Automotive
The world moves with plastics

Plastics
The Material for the 21st Century

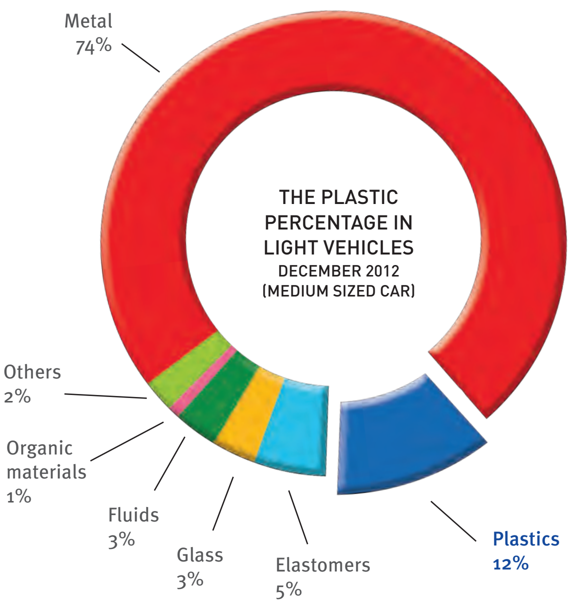
Plastics enable resource efficient mobility

“Curbing mobility is not an option. Neither is business as usual. We can break the transport system’s dependence on oil without sacrificing its efficiency and compromising mobility – it can be win-win.”

Siim Kallas, Vice-President of the European Commission and Commissioner for Transport[1]

Plastics enable resource efficient mobility and better functionality by replacing heavier, traditional materials by lightweight plastic materials. Through an increased use of plastics, automotive manufacturers can address growing environmental concerns, ever tougher legislative measures aimed at breaking the dependence on oil and reducing man-made emissions that threaten the environment. Using more plastics also helps the car makers to overcome the economic impacts of the global crisis which led to profound changes in global manufacturing.

The use of plastics in the construction of automobiles gathered pace during the 1950s and it is now hard to imagine a car without plastic.
The average modern car weighing 1,500 kg contains between 12-15% of plastic materials[2]. This equates to over 2,000 plastic parts of all shapes and sizes; from lights and bumpers, to engine components, dashboards, headrests, switches, clips, panoramic roofs, seats, airbags and seat belts. So it’s no surprise that plastic is now the second most commonly used material in automobile manufacture.



Source: Association Française de Mécanique (AFM)

Plastics have revolutionised the construction, performance, safety and functionality of cars.
Single mould components have helped manufacturers to decrease vehicle assembly time, quickly introduce design innovations and trim costs. Plastics help to make cars lighter, thus reducing fuel demand and greenhouse gas emissions. Reducing a modern car's weight by 100 kg cuts fuel consumption by approximately 0.2 litres per 100 km and reduces CO_2 emissions by around 10 g/km. Elsewhere, durable polyester fibres have made seat belts a reality whilst high-strength nylon has led to the introduction of airbags in cars.

Under the bonnet, plastics help the functionality of cars, as for example with the Air Intake Manifold, which today is made of glass fibre reinforced plastics, allowing for optimised air flow, design freedom and general reductions in weight and cost.

With growing global pressure to reduce greenhouse gases – the EU has devised a roadmap for moving to a competitive low-carbon economy by 2050 – the automotive industry continues to look for ways to reduce emissions. Plastic is now contributing to a number of exciting innovations in this field, including key components for electric, hybrid and hydrogen-powered vehicles.

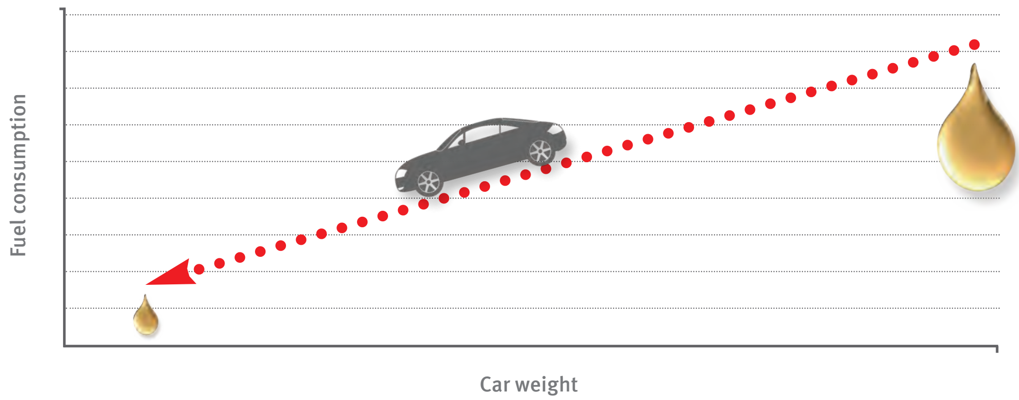
1. http://ec.europa.eu/commission_2010-2014/kallas/headlines/news/2011/03/2011_03_28_white_paper_en.htm

