

# Plastics

Architects of modern  
and sustainable buildings



**Plastics**

The Material for the 21st Century

#### Sources:

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- <sup>2</sup> “The Impact of Plastics on Life Cycle Energy Consumption and Greenhouse Gas Emissions in Europe”, Report by Denkstatt GmbH (June 2010), p. 14.
- <sup>3</sup> “The Impact of Plastics on Life Cycle Energy Consumption and Greenhouse Gas Emissions in Europe”, Report by Denkstatt GmbH (June 2010), p. 14.
- <sup>4</sup> “Plastic Waste from Building and Construction”, Consultic Marketing & Industrieberatung GmbH.
- <sup>5</sup> “The benefits of pipeline innovation” by Alessandro Marangoni, Professor, Bocconi University in Milan (2008).
- <sup>6</sup> For pipes: TEPPFA (The European Plastic Pipes and Fittings Association)  
“Why use Plastic Pipe Fittings”, TEPPFA (The European Plastic Pipes and Fittings Association) website.  
For windows: “Towards Sustainable Plastic Construction and Demolition Waste Management in Europe”, APPRICOD Report, p.14.
- <sup>7</sup> “Energy Saving Potentials from the use of Modern Window Systems in Europe”, Marcus Hermes (March 2006), p.16.
- <sup>8</sup> “Innovations for Greenhouse Gas Reductions”, International Council of Chemical Associations - ICCA (July 2009), p.31.
- <sup>9</sup> The European PVC industry website, PVC recycling by application.
- <sup>10</sup> “Buildings and Climate Change - Status, Challenges and Opportunities”, United Nations Environment Programme (2007).
- <sup>11</sup> Plastics the Facts 2011 p.7.

## The building and construction sector in Europe

In October 2011, the world's population hit 7 billion. Fulfilling the needs of this many people without depleting the earth's resources means that today there is an ever increasing demand for products and services which meet the environmental, societal and economic elements of sustainability.

Today in Europe, buildings are responsible for roughly 40% of the EU's energy consumption and greenhouse gas pollution<sup>1</sup>. Improving the energy efficiency of new and old buildings is therefore one of the keys to tackling climate change and saving resources.

At the same time the global economic downturn post-2008 has had a significant impact on the building and construction sector in Europe. The challenge for all involved in the sector is to find and develop products and applications that are cost-effective, high quality and environmentally sustainable at the same time.

## European energy performance of building targets

Around 70% of the energy used in buildings is due to space heating and cooling. Making our buildings more energy-efficient and reducing the amount of energy required is key to minimising their environmental impact.

With new legislation on the energy performance of buildings adopted in 2010, the European Union has set targets for:

- All new buildings to be “nearly zero energy” by 2021.
- All new public buildings to be “nearly zero energy” by 2019.

However, even in 2050 most buildings will have already been built before 2010. It is vital that, in parallel, an ambitious and systematic programme of energy-efficient renovation of existing buildings is undertaken.



Photo this page - plastics make our buildings more energy efficient; solar modules made from plastics are used in solar roof panels, even on inclined surfaces.

Photo cover - plastic materials enhance the architecture of the future, allowing flexible, lightweight and durable design.

## Benefits of plastics in building and construction

Meeting ambitious targets on the energy efficiency of buildings would be difficult, if not impossible, without the solutions provided by plastics.

The use of plastics in building and construction saves energy, reduces costs, enhances quality of life and helps to protect the environment at the same time. Plastics applications also tend to be easy to install and require minimal maintenance. As such very limited additional consumption over energy and resources is needed to ensure their continued functionality.

There are over 50 different families of plastics and most have something different to offer the construction industry.

Among other things:

- **Within the structure of a building**, plastics contribute to insulation, window-installation, wiring, piping and roofing.
- **Inside the home**, plastics provide wallpapering, flooring, awnings, laminated kitchen and bathroom furniture.

Not only do plastics offer great practical solutions, they make a huge contribution to improving the energy efficiency of buildings which is necessary in order to tackle climate change and preserve resources. In fact, in terms of its whole life-cycle, plastic is one of the most energy-efficient materials.

## Why use plastics?

Plastic polymers have a number of vital properties which, exploited alone or together, make a significant and expanding contribution to our needs in building and construction.

Plastics are durable and corrosion-free



They are ideal for applications such as window frames and pipes which can last for over 50 years.

