Plastics' contribution to climate protection

Plastics
The Material for the 21st Century

Life cycle approach provides greater perspective

The findings of the Denkstatt study clearly demonstrate the value of taking a life cycle approach when devising policy to reduce greenhouse gas emissions. This approach highlights the bigger picture; that although the production of plastics is energy intensive, they save significant amounts of energy and reduce harmful CO_2 emissions during their use phase.

The life cycle approach shows the interdependencies between production and use: the more oil used to create more plastics, the more oil is saved in other sectors. For example, plastic insulation saving energy and food packaging reducing transport fuel costs.

PlasticsEurope encourages the manufacture of plastics using the most efficient, resource sustainable processes which include minimising the environmental impact of end-of-life waste.

Policy recommendations for reducing greenhouse gas emissions

But what are the implications of these research findings for policymakers? PlasticsEurope recommends that those responsible for policy consider the following principles when designing greenhouse gas emissions reduction guidelines:

1. Focus on the opportunities which give the biggest, most effective and cheapest returns in terms of CO_2 benefits. For example, energy efficiency solutions like insulation, renewable energy production, transportation and CO_2 efficient packaging.

2. Support the design and implementation of energy efficient technologies which change the way things are done.

3. Incentivise and reward those who proactively implement energy efficient solutions.

4. Champion the development of the most resourceful and prolonged uses of current energy and feedstock supplies.

Develop waste policies which promote the most efficient and sustainable recovery or recycling solutions whilst also diverting all plastic waste from disposal.

According to the IPCC, (Intergovernmental Panel on Climate Change) human activity is contributing to climate change. As the World's population increases and more countries develop economically, so does energy consumption and the subsequent greenhouse gas emissions. This has potentially disastrous consequences for our planet, making climate protection activities a top priority.

There are many materials which play a crucial role in meeting the needs of modern society, including plastics. Traditionally, the main priorities when choosing a material were to look at efficiency, durability and interaction with other components, all in a cost effective way.

However, increased awareness around the dangers of greenhouse gas emissions to the climate means that the environmental properties of materials must now also be considered. More and more, sustainability is becoming a key part of governmental policy, making it imperative that the environmental impact of materials is carefully considered during selection. Otherwise the EU will be unable to honour its commitment of reducing greenhouse gas emissions to 20% below the 1990 level by 2020.

Plastics' role in climate protection

Plastics are essential to modern living and are also vital in delivering a low carbon economy. Plastic products, from building insulation and window profiles to lightweight components for cars and aircraft, reduce emissions.

The global chemical industry already has a good track record for reducing its greenhouse gas emissions and is committed to continually improving. However, the positive impact which plastics have on climate protection throughout their lifecycle is not always fully understood and appreciated. Environmental impacts are often complex and even, at times, counter-intuitive. The selection of materials must be assessed based on rational rather than emotional criteria.

To help clarify this issue, PlasticsEurope commissioned a study by the Denkstatt Institute in Austria in 2009. The aim of this study was to analyse and quantify the effects of using plastic products on the World's energy consumption and how this impacted greenhouse gas emissions.

The report, entitled "The impact of plastics on life cycle energy consumption and greenhouse gas emissions in Europe" was published in June 2010.

A World without plastics

Imagine a World where plastics do not exist and they are replaced, where possible, by a mixture of alternative materials. There would be no lightweight plastic chairs or food containers and no DVDs.

This was the hypothetical scenario used by the Denkstatt Institute to evaluate the environmental impact – in terms of greenhouse gas emissions – of replacing plastics with alternative materials over their life cycle.

This was, of course, a highly theoretical approach. Plastics have now become such a crucial essential part of modern life that it is impossible to imagine a World without them. However, the value of conducting research around this hypothesis meant that it would be possible to clearly highlight the environmental impact of plastics compared to alternative materials.

Of course, not all plastics can be substituted with other materials. Items like CDs and DVDs, or airbags can only be made with plastics.

