HOW TO INCREASE THE MECHANICAL RECYCLING OF POST-CONSUMER PLASTICS

STRATEGY PAPER OF THE EUROPEAN PLASTICS RECYCLERS ASSOCIATION

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EuPR
European Plastics Recyclers

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1 EXECUTIVE SUMMARY

Europe is leading the market in terms of sustainable development thanks to the abundance of European legislation aiming to protect the environment. The European Lisbon Treaty goes even further than previous treaties on the environment. The new treaty states that the European Union should aim for the 'improvement of the quality of the environment' and should not only protect it.

The recycling of post-consumer plastics waste is a challenging and multifaceted topic, for which many solutions exist such as mechanical recycling.

This paper first offers an analysis of the plastics industry profile, paying special attention to plastics recycling. Second, it provides an overview of the current post-consumer plastics recovery operation, underlining the benefits of mechanical recycling. Finally, with this paper, EuPR gives a recommendation of 10 fundamental actions to increase the recycling of post-consumer plastics waste:

1. Close monitoring of the national collection systems and better harmonisation of the different European collection systems;
2. Stop the use of unsustainable technologies (bioplastics and Oxo-degradables) for plastics. Collection systems should create separate streams for these new materials;
3. Specific mechanical recycling targets for plastics in the Waste Framework Directive;
4. Limit the export of plastics waste to secure supply for European recyclers;
5. Favourable fiscal system for the European recycling industry;
6. Effective solution offered to plastics recyclers to comply with REACH. All stakeholders should support recyclers in creating REACH-compliant Safety Data Sheets;
7. Elimination of discriminating legislation or standards prohibiting the use of recyclates;
8. Substantial increase of green public procurement and a mandatory minimum recycled content for eco-labels;
9. Economic instruments to promote recyclates similar to the inclusion of the waste and recycling sectors into the ETS; and
10. Reinforced communication and cooperation with the whole value chain.

EuPR is willing to cooperate with all market stakeholders and policy makers in order to achieve better post-consumer plastics recycling shares and to move towards a 'recycling society'.

Bernard Merkx

EuPR President

2 INTRODUCTION

2.1 EUROPEAN PLASTICS RECYCLERS (EUPR) ASSOCIATION

EuPR[1] is a relatively young association, comprising plastics mechanical recycling companies and associations. It was set up in December 1996 as a member of EuPC (European Plastics Converters) and it represents approximately 80% of the estimated European plastics mechanical recycling capacity.

EuPR's mission is to create a good business climate for mechanical plastics recyclers by:

- Representing the plastics recycling industry vis-à-vis the European institutions and industry organisations;
- Promoting the use of plastics recyclates;
- Promoting the development and use of harmonised European standards for plastics recyclates;
- Initiating and stimulating European studies for the plastics recycling industry; and
- Offering a networking platform for its members.

2.2 INDUSTRY PROFILE

The European plastics mechanical recycling industry is a rather new industry, consisting of more than 1,000 companies – mainly small- or medium-sized – and employing around 30,000 people.

Originally, plastics recycling grew alongside the plastics industry, with companies initially concentrating on the reprocessing of production and the processing of scraps. But over the years, the recycling of post-consumer plastics gradually took off, with important growth being recorded in the last decade. This industry, therefore, plays a significant and essential role in today's move towards a sustainable society.[2,3]

