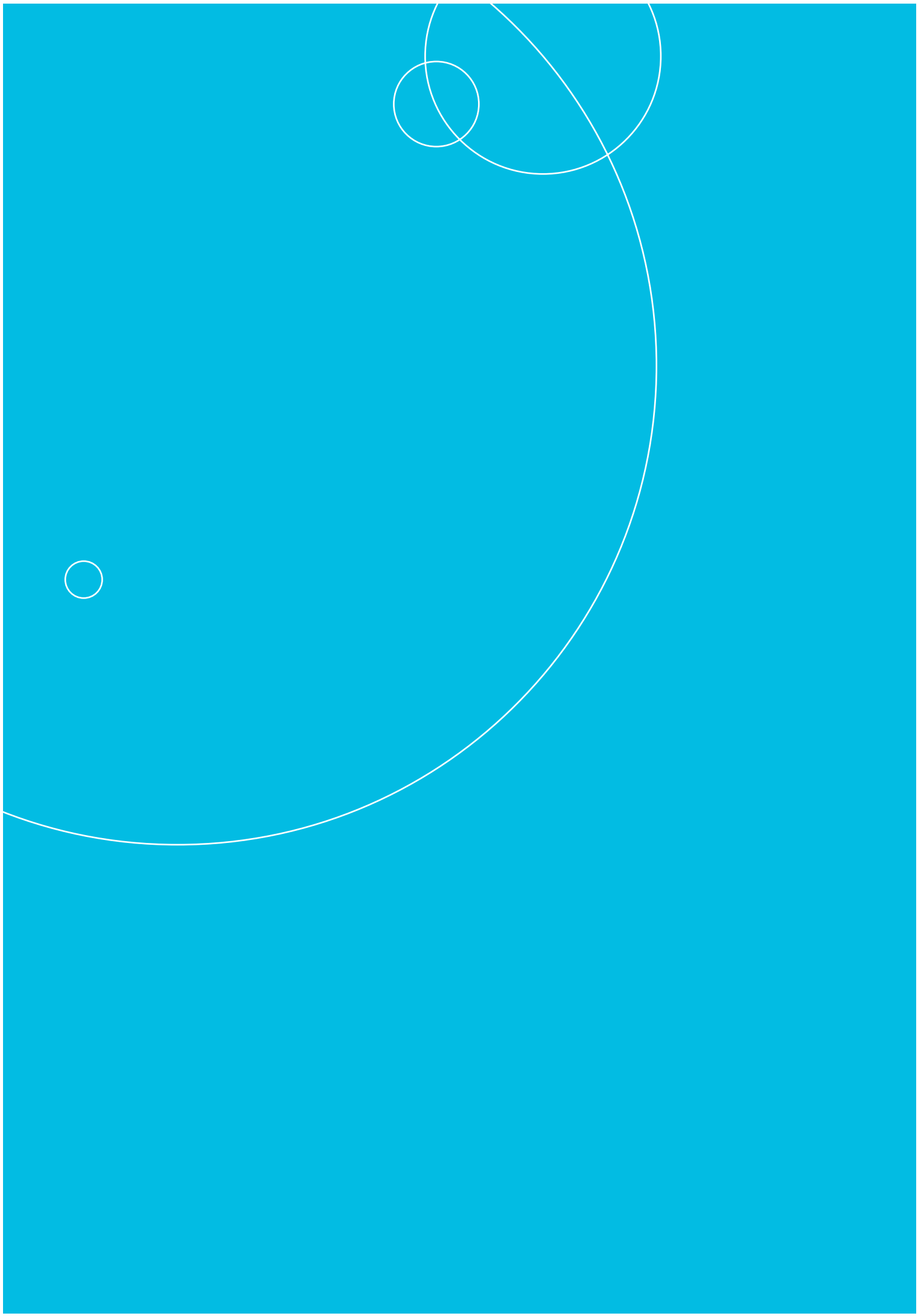

Plastics –
think differently about energy
Saving energy
Protecting resources
Securing the future
Plastics
The Material for the 21st Century



Contents

Global Warming.
Saving energy is possible. We have the solutions.

