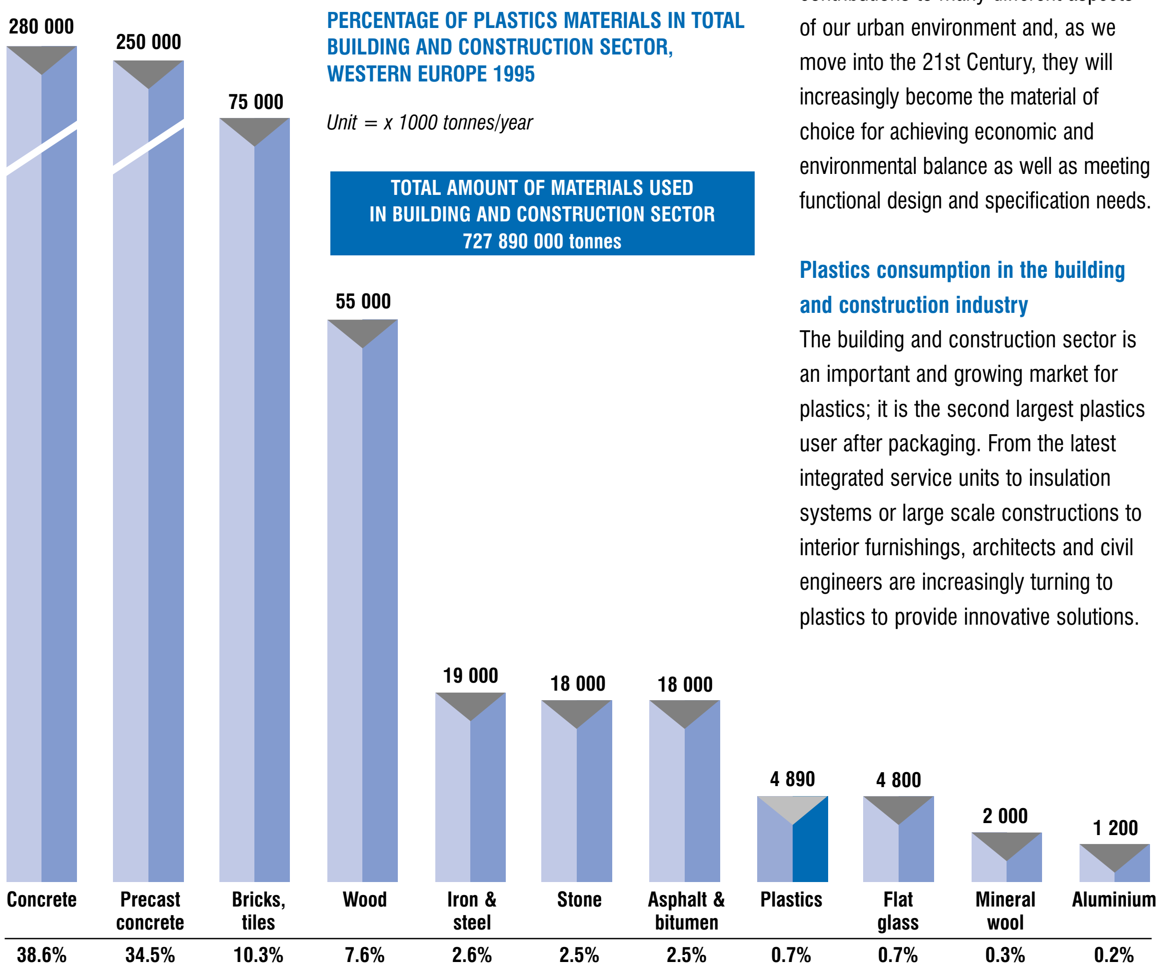
A MATERIAL OF CHOICE IN BUILDING AND CONSTRUCTION

Plastics consumption and recovery in Western Europe 1995

APME
ASSOCIATION OF PLASTICS
MANUFACTURERS IN EUROPE

Balancing the building and construction needs of a booming global population with the protection of the natural environment is one of the greatest challenges facing city planners, architects and civil engineers today.



Plastics have made enormous contributions to many different aspects of our urban environment and, as we move into the 21st Century, they will increasingly become the material of choice for achieving economic and environmental balance as well as meeting functional design and specification needs.

Plastics consumption in the building and construction industry

The building and construction sector is an important and growing market for plastics; it is the second largest plastics user after packaging. From the latest integrated service units to insulation systems or large scale constructions to interior furnishings, architects and civil engineers are increasingly turning to plastics to provide innovative solutions.

During 1995, 4.89 million tonnes (20 per cent of the total amount of plastics used) was required by the building and construction sector. Compared to other materials the total volume of plastics used is small but they make a significant contribution to a huge variety of applications. Plastics' versatility combined with their durability, strength, cost effectiveness, low maintenance and corrosion resistance make them a resource-efficient choice.

Buildings created since the 1950s will almost certainly contain plastics in applications such as piping, windows, roofing, flooring, cable sheathing, ducting and insulation. More recently, architects' specifications also include washroom furniture and kitchen fittings. Today, advanced composites and resins are meeting new challenges providing high performance benefits that other materials cannot achieve.

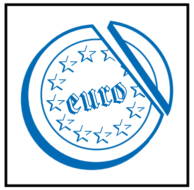
Professor Jan Brouwer, a leading Dutch architect, states that "in the future, there will be few construction needs that plastics and advanced resins cannot meet". Indeed, experts predict that consumption will rise to almost eight million tonnes by the year 2010, but even that figure will pale in comparison with those of succeeding generations as the remarkable qualities of plastics are more widely recognised.

