Plastics: Too valuable to be thrown away

Recovery, recycling and resource conservation

PlasticsEurope
Association of Plastics Manufacturers

Plastics:
Innovative solutions with resource saving potential

Plastics have changed the world, and they continue to do so. They have enabled the production of totally novel products, driven forward technological progress perhaps more than any other material and opened new horizons for engineers to realize their ideas. The innovative potential of plastics is far from exhausted.

Materials have always given their names to the great development eras of mankind: Plastics first started to show their potential 50 years ago but the era of plastics has really just begun.

Plastics are innovative materials. Many forms of technical progress – e.g. in aviation and space flight, in automobile and aircraft construction, or in electrical engineering and communication technology – would be unthinkable without the targeted use of new materials. Technical progress and material development go hand in hand. In this process, polymeric materials are trailblazers for economic, ecological and social progress.

Plastics are eco-efficient in many ways. For example, they efficiently insulate buildings, they provide lightweight and safe packaging, they reduce the weight of cars and make them quieter; and they help us to harness the sun and wind as energy sources. Also, at the end of their useful life, plastics still have a lot to offer – they are simply too valuable to be thrown away and various different recovery pathways are available to recover their value.

Plastics help to conserve resources

In Western Europe, around 80% of mineral oil is used solely as an energy source. As diesel or petrol in vehicles, in heating systems or for electricity generation. In other words: 8 out of 10 litres of petroleum are burnt directly.

Only around 4 - 6% of mineral oil and gas is used in the manufacture of the wide range of plastics and a large share of these actually help us to cut the use of oil for energy purposes, for example by reducing consumption for cars by decreasing the overall weight of the vehicle or by considerably reducing the energy required for heating as a result of effective insulation of buildings.

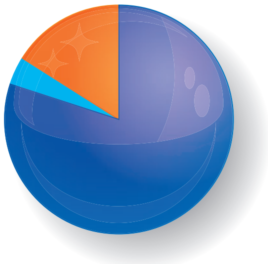


Figure 1. Mineral oil use in Europe

It is obvious that transport and heating are the biggest consumers of energy but to reduce the consumption of energy overall it is also important to understand in what phase of a product's lifecycle most energy is consumed. This enables a targeted approach for the development of savings options. Today we understand that by far the largest volumes of primary resources are consumed during the use phase of products – on average 80% of total energy consumption. This is called the 80 / 20 rule. This rule is true for most things: cars, TV sets or packaging etc.

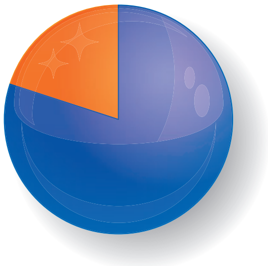


Figure 2. Energy consumption: 80 / 20 rule

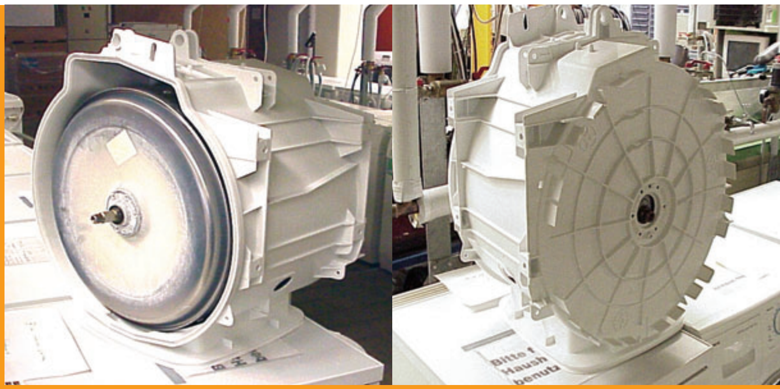
This is illustrated well in large domestic appliances for which very precise figures are available. Here, energy consumption during the use phase is actually even higher than 80%. In fact 90% of energy consumption can be expected during the use phase, 9.8% for manufacture, and 0.2% for managing the end-of-life stage. Therefore, it is easy to see that reducing energy demand during the use phase is of particular importance: the less electricity a TV set requires or the less water a washing machine consumes, the better – not only for the consumer's purse, but also for the environment. Furthermore, new, more energy efficient products also improve industry competitiveness.

Exemplary excursion for resource saving
A specific example in the field of large domestic appliances is when the 'lye' container in a washing machine is made out of plastic.