The potential for saving energy is still far from being exhausted. There are highly effective and sustainable methods of cutting the consumption of energy in traffic and transport, heating, product packaging – methods, which would be unthinkable without plastics.

Discussions about energy saving are closely related to a grave concern about global warming, as it increases the potential for strong winds and rising water levels as well as changing our global vegetation zones.

Representatives from politics and the industry are trying to counteract this development. According to the Kyoto protocol agreed upon by the international community, the total amount of relevant greenhouse gases recorded in 1990 is to be reduced by 5.2% by 2012. At their summit meeting in March 2007, Europe's Heads of State and Government agreed that all 27 member states are to reduce the emission of greenhouse gases recorded in 1990 by 20% by 2020.

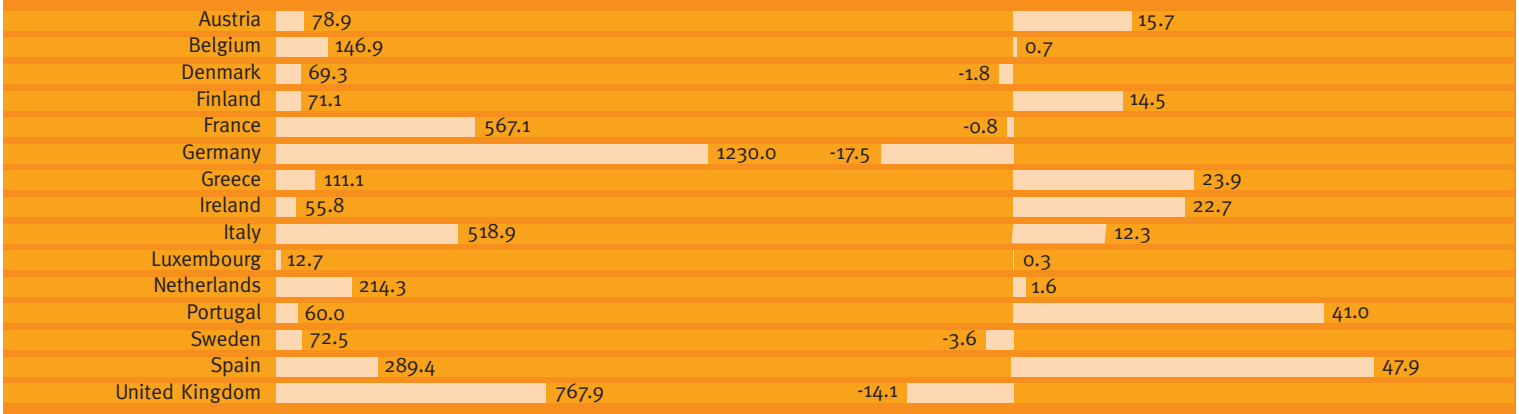
The all clear is still a long way off

While in some countries CO_2 emission has been substantially reduced since 1990, in many European countries this has not happened. Even highly developed industrial nations are nowhere near a serious reversal of this environmental trend.

Plastics do not waste energy – Plastics protect the climate!

- Plastics production consumes only a small amount of raw material. As they use up only between 4% and 6% of the total amount of mineral oil consumed, plastics have a relatively low demand – in contrast, almost 90% of this mineral oil is consumed by heating and fuel, which is a one-off and short-term deployment.
- Plastic products have a long service life, high wear resistance and the energy consumed for their development is generally comparably low.
- The production of plastics is straightforward and cost-efficient.
- Plastics are lightweight: compared with other materials such as glass, metal and ceramics, they are up to 85% lighter, which significantly reduces the energy consumed by cars, commercial vehicles, trains, buses and aircraft. A car with 100 kg less weight consumes up to 0.6 litres less fuel over a distance of 100 km.
- Plastics are indispensable for the production of solar cells, solar panels and windmills, as they are weather-resistant, durable and meet the utmost safety standards.
- While plastics store the energy that is used for their production, the energy used for heating for example is irretrievably lost: the energy stored in the plastic product can be re-used by means of recycling or retrieved for the production of heat in cogeneration plants.