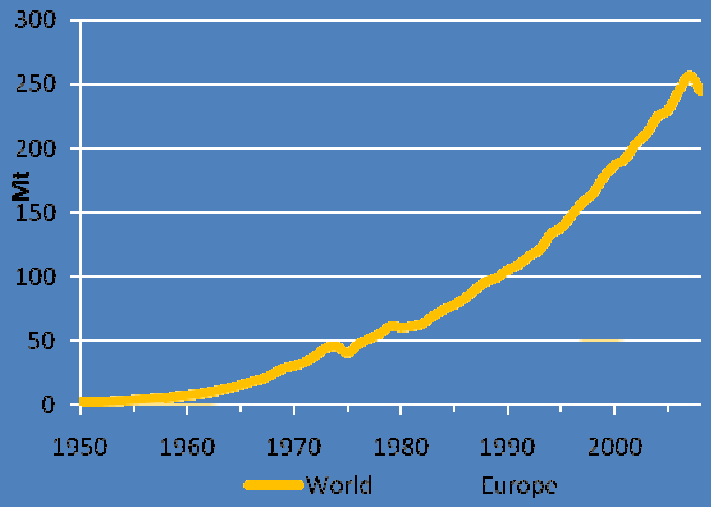
[1] http://www.plasticsrecyclers.eu
[2] The Packaging and Packaging Waste Directive 2008/98/EC
[3] The Waste Framework Directive

2.3 THE PLASTICS INDUSTRY IN EUROPE

2.3.1 THE VIRGIN PLASTICS MARKET

According to *The Compelling Facts About Plastics 2009*,[4] the total global production of plastics grew from around 1.5 million tonnes in 1950 to 245 million tonnes in 2008.

2-1 WORLD PLASTICS PRODUCTION 1950-2008



Source: The Compelling Facts About Plastics 2009

EU27+NO/CH represent 25% of the global plastics production, with approximately 60 million tonnes per year. Germany is the major producer, accounting for 7.5% of the global production, followed by the Benelux (4.5%), France (3%), Italy (2%) and the UK and Spain (1.5%).

There are five high-volume plastics families: polyethylene (including low density (LDPE), linear low density (LLDPE) and high density (HDPE)), polypropylene (PP), polyvinylchloride (PVC), polystyrene (solid PS and expandable EPS) and polyethylene terephthalate (PET). Together, the big 5 account for around 75% of all plastics demand in Europe.

The packaging industry remains the biggest plastics end-user at 37%, followed by the Building and Construction sector at 21%. The Automotive and Electrical & Electronic industries use 8 and 6%, respectively. Finally, medical, leisure and other applications use 28%.

[4] The Compelling Facts About Plastics 2009 - a study carried out by EuPR, EuPC, PlasticsEurope and EPRO. For more information see: http://www.plasticsrecyclers.eu

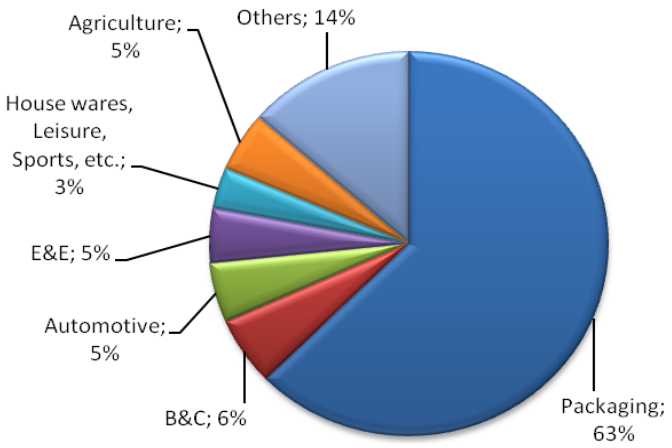
2.3.2 *THE PLASTICS WASTE MARKET*

Plastics converters used 48.5 million tonnes of plastics in 2008, down 7.5% on 2007. Of all the plastics used by consumers, 24.9 million tonnes ended up as post-consumer waste, up from 24.6 million tonnes in 2006.