Life cycle analysis

The research considered several cases in detail which represent 75% of the replaceable plastics market. Results were then projected across the industry. The detailed case studies covered the three main phases of a product life cycle – production, use phase and waste management. (The study is not a full Life Cycle Assessment (LCA) by strict definition of ISO 14040 and 14044; however the principles of the standard have been followed and the data for comparison within the case studies are extracted from public LCA databases).

The plastics industry is one of the first industry sectors that understood the importance of life cycle thinking in process and product optimisation and in policy making. To such end, the plastics industry created, back in the nineties already, LCI (Life Cycle Inventory) datasets of their intermediates, polymers granules and articles made out of the granules.

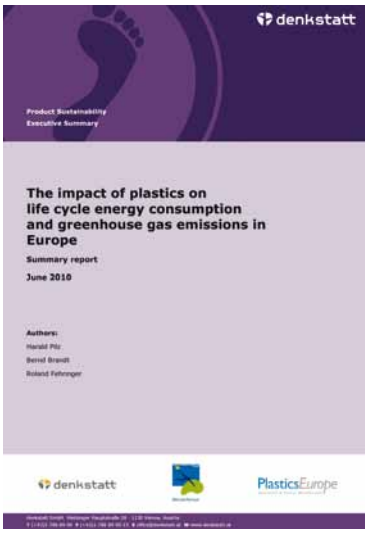
Expanding the scope

The Denkstatt study was divided into two distinct parts. The first part was an update of an earlier study conducted by GUA/Denkstatt in 2005 called “The contribution of plastic products to resource efficiency”. This report looked at the greenhouse gas emissions and energy savings arising from using plastic products. The 2009 study expanded the countries covered in this research from EU-15 to the current EU-27. It also updated material datasets used in the case studies selected to include a life cycle analysis of 32 business cases covering 173 applications.

The second part of the research featured additional evidence and arguments on the beneficial aspects of plastics with regards to energy efficiency and climate protection. This was based on current trends and included a forward projection to the potential scenario in 2020.

The new study was also expanded to include additional analysis on the overall CO_2 impact of specific product examples over their life cycle. This meant comparing the overall CO_2 savings achieved during a product’s lifetime with the CO_2 emissions incurred during production and disposal.

The study was peer-reviewed by Professor Adisa Azapagic of the University of Manchester in the UK and Roland Hischier, EMPA Sankt-Gallen in Switzerland.



Significant energy and emissions savings over the life cycle

The conclusions of Denkstatt's research clearly shows that, right now, plastics have an important role to play in the journey towards sustainability.

The study found that if plastics, where feasible, were substituted by traditional materials in the EU, they would generate 61% more greenhouse gas emissions and lead to a 57% increase in energy consumption. This is proof that plastics are already positively helping climate protection.

Additionally, if plastics were substituted with alternative materials, this would almost quadruple the weight of products and applications by creating 3.7 times more mass. Not only would this impact transportation emissions but it would have a huge effect on waste management. There would be a lot more materials to dispose off into landfill sites at the end of a product's life, or to recover into more useful products.

The report highlighted the importance of considering these greenhouse gas emissions and energy savings across the entire lifecycle of a product – and not just in one area. However, the research acknowledged that the production and use phases generate the most significant savings.

Some plastic products deliver exceptional life cycle climate change benefits. For example, plastics insulation uses a tiny amount of energy in its production compared to the savings made over its life cycle. Over its complete life time, 290 million tonnes of CO_2 were saved through the plastic insulation installed in the EU in 2004 – with only 1% of CO_2 created during production. The production energy required to make one insulation panel is recovered after four months of use in a house.

Another example is car and aviation emissions. On average 15-20% of materials used in the construction of a car are plastics. However, the weight of each car is not increasing as much as if alternative materials were used in place of plastics. This saves around 5% in emissions. For aviation, 22% of the Airbus A380 are made of plastics, helping to reduce fuel consumption by 15% over its life cycle.