This brochure will give you an insight into the contribution of plastics to individual sectors.



Emission of greenhouse gases from 15 EU countries in million tonnes.

Source: EUA

Changes in individual countries compared to the base year of 1990 in %. Between 1990 and 2003, the overall emission of dangerous gases in the 15 member states went down by only 0.9%.

Construction and Housing
Perfect climate protection for houses and apartments.

The global temperature has already risen. The emission of carbon dioxide (CO_2), one of the main causes of global warming, has hardly gone down. Even in Germany, about 75 % of domestic buildings still consume 20 litres of fuel oil per square metre every year, while a reduction of our energy consumption by 75 %, 90 % or even more would be easy to achieve. The technical potential for this change is available and has been proven in practical applications. Plastics insulation of buildings is one crucial element in the struggle for an energy-saving, environmentally-friendly domestic environment and a high quality of living.

The three-litre house is possible – everywhere

Just like so-called "three-litre cars", i.e. cars that consume only three-litres of petrol per 100 km, the concept of a "three-litre house" is already in place in France, Italy, UK and Germany. And this concept is not only feasible for new houses. The insulation of old buildings that waste a substantial amount of energy can cut the fuel oil or gas consumption from 20 litres to 3 litres per year per square metre. Applying plastic insulation panels of only 20 cm to the building's exterior, roof and cellar ceiling as well as installing plastic insulating windows can save energy and, correspondingly, reduce CO_2 emission. So-called Passive Houses with energy-saving insulation windows, air heat recovery and solar panels have an annual demand for heat of less than 1.5 litres of fuel oil per square metre. An investment that improves the quality of living, increases the value of the building and delivers a rapid return.

A look into the future

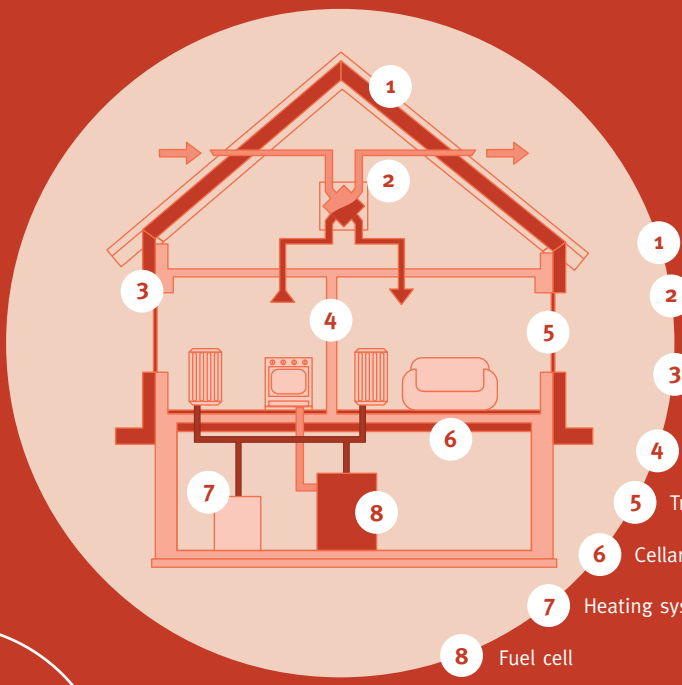
At present, "zero-energy houses", are already tried-and-tested throughout Europe. These houses consume no fossil fuel, i.e. gas or oil at all. It is partly due to the use of modern polymer materials that zero-energy houses will become more widespread in the future. With plastics, even historical buildings can be converted into energy-saving houses. One perfect example of this is the renovation of a 210 year-old listed timber-framework building in Babenhausen/Germany. Thanks to insulation with plastics materials, this building is now a low-energy house.