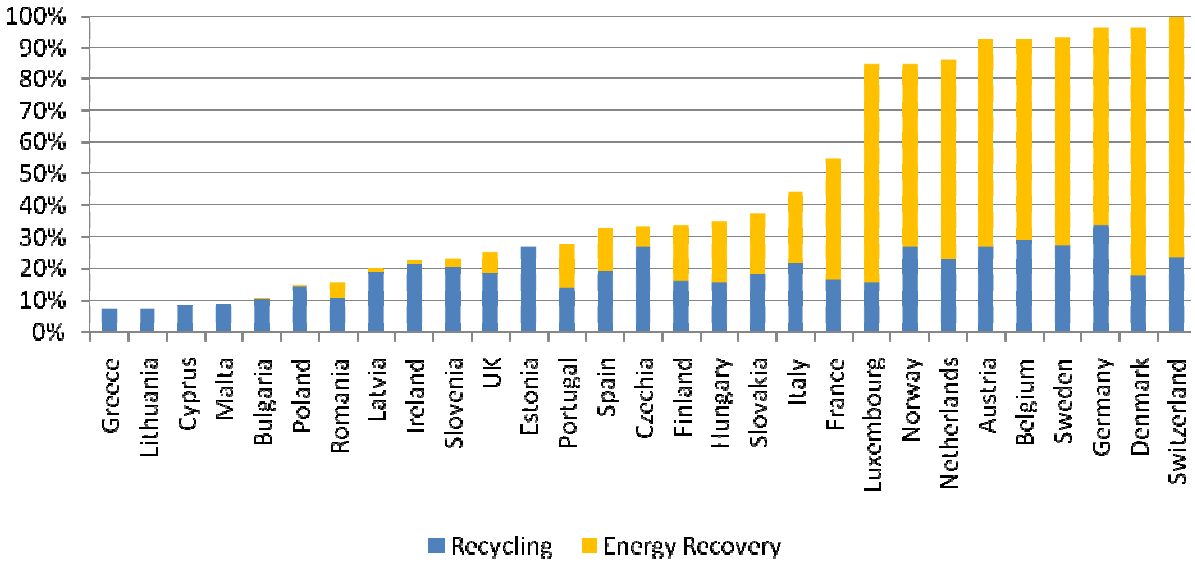
51.3% of post-consumer used plastics was recovered, and half went to disposal. Of the 51.3% recovered, 5.3 million tonnes were recycled – as material and feedstock – and 7.5 million tonnes were recovered as energy. Therefore, the potential for recycling remains very high if the diversion from landfill is implemented.

The collection and sorting of suitable post-consumer materials as input for recycling operations is extremely important, from both a cost and quality point of view (see point 4.1 Controlled and Harmonised Collection Systems).

2-2 GENERATION OF POST-CONSUMER PLASTICS WASTE BY APPLICATION



2-3 RECYCLING AND ENERGY RECOVERY RATES 2008



Source: The Compelling Facts about Plastics 2008

3 PLASTICS WASTE MANAGEMENT: OVERVIEW OF RECOVERY OPERATIONS

Recycling has become a 'hot topic' nowadays. This is particularly the case since the revised Waste Framework Directive has set a minimum recycling target of 50% for household waste and 70% for building and construction waste, which must be reached by 2020 by all Member States for each of the different materials, including plastics.

To better protect the environment, the European Union requests that Member States take measures for the treatment of their waste, which must be in line with the following hierarchy, listed in order of priority:

- **Prevention:** measures taken before a substance, material or product has become waste;
- **Preparing for reuse:** any operation through which products or components that do not constitute as waste are used again for the same purpose for which they were initially created;
- **Recycling:** any recovery operation through which waste materials are reprocessed into products, materials or substances for their original or other purposes;
- **Other recovery, notably energy recovery:** any operation the principal result of which is waste that serves a useful purpose; and
- **Disposal:** any operation which does not constitute recovery, even when the operation has as a secondary result the reclamation of substances or energy.

Member States are currently implementing several legislative measures to reinforce the abovementioned hierarchy, the T different levels of which are analysed below, emphasising the critical issues regarding plastics mechanical recycling.