2. Plastics content heavily depends on the type of vehicle, on the (extra) equipment, etc.

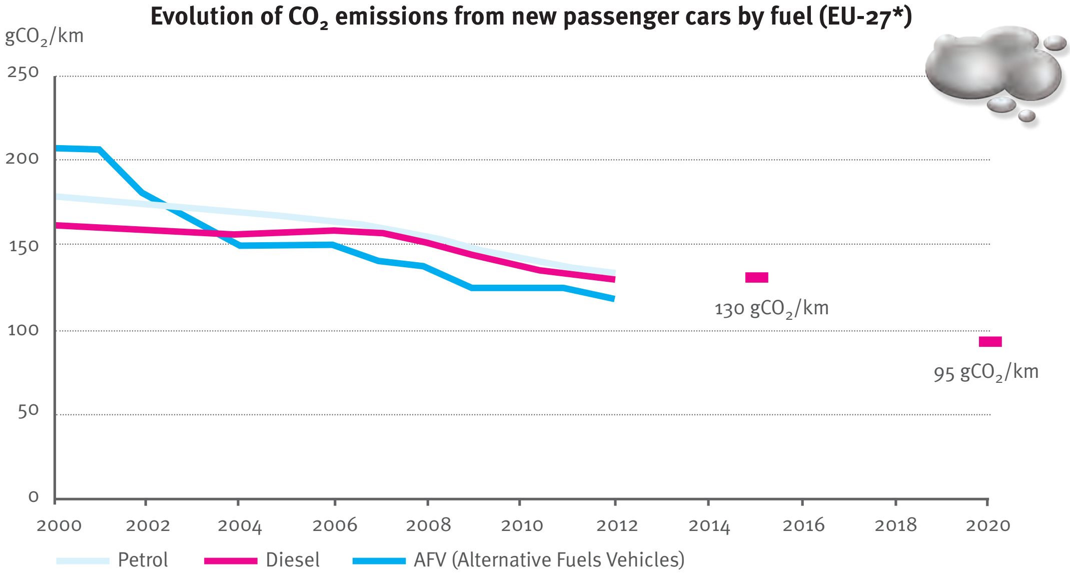
Plastics save energy and reduce CO_2 emissions

The drive for lower CO_2 emissions continues to gather momentum in the twenty-first century. The use of innovative plastics in cars is helping the automotive industry to cut both costs and emissions. Plastic is, for example, one sixth the weight of steel and has a lower environmental footprint.

The EU Regulation EC 443/2009 on CO_2 and cars states that the EU car manufacturers' fleet average has to be aligned with 130 g CO_2/km, partially as of 2012 and completely by 2015. In addition, the integrated approach measures (e.g. eco-innovations) should bring the average emission to 120 g CO_2/km.
Weight loss is thus critical if CO_2 emissions and the associated fuel costs of a car are to be reduced. Reducing the weight of the bodywork of an average car by 100 kg cuts the CO_2 emissions by 10 gr/km. The weight savings of all the plastic parts used thus represent a reduction of 750 litres over the 150,000 km life of an average car. These weight savings also represent a cost reduction for the consumer of approximately 1,000 EUR
(at 1.33 EUR/litre).



Evolution of CO_2 emissions from new passenger cars by fuel (EU-27*)



* The geographical scope of the data changes over time from the EU-15 to the EU-25 and the EU-27.

Source: EEA report – Monitoring CO_2 emissions from new passenger cars in the EU – data 2012

Plastics are crucial for passenger safety

As cars become lighter there might be a concern that safety is compromised. In fact, the opposite is true: plastics are actually the crucial components in car safety. Energy absorbing plastic bumpers, durable polyester fibre seat belts, high-strength nylon airbags and child restraint plastic seats have all helped to make cars safer for all road users.

Increasing passenger safety

Seat belts, made from strands of durable polyamide or polyester fibres, have probably had the greatest single effect on reducing road casualties over any other safety feature. According to an EU road safety study (2008), using a seat belt could save up to 7,300 lives per year in Europe[3]. The European Transport Safety Council's (ETSC) estimates show that about 50% of all drivers and passengers that die in a fatal accident in the EU could have survived if they had worn their seat belts.

Airbags, made from high-strength nylon or reinforced polyamide fibres, are another safety feature, which reduces injuries. They cushion impact in the event of frontal collisions when car occupants can be injured by being thrown onto unpadded parts of the car interior such as the steering wheel and the dashboard.

Children in cars need appropriate child restraints for their age and size which can only be manufactured safely and cost-efficiently with plastics. These include infant carriers, child seats, booster seats and booster cushions. European Commission statistics show that forward-facing child safety systems have been shown to have an injury reducing effect of approximately 60% while the rearward-facing kinds have been shown to reduce injuries by a further 30-35%[4]. Child safety seats fulfil strict testing conditions according to industry standards.

Most modern cars use plastics for head lamps that are virtually shatter proof. In addition, headlights made from plastics can be moulded into any imaginable shape, which allows lamps to adapt to differing light conditions, thereby increasing visibility.

Plastics are also used for vehicles active parts, for example driveshafts. In the event of an accident, the shafts split lengthwise without bending. A conventional shaft would risk bending, thereby possibly puncturing the tank or the car's interior.