Plastics from roof to cellar

Modern plastics are not only important for thermal insulation measures:

- Plastic thermal insulation panels protect buildings from weather damage and increase the building's durability.
- Plastic heating, water and sewage pipes are vastly superior to conventional pipe systems: the production of plastic pipes is more cost-efficient and uses less energy; plastic pipes are more flexible than metal pipes, non-corrosive and guarantee high-quality drinking water.
- Metal water pipes damaged by lime scale can be repaired by means of a special plastic-resin coating to protect the pipes from future lime scale damage.

Energy-saving and environmentally-friendly living: efficient insulation with plastic materials can really help reduce the energy consumption of buildings old and new.



1 Roof insulated with plastic materials
2 Ventilation system/heat recovery (plastic pipes)
3 Exterior façade insulated with plastic materials
4 Interior insulated with plastic materials
5 Triple-glazed plastic windows
6 Cellar insulated with plastic materials
7 Heating system/heating pipes made from plastics
8 Fuel cell

Source: BASF

At Home
Making people's life easier. And Nature's, too.

Washing machines, refrigerators, flat-screen monitors, dishwashers – plastics have become so commonplace that we hardly notice them anymore. Plastics, however, not only make our lives easier when it comes to cooking or washing the dishes. Modern polymer materials help us economise on valuable resources such as energy and water in a way that would have been inconceivable only a few years ago.

Saving billions of litres of drinking water

Thanks to smart plastics engineering, the water consumption of modern washing machines is as low as never before: the plastic tub enclosing the drum fits accurately and minimises the occurrence of dead spots, where unused water could gather. While in the years between 1985 and 1990 washing machines used about 100 litres of water per washing cycle, modern machines and modern detergents have helped cut this figure to between 50 and 60 litres. In 24 million households in France, which use their washing machines about 100 times a year, this improvement saves at least 950 million litres of valuable drinking water. Correspondingly, heating it consumes less energy. In the bathroom too, even our little plastic showerhead offers more than meets the eye: a sophisticated water system reduces the water consumption by up to 50%.

Using less electricity

Apart from a better-quality picture and the elimination of radiation emission, there are other good reasons for the vast success of LCD and plasma televisions, which quickly superseded conventional TV sets. As the picture is created on a flat plastic screen rather than in a large tube, the new sets are extremely flat. As the picture is created on a flat plastic screen rather than in a large tube, the new sets are extremely flat. This feature saves a lot of space and their energy consumption is also substantially lower.

Until recently, cooling devices and refrigerators were rated among the most substantial energy wasters of modern households. Today's modern refrigerators in the efficiency class A operate with up to 50% less energy than those built in 1990. Devices equipped with state-of-the-art technology of efficiency class A++ consume even 70% less. This is the benefit of premium-quality plastic insulation foam. It keeps the cold in where it belongs – now there is a real energy saver!

Protecting resources

It is well known that browsing the internet would be impossible without super fast plastic-coated broadband cables. Many people may not realise that plastics are a major contributor to the trend for more miniaturisation, which protects resources in a tangible way. Be it mobile phones or MP3 players, these modern devices would be impossible to manufacture without polymer materials that combine particular mechanical, electrical and optical properties and therefore integrate many different functions in one tiny housing.

Plastic products of the future

The potential for deploying polymer materials in the household and the workplace in order to save energy is far from exhausted. New and groundbreaking innovations keep being introduced into the market. British plastic electronics manufacturer Plastic Logic Ltd., for instance, invests in electronic paper. This so-called e-paper is actually a thin, flexible and electricity-saving plastic display, which can be used as an electronic newspaper or encyclopaedia, as it can be edited and updated as required.

E-paper prototype:
The portable plastic decoder fits into (almost) every bag.