3.1 PREVENTION

As stated in the Waste Framework Directive, '"prevention" means measures taken before a substance, material or product has become waste, that reduce:

a) the quantity of waste, including through the re-use of products or the extension of the life span of products;

b) the adverse impacts of the generated waste on the environment and human health;

c) or the content.'

3.2 REUSE

Reuse refers to operations though which products, which have been created and designed to accomplish a minimal number of trips or rotations within their lifecycle, are selectively collected and reconditioned, i.e. brought back to a functional state and used again for the same purpose.

Examples:

- Refillable soft-drink bottles, collected via deposit systems and reconditioned via cleaning; and
- Multi-trip plastic crates and pallets.




3.3 RECYCLING

As previously stated, recycling refers to any recovery operation though which waste materials are reprocessed into products, materials or substances for their original or other purposes .

The term 'material recycling' is used in the European Directive 2008/98/EC to distinguish the recycling of various materials (metals, paper, glass, plastics, etc.) from non-recycling operations, such as energy recovery and landfilling. The various available options (recycling via mechanical, chemical and biological routes) have made recycling more complicated for plastics materials. Originally, only direct polymer recovery and reuse via mechanical recycling were covered by the Directive. Before the directive's revision various chemical recycling routes, and even energy recovery, were promoted by some organisations in order to be also considered as recycling.

It is the belief of EuPR that only the chemical recycling processes that aim to recover mainly monomers and chemicals from post-consumer plastics for subsequent use as a feedstock for polymer production (i.e. monomer recovery) should be classified as 'material recovery'. As a consequence, when products of a chemical recycling process are mostly used as an alternative fuel in chemical or power plants, such operations should be considered as energy recovery.

For the abovementioned reasons, EuPR prefers to differentiate between mechanical recycling, chemical recycling and energy recovery and, consequently, refrains from using the term material recovery.

3.3.1 *MECHANICAL RECYCLING*

Mechanical recycling refers to operations that aim to recover plastics waste via mechanical processes (grinding, washing, separating, drying, re-granulating and compounding), thus producing recyclates that can be converted into new plastics products, often substituting virgin plastics.

For mechanical recycling only thermoplastic materials are of interest, i.e. polymeric materials that may be re-melted and re-processed into products via techniques such as injection moulding or extrusion. Thermosets cannot be reprocessed in this way but may be chemically recycled back to feedstock or used as a carrier (e.g. cement kilns).

Thermoplastics represent a variety of multiple polymers with different physical and mechanical properties. A major hurdle for mechanical recycling is that these different polymers are generally non-miscible or compatible with each other. This means that a mixture of different polymers can have inferior mechanical properties which make the recyclates unsuitable for many applications. Consequently, the mechanical recycling of plastics waste is generally only feasible for homogeneous, single polymer streams or for defined mixtures of polymers that can be effectively separated into the individual polymers.

Most mechanical recyclers obtain their input material from collecting and sorting organisations. The market value of recyclates and the costs of the recycling process determine the value of the input material, rather than the actual costs of collecting and sorting which in general should be lower.

Since recyclates aim to partly substitute virgin polymers in existing applications, their market value is directly linked to virgin prices. Converters, however, are only willing to pay a lower price than the corresponding virgin resin price because of the assumption that the quality of recyclates is lower than that of virgin materials. It appears that the marketing advantage of using eco-friendly recyclates is not yet strong enough to overcome the abovementioned price gap (see below).

Examples of mechanical recycling of post-consumer plastics waste:

- Collection and grinding of sorted, clean PP crates and blending of the regrind with virgin polymer to mould new crates;
- Collection of PE-LD films used in agriculture and industrial packaging, pre-washing, grinding, washing, separating, drying and melt-filtration/re-granulation and processing into refuse bags;
- Collection of PVC pipes, roof-membranes and window-profiles from buildings, grinding, washing, separating, drying and reprocessing into similar or other applications; and
- Collection and sorting of PET bottles used for drinks packaging, grinding, washing, separating, drying and processing into polyester fibres, sheets or containers.