3. European Commission, DG Mobility and Transport, section "Road Safety – Cars – Seat belts"

4. European Commission, DG Mobility and Transport, section "Road Safety – Cars – Safety design needs"

13:54
99.4 SR P3
Tankesmedjan
AUTO CLIMATE
Auto Braking was activated
13:45

Reducing the effect of vehicle impact on pedestrians, cyclists and other road users

Since 2003, EU legislation has been strengthened to reduce injury risk for vulnerable groups such as pedestrians, cyclists and other road users through mandatory energy absorbing car fronts and blind spot mirrors. Plastics have been instrumental in developing state-of-the-art bumper designs and energy absorbing elements specialised in maximising occupant and pedestrian safety. A plastic bumper usually weighs 50% less than one made of alternative materials, while absorbing four to five times more energy.

Realising the technological safety aids of the future

Plastics are also imperative to electrical safety aids, the technology required to realise the European Commission's Action Plan for the deployment of the Intelligent Transport System (ITS). More than GPS, ITS is a portal which enables information exchanges between vehicles or between vehicles and infrastructure. This technology would be challenging without plastics which enable all forms of in-car human-computer interfaces such as touchscreens, buttons and sensors. The technology will enable information on speed limits, traffic flows congestion and pedestrian recognition thus helping Europe reach its goal of halving the number of deaths on its roads by 2020.

Indeed, plastics enable all forms of in-car human-computer interfaces including touch screens, buttons and sensors. According to the European Commission these systems reduce congestion by 5-10% (through dynamic navigation), the number of fatalities by 5-15% and of injuries by 5-10% (through speed alert, lane keeping support or e-Call technology)[5].

5. ITS Action Plan and Directive, European Commission, DG Mobility and Transport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SPORTS ECONOMY


MN ZX 2456

Plastics provide comfort and cost-effective design opportunities

Today's lightweight, durable plastics give designers and engineers the freedom to create innovative design concepts on vehicles which enhance passenger comfort at a realistic cost. This extends to the cockpit, surfaces, textiles, lighting and sensors as well as the car's shape and external accessories like door handles, mirror frames, wheel covers and rims and bumpers integrated with the front end.

Tailor-made, ergonomic bumpers and dashboards can now be moulded as single parts instead of the multi-components of yesterday, saving both time and money. This also means that new design innovations can quickly and cheaply be introduced to the production line. Plastic body filler, which fixes small imperfections without the need for welding or grinding, keeps small repair and maintenance costs to a minimum.

Specifically, designers are taking advantage of the design freedom that plastics provide to create innovative glazing designs. These include streamlined head lamps, recessed rear lamps and electrochromatic roof panels which can be changed from transparent to opaque at the flick of a switch.

Using plastics in electrical components provides manufacturers with numerous benefits including greater design and circuit layout flexibility, shorter process sequences and a reduction in the amount of different raw materials necessary to build each component.

Rear light

Lightweight climate comfort seat

All-plastic roofs filter UV rays

The heat-stable charge air duct replacing the metal part weighs only half as much.

First all-polymer wheel rim

Plastics – the high-tech functional material driving cutting edge innovations and sustainability

Plastics have a number of benefits over traditional materials used in the automotive industry. They can significantly accelerate production and assembly time as well as vehicle running costs. They also improve design, comfort, safety features and enhance environmental performance.

Plastics are innovative

Plastics are essential if the next generation of low-carbon electric, hybrid and hydrogen vehicles are to be realised. With challenges around the current battery technology – including short driving ranges and the frequent need to recharge heavy batteries which add 300 kg of weight to the car – plastics have a significant role to play. The use of more plastic body work will help increase the driving range. Plastics are also being used to create fuel cells for the first generation of emission-free hydrogen cars, which are currently in development.
Further innovations include plastic wheels weighing only 6 kg, saving 3 kg per wheel, lightweight seats which better regulate seat heating and humidity, and inflatable seat belt airbags which distribute crash forces over five times more body area than conventional seat belts.

Plastics are sustainable

High-performance plastics continue to drive sustainability in vehicles by making them lighter, more fuel-efficient and thus friendlier to the environment. They improve engine efficiency, or enhance rolling and air resistance. Plastic active manifold systems for direct-injection gasoline engines increase torque and engine power whilst lowering emissions.