PLASTICS • Meeting today's building and construction needs

Why use plastics? *Polymers have a number of vital properties which, exploited alone or together, make a significant and expanding contribution to our building and construction needs.*

Durable and corrosion resistant
plastics are durable, making them ideal for applications such as window frames and pipes which can last for over 20 years. In addition, plastics resist corrosion from water and many chemicals, reducing the wear and tear and increasing longevity.

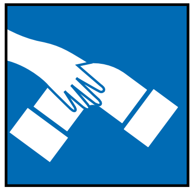
Insulation
plastics provide effective insulation for cold, heat and sound, saving energy and reducing noise pollution.



Cost effective
plastics components are often more economical to produce in custom-made forms, they are durable, resistant to corrosion and have a long life.

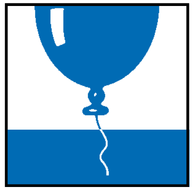
Maintenance free
because of their durability, maintenance such as painting, is minimised and often removed completely.

Hygienic and clean
plastics are a hygienic choice for household surfaces and floor coverings because they are impermeable and easy to clean.



Ease of processing/ installation
plastics' mouldability means that often several components can be combined in one, making them easy to manufacture and install.

Environmentally sound
plastics save resources through cost-effective production, ease of installation and long-life. After use, plastics can be re-used, recycled, or turned into a source of energy.



Light weight
plastics' light weight contributes to reducing man hours and the need for heavy equipment, such as cranes. Plastics are also easier to transport and store.

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Plastics solutiohs in action

Plastics – building for strength and durability
Today, civil engineers are able to exploit the new dimensions of creative planning and design made possible with polymers.

- **Bridges capable of withstanding the heaviest vehicles now include plastics. Expanded polystyrene (EPS) foam, which acts as a void filler is used to reduce a bridge's total deck weight. Aerial pedestrian walkways constructed using complex yet lightweight polymer resins have been built in a fraction of the time and cost required with other materials, and without the need to employ major construction equipment.**
- **The world's first advanced composites road bridge was built at Bond's Mill, across the Stroudwater Canal in Gloucestershire, UK in 1994. It is 8.2 metres long and 4.3 metres wide and capable of carrying vehicles weighing up to 40 tonnes. The use of lightweight polyester resin sections removed the need for either a lifting tower or a counterweight. It also enabled foundations from the previous fixed bridge to be reused with minimum modifications.**

Plastics – creating networks across Europe
Plastics are a popular choice for modern water, gas and sewage piping. They offer high corrosion but low flow resistance to the fluids they carry, can be used above or below ground, and are easily manufactured in a range of shapes and sizes. Plastics liners and inserts help to repair and restore thousands of miles of ageing concrete and clay piping, saving huge amounts of money and minimising disruption that is often necessary to replace damaged underground systems.

- **Le Stade de France has been built to host the country's major sporting events, including the 1998 World Cup. A PVC membrane was specified for the roof of the stadium because of its many qualities in construction applications. PVC is lightweight, strong and durable enough to withstand wind and light, and is reliable, safe, flexible and easy to install cost effectively. PVC was also used for the drainage systems under the turf and the piping systems laid under the floor slabs of the stadium.**

Plastics – controlling interior climates
Plastics are setting and meeting new standards. Solar co-generation systems now rely on plastics to collect, store and distribute energy throughout buildings and are designed to be self maintaining and have a low impact on the environment.

- **Keppler University in Linz (upper Austria) has developed a plastics solar cell system which can be inserted into panes of glass to reduce heating costs. The invention follows the natural principles of photosynthesis, whereby light falling through the window is captured by the solar cells and converted into a source of electricity.**

PLASTICS DEMAND

Today, construction accounts for 20 per cent (4.89 million tonnes) of Western Europe's total plastics consumption of 24.9 million tonnes.

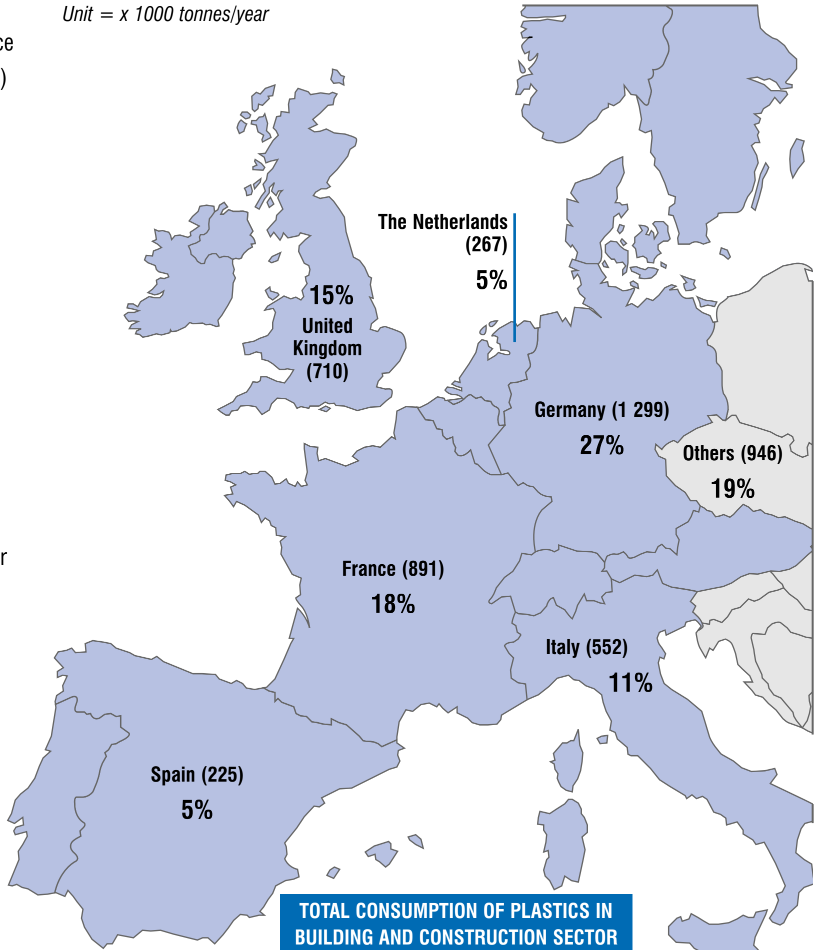
Within Western Europe the German building and construction industry is the largest individual user of plastics (1.29 million tonnes), followed by France (891 000 tonnes), UK (710 000 tonnes) and Italy (552 000 tonnes). The Dutch building and construction industry accounts for one quarter (267 000 tonnes) of the country's total plastics consumption, the highest percentage in Western Europe.