Environmentally-friendly washing machines: plastic tubs reduce the energy and water consumption.

Packaging
The best protection – with less and less packaging material.

Several million tonnes of food and goods are transported from manufacturer to end consumer – from toothbrushes to heavy-duty machinery. Fruit, beverages, meat, pharmaceuticals: the production of these goods often consumes a significant amount of energy and they must be delivered to the customer quickly and without damage. There is hardly a material as versatile and as suitable for a high number of intelligent and environmentally-friendly packaging solutions as plastics.

From heavy duty to delicate: the magic packaging material

- Wafer thin film with a weight of only a few milligrams can protect and seal meat, fruit, vegetables, cheese and coffee while also ensuring that these products are still fresh and healthy when they reach their final destination. Fish is a perfect example: from the minute it is caught at sea to its final storage in the freezer, it needs to be kept cool at all times. This feat would be impossible to achieve without modern polymer materials.
- When we buy juices, milk and a wide range of other beverages, they are vacuum-packed in plastic containers to ensure that they are aromatically fresh and unadulterated. Often, these are transported in particularly environmentally-friendly, returnable plastic crates.
- On their way from the manufacturer to the corporate end consumer, most large appliances, from refrigerators to machines, industrial bulk solids and liquids are perfectly protected by plastic packaging.
- Pharmaceuticals in blister packages are safely protected from moisture, light and damage. A tamper-free plastic package guarantees that the medicament has been delivered to the patient in its original condition.

Saving weight means saving electricity

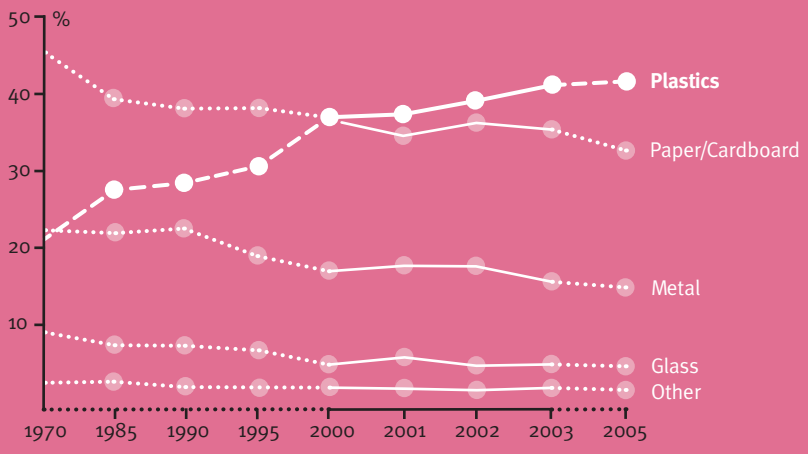
No matter how wide the variety of plastic packaging, they all have one thing in common: they are becoming lighter, less bulky and more resilient. These features not only help cut down on the waste of valuable raw materials, it also reduces the weight to be transported and the corresponding transport costs for both disposable and returnable products. On average, plastic packaging accounts for only between 1% and 3% of the total product weight. It takes 2 grams of plastic film to package 200 grams of cheese. 1.5 litres of liquid can be safely stored in a bottle with a weight of only 38 grams and a tub containing 125 grams of yoghurt weighs only 4.5 grams. The ecological balance sheet of plastic packaging, i.e. the sum total of the corresponding energy consumption for production, transport and disposal and other effects on the environment is often second to none. It is not surprising, therefore, that plastic packaging applications such as milk in a plastic tube are awarded prizes, for example, the German Environmental Label of the “Blue Angel”.

More packaging without plastics

Source: GVM study

The German association for research into the packaging market (GVM) did a sample calculation for the following scenario: if for example, we stopped using plastic packaging, the weight of packaging would be four times higher, packaging material production costs would almost double and the amount of waste would be 1.6 times higher.

Share of various materials in the German packaging market in per cent of their production value. This development is also typical of other European countries and it shows the following: in Europe, plastics packaging is indispensable.