Plastics effectively insulate from cold, heat or sound



They save energy, offer great value for money and reduce noise pollution.

Plastics are light weight



They contribute to savings by reducing man-hours and the need for heavy equipment such as cranes; they are also easier to handle, transport and store.

Plastics can either be recycled or their energy recovered



The overall recovery of plastic waste in the building and construction sector shows a positive trend, improving from 56.2% in 2010 to 57.6% in 2011.

Plastics are easy to maintain, easy to clean and impenetrable



They are ideal for household and hospital surfaces or floor coverings that must remain hygienic.

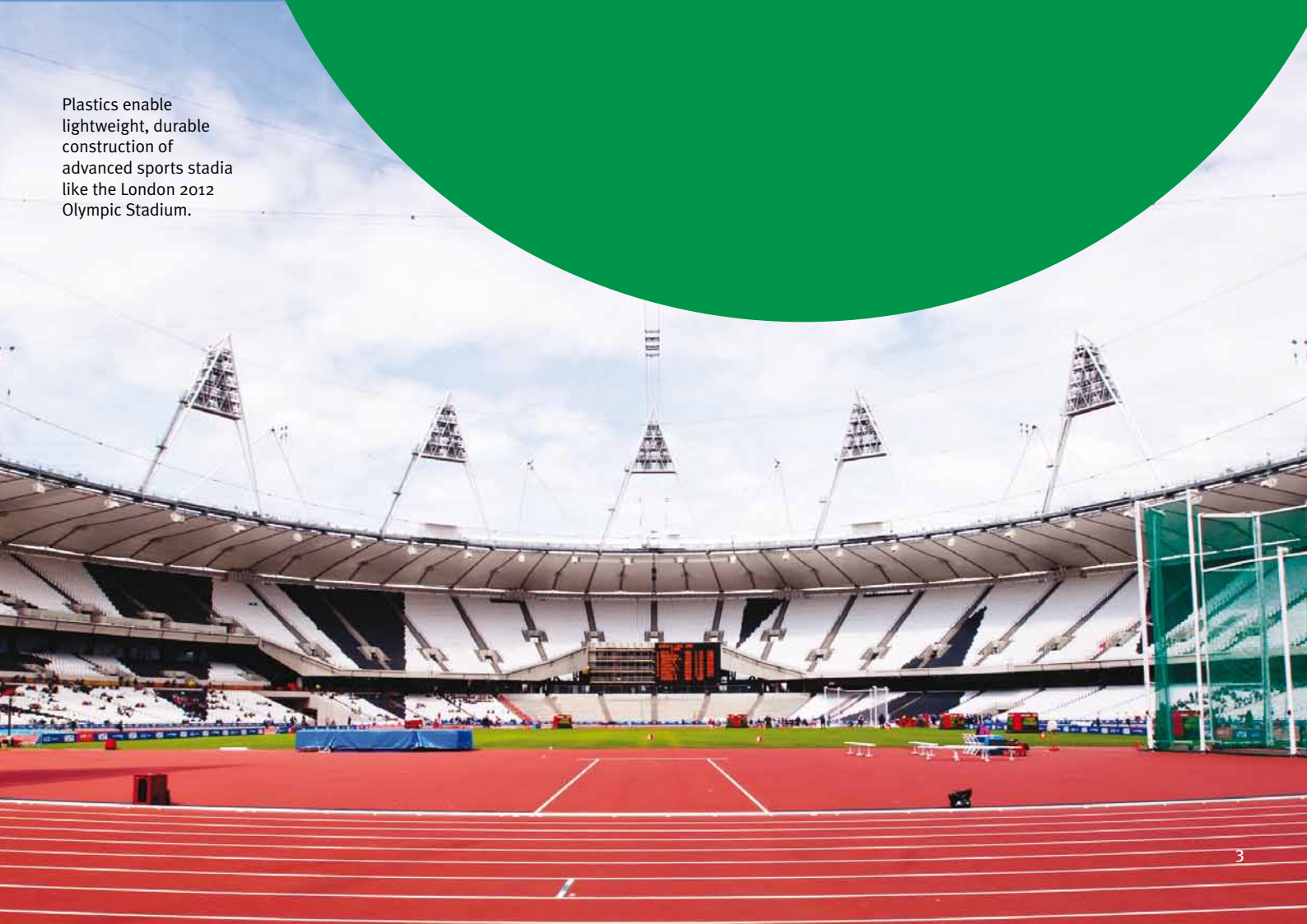
Overall, plastic components are often more economical to produce, even in custom-made form, than alternatives. The ease with which plastics can be moulded means that many components can be combined into one, making them easy to manufacture and install.