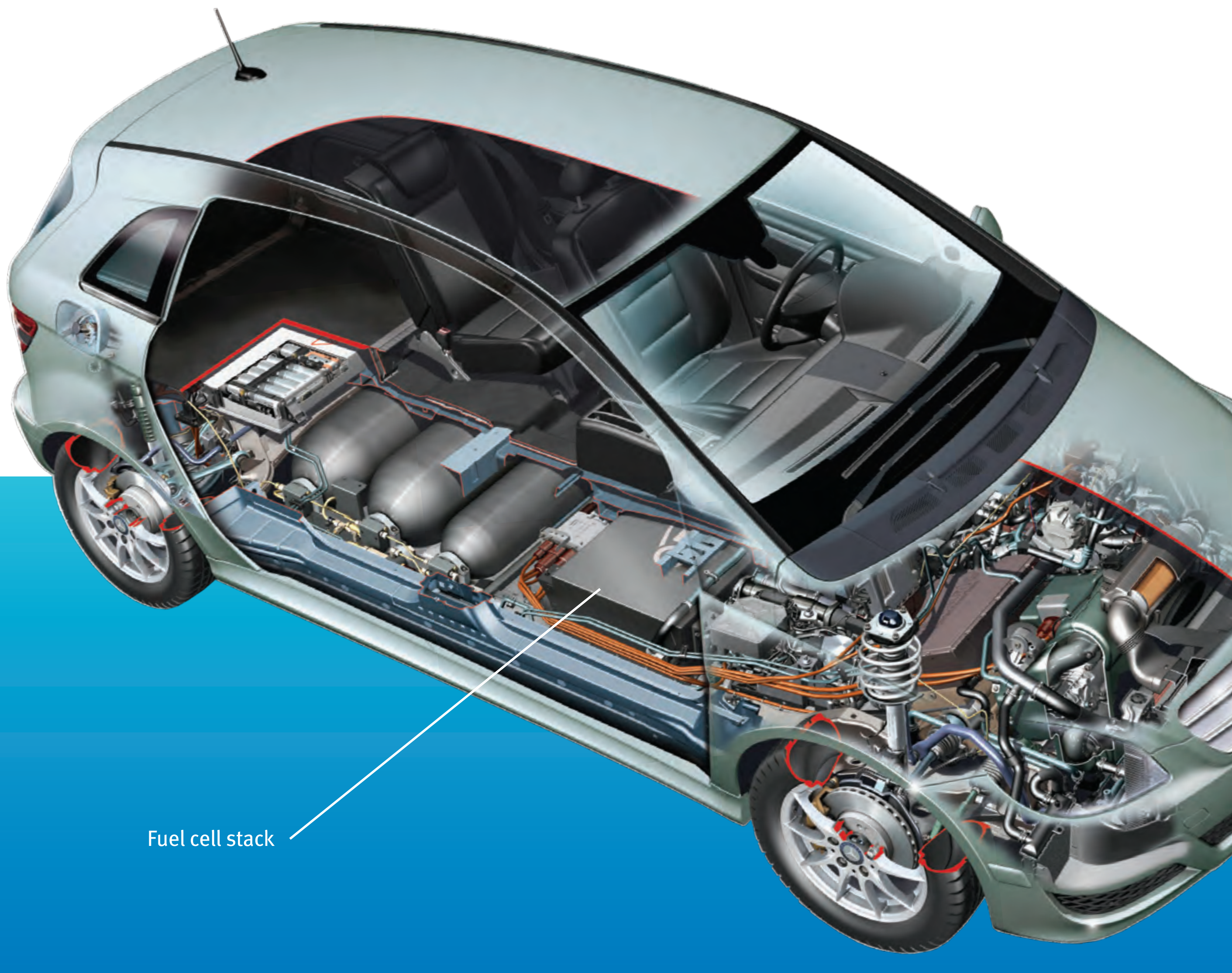
Specifically:

- Plastic throttle housings are 40% lighter per part than the traditional materials equivalent and cost up to 40% less. Additionally, their low thermo-conductivity could eliminate the risk of freezing and consequent breakages.
- Air intake pipes and fuel tanks are almost entirely made from plastics saving 50% in weight against alternative materials.
- Plastics windscreens and windows filter out most infrared rays reducing thus in-car temperature and consequently the use of air conditioning.
- Plastics are also used to create fuel cells which power hydrogen cars. As these cars will become more common, the introduction of these technologies will help Europe achieve its 2020 goals of ensuring that 10% of the transport sector must supply its energy needs from renewable sources.

Natural fibre-reinforced plastics, i.e. plastics enhanced with flax and hemp fibres – as well as biobased plastics are currently used as materials in the automotive industry. These materials are lighter and more resistant to breaking and splintering. They are used in dashboards, door covers and interior parts.

Besides using fibres in standard plastics, new materials are developed to provide a 100 % biobased solution for certain car parts. Developers at Hanover University are currently working on mirror housings or petrol cap.


YARIS HYBRID
HYBRID


Fuel cell stack

Hybrid components: Strong metal/plastic compounds

A "plastic-metal hybrid" is not a type of hybrid vehicle, but rather an innovative process which helps the automotive industry make greater use of plastics by joining plastics and metal together, creating high-tech materials to benefit from the strengths of both materials.

Plastic/metal hybrid components may, e.g., consist of a thin metal sheet supported by ribbing made from plastics. The metal provides the strength and stiffness, while the plastic ribbing gives the support necessary to prevent premature buckling. In comparison with previous technologies, the combination of plastics and metal enables highly load-resistant production and low-cost parts.

This technology has numerous advantages:

- high functionality integration
- increase of performance
- improved dimensional tolerances
- avoiding the buckling of thin-walled steel structures
- excelled crash behaviour
- high stiffness
- low weight

Although plastics have an important presence in many applications, the use of plastics in load-bearing structures has, to date, been low, due to mechanical and safety related reasons. With metal structures becoming lighter and thinner, their lack in strength has become a problem. The plastic-metal hybrid technology corrects this problem by combining the advantages of these two materials.

Plastic-metal hybrids are thermoplastic components, which are reinforced with steel. One way of steel-plastic combination is to integrate steel cord fabrics into injection moulded thermoplastic parts.

Plastics are used to create fuel cells which power hydrogen cars. These technologies will help Europe achieve its 2020 goals of ensuring that 10% of the transport sector must supply its energy needs from renewable sources.

Reducing vehicle running costs and providing resource efficient solutions

Plastics play a crucial role in reducing the cost of ownership and environmental impact of vehicles. Indeed few, if any, materials can make cars safer, lighter, more fuel-efficiency and thus more friendly to the environment.

