

THE SUSTAINABILITY OF PLASTICS PRODUCTS

Plastics products make a significant contribution to the EU's Economy

- The Plastics Conversion – the industry which makes plastics products is one of the largest manufacturing industries in EU, contributing significantly to its economy. It has an annual turnover of EUR 140 billion and manufactures 40 million tons of plastics products each year. The chemicals, rubber and plastics manufacturing sector in the EU-25 generated EUR 241 billion of value added. Within the activities of rubber and plastic products manufacturing, the principal activity was plastics manufacturing which generated a little under one quarter (23%) of the value added generated by the whole of the chemicals, rubber and plastics manufacturing sector.
- The European plastics converting industry comprises more than 40.000 plastics companies in Europe of which 3.800 in France, 5.795 in UK, 1048 in Poland and 600 in Romania. These provide more than 1.7 million jobs, corresponding to about one in three people within the chemicals, rubber and plastics manufacturing workforce. Hungary has the highest number of employees in the plastics industry, 284.000 employees. There are 156.000 employees working in the plastics industry in France, the UK's plastics industry employs 177.000 people.
- Labor productivity in the plastics industry is 30% higher than the industrial average.
- The EU-25's plastics industry had EUR 4.3 billion trade surplus in 2005. Most of the surplus came from the category described by EUROSTAT as 'plastic plates, sheets, tubes and profiles'.
- Plastics converters offer cost efficiencies to their supply chains. Products are cost effective, amenable to both mass production and small scale manufacture. Plastics offer great design freedom and their attributes such as lightweight, strength, and portability facilitate their movement along distribution chains with attendant cost efficiencies.
- The Plastics Conversion industry invests in the future and has an active engagement with an infrastructure of University Departments through the EU specializing in relevant branches of materials science and process engineering. Some examples are the IPMTE at the University of Loughborough in the UK, and RWTH in Aachen. Through EuPC and its national association members the plastics conversion industry supports EU research programmes and participates in several projects with EU funding such as Polycond, FlowFree, LabelAgriWaste, Pegassus, Ecodis.

Manufacturers of plastic products make a positive contribution to EU society

- Plastics converting firms offer high quality and stable employment. There are many employment opportunities in plastics converting throughout the EU in all disciplines:
 - Process control and engineering
 - Quality assurance
 - Product design and development
 - IT
 - Sales and marketing
- Plastics converting firms have safe, well controlled working environments. Many are operating 'Clean Room Environments' and have to demonstrate high levels of hygiene to their customers.
- Plastics conversion companies have a highly trained staff. They help the personal development of their employees. The industry is served by a training infrastructure such as that provided by the Polymer Skills Academy in the UK. EuPC encourages this by the creation of EuroPlastic, the first European diploma of plastics industry after high school.
- Plastics products improve levels of safety. Plastics products offer a high degree of **safety** as they are shatter-proof, and impact resistant. From the standpoint of chemical safety plastics products are inert and any transfer of constituents is limited to negligible proportions. EU manufactured plastics products meet all the EU safety requirements in particular EU Directives on plastics in contact with Foodstuffs, Toys, Medical Devices and Water quality. Very often plastics products are preferred by regulators and customers for their safety qualities.

Plastic surfaces do not harbour germs and can be easily cleaned, an important factor in maintaining hygiene levels in hospitals where plastic construction products and medical devices are widely used.

- Plastic products bring convenience. Because plastic products are lightweight and easy to handle, they are convenient to purchase, carry home and use. This is an important factor when increasingly all members of a family are working and single people especially women are working longer. Plastics packaging facilitates ready made meals and plastics construction products for the home are easy to install and are relatively low maintenance compared to products made from other materials. Because plastic products are self-coloured they don't require painting.

Plastics Products Bring Environmental Benefits

- **Limited oil consumption**

Only about 4% of oil goes into the creation of plastics raw materials. Moreover only 4% is used as energy in the manufacturing of plastics products. This means that less energy is needed to convert plastics from raw materials into a finished product than to make comparable products from other materials.