Each plastics type has different properties which provide benefits right across the building and construction sector.

PVC dominates the building and construction market accounting for 55 per cent by weight of total plastics used (2 702 million tonnes). Three other plastics – expanded polystyrene (EPS), extruded polystyrene (XPS) and polyurethane (PU) – make up an important 21 per cent (1.044 million tonnes). In addition, high density polyethylene (HDPE) and low density polyethylene (LDPE) make up 13 per cent (585 000 tonnes) of the total amount of plastics consumed in the building and construction sector and are important materials for use in the manufacture of pipes and ducts.

PLASTICS CONSUMPTION BY COUNTRY IN BUILDING AND CONSTRUCTION SECTOR, WESTERN EUROPE 1995

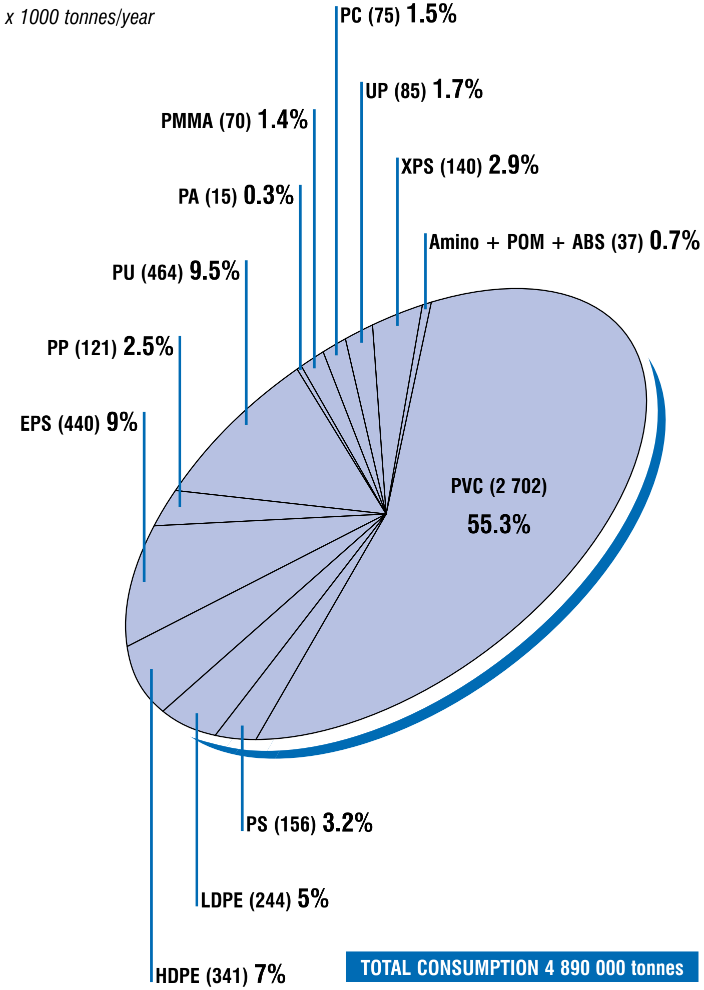
Unit = x 1000 tonnes/year



TOTAL CONSUMPTION OF PLASTICS IN BUILDING AND CONSTRUCTION SECTOR 4 890 000 tonnes

PLASTICS CONSUMPTION BY RESIN IN BUILDING AND CONSTRUCTION SECTOR, WESTERN EUROPE 1995

Unit = x 1000 tonnes/year



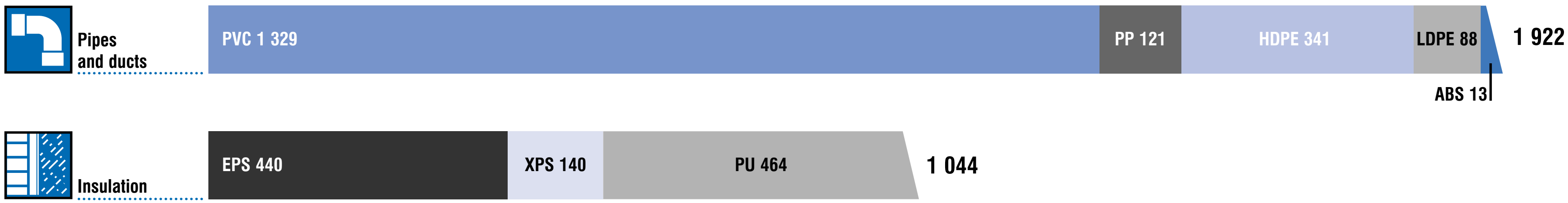
TOTAL CONSUMPTION 4 890 000 tonnes

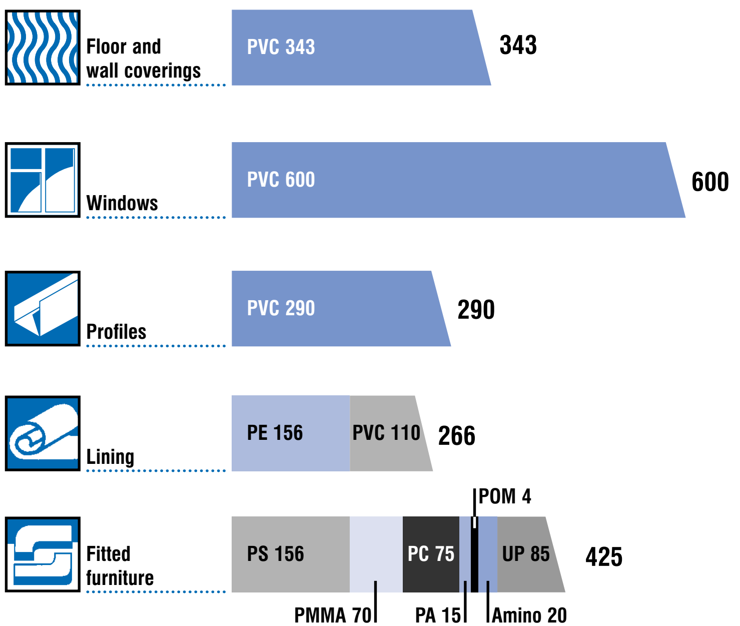
PLASTICS CONSUMPTION THROUGH APPLICATIONS

Over the last 20 years, consumption of plastics in the building and construction sector has increased dramatically as architects and specifiers begin to appreciate the benefits the material can bring to many different applications.

PLASTICS CONSUMPTION BY PRODUCT AND RESIN IN BUILDING AND CONSTRUCTION SECTOR, WESTERN EUROPE 1995