Source: GADV/RKW, IK

Mobility: Cars, Buses, Trains
Getting places and protecting the environment.

The freedom of automotive mobility has its price. The effects manifest themselves in global warming and soaring petrol prices: over the past years, the price of petrol in Europe has risen dramatically and there is no end to the price hikes in sight. In times of diminishing fossil fuel resources, intelligent and responsible driving is a wise approach that will pay off. In addition to innovative engine technology and an environmentally conscious approach to motoring, modern polymer materials help reduce the car's fuel consumption, while also enhancing driver comfort and safety.

... and lighter

A modern mid-range car with a weight of about 1,000 kg contains of up to 15%, i.e. 150 kg, of plastic material: car body parts such as spoilers and bumpers, instrument panels and headlights are made from plastics, as are side trim and interior trim, dashboards, seats and airbags, carpets, tyres, seals and gaskets, fan belts, gearbox mountings, engine covers and many small components. The reasons for the success ofplastics are manifold. Polymer materials will easily take almost any required shape, improve safety and comfort, can be processed easily and cost-efficiently and they save weight, which translates into lower fuel costs.

Intelligent solutions for more mobility

There is an almost infinite number of areas of application for polymer materials. Made from plastics, individual parts such as valve caps, air filters and air intake pipes can be integrated into one unit. Formerly made from metal, today's air intake pipes and fuel tanks are almost entirely made from plastics: they are non-corrosive and easier to mount, while also saving between 40% and 50% in weight. Plastics have also taken the place of glass in modern automotive engineering. Modern headlights, rear lights and even rear and side windows are made of plastics, because it saves weight, enhances the safety of the product and provides broad design flexibility.

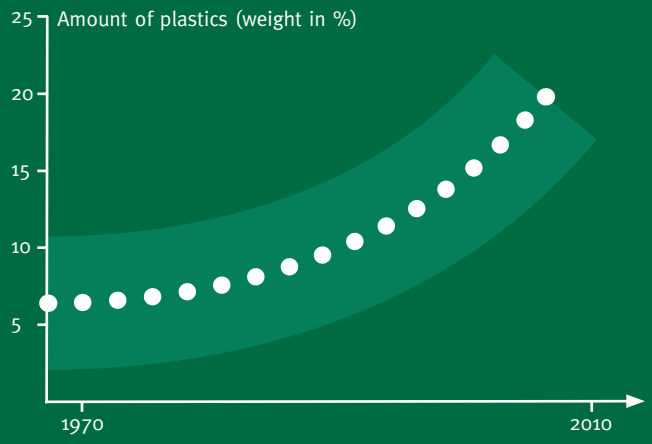
On the fast track with buses and trains

Plastics have also become established as a construction material for buses and trains. In contrast to conventional vehicles, railway carriages, end cars and buses made from plastic are 30% lighter. This saves energy, investment and maintenance costs, while also reducing wear. Less weight means less strain on the material – for faster and quieter trains and buses.

Mobility of the future

In conventional vehicle design, metal and plastics were generally treated as opposing materials, one excluding the use of the other. The future, however, belongs to hybrid technology, which uses the benefits of combining both materials in one unit. This approach increases the sturdiness and strength of the products and additional features can be integrated easier and in a more compact manner. This way, the weight of the finished product is about 40% less than that of a pure metal construction!

There is a distinct trend in automotive engineering for a replacement of conventional materials with plastics. Lightweight properties, broad design flexibility and aspects of safety are major advantages in favour of the material of the 21st century. Today, plastic components already account for between 12% and 19% of the total weight of a vehicle.



Source: Mercedes, BASF

Mobility: Aeronautics, Astronautics, Marine
Saving energy while travelling by water and by air.