In addition to this are ongoing efforts to make plastics conversion even more energy efficient. Guidance in the form of a 'state of the art' manual on achieving energy efficiencies in plastics conversion is available through the EU-funded RECIPE project.

- **Energy savings of plastics products in use.**

The lightweight of plastics products means lower transportation costs, less fuel use and less pollution. This is demonstrated in the transportation of plastics packaging and in the increasing use of plastics components in cars and aircraft.

Plastics products have low heat conductivity and are excellent insulating materials. Plastics building products are therefore strongly contribute to the efficiency of homes, factories and public buildings through such products as EPS, wall-insulation and PVC roofing membranes and windows.

- **Resource efficiency**

Because of the high strength to weight ratio of plastics products, they are able to do their jobs using a lot less material than other products. There are ongoing efforts to make plastics products even more resource efficient. Over time materials and design improvements have reduced weight of plastics products even further.

- **Plastics can be recycled.**

The European plastics recycling industry has a turnover of EUR 1.000.000, has more than 10.000 employees and has 2.000.000 T/year total production. Recycled plastic products are used to create new products. These new products are made from either single plastics or less frequently mixed plastics.

- **Energy can be recovered from used plastics products.**

Used plastics products which cannot be recycled are amenable to energy recovery. On average plastics products have a calorific value (35 MJ/KG) greater than coal and are a potentially rich source of energy from waste. In an incinerator, plastics assist the combustion of other materials and minimise the use of additional fuels. Not only is the waste sterilised, it is also reduced in volume by up to 90%. This dramatically eases the burden on landfill. Plastics products can be safely incinerated and with well managed

modern incineration equipment conforming to EU emission standards they do not present any particular issues. Used plastics products are a significant contributor to energy sources in Denmark, Switzerland, Luxembourg and Japan. In Denmark there are 29 energy from waste plants and 26% of Danish wastes arising are utilized in energy from waste schemes.

Plastics products bring specific benefits in diverse applications

The possibilities of plastic applications are endless. Plastics adapt easily to society's emerging needs, the changing requirement of every type of consumer, to trends, to the needs of every type of consumer and their lifestyle and habits, and to every distribution channel.

Plastic products make a fundamental contribution to sustainability schemes such as the availability of good housing, provision of high standard healthcare, and transportation of drinking water.

We are providing information below, application by application of the benefits brought by plastic products in different applications.

Automotive industry

- The use of plastics make a vehicle lightweight. Without plastics, it is estimated that today's cars would be around 200-300 kg heavier. Motor engineers have a rule of thumb, 1 Kg of plastics in vehicles replaces of 1.5 kg of conventional materials. By volume more plastics are now used than steel, however the low weight of plastics means that they account for only 15% of an average car's weight. Bumpers, Facias, Bonnets and Boot lids are now mainly based on plastics. For example a plastics bumper now weighs 3 to 4 Kgs compared with a metal bumper with a weight of 6 - 8 Kg. All cars now employ plastics bumpers.
- The weight savings achieved by the use of plastic products is responsible for saving fuel and reducing emission pollution. This amounts to 0.5 ltrs of fuel per 100 km which represents 750 liters for a car with a lifetime of 150,000 kms. Each year this equalivalent to 12 million tons of oil saved across Europe. As a consequence of the use of lightweight plastics in cars, and a reduction of around 30.000 billion tons of CO₂ emissions.
- Plastics products also enhance the fuel efficiency of a vehicle by the new design possibilities which they offer. This helps to reduce the drag coefficient of today's cars through the streamlining of body shapes.
- Plastics components bring a further environmental benefit by making a considerable contribution to noise reduction by deadening sound.
- Plastics products also makes the manufacture of cars cost effective helping to make cars more affordable to consumers. Manufacturing is accelarated and

made simpler because plastics components allow the integration in one piece of several components traditionally made from different materials and joined together. This has revolutionised the assembly process.