Here, the key to resource conservation is the almost unlimited freedom in shaping and forming that plastics provide to designers.

This allows near to perfect adaptation of the inner parts of the washing machine. Dead spaces with no use that gather water can thus be minimised. This can reduce water consumption per washing cycle by up to 2 litres, and water, which is not required, will not be heated unnecessarily. Additionally, this clearly also saves electricity.

Extrapolations show that if a country like France or the United Kingdom, with about 25 million households, used such optimally designed washing machines, an average saving of 4 billion litres of water and 200 million kilowatt hours of electricity would be achieved each year. For Europe in total, with around 270 million households, savings of 40 billion litres of water and 2'000 million kilowatt hours could be expected. This amount of electricity is equivalent to half an average-sized coal-fired power station.



Assuming that a European citizen consumes on average 160 litres drinking water per day for hygiene, washing, cooking etc., the huge amount of water saved would be enough to supply a city the size of Frankfurt, Genoa, Glasgow, Marseille or Saragossa with enough drinking water for a whole year. In this way it is easy to see that plastics make a very important contribution to environmental protection.

Plastics: Too valuable to be thrown away

At some point, every product comes to the end of its useful life. This is when end-of-life management becomes necessary. At this stage, there are three quite different recovery options for products made from plastics.

Mechanical recycling

This is the mechanical grinding down and sorting of used plastics directly back into re-processable granules or recyclates. The chemical structure remains almost unchanged. The small ground-down plastic pieces are cleaned and separated into different grades. Mechanical recycling makes sense when the plastic recovered is clean and of a single type.

Good examples of this type of recycling are used PET bottles, industrial films made from polyolefins or PVC window frames. Large quantities of good quality material, which has not suffered any form of degradation during use, can be collected using appropriately organised collection systems so that mechanical recycling is an economically viable option.

Feedstock recycling

This is the breaking down of plastics into its chemical components using heat or chemical reaction. The chemicals produced are mostly oils or gases, from which new plastics or other chemical feedstock can be manufactured. Feedstock recycling is the solution where lots of different plastics are mixed together or where the material is contaminated with other substances.

There are several technologies available for feedstock recycling including: pyrolysis, gasification, depoly-merisation, blast furnace or smelter operations etc. While the technical feasibility of these processes, which are usually co-fed with pre-treated plastics waste – predominantly from household waste and also from complex products such as shredder fractions from electrical waste like old washing machines or end-of-life vehicles – has been well proven; under current market conditions only the blast furnace technology is economically viable at industrial scale. The VoestAlpine blast furnace plant in Linz/Austria, is a working example.

Energy recovery

This is the combustion of plastic waste, while simultaneously using the energy for generating electricity or steam or for providing process heat. Energy recovery is particularly suitable for mixed or contaminated fractions of plastic waste.

Again, both mixed household waste as well as organic fractions from complex products like electrical waste or old cars can be used for these technologies. Examples of such systems in operation are municipal solid waste incinerators, e.g. in Wurzburg/Germany or in Vienna/Austria, a cement kiln near Zurich/Switzerland or other technologies such as pulp and fibre production, e.g. in Lenzing/Austria or in the UK.

A separate set of fact sheets illustrate in more detail some examples of these technologies for all plastic waste management routes.

Used plastics as a substitute for mineral oil

The raw material for the manufacture of most plastics today is mineral oil. It is cost-efficient and, in effect, using a small amount of oil helps us to reduce the use of a far larger amount of oil in energy applications. Plastic is used to make a whole range of products for crafts, households, leisure, sports, medicine etc. But when plastic products can no longer serve their purpose, we need to recover the value that has been invested in order to produce them.

The high calorific value of plastics is actually similar to that of fuel oil. Therefore, plastics can partly substitute fuel oil as primary raw material, immediately conserving primary resources.

So where it is not technically or economically feasible to recycle the plastic material in any other way, this is definitely the best option. It makes no sense to advocate reprocessing just for the sake of it, there needs to be sufficiently large markets for products recovered from used plastics – be they recyclates, chemical raw materials or energy for other recovery options to be viable. There is no point in manufacturing new products that nobody wants to have. As a matter of principle, it is important that all three recovery paths be used in plastic waste recovery.