Unit = x 1000 tonnes/year





Plastics offer day-to-day advantages which we often take for granted but which bring comfort and efficiency to our daily lives. The different properties plastics exhibit make them suited to a range of applications.

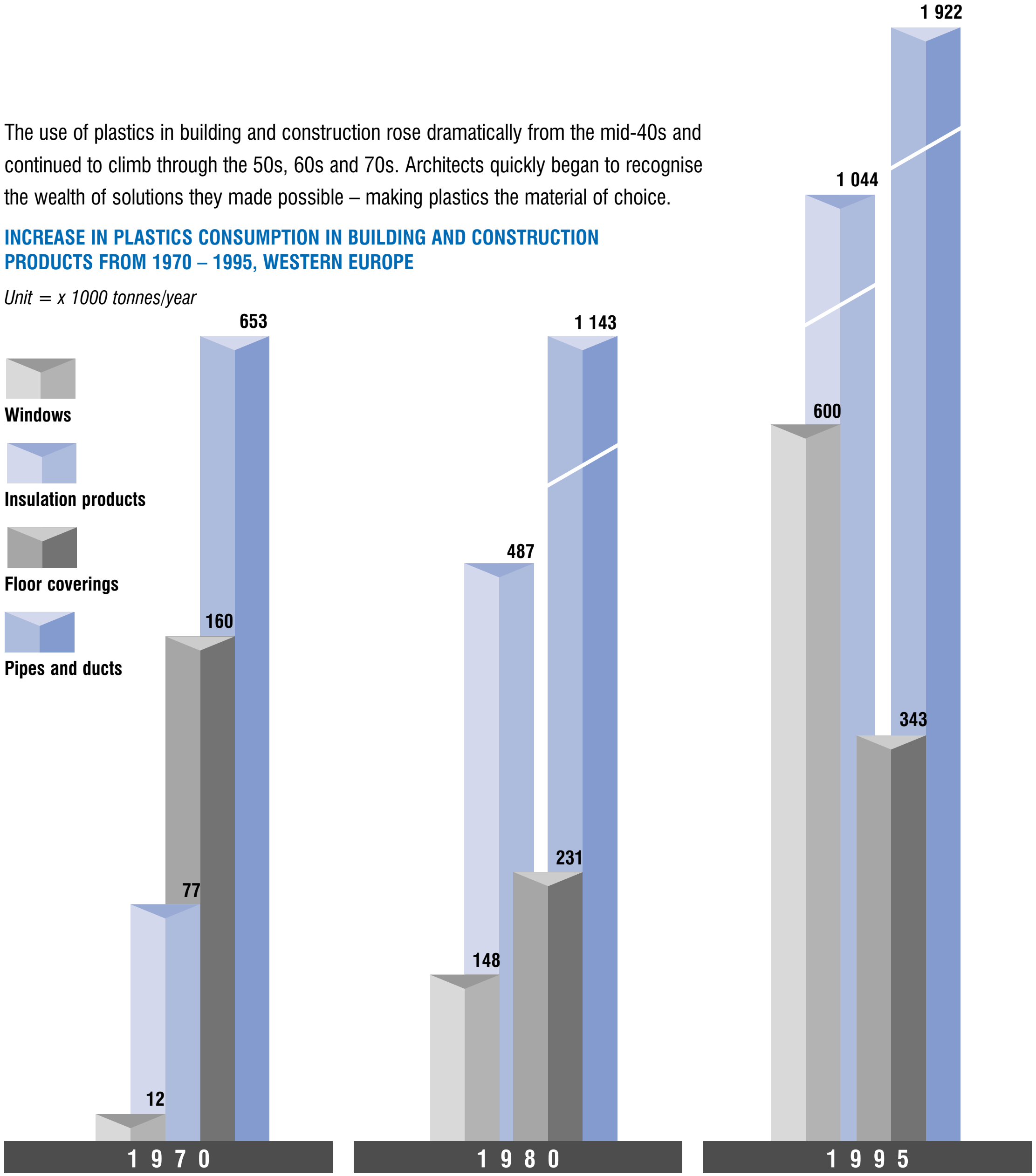
- **The ease of processing and lightness of plastics coupled with their strength and durability makes them the ideal material for use in modern windows. Indeed PVC consumption for this particular purpose has risen from 12 000 tonnes in 1970 to 600 000 tonnes in 1995.**
- **Plastics are a popular choice for modern water, gas and sewage piping as they offer high corrosion resistance but low flow resistance to the fluids they carry, can be used above or below ground and can be easily moulded in a range of shapes and sizes. Consumption of plastics in pipes and ducts has risen from 653 000 tonnes in 1970 to 1 922 000 tonnes in 1995.**
- **The exterior environment is something we demand greater protection from and the use of plastics in thermal and sound insulation for our buildings has grown steadily seeing the consumption of EPS, XPS and PU rise from 77 000 tonnes in 1970 to 1 044 000 tonnes in 1995.**
- **Plastics also make it possible to produce interior fixtures and fittings that are not only desirable but hygienic, durable and easy to maintain. The use of plastics in floor coverings is a perfect example, rising from 160 000 tonnes in 1970 to 343 000 tonnes in 1995.**