## Did you know?

- Plastics are one of the most energy-efficient materials over their entire life-cycle.
- Plastic applications tend to be easy to install, take up limited space, require minimal upkeep and continue to function to their full potential for decades.
- The typical lifespan of plastic applications in building and construction is 30 to 50 years, with many plastics pipes installed over 50 years ago continuing to function as well as ever today.
- Plastics not only contribute to the protection of the environment but they also provide highly skilled jobs and increase the competitiveness of the building sector through cutting-edge green technology.
- The building and construction sector is the second largest market segment for plastics in Europe, after packaging, providing employment for hundreds of thousands of Europeans.

Plastics enable lightweight, durable construction of advanced sports stadia like the London 2012 Olympic Stadium.



# Plastics applications

## Plastics from roof to cellar

Affordable, quality, energy-saving and environmentally-friendly living can be achieved by equipping our homes with plastics. Their versatility, functionality, performance and aesthetics are such that they can be found throughout the house, from the roof to the cellar:

### Plastics are used outside a building:

- To weather-proof, coat and insulate the exterior facades of the building.
- To channel rain water in gutters and downpipes.
- To insulate the underside of the roof.
- To provide draft-proof and highly insulated window frames.
- To landscape the outside space.

### Architects and engineers use plastics:

- To give shape to their imagination; all over the world architects design innovative building structures which could only come true with plastics.
- To tailor-fit buildings to their surroundings.
- To strengthen structures such as bridges that must withstand very heavy loads.
- To enable new technologies which harness renewable energy.

### Plastics are used in the structure of a building:

- To insulate and sound-proof walls.
- To insulate the cellar.
- To bring clean water and evacuate sewage through pipes.
- To bring fresh air or heating through ventilation or heat recovery systems.

### Plastics are used inside a building:

- To enable economic and energy-efficient lighting solutions.
- To paint, tile and clad living spaces, particularly those that must remain hygienic such as kitchens and bathrooms.
- To sheath wires and cables.
- To enable a myriad of features, furnishings, textiles and appliances.



Photo this page - installation of plastic roof insulation.  
Photo opposite page - a terminal building of Charles de Gaulle Airport in Paris. Plastics allow specially adapted structures with curving trusses extending from the roof to take up the external walls.





### Less material – better insulation

The use of plastic insulation materials enables significant long-term financial and energy savings. Over its lifetime, plastic insulation saves more than 200 times the energy used in its manufacture.

In addition to being energy-efficient, it is resource-efficient and makes optimum use of space. This is because, intrinsically, many plastics are very good insulators - whether it is to sheath the cabling in domestic appliances or the inner walls of buildings. Plastic insulation materials are simple to install, highly durable and perform at the same high level over the whole life of the building.

Beyond its practical benefits, plastic insulation brings Europe closer to its goal of energy security by reducing its overall demand for energy. It does that by enabling renewable energy technologies but also by enhancing the insulation of newly built and old buildings.



## Plastics in building and construction in numbers

**9%**

additional greenhouse gas savings compared to alternative materials used in building insulation<sup>2</sup>

**16%**

additional energy savings compared to alternative insulation materials<sup>3</sup>

**21%**

the percentage of total plastics consumption that goes into the building and construction sector: the second largest application after packaging<sup>4</sup>

**22.2 billion**

the savings in euro provided by the use of plastic pipes in water mains in Italy when compared with alternative materials<sup>5</sup>

**Over 50**

the typical life span in years of many plastics cables, pipes and window profiles<sup>6</sup>

**80 million**

the amount of new windows needed in Europe every year; if plastic window frames were installed with every new window, it would be the equivalent of eliminating the need for five large power stations<sup>7</sup>

**233:1**

the proportion of energy savings over the life time of plastics insulation to energy used for its production<sup>8</sup>

Photo this page - Plastic pipes provide a sustainable and safe way to distribute valuable drinking water and to evacuate sewage water.  
Photo opposite page - plastic window frames.