Travelling by water, by air or in space with zero gravity – aviation, aerospace engineering and navigation are inconceivable without plastics. A mere glance at the interior of an aircraft will confirm this statement. Be it doors, windows, seats, interior trim or equipment, when designing an aircraft, every gramme counts in order to minimize weight to maximise speed. But heavy-duty plastics are indispensable for the compliance with the stringent safety requirements of sensitive parts such as rudders and stabilisers, wing housings, flaps, spoilers and last but not least, tyres.

Airbus A380 – a world record made from plastics

The Airbus A380-800 can transport up 853 passengers – 555 in the standard version – which makes it the largest passenger aircraft in the world. Fibre composites account for about 25% of the material that went into making this plane. Thanks to this high amount of plastics, a fully occupied A380 can cover a range of 14,800 km and uses only 3.3 litres of kerosene per passenger over 100 km. With these features, the A380 clearly outperforms the Boeing 747-800, which accommodates 390 passengers, and not only in terms of size. The Boeing 747 has a range of 12,200 km and a kerosene consumption of 4.3 litres per passenger over 100 km. Equipped with these outstanding features, the A380 clearly sets new standards in aircraft engineering and passenger comfort.

Lighter, quieter and better for the environment – the aircraft of the future

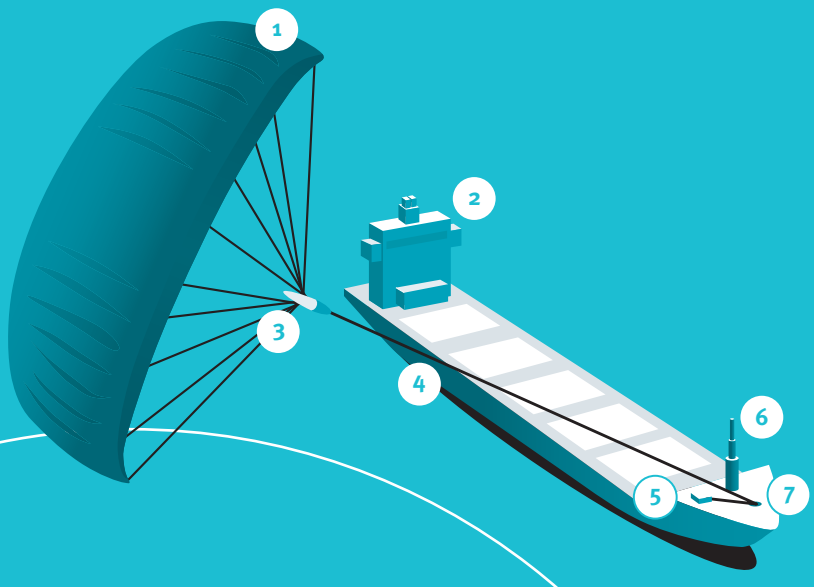
But the A380 does not mark the end of the scale. In the future, composites will account for 40% of the material that is used to build wide-bodied aircraft. Equipped with plastic fuselage and wings, these aircraft will provide superior strength and aerodynamics. According to the objectives outlined in “Vision 2020”, a strategy paper published by the German Aerospace Centre DLR, these even lighter aeroplanes will emit 50% less carbon dioxide and 80% less nitrogen.

6,800 HP generated by wind power – sailing container ships

The next-generation power engine for cargo ships, yachts, large oil tankers and cruise liners could even be a wind-powered towing kite propulsion system! The towing sails which are being manufactured by SkySails, consist of a large towing kite similar to a paraglider of up to 5,000 m^2 in size. The propulsion system uses offshore wind power to tow the ship along its required course. With a propulsion power of up to 6,800 PS, the aerofoil relieves the ship’s engine and reduces the vessel’s fuel consumption by up to 50% in favourable sailing conditions. The environmentally-friendly, innovative towing kite with fully automatic control is made from high-strength, weather-resistant plastic fabrics.

An ingenious idea: towing sail made from plastics as a wind-powered propulsion system for boats. The market potential is enormous.