PLASTICS CONSUMPTION THROUGH APPLICATIONS

The use of plastics in building and construction rose dramatically from the mid-40s and continued to climb through the 50s, 60s and 70s. Architects quickly began to recognise the wealth of solutions they made possible – making plastics the material of choice.

INCREASE IN PLASTICS CONSUMPTION IN BUILDING AND CONSTRUCTION PRODUCTS FROM 1970 – 1995, WESTERN EUROPE

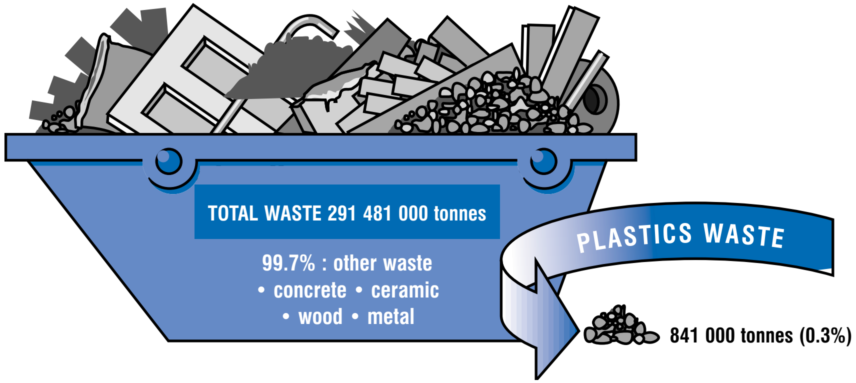
Unit = x 1000 tonnes/year



PLASTICS WASTE BY SECTOR

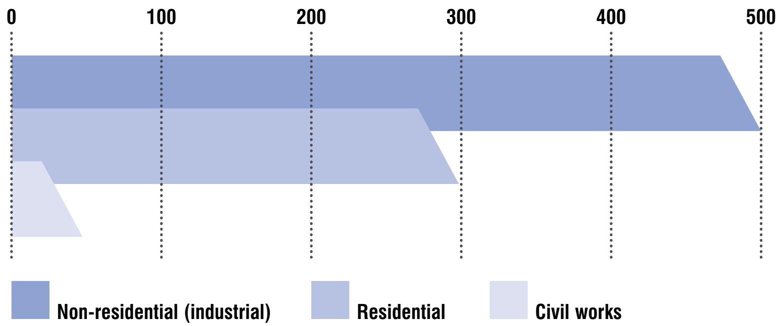
In 1995, 291 million tonnes of construction and demolition waste was generated with concrete, ceramics, metal and wood contributing the four largest sources of waste. Plastics contributed less than half of one per cent (0.3 per cent) to this total – 841 000 tonnes. Of the total amount of plastics waste produced, fixed floor coverings was the highest contributor (274 000 tonnes) followed by fitted furniture (250 000 tonnes), pipes and ducts (96 000 tonnes) and insulation (84 000 tonnes).