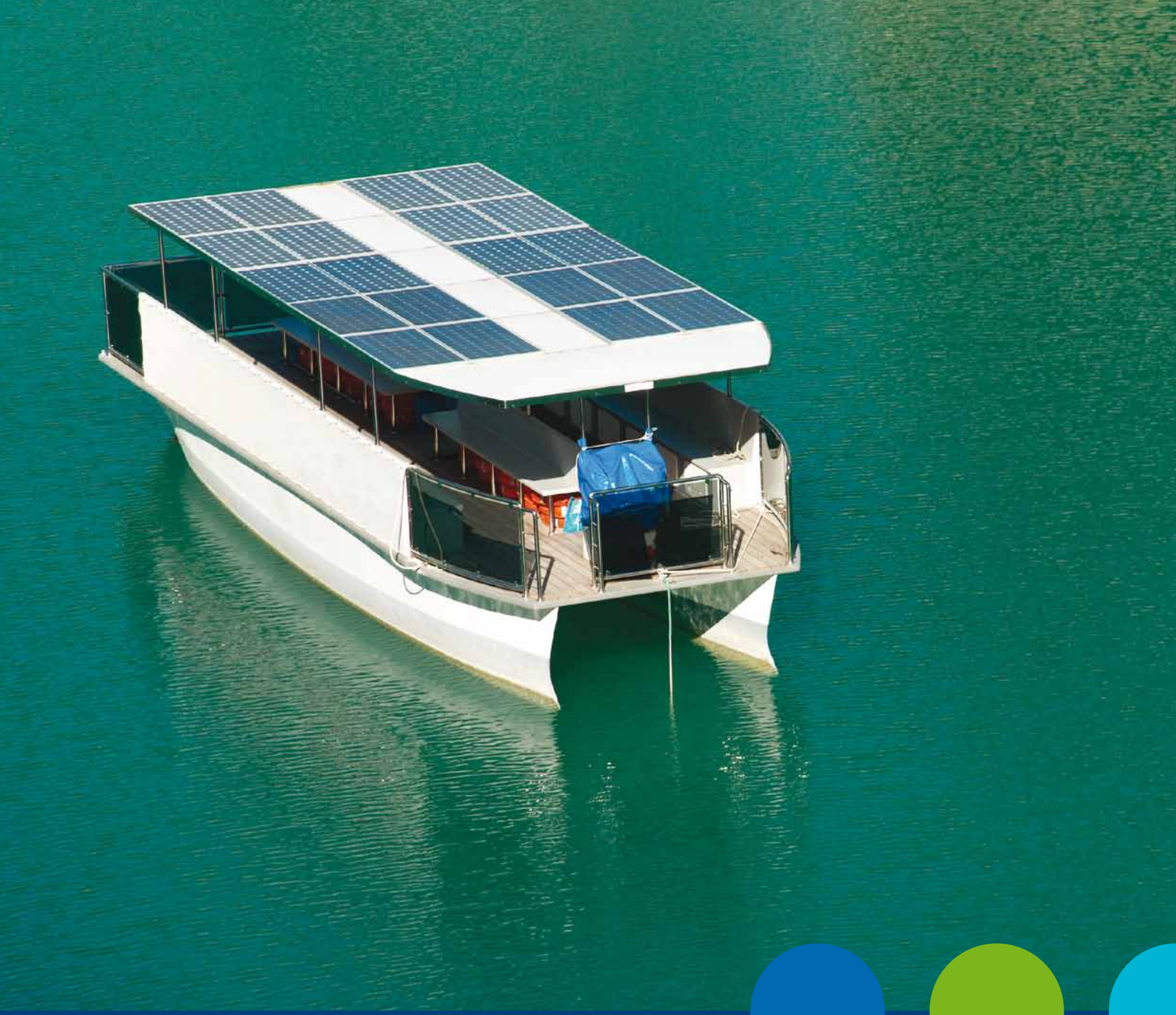
Plastic packaging helps preserve food for longer – thus minimising waste – and reduces weight compared to traditional packaging. Compare the weight of traditional material packaging which represents 36% of overall product weight to similar plastic pouches that only contribute 3.6% to the total product weight. This significantly reduces transport emissions. If plastic packaging was not used to preserve food and drink, retailers would make at least 50% more truck journeys within the EU.