1. Towing kite
2. Control system
3. Control pod
4. Towing rope
5. Winch
6. Launch and recovery system
7. Point of force transmission



Source: SkySails

Renewable Energy
The infinite power of the elements.

The development of renewable energy resources is booming. Solar and wind power, geothermal heat and biomass are inexhaustible. Shining on the earth, the sun generates 15,000 times more energy than the total primary energy consumed worldwide in one year. About one thousandth of the energy generated by the sun shining on us alone would suffice to cover our total energy demand. Already, certain villages in Europe are using renewable energy to meet almost all of their heating, hot water and electricity requirements – with innovative solutions made from state-of-the-art plastics!

Wind Power – (almost) 24/7

Wind power is only one of many possibilities of using renewable energy. In order to tap this energy on a commercial scale, windmills must be equipped with very long rotor blades. These blades are almost entirely made from fibre-reinforced plastics, as only this material is able to withstand the permanent mechanical stress on a rotor of this size. At present, offshore windmills are built with a rotor diameter of 125 m and a rated output of five megawatts of electricity.

Solar power – even when the skies are grey

Modern solar water heaters can supply up to 65% of a household's annual hot water demand. Photovoltaic collectors that can satisfy solar energy into electricity can cover the remaining energy requirements of a so-called Passive House at the very least. This would be impos sible without plastics as many important components such as the collector housing, the pipe insulation or even the central control system are made from polymer materials.

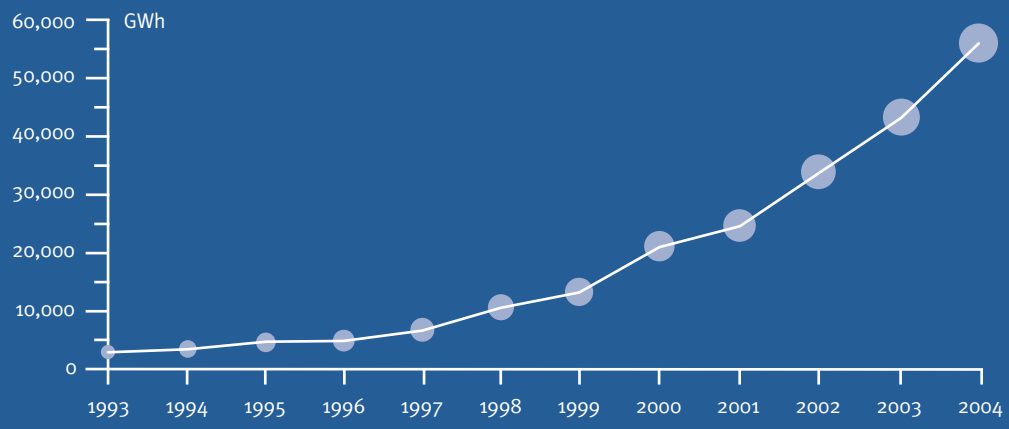
Hydrogen fuel cell – energy with (almost) zero emission

The development of a polymer electrolyte fuel cell, which uses the electricity generated by a chemical reaction between hydrogen and oxygen, is still underway. Hydrogen in the fuel cell is separated from oxygen by a wafer thin plastic membrane, which controls the hydrogen's chemical reaction with the oxygen. The energy produced in the wake of this reaction can be used everywhere: for producing electricity or heat and for car or bus engines as the first fuel cell prototypes have already shown.

Renewable energy with major prospects for the future

Europe will take a leading part in the development of new sources for renewable energy. At a meeting in Brussels in March 2007, the EU's 27 heads of state and government agreed to boost the share of renewable energies in the European energy balance from currently 6.4% to 20% by 2020. Intelligent plastics solutions will make a substantial contribution to the improvement of the European energy balance sheet.

The graph shows that in 25 EU states, the use of wind power as an energy source has experienced a massive increase since 1993. Rotor blades made from fibre-reinforced plastics are a major contribution to this development.



Source: Eurostat

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