Lower running costs for consumers

Plastics reduce the weight of modern cars, thereby lowering fuel consumption in the average car by 750 litres over a lifespan of 150,000 km. Assuming an average car will travel roughly 150,000 km over its lifetime and assuming an average of 12 km per litre, a car would thus save up to 10,000 km of fuel, or in other words the equivalent of 10,000 km of driving for free.

The efficiency of cars is further enhanced thanks to the strength and durability of plastics. This has helped to expand the average lifespan of a car to over 12 years by providing, for instance, better protection against corrosion.

Greater resource efficiency

Despite the widespread use of plastics, the natural resources needed to produce automotive plastics represent just 0.3% of global oil consumption. In existing applications, when it comes to CO_2 reduction, plastic is a very energy-efficient material enabling resource-efficient solutions. The substitution of plastic with other materials would in most cases increase energy consumptions and greenhouse gases emissions.

Furthermore, plastics do not only save energy and reduce greenhouse gas emissions, they also save land, water and mineral/metal resources. Comparing an automotive fender made of plastics with one made of a traditional material has shown a clear advantage of using plastics for greater resource efficiency over the entire life cycle.

If plastics in a car were to be substituted with other materials, additional energy of 1,020 MGJ/a (million giga joule/annum) (+26%!) would be needed. This can be compared to the energy needed for heating and providing warm water for 40 million people or nearly the entire population of Poland.

Resource efficiency of plastics in the automotive sector
Fender case study: plastics versus traditional materials

Source: Beyond "carbon footprint": The contribution of plastic products to various resource savings – denkstatt GmbH, Vienna, 2012

Plastics recovery at the end-of-life

Plastics can also be recovered when a vehicle reaches its end-of-life stage, thus helping to meet the EU's End-of-Life Vehicles Directive 2000/53/EC.

This states that currently a minimum of 85% by weight of an end-of-life vehicle is re-used or recovered, including 5% energy recovery. No later than January 2015, this re-use and recovery should reach a minimum of 95% with a minimum of 85% recycling by an average weight per vehicle per year.

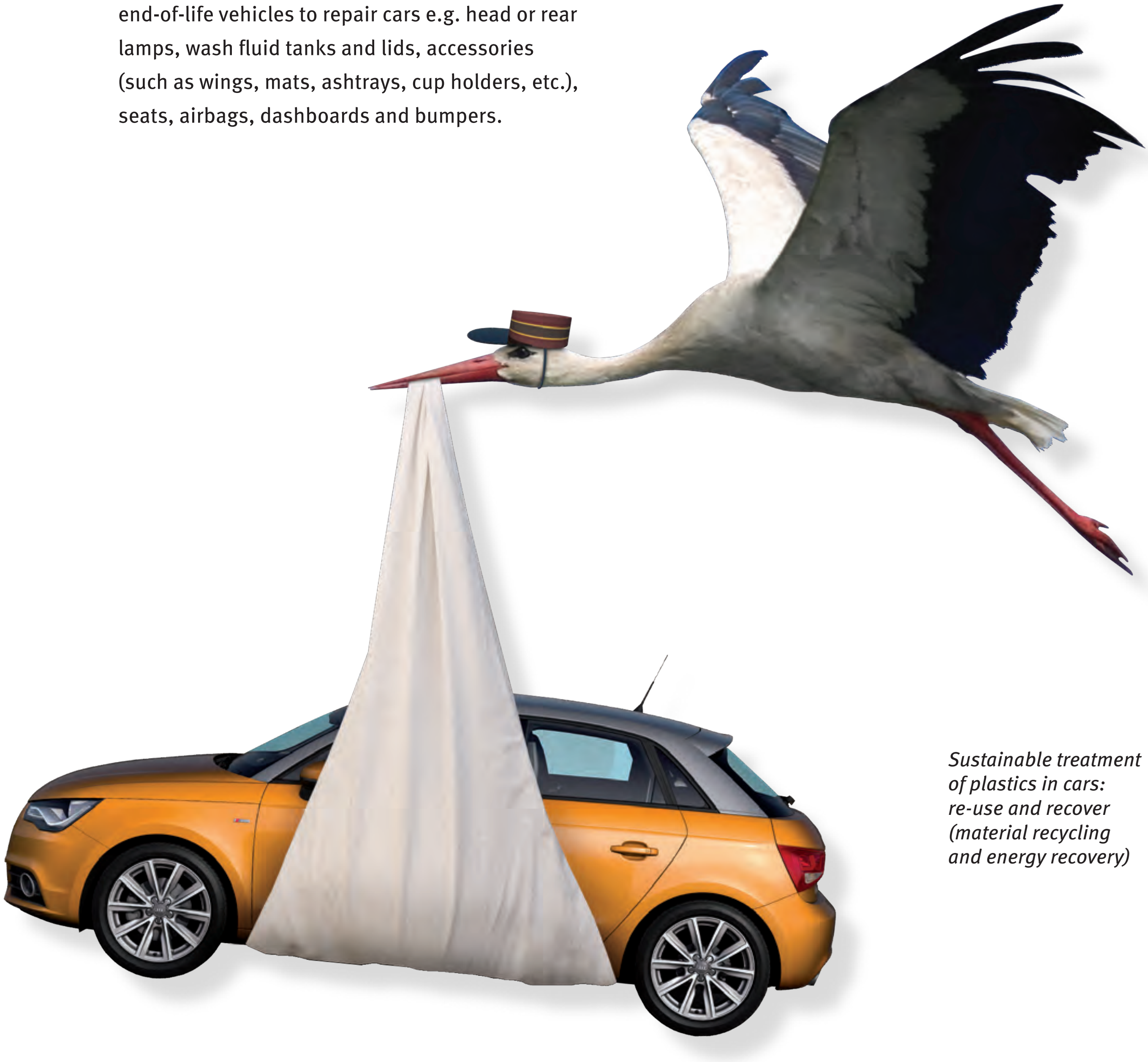
Plastics recovery includes

- Using plastic parts from accident, damaged or end-of-life vehicles to repair cars e.g. head or rear lamps, wash fluid tanks and lids, accessories (such as wings, mats, ashtrays, cup holders, etc.), seats, airbags, dashboards and bumpers.