- Manufacturing costs are also lower with the elimination of all or part of the spraying process.
- The use of plastic components permits car designers to be highly creative and to respond to changes in fashion. Colour is a big influence of the purchasing decision, even in the used car market. With plastics, colour can be part of the material its allowing consistency, depth of finish and excellent colour-fast properties.
- **Interior components**

- **Fuel systems**

- The 2006 **Toyota Crown** and **Lexus GS-300** boast a fuel-savings component that according to Toyota has a 1% fuel savings – 6 gallons of gasoline per vehicle per year- which means the component will pay for itself through fuel savings the first 6 months of vehicle ownership. Similar savings through traditional weight-reduction-to achieve fuel economy models would require the vehicle to weigh nearly 25 kgs less.

- **Exterior components**

- Body panels, bumpers, fenders, chassis coatings.

Aerospace industry

- As with motorvehicles the use of plastic products in aircraft and their contents reduces weight, fuel consumption and emission of pollution. Plastics weighs less than aluminium and therefore planes burn less fuel.

- Some 22% by weight of the **Airbus 380** aircraft is built with carbonfibre reinforced plastics. This burns fuel per passenger at a rate comparable to that of an economical family car.

- Boeing's** new **787 jets**, are mostly built with plastic composites, require far fewer parts because there is less to bolt together. Fuel savings are anticipated at around 20%.

Packaging

- With plastics packaging it is possible to pack more products using less material than with packaging made from traditional materials.
- The durability of plastics packaging protects goods from deterioration. The rigidity of plastics packaging protects goods from physical impact and their barrier properties protect them from chemical degradation. This increases the shelf life of goods and promotes their longevity.
- The light weight of plastics packaging means that less fuel is used in its transportation providing both fuel and cost savings to distributors, retailers and the consumer.

If there was a change from plastics packaging to traditional packaging materials overall packaging consumption would increase 291 % by weight, resulting on an increase in manufacturing energy of 108 % and a rise in the volume of waste by 158% (source: Gesellschaft für Verpackungsmarktforschung).

- There is an ongoing trend to reduce the weight of plastics packaging. This achieved through design, innovations, materials, technology and process innovation. An article packed in plastics packaging is today 28% lighter than 10 years ago. This means a reduction of some 1.8 millions of plastics packaging.
- Plastic packaging is eminently recyclable with 1.5 million tons recycled annually. The industry is served by an efficient infrastructure of collection and recycling facilities across the EU, supported by the EU Packaging and Packaging waste Directive. The DSD Green Dot system in Germany and the network of compliance organizations in the UK such as Valpack, are examples of national responses to the need to reach recycling targets for packaging.
- Plastic packaging is safe and promotes hygiene through its sealability. Plastics packaging can be transparent allowing customers to inspect the quality of the goods contained.
- Plastics packaging is easily printable and can carry instructions for the appropriate use of the packs content and detail its ingredients.

- **Bottles**

 - **PET bottles**

- **Cosmetic Packaging**

Plastic packaging in the beauty sector for instance, ensures consumer safety by meeting all the crucial requirements of styling, colour, feel, chemical resistance, preservation and accurate dosage. It can facilitate better make-up or skincare practices.

- **Film**
 - **Bags**

During their life cycle, plastic bags require about one-third less energy to make than paper bags.

- **Food service packaging**
 - **Food trays**

 - **Vending cups**

A study comparing **paper and EPS cups** showed that paper cups consumed 15 times more steam and 13 times more electricity in their manufacture than their EPS equivalents. (Source: Hocking, "Environmental Management". No. 1991).

- **Industrial packaging**
 - **Crates**

- **Pharmaceutical packaging**

Building and construction

- Plastics building products are extremely durable and have demonstrable lifespans of at least 70 years. There are plastic pipe installations in use since the 1930s which are still fully integral and operational. Plastic windows have a lifespan of 35 years.
- Because of the low conductivity of plastics plastics building products are energy efficient.