As these examples show, the deployment of plastics enables greenhouse gas emissions reductions and energy savings across a wide range of modern applications.

Reductions in greenhouse gas emissions

The use of plastics decreases greenhouse gas emissions:

- Current savings of 124 million tonnes per annum are comparable with the entire CO_2 emissions of Belgium in a year time
- These savings currently represent 39% of the EU15's original Kyoto CO_2 reduction target – or approximately 16% of the EU27's target for 2020 of 780 million tonnes
- If plastics were not used, the EU would be unable to meet its Kyoto greenhouse gas emissions reduction targets.



Energy savings

Plastics provide significant energy savings which strongly contribute to reducing harmful emissions. These include:

- Consuming 2,4 billion Gigajoules less energy per year than alternative materials
- Saving 53 million tonnes of crude oil per year – this is the equivalent of the annual consumption of 46 million cars.

Plastics' potential for reducing society's carbon footprint

The new study also provides an insight into the carbon footprint of plastics. The researchers were able to work out how plastics impact the carbon footprint of European citizens.

The daily activities of individuals create – on average – an annual carbon footprint of approximately 14 tonnes of CO_2 equivalents per capita. Of this, just 170 kilograms of CO_2, or 1.3%, is attributable to plastics. This is a tiny figure, considering that of the rest of the activities that contribute to an individual's carbon footprint, 18% is on leisure and recreation, 14% is for space heating, 13% is for food, 7% is for commuting and 6% is on aviation.

The Denkstatt report was also able to highlight the importance of the production and use phase of plastics in addressing climate change by assigning plastics a carbon balance score. This score was achieved by comparing the CO_2 emissions emitted during production and the end-of-life phase with the savings made during the use phase.

The carbon balance score of the total markets of plastic products in the EU27+2 is presently in the range of 5-9. This means that for every tonne of emissions created during production, 7 tonnes will be saved over a product's lifetime.

Denkstatt also estimated what the situation would look like if full use was made of plastics as a climate protection measure. So, for example, if all houses in Europe used plastics insulation panels, the carbon balance score would improve to 9-15 by 2020. For every tonne of emissions created during the production phase, 12 tonnes would be saved over the product's lifetime. This shows that the future environmental benefits of a product from a climate protection perspective are far higher than the additional emissions created during production.

This carbon balance score, therefore, highlights the plastics paradox – the more fossil fuels which are used in a constructive way to create plastics, the more energy and CO_2 will actually be saved over the longer term.

Carbon balance of EU27+2 plastics market	2007 Mt Co_2-equ.	2020 Mt Co_2-equ.	Av. changes until 2020 Mt Co_2-equ.
Production	**160**	**180**	
Production increase (2% p.a.)			47
Increased material efficiency			-21
20% PE from renewable resources?			-6
Effects of recycling/recovery/disposal	**-1**	**-6 to +18**	**-5 to +19**
Exemplary use effects			
Substitution of less efficient materials	-46 to -85	-59 to -110	-19
Fuel savings	-17	-34	-17
Insulation	-540 to -1.100	-1.200 to -1.800	-700
Prevented food losses	-100 to -200	-150 to -300	-75
Wind power rotors & solar panels	-60	-250 to -500	-310
Total carbon balance	**-600 to -1.300**	**-1.500 to -2.500**	
Ratio (use + recovery) vs production	**-5 to -9**	**-9 to -15**	

"Carbon balance" of the total market of plastic product in the EU27+2 for 2007 and for 2020 (estimated extrapolation) showing the GHG emissions of the production and end-of-life-phase as well as exemplary estimated ranges of use benefits (negative values) enabled by plastic products. The last line gives the ratio of GHG-credits from the use phase (and recovery phase) divided by the GHG emissions from the production phase.