## Windows – saving energy for decades

The heat savings offered by modern plastics window profiles, as a result of huge technological progress in recent years, make them the application of choice in low-energy buildings. In addition, their durability and hardness means that high-quality plastics windows can last for over 50 years with little or no upkeep required. This cuts out the cost and time needed to fix or re-paint them, as well as the financial and energy resources involved in replacing them.

A further advantage is the variety of design possibilities that plastics window profiles offer. They can come in almost all colours, styles and settings to suit any kind of architecture, from the cutting edge of modern design to renovated historical buildings.

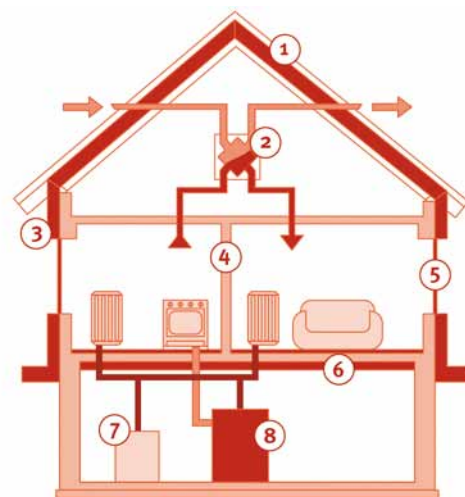


At the end of their lives, plastic window frames can be recycled or handled in a waste-to-energy scheme. Almost 83,000t of window profiles and other profiles were recycled in 2009 as a part of the schemes funded by the PVC industry.<sup>9</sup>

## Plastic pipes – durable, flexible and safe

Plastics are a popular choice for modern water, gas and sewage piping. Plastics pipes are:

- **Durable** – highly resistant to corrosion.
- **Versatile** – can be used above or below ground and easily produced in a range of shapes and sizes.
- **Economical** – easy to install and require very little maintenance over time.
- **Long-lasting** – can function normally for up to and over 50 years.
- **Safe** – the most reliable option to transport water.
- **Energy-efficient** – preventing heat from escaping because plastics are good heat insulators.



- 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

Diagram of house showing where plastics play a role in reducing energy consumption and saving costs.

# Plastics and energy efficiency

## Save energy with plastic materials

Currently, buildings are responsible for roughly 40% of the EU's energy consumption and greenhouse gas pollution. So reducing energy consumption in buildings is key to achieving Europe's goals on climate change and green growth. Thankfully the solutions already exist to make significant changes to the environmental impact of our buildings – we just need to make more effective use of them.

Purely in terms of weight, very little plastic is used in buildings compared to other materials. However, this limited weight allows a major contribution to energy savings through space maximising insulation, durable piping, and long lasting window frames.

## Passive houses

A passive house is a building in which a comfortable interior climate can be maintained without active heating and cooling systems thanks to insulation. Since the house heats and cools itself, it is “passive”. The combined energy consumed by a passive house should be less than a quarter of the energy consumed by an average new construction that complies with applicable national energy regulations.<sup>10</sup> Plastics are necessary if these ecological savings are to be achieved in the most cost-effective and easily-maintainable way.

Although the technologies used to achieve this standard are modern, the concept of the passive house was inspired by traditional Scandinavian houses topped with sod roofs which insulate the building so well that very little active heating or cooling is necessary.

## Did you know?

- Simple things like combining thermal insulation with triple glazed windows can reduce energy consumption by up to 80%.
- Plastics are one of the few materials that can do both jobs.
- Plastic insulation products save over 200 times more energy over their lifetime than is used for their production and are roughly 16% more energy-efficient than alternative insulation materials.
- If plastic window frames were installed all over Europe tomorrow we would eliminate the need for five large power station.
- Plastics are a source of stored energy and, when not recycled, can be used to generate heat power at the end of their useful life.



## Plastics' energy balance sheet

Saving energy and money as well as reducing CO<sub>2</sub> emissions, becomes easily feasible with solutions made from plastics. The potential for saving money is multiplied by the fact that plastics continue to function to their full potential for decades and need little, if any, maintenance.

The “plastic paradox” is a phrase coined to describe how, with plastics, “the more you use, the more you save”. On average it only takes one year to recover the energy used to produce plastic insulation material needed to cover a standard house. The paradox also holds true for plastics window frames. Each year over 80 million new windows are needed across Europe. Thanks to their highly efficient insulation properties, if plastic window frames were used all over Europe, they would help save 40 million kilowatt hours of energy or the equivalent of the nominal output of 5 large power stations.