- Plastics building products are light weight and easy to handle. They are easy to install and require relatively little maintenance. They do not require painting.

- Because of their light weight plastic building products promote safety. Injuries are minimised from falling products, and the easy maintenance reduces the need to work at heights, a frequent source of injury in the building and maintenance trades.

- Plastics building products are recycled in increasing quantities. The major plastics material used in building application is PVC. The European PVC industry has made Voluntary Commitment to support its sustainability – Vinyl 2010 - and there is an annual progress report which charts achievements in the recycling of plastics windows, pipes, flooring and roofing membranes.

- **Bridges**

The use of plastics in European bridge building is increasing. Light weight plastics filling materials are favoured to provide solutions to load bearing problems in soft subsoil areas. Traditional load bearing materials such as sand and rock are being replaced by expanded polystyrene. In Norway alone several hundred road projects involving EPS fills have been completed.

- **Insulation**

This can either be expanded polystyrene (EPS) or polyurethane foam (PEU). In a typical house, it is estimated that the energy equivalent to that needed to produce insulation in the first place is saved after only one year of use. The CO₂ reduction in the same period is two to five times higher compared to CO₂ caused in production. Over 30 – year lifespan, these figures rise to 40-60 times higher savings compared to production for energy and 10-40 times higher savings compared to production of CO₂ emissions.

- **Flooring products**

Floor Coverings made from plastics are long lasting, hygienic and easy to clean. The huge variety in quality and design make them suitable for any application.

- **Pipe**

Plastics pipe systems play an increasingly important role in infrastructure renewal in the EU. Plastics offer an effective solution to the problem of leaking urban sewer pipe networks which contaminate ground water purity. Plastics pipe replacements can be introduced whilst minimising the environmental impact of repair activities. Existing manholes are used to feed plastics reliners into the damaged pipes. Leaks are therefore sealed without removing the pipes and obstructing heavily congested roads. When a plastic pipe carries corrosive fluid through the ground near a river, it prevents pollution of the groundwater, conserves the quality of the water in the river and protects wildlife.

A lifetime of 100 years for PVC water pipe systems has been demonstrated in the Netherlands by TNO Science and Industry with industrial partners.

A low level of defects in flexible plastics pipe systems used in sewerage applications was demonstrated in a TNO study. This means less leakage from pipes and less risk to health.

- **Roofing Products**

Thermoplastic membranes (a form of sheet) are suitable when specially shaped surfaces have to be waterproofed for example where they have to follow the sweep of curved roof surfaces. Thermoplastic roofing membranes are available in a wide range of materials with a multitude of fastening methods and offer a maximum design freedom. With highly tear-resistant reinforcements they are tension-resistant yet sufficiently flexible. In terms of dimensional stability, thermoplastic waterproofing systems are unmatched, withstanding extreme temperatures.

Thermoplastic membranes also assist in the renovation of older buildings as they can be applied by laying them loose or by fully bonding them to the surface.

- **Waterproofing**

Landfill:

Polymeric Geomembranes function as the primary barrier to protect the environment by avoiding the migration of leachate and gas out of landfills, as well as the intrusion of rainwater into the landfill. Geomembranes provide excellent durability, chemical resistance, mechanical strength, flexibility and resistance to UV radiation

Tunnels

Owing to the inherent complexity of construction, tunnels must have a life expectancy of several decades.

All components of these works should have similar characteristics, especially the waterproofing system. The waterproof liner protects and makes the construction safer. Over its whole working life, it allows considerable cost savings in terms of maintenance and repair. Since the creation of the first tunnels, water seepage has been one of the main problems. Virtually no tunnel is ever bored into a completely dry substrate.

Historically, water has been one of the most serious problems encountered in underground works

and it requires extremely expensive repair and renovation works.