3.3.2 *CHEMICAL RECYCLING*

Chemical recycling refers to operations that aim to chemically degrade the collected plastics waste into its monomers or other basic chemicals. The output may be reused for polymerisation into new plastics, for production of other chemicals or as an alternative fuel.

Several technologies have been or are being developed by major chemical companies. In general, investment levels and energy consumption are such that only very large-scale plants are expected to be economically viable. Therefore, another key factor is ensuring the supply of sufficient input materials of the right quality.

3.4 ENERGY RECOVERY

Energy recovery refers to operations that aim to use the released energy obtained during the combustion of plastics waste. This energy can be used to produce heat and/or electricity for domestic or industrial use.

3.5 DISPOSAL

Final disposal of waste or residuals from the aforementioned operations, through landfilling or incinerating without energy recovery, is not considered as a recycling or recovery operation and is therefore not included in this paper.

4 How to Increase Mechanical Recycling

4.1 Controlled and Harmonised Collection Systems

A valuable waste stream for plastics mechanical recycling starts with the design of the product.

National legislation needs to be harmonised to enable the best option for waste management. Although all legislation is based on the European Waste Framework Directive, there are striking differences between the approaches and systems for plastics waste management across the EU Member States. The spectrum goes from focussing on industrial packaging, with national authorities only monitoring volumes, to a nation-wide household collection sorting and recovery system with heavy funding (from government or green dot contributions). For recyclers this has resulted in significant differences in delivery conditions for obtaining similar sorted materials, depending on the country of operation. The resulting distinctions in cost structure lead to a disturbed market because the sale of recyclates is a European trait rather than the purchase of input materials. Harmonisation of waste management policies and green dot systems should lead to a level playing field.

Second, plastics waste should be available in sufficient quantities at identifiable sources and in a form that allows selective collection and sorting. That way material suitable for the production of recyclates with low residual levels of contamination and other materials can be collected. The development of low-cost, efficient sorting techniques would enhance the amount and quality of recyclates. Therefore, ensuring the supply of such waste materials is extremely important (see 4.4 Limit the Export of Plastics Waste and 4.6 Transparent Pricing System).

Consequently, EuPR calls for:

- Closer monitoring and transparency of the national collection systems concerning the way targets are met;
- More harmonisation of the different collection systems through legislation;
- Establishment of specific mechanical recycling targets for plastics in the Waste Framework Directive; and
- Reinforced communication and cooperation with the whole value chain.

4.2 *DESIGN FOR RECYCLING IS A CHAIN RESPONSIBILITY*

Assessment of end-of-life aspects, particularly recyclability, should be one of the key criteria in the first stages of a product's conception and design.

The organisation behind the new product (e.g. brand owners) plays a crucial role in its design, which will eventually end up as input material for the mechanical recycling industry.

For instance, several European plastics organisations have come together to launch the European PET Bottle Platform (EPBP),[5] a voluntary initiative that will offer a service to the packaging industry by assessing new PET bottle formats that enter the European plastics recycling stream. This front-end evaluation process is expected to assist the move towards a more sustainable PET recycling industry in Europe.

This platform includes the main stakeholders involved in the PET recycling value chain:

- ABC (Alliance for plastic Beverage Containers sustainability);
- EUPR (European Plastics Recyclers);
- EPRO (European Association of Plastic Recycling and Recovery Organisations); and
- Petcore (PET containers recycling Europe).

[5] http://www.petbottleplatform.eu/

4.2.1 COMPLEX PRODUCTS

Products made of components of different polymers and/or other materials are generally more difficult, and sometimes impossible or not economically feasible, to recycle. When developing new products, end-of-life aspects – especially recycling ones – should be an integral part of the design process (design for recycling).

Problems arise when an established product stream that is recycled changes from a single-polymer design to a multi-polymer design.