## Renewable energy and building construction

Solar modules made from plastics are used in solar roof panels for covering inclined roofs, cladding or UV protection elements.

Another innovation which depends on plastic is the fuel cell which converts hydrogen and oxygen into electric power. Heat and water can be used wherever electricity is required, including in the household.



### Eco-commercial office building

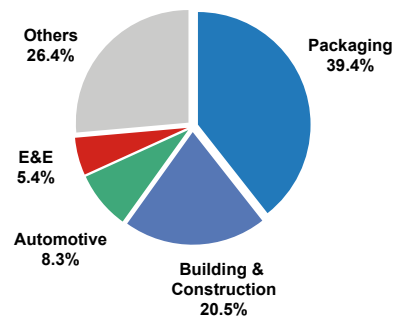
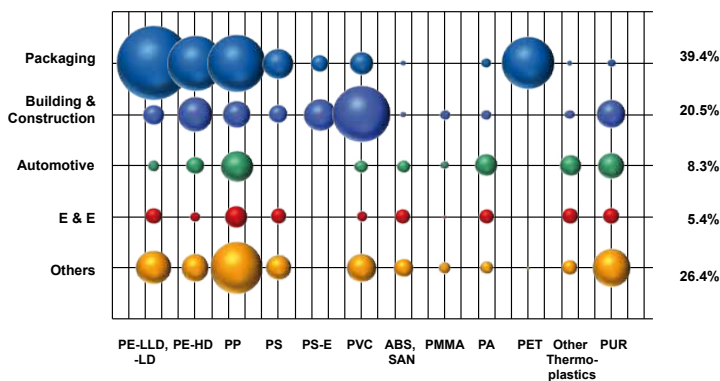
All the energy needed for heating, ventilation, lighting and day-to-day operation is obtained from renewable sources, namely geothermal heat and sunlight. In conjunction with an insulation concept based on polyurethane raw materials, this building achieves an emission-neutral energy balance over the course of a year.



# Plastics production, demand and waste management

## Demand for plastics in building and construction

Building and construction is the second biggest market for plastics in Europe, representing about 21% of the overall demand in Europe. Within the EU, Poland - in proportion - is the largest market, using 28.5% of plastics in building and construction.<sup>11</sup>



European plastics demand\* (47.0 Mtonne) by segment 2011.  
Source: PlasticsEurope Market Research Group (PEMRG) - for Central Europe in cooperation with Eastern and Central European Business Development (ECEBD) / Consultic Marketing & Industrieberatung GmbH.  
\* EU27+N/CH incl. other Plastics (-5.7Mtonne).

There are different types of plastic resins with a variety of grades which help deliver the specific properties that each application requires.

The “big three” plastic types in building and construction are:

- Polyvinyl chloride (PVC) – used in pipes and in building products such as window frames, floor and wall coverings, swimming-pools, cable sheathing and roofing.
- Polyethylene (PE) – used to build pipes and other hardwearing products as well as to insulate cables.
- Polystyrene (PS) – used in a variety of ways from insulation foams to bath and kitchen units.

Demand for plastics in building and construction grew strongly between 2004-2007 before being affected by the global economic downturn in 2008. Since then, the construction industry experienced a particularly tough year in 2010, but moderate growth resumed at the start of 2011.



Photo this page - panels made of expandable polystyrene (EPS) improve insulation in newly built and renovated constructions. Integrated carbon within the cell structure make the panels heat absorbent, thereby significantly improving insulation.

## Plastics at end-of-life

Plastic applications offer significant energy savings throughout their use-phase and have an ever increasing range of sustainable options once they reach end-of-life.

Across the 27 Member States of the European Union (EU-27) plus Norway and Switzerland, more than half of plastics building and construction waste is being diverted from landfill through a combination of recycling and energy recovery. However, trends show strong disparities in recovery rates from country to country. Germany provides an example of what can be achieved with the right infrastructure and regulations in place, recovering nearly all of its plastic building and construction waste while Southern Mediterranean countries send most of it to landfill.