- Mechanical recycling: Material reprocessing of end-of-life plastics from Automobile Schredder Residue (ASR) or from automobile parts such as bumpers and battery housings into plastic products.

- Feedstock recycling: Material reprocessing by chemical means into basic chemicals, monomers for plastics or hydrocarbon feedstock

- Energy recovery: use of waste plastics as a means to generate and recover energy.

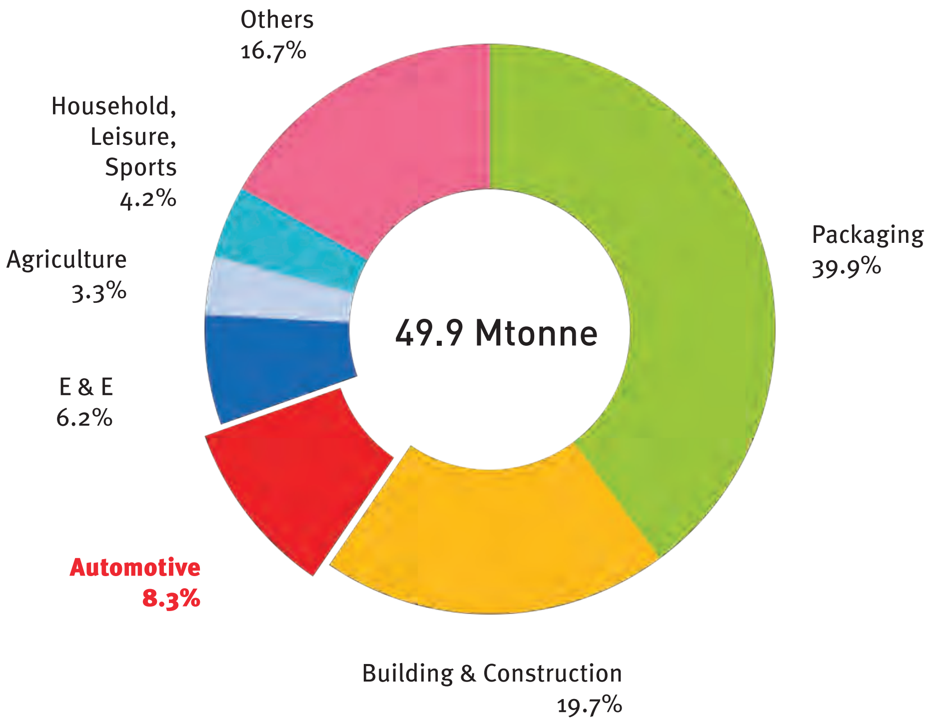


Sustainable treatment of plastics in cars: re-use and recover (material recycling and energy recovery)

Overview of plastics in the automotive industry

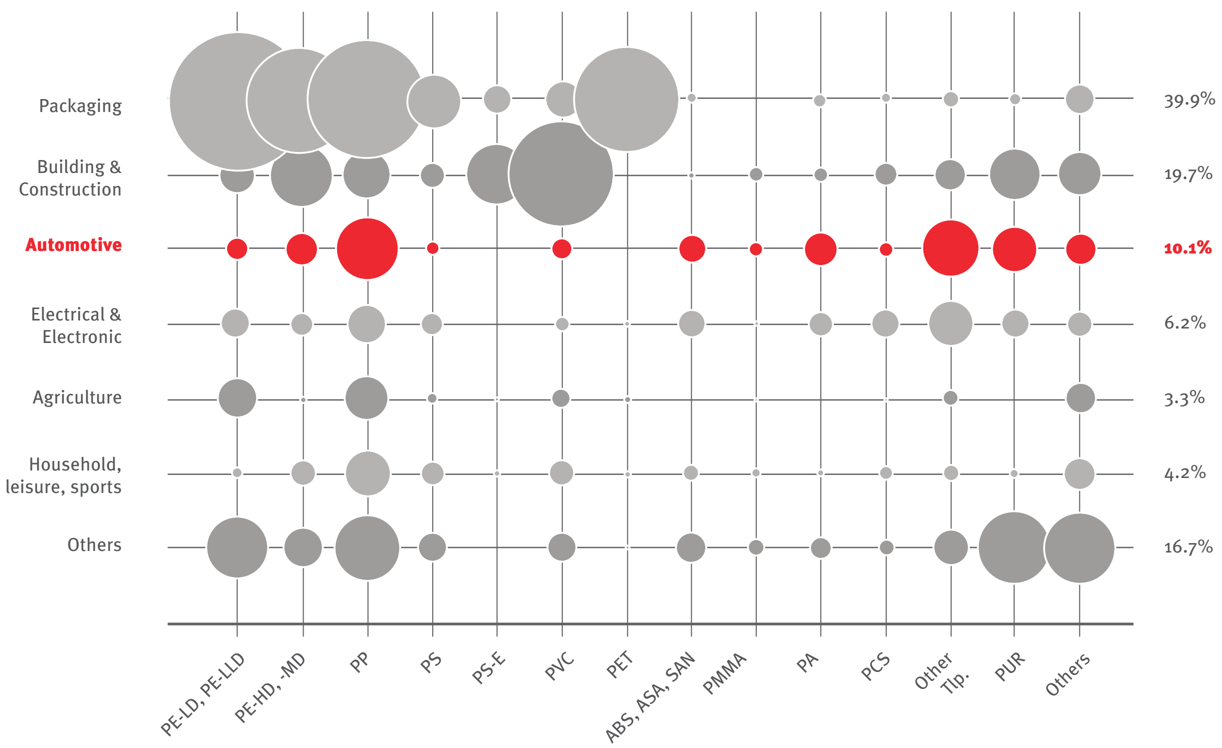
The unique nature of plastics means that they can be found throughout the vehicle, in the interior, exterior, under the hood, from lights and bumpers, to engine components, dashboards, headrests, switches, clips, panoramic roofs, seats, airbags and seat belts.