Different plastic applications, different legislation
Plastics are used in a range of quite diverse applications, and legal provisions in Europe are similarly diverse: The Packaging and Packaging Waste Directive (hereafter Packaging Directive) covers packaging, the End-of-Life Vehicles Directive covers cars, the Directive on Waste Electrical and Electronic Equipment covers electrical appliances, and so forth. Plastics manufacturers have been actively involved in the framing of all of these pieces of legislation to help find the best solutions for society. Working through their trade associations they supply knowledge about the technical options, develop concepts and provide information. In this way, they are sharing the responsibility for their products.

The Packaging Directive as an example
Out of all plastics waste streams, the packaging sector goes furthest back. Due to relatively high demand in packaging and its short-life characteristics, used packaging contributes to two thirds of the total volume of post-consumer plastic waste in Europe.
Since 1994 the European Packaging Directive has been the law applying to packaging at its end-of-life. According to the Directive, all market actors such as bottlers, retailers, waste management operators and municipalities subject to public law, share the obligation to organise the collection of used packaging and to channel it to reuse or recovery. Some countries were early implementers of packaging waste laws. These included Germany in 1991, France in 1992 and Austria in 1993. Until today, the European Packaging Directive has been updated in 2004 and the new European member states have also transposed the European Directive into national laws. In order to ensure recovery in the plastic packaging sector, diverse take back systems have been installed in the different EU member states taking the individual infrastructures of each country into account.

In the early years of the European Packaging Directive entering into force, the primary goal of the plastics industry was its contribution to ensuring the recovery of used plastics and creating the necessary recovery capacities. The pre-requisite level of recovery was achieved within just a few years. Today's goal is eco-efficiency, which means recovery that is efficient both in ecological and economic terms.

Waste management vision

The plastics industry has developed its own long-term vision for waste management. The overriding goal of plastics manufacturers is to reduce the impact of plastics waste on the environment by:

- Diverting organic rich waste streams from landfill as much as possible and, thus, conserving primary resources
- Utilising a mix of recovery options in order to save material or energy resources, taking eco-efficiency into account
- Treating and recovering plastics waste streams under defined environmental quality standards
- Taking a comprehensive approach into account along all stages of the life-cycle so that the largest environmental benefit, which can be achieved during the use phase of the plastic product, would not be impaired by a too detailed regulation of another stage in the life cycle.

Consequently, waste management should strive to develop intelligent solutions for both material recycling and energy recovery of plastic-rich waste streams. Today, there are not only rules in force for packaging, electrical and electronic equipment and vehicles at their end-of-life; but there are also framework regulations with stringent environmental provisions that determine the basic principles for treating all kinds of waste. These are predominantly the Waste Shipment Regulation, the Waste Framework Directive, which determines the boundary between recovery and disposal, the Landfill Directive and the IPPC Directive, which also defines the best available technologies for waste management operations. On the basis of these, the environmental performance with low emissions into air, water and soil is secured and at the same time high recovery efficiency utilising both material and energy resources is ensured.

In addition to the legal requirements, technically innovative processes, well-established infrastructure and cost-efficiency of the respective waste management operation are also important so that an optimised eco-efficient waste management system can be achieved. Industry and active players along the value chain have significant expertise in market economics, processing technologies as well as innovative waste management processes, gathered over years of experience, and has an in-depth knowledge about all recovery options, be it mechanical recycling, feedstock recycling or energy recovery. A series of fact sheets exist which provide illustrated examples for these different recovery routes. Sound, science-based, examinations, test trials, analysis and environmentally and ecologically-sound assessments are documented in diverse technical reports and peer reviewed studies by respected independent institutions across Europe. This information is publicly available from www.plasticseurope.org in the library section and under ‘resource efficiency’.

A statistical survey also exists giving an overview of the status quo of plastics waste management across Europe. Data is available for EU 27 countries plus Norway and Switzerland. From this survey it is clear that plastics waste management is not being undertaken uniformly across Europe. Instead, each country has a different waste management infrastructure with different key players and stakeholders. This makes it necessary to have a closer look at each individual country when considering the best option for future development in end-of-life waste management.

PlasticsEurope offers the opportunity for dialogue and mutual exchange of information and experience across Europe via the national associations of plastics manufacturers in Europe and its respective organisations. This information exchange allows direct contacts with interested stakeholders as well as workshops and fact-finding visits etc.. PlasticsEurope is delighted to engage in such knowledge sharing.

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