Renewable energy
The report showed that plastic materials also play a key role in enabling renewable energy production.

For example, modern wind turbines have large rotor blades that are only possible by using modern plastic materials. An alternative material could not do the same job. The report takes the assumption that the rotor accounts for 33% of greenhouse gas emissions savings enabled by the wind turbine plant, others use 100% because without rotor no energy can be generated. Even with the lower allocated credit of the plastic rotor, the benefit is already 140 times higher than its production impact. When plastic film used in photovoltaic film panels accounts for only 25% of the total greenhouse gas emissions saved by the product, the use benefit of the plastic film is 340 times higher than the production impact.

Resource efficiency
The report also shows that plastic products make a significant contribution towards environmental protection by offering resource efficient solutions. As plastics are lighter than alternative materials, they have enabled a 70% reduction in terms of mass in the products we use. This means fewer resources are required during manufacture. Plastics also last for a long time and need minimal repair.

Plastics also help to aid technological innovations. The report found that energy consumption and greenhouse gas emissions decreased when new technologies, such as MP3 files and digital cameras with SD cards, were compared to their older counterparts. These included CDs and analogue cameras with film cartridges.

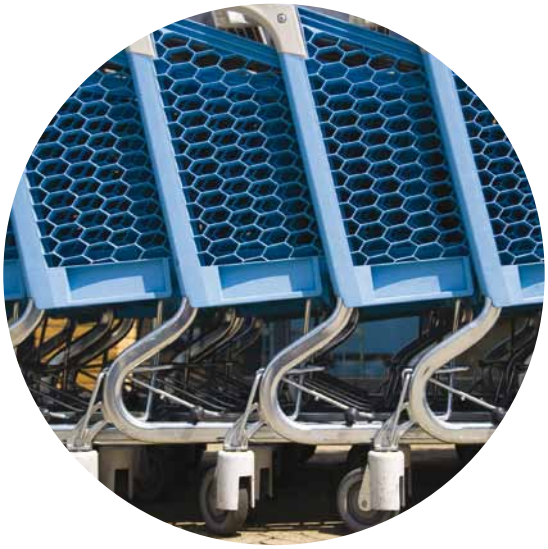
A truly sustainable solution

The Denkstatt report concludes that plastics are an incredibly energy efficient material. Existing plastic products enable significant savings in energy and greenhouse gas emissions. Contrary to popular belief, these savings would decrease dramatically if plastics were replaced with alternative materials.

Throughout the plastics life-cycle, the production and use phases are the most important in terms of impacting climate protection. Plastics save 7 times their production impact, in terms of greenhouse gas emissions, and this figure could rise to 12 if all possible plastic solutions were implemented in the market. The increased adoption of key plastic products – including thermal insulation, food packaging and renewable energy generation – enables extraordinary 'use' benefits.

When looking at the total usage of non-renewable oil and gas-based fossil fuels, plastic products account for just 4%. Paradoxically, the increased use of plastics would actually reduce the overall consumption of non-renewable fossil fuels and, therefore, society's greenhouse gas emissions.

Using plastics will preserve and maximise valuable and finite fossil fuel resources and protect the World's fragile environment. Plastics truly are the 21st century sustainable solution for climate protection.



For detailed information on plastics contribution to climate protection, see full report carried out by Denkstatt consultancy available on PlasticsEurope website (www.plasticseurope.org) under Learning Centre/Publications.

EU 27+2 represents the 27 European Union Member States plus Norway and Switzerland.

2-litre house – leading the way in energy efficiency

Picture courtesy of ECVM

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