PLASTICS CONTENT IN TOTAL BUILDING AND CONSTRUCTION WASTE, WESTERN EUROPE 1995



ORIGIN OF PLASTICS WASTE

Unit = x 1000 tonnes/year



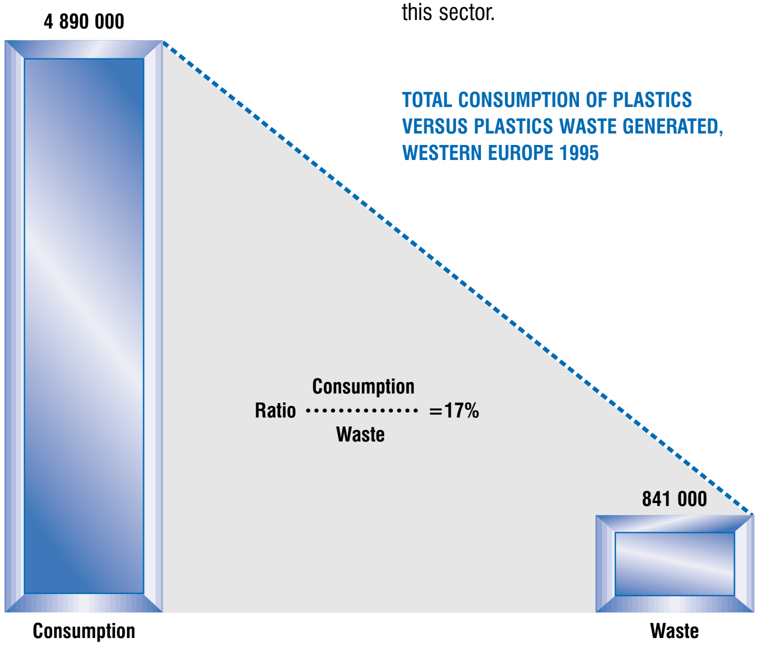
PLASTICS WASTE BY SECTOR

Of the 841 000 tonnes of plastics construction waste generated in 1995, 85 per cent was diverted from landfill and recovered through a combination of mechanical recycling and energy recovery.

The ratio of plastics consumption by the building and construction sector versus plastics waste generated in the same year is relatively low at 17 per cent. This is because the construction sector uses many plastics in long-life applications.

The plastics used in building and construction have a life expectancy of more than 40 years. It is estimated that plastics pipes and ducts have a life span of up to 100 years and plastics windows a life-span of up to 50 years, based on information available today. Durable and strong, they are ideally suited to long-term applications demanded by this sector.

TOTAL CONSUMPTION OF PLASTICS VERSUS PLASTICS WASTE GENERATED, WESTERN EUROPE 1995



THEORETICAL MODEL USED TO CALCULATE QUANTITIES OF PLASTICS WASTE ARISING IN THE BUILDING AND CONSTRUCTION SECTOR

Unit = x 1000 tonnes/year

Number of years after which the product becomes waste	<2	2-5	5-10	10-20	20-40	>40
Pipes and ducts		1	1	3	20	75
Windows			1	2	32	65
Insulation	2			10	50	38
Lining	5		10	25	40	20
Profiles	3		5	30	50	12
Fitted furniture	1		25	49	20	5
Fixed floor coverings	5	2	20	68	5	
Wall coverings	2	8	50	30	10	

PLASTICS WASTE • A forecast of the future for the building and construction sector

From 0.84 million tonnes in 1995 plastics construction waste is estimated to reach 1.17 million tonnes by the year 2000, a growth rate of 7 per cent. But from the year 2000 to 2010 this growth rate is forecast to slow to 5.3 per cent. And plastics waste will continue to represent a small fraction of total waste produced across the building and construction sector.

This theoretical data offers an invaluable snapshot of the future which will help each individual country and region across Western Europe to plan and provide suitable systems for our waste management needs. With such a variety of plastics waste, a flexible recovery strategy taking into account local, regional and national infrastructures as well as social and geographic factors is needed to ensure environmental and economic benefits.

FORECAST OF PLASTICS WASTE FROM BUILDING AND CONSTRUCTION, WESTERN EUROPE 1995

Unit = x 1000 tonnes/year	YEAR 1995	YEAR 2000	YEAR 2010
Floor and wall coverings	274	285	370
Pipes and ducts	96	240	380
Insulation	84	132	400
Profiles	72	105	160
Lining	59	84	150
Windows	6	12	65
Fitted furniture	250	320	450
TOTAL	841	1 178	1 975

WASTE MANAGEMENT

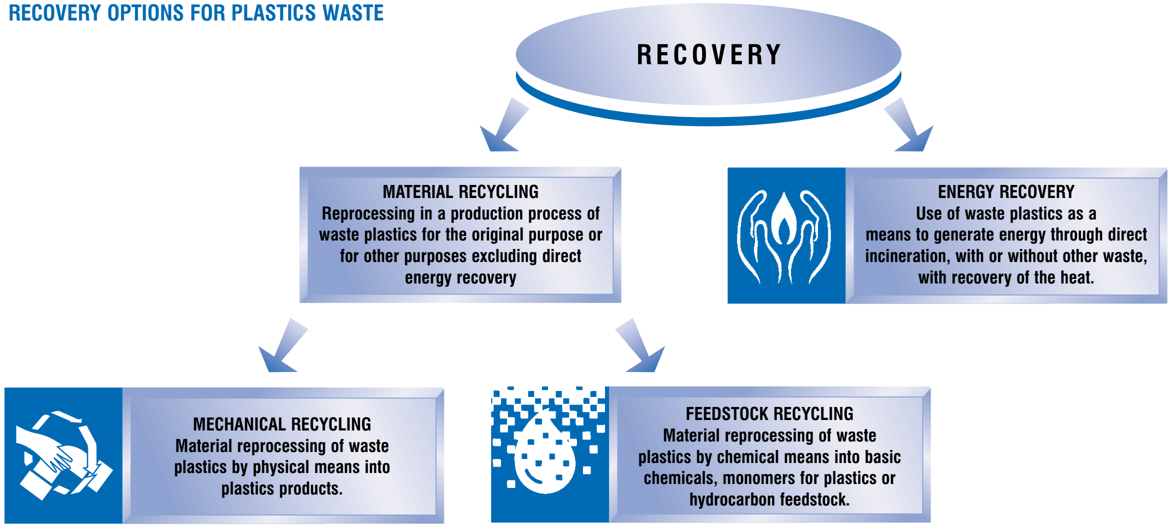
The European plastics industry is committed to minimising use of resources and maximising recovery.