Europe plastics demand by segment, 2016



Source: PlasticsEurope Market Research Group (PEMRG) and Conversio Market & Strategy GmbH
Data includes revised figures for the categories "Other Thermoplastics" and "Other Plastics".
The segments "Agriculture" and "Household, Leisure, Sports" had been first-time included for 2016 (in previous years included in "Others").

Europe plastics demand by segments and resin type, 2016



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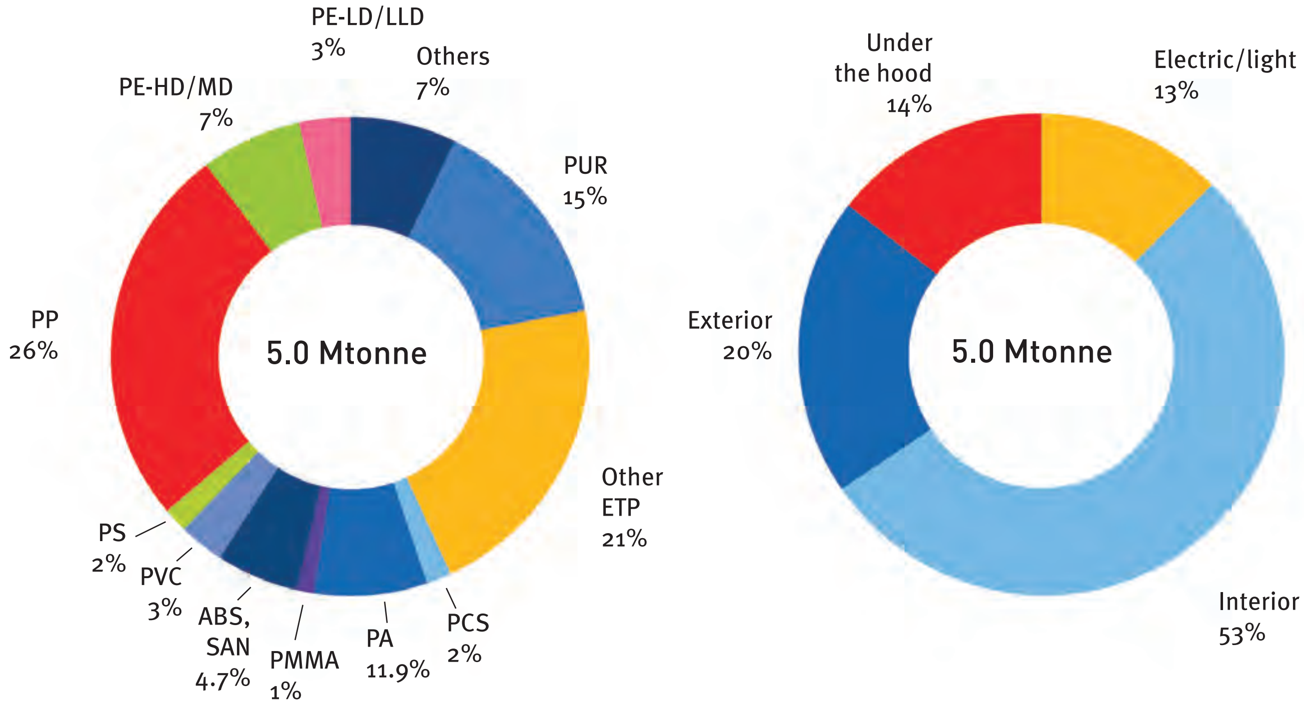
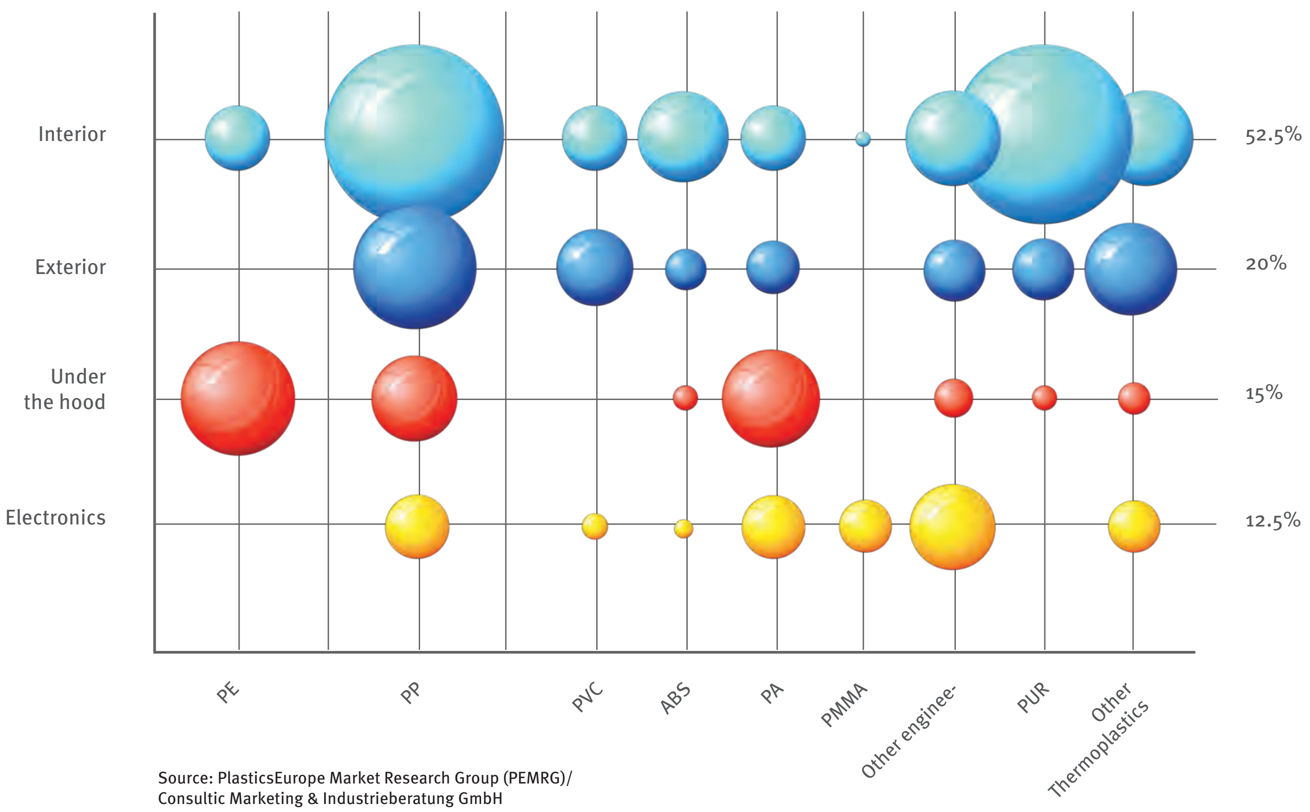
The use of plastics in the automotive sector, Europe, 2016