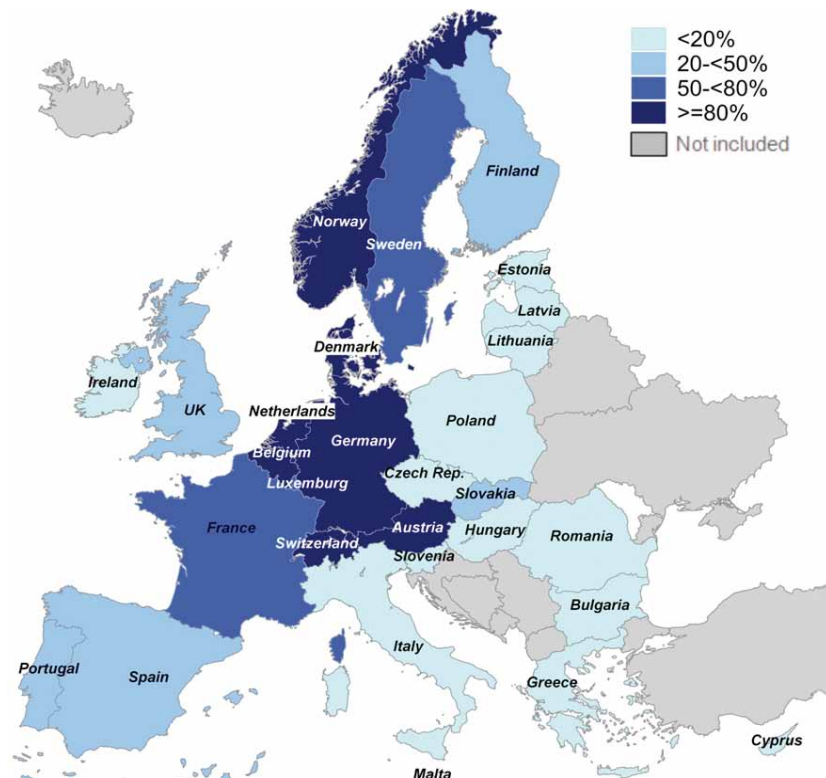
In other major markets the picture is more nuanced. While the UK has been leading the way in terms of recycling rates it sends roughly two thirds of its waste to landfill due to the minimal use of energy recovery.

In contrast, Scandinavian countries have overall recovery rates of almost 80% thanks to a strong focus on energy recovery.

The overall recovery of plastic waste in the building and construction sector shows a positive trend, improving from 56.2% in 2010 to 57.6% in 2011. The European plastics industry will continue its efforts to increase this recovery rate throughout Europe, as part of its overall objective of zero plastics to landfill by 2020.

The industry has already been working to promote effective waste management of plastics products in building and construction for a number of years through voluntary commitments such as the pioneering VinylPlus programme on the sustainable management of PVC.

Recovery of plastics waste in building and construction (2011).  
Source: PlasticsEurope MarketResearch Group (PEMRG)



## Plastics in the future

Plastics have changed our lives like no other material. Even though they can often be taken for granted, modern construction without plastics is simply unimaginable!

Since plastics are the material for the 21st century, let's see what the future could hold for it...

- In the very near future, highly transparent photovoltaic cells will be printed onto plastic films as window glazing bringing about high-efficiency power-generating windows.
- In the future, architects and designers will use acrylic panels and fibre-reinforced plastics to mould buildings into any shape.
- The resistance to corrosion, light weight and strength of fibre-reinforced plastics composites will enable the construction of durable load bearing concrete structures like bridges.





Masdar (Abu Dhabi), a city created in 2006, operates to reach the boundaries of renewable energy and sustainable technology. Buildings in Masdar are eco-building prototypes, combining energy efficiency and construction economy with leading-edge design adapted for a subtropical climate. The aim is to develop new solutions in the field of optimised-energy-consumption buildings through, for example, the use of plastics. Smart, giant parasols, “corridors” running through the city for natural ventilation; laboratories and offices of concrete covered with large plastic cushions (ETFE) which reflect the sun’s rays and lessen their effects; roofs of plastic and photovoltaic panels...

Among other materials, polystyrene foam is used for optimum thermal insulation of buildings. Polyurethane, for example, makes it possible to insulate cool air intakes, ensuring maximum efficiency, while microscopic plastic capsules filled with wax are incorporated into the plaster or concrete, absorbing excess internal heat through phase-change processes.

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