This means making the most of all recovery options available – mechanical and feedstock recycling and energy recovery. As a result, we can take advantage of the recovery option which best meets individual circumstance, product type and physical conditions, and balances technical, environmental, economic and local market factors.

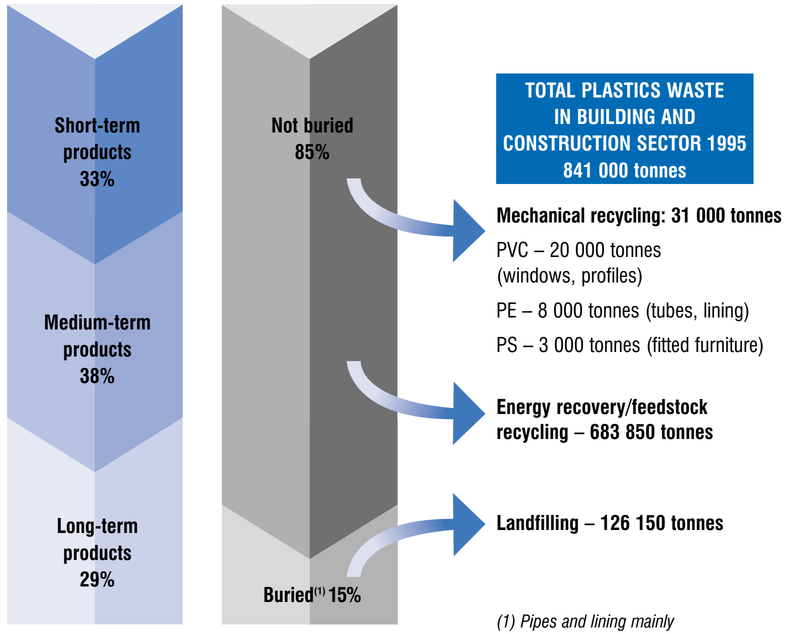
Considerable research and investment has been made to increase recovery. In 1995 a total of 841 000 tonnes of plastics construction waste was generated and 85 per cent was recovered.

Of the total 85 per cent diverted from landfill, 31 000 tonnes of plastics was mechanically recycled from windows and profiles, tubes and lining and fitted furniture.

RECOVERY OPTIONS FOR PLASTICS WASTE



MANAGEMENT OF PLASTICS WASTE, WESTERN EUROPE 1995



(1) Pipes and lining mainly

RECOMMENDED RECOVERY OPTIONS DEPENDING ON PHYSICAL CONDITION OF PLASTICS WASTE

CONDITION OF PRODUCT WASTE	Mechanical recycling			Feedstock recycling	Energy recovery
	Single plastic		Mixed plastics		
	In same product	In other product			
Clean single plastic	●●	●●		●	●
Contaminated single plastics	●	●		●●	●●
Clean mixed plastics			●	●●	●●
Contaminated mixed plastics				●	●●
Clean mixed materials*					●●
Contaminated mixed materials*					●●

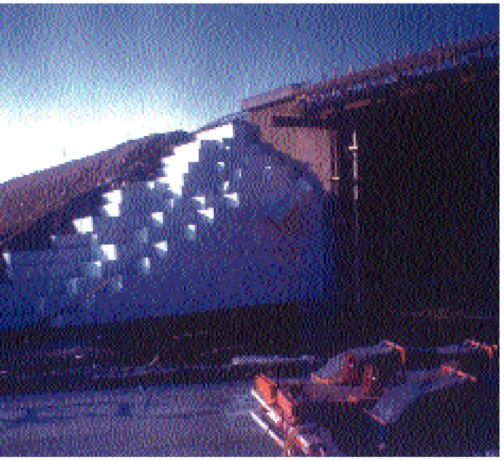
●● preferred option when available
● other option
* *composites, e.g. plastic-metal or plastic-wood/paper combinations*

PLASTICS IN BUILDING & CONSTRUCTION • Providing essential benefits throughout the life-cycle

Plastics – designing for future strength

The Normandy Bridge in France crosses 856 metres of the Seine to link Honfleur and Le Havre. The bridge, 2 140 metres long and 23 metres wide, had to meet a number of technological challenges including resistance to vibrations caused by rain driven by strong winds gusting up to 180 kilometres per hour as well as resistance to sound and water.

Today a total of 184 cables, each sheathed with aerodynamic polypropylene, support the Normandy Bridge. The material was chosen by designers because of its light weight, non-corrosive properties and ability to absorb vibrations five-times more effectively than normal composite cables.



Plastics and fire

Plastics – like other materials made from carbon-containing chains for example, wood, wool and leather – are combustible.

Any accidental fire usually involves a combination of many different materials, resulting in a mixture of combustion gases, some of which may be toxic. Such gases will be produced regardless of whether plastics or traditional (or natural) materials are involved. The nature and amount of combustion gases will be dependent on factors including the material burning and the amount of air available. The immediate danger in all fires is from heat, lack of oxygen and generation of carbon monoxide. Extensive tests have shown that, in a fire situation, the gases generated by plastics are not more toxic than those from natural materials.

Plastics can now be formulated for use in building applications, to provide far higher fire protection than was imaginable 30 years ago. Modern fire-resistant plastics materials can be difficult to ignite, but stop burning quickly when the source of heat is removed.

Plastics – the future of temperature control

Plastics offer architects and designers a vision of the future, and polymer technology will continually provide new opportunities to meet aesthetic demands, technical advance and environmental protection. That future vision is now becoming reality as breathing plastics membranes in walls, roofs and floors are being used to regulate perfect levels of temperature and humidity in energy efficient homes.

Two 'intelligent' polymer materials designed to provide shade and prevent overheating are being promoted as an alternative to mechanical devices such as shutters, blinds and awnings in modern buildings. The two polymers which make up the 'glass' are transparent at normal room temperature but become translucent when exposed to bright lights. Light hitting the polymer is scattered, reducing heat build-up but allowing adequate light into rooms.

RECOVERY • Recycling in action

Future waste levels will remain low. In 1992 plastics accounted for less than half a per cent of the total waste arising, an overall figure which will be largely unchanged based on forecasts for 2010.

Commitment from the plastics industry to minimise our use of resources has yielded positive results. However, experience shows that separate collection and sorting of plastics waste from construction and demolition is still difficult and quantities are very low.

Mechanical recycling of plastics is most appropriate where significant amounts of clean, single polymer items are available – such as window frames, doors, floor coverings and furniture.

- **A new slate replacement for roofing buildings is being developed in the UK and will be produced using more than 3 000 tonnes of recycled expanded polystyrene (EPS) packaging. The new material, which is fire retardant and frost proof, is 50 per cent recycled EPS and 50 per cent slate dust**
- **A recycling organisation in Denmark has begun to manufacture fences and sound and shelter barriers out of recycled plastics jars**
- **A Swedish based company has begun an operation with the Swedish Petroleum Institute to collect old plastics containers from petrol stations and recycle them into 'poly-plank', a material which can be used in building and construction**
- **A German company which manufactures plastics window and door frames is now making new frames out of granulated recycled plastics recovered from old windows and doors. The core of the window frame (70 per cent) is made from recycled plastics, and the outer layer is covered with new plastics**
- **A Dutch pipe industry scheme collects PVC pipes for co-extrusion into new sewer pipes, with the core layer from recyclate making up 60 per cent of the total pipe, meeting all performance standards.**

RECOVERY
• Feedstock recycling

Feedstock recycling is a process unique to plastics, which breaks down polymers into petrochemical feedstock or products which can be used to make new plastics. It offers new ways to recycle plastics, overcoming some of the limitations of mechanical recycling which requires large quantities of clean, homogeneous plastics waste.

Sorting and cleaning of plastics waste is not necessary for feedstock recycling. This reduces collection and sorting costs.

- **Germany is at the cutting edge of feedstock recycling research and technology and in 1996 recycled 251 000 tonnes of plastics using this method**
- **A consortium of APME member companies outside Germany is currently finalising technology which will help to engineer a commercial capacity sized plant. Work will be completed by the end of 1997.**

RECOVERY • Energy from waste

Energy recovery will also play a central role in increasing plastics recovery levels from construction waste. On average, plastics have an energy content equivalent to that of oil. This valuable energy source can be recovered in a number of ways:

- **combustion with other waste for recovering energy in municipal solid waste combustors**
- **selective separation or 'pre-treatment' to produce a particularly high calorific alternative fuel for use in energy intensive industrial processes.**

Energy recovery from plastics waste has been the subject of a number of extensive research projects, and results have consistently demonstrated that combustion of plastics waste is a clean and safe process which can reduce emissions, ensure safer incinerator residues and improve energy yield. It also, naturally, reduces our dependency on fossil fuels.

For example, waste – of which plastics are a part – consigned to the average European dustbin in one year contains enough energy to heat 500 baths or power 5 000 hours of television viewing.

Likewise, pre-treated plastics packaging waste as a supplement to traditional fuel sources such as coal and wood is being used successfully at a power generation plant in Finland. The plant operates at an 85 per cent energy conversion rate and the energy created is used in three ways:

- **electricity for the Finnish national grid**
- **process steam used by local industry**
- **hot water, providing heating for local homes and community services.**

APME

PLASTICS

THE MATERIAL OF CHOICE FOR BUILDING AND CONSTRUCTION FOR THE 21st CENTURY

From manufacture through to use and disposal at the end of life – plastics offer optimum use of resources and minimum waste.

The information contained in this report was sourced by the Sofres Group. The data has been drawn from product manufacturers, professional associations representing the materials and building and construction industry sectors, and in-depth reviews of all recent and relevant published information including specialist media and statistical sources.

Final consumption statistics quoted take into account the import/export flows of empty and filled packaging.

Statistics quoted exclude plastics used for packaging construction materials and equipment, as they are not used in the physical construction process. About two per cent of total plastics consumption in construction (100 000 tonnes) is used in these forms of packaging.

In addition, in the 1992 data, cables were included in APME's *Building and construction sector: plastics consumption, waste and recovery in Western Europe* report. For the 1995 data, all cables (870k tonnes of plastics) are included in APME's *Electrical and electronic sector: plastics consumption, waste and recovery in Western Europe* report.

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