EU28+2



Source: PlasticsEurope Market Research Group (PEMRG)

Use of plastics in the automotive industry by products/applications*, Europe, 2011



Source: PlasticsEurope Market Research Group (PEMRG)/
Consultic Marketing & Industrieberatung GmbH

* Estimate

Plastics and the automotive sector in numbers

0 The amount of plastics that could be found on a car in the 1950s.[1]

3 The percentage of fuel consumption saved per 5% reduction in the weight of the bodywork.[2]

6 The weight (in kg) of the modern all-plastic wheel rim.

8.3 The demand in percentage of plastics for automotive in Europe.

12 The average lifespan in years of a car thanks to the greater use of plastics.[3]

12-15 The percentage amount of plastics found in a modern mid-range car weighing about 1500 kg.[4]

100 The weight (in kg) of plastics which can cut an average car's fuel consumption by 750 litres over a lifespan of 150.000 km.[5]

225 The average amount of plastics, in kilograms, found on board a modern mid-range vehicle.[6]

250 The number of times automotive windows and lights made from plastics are stronger than those made of glass.

300 The number of lives that could almost certainly have been saved in 2007 in the UK alone if all car occupants had been wearing a seat belt. That's roughly one life a day![7]

2000 The number of plastic parts found in an average car.[8]

7300 The number of lives that could be saved in the EU each year by using seat belts.

49.000 The number of years a 60-watt bulb would be kept continuously lit by the additional energy spent over the whole life-cycle of a typical car if existing plastics components were replaced by other materials.[9]

250.000 The number of lives that could be saved in the EU each year by using seat belts.[10]

1. VCI (Verband der Chemischen Industrie) Fact Book brochure
2. VCI (Verband der Chemischen Industrie) Fact Book brochure 02
3. APME brochure "A Material of choice" p.2
4. VCI (Verband der Chemischen Industrie) Fact Book brochure 02
5. APME brochure "A Material of choice" p.3
6. VCI (Verband der Chemischen Industrie) Fact Book brochure 02
7. ThinkDirect "Always wear a seat belt"
8. VCI (Verband der Chemischen Industrie) Fact Book brochure 02
9. Automotive applications of plastics PlasticsEurope factsheet (August 2006)
10. European Commission, based on Fatality Analysis Reporting System, 2009 Data Summary, US Department of Transportation

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