Examples:

- PE-LD packaging films often contain combinations of other polymers (PE-LD, PE-LLD, EVA and PLA); and
- PET barrier bottles combining PET in multi-layer systems with other non-compatible polymers such as PLA or Oxo-degradables.

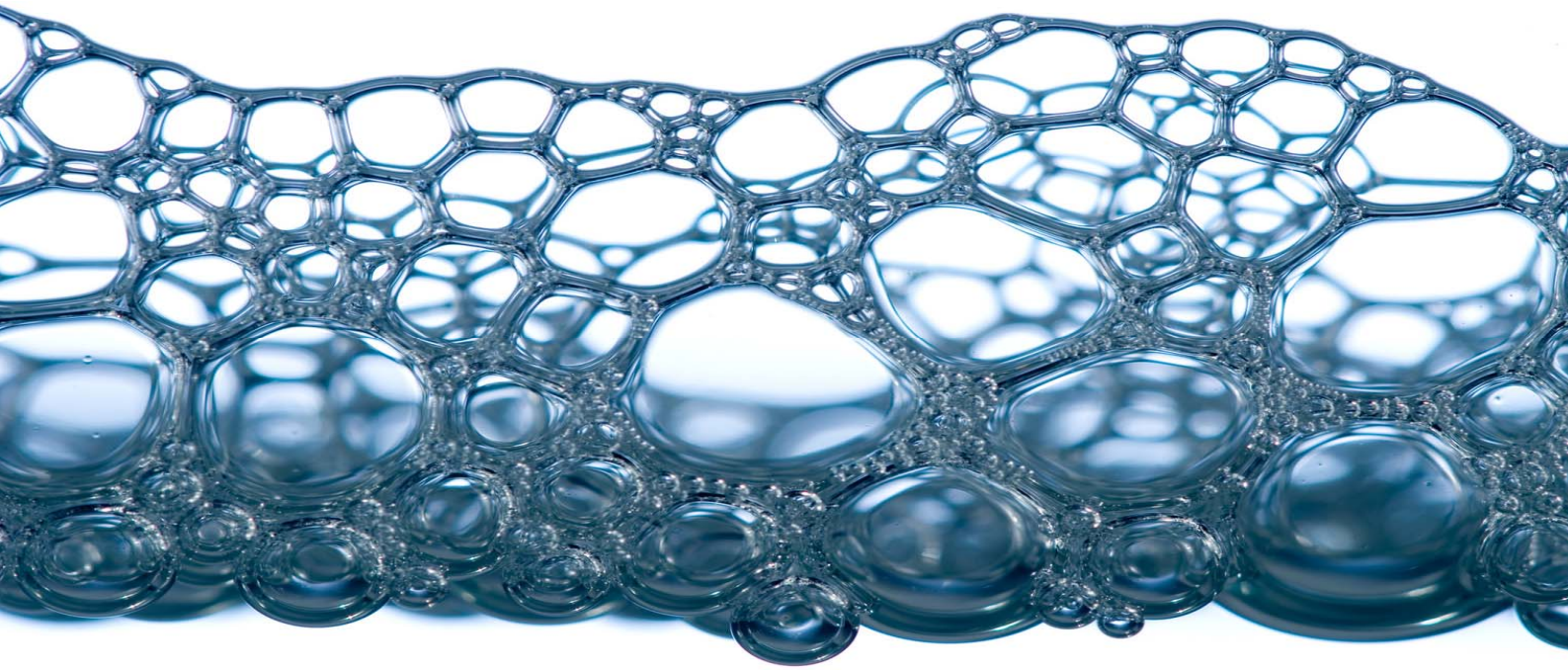
This is why a 'design for recycling' and a recyclability assessment need to be an integral part of the development process of any new product. Legislation could play an important role in increasing the eco-design of products put on the market.

Communication and cooperation between the different actors of each product value chain are therefore needed. Hence, EuPR welcomes initiatives such as that started by the European PET bottle value chain, creating a technical platform to access the recyclability of future products.