Water reservoirs:

Waterproofing systems with synthetic Geomembranes have been designed and installed for hydraulic structures since 1950s.

There is a long record of success in different applications: lining of dams, reservoirs & water lagoons, canals, sewage stations and hydraulic tunnels. The main aspects related to the use of geomembrane within these type of applications, are the durability specially for exposed products to the UV radiation, mechanical properties when geomembranes have to resist very high hydrostatic head, movement of the structure, and very high gradient at the boundaries where the geomembrane is sealed against the structure.

In some cases they must have the capability of resisting seismic events, of bridging joints and unforeseen cracks, of resisting very aggressive environment when the geomembrane is left exposed on the upstream face of the structure (UV rays, ice, waves, impact of debris, vandalism, etc).

In some other cases flexibility and weldability are a must.

Finally sometimes the resistance to the chemical attack could be the decisive variable.

- **Windows**

Several studies have illustrated the relatively low environmental impact of PVC windows compared to traditional materials, an eco balance study carried out by Swiss Fedal Laboratory for Materials (EMPA) illustrated that whilst PVC windows may be more expensive than a wooden frame, over their lifetime they have the lowest environmental cost especially when they are recycled at the end of life. This has been reinforced by the European Commission 'Life Cycle Assessment of PVC and of Principal Competing Materials' which, reviewing a wide range of available studies for PVC and its alternatives in windows, mainly Wood and Aluminum, came to "comparable conclusions" with "no winner in terms of preferable materials".

- **Wire and cable**

Defense and security

- **Protective devices**
 - **Helmets**
 - **Shields**
- **Weapons**
 - **armored vehicles**
 - **war ships**

Healthcare

- Plastics products in healthcare are safe, hygienic and biocompatible. They are accepted by the human body and are used widely in prostheses, heart valves, tubes inserted into the body, and systems for the slow release of drugs.
- The design freedom available with plastics means that plastics products can be shaped into any contour reflecting the needs of patients and healthcare providers alike.
- The electrical properties of plastics enable their use in a wide range of medical devices and monitoring equipment.
- Plastics medical products are cost effective and can be made available in large quantities and readily disposable. This is crucially important in the promotion of hygiene in healthcare and the prevention of cross infection.

- **Artificial body parts**

Artificial hips and knees use plastics to help provide smoothly working, trouble-free joints.

- **Optical products**

Plastics reduced the weight of **eyeglass frames** and **lenses**, while improving their strength and shatter resistance. Plastics also provide another option, contact lenses.

- **Surgical Gloves**

Made of soft pliable plastic, these help preserve the sterile environment of hospital operating rooms and avoid allergic infections associated with the use of gloves made from some other materials.

Leisure

- The durability and light weight and design freedom available with plastics products has been made them suitable for a wide range of sports equipments.
- **Cycling**
- **Football**

- **Footwear**

The use of plastics components in sports shoes have combined strength with low weight and help to protect feet from the shock of impact and helps to minimise injury.

- **Kits**

- **Pole Vaulting.**

It is possible to jump higher with a plastics pole. In 1900 the first record pole vault jump was 3.62 meters. Now that record is doubled using a plastics pole which has the additional flexibility and strength which enable the athlete to propel them to greater heights.

- **Rowing**

In rowing, the now widely used 'Cleaver' oar uses carbon fibre in the shaft of the blade and this light weighting enables oarsmen to achieve extra centimetres per pull when competing.

- **Skating**

- **Skiing**

Skiing requires no-compromise peak performance. Carbon fiber composite poles are extremely durable, light and agile in situations requiring both split-second reactions and direct power.

Sports surfaces

- **Stadia**

- **Surfing**

Composite boards offer about 15 to 30 percent more flexibility than a comparable foam-and-fiberglass board. The extra flexibility, without breaking, helps keep more of the board in contact with the wave at any given time, "which results in more efficient energy transfer between board and wave." Epoxy composites have good tensile and fatigue strength. So the boards hold up to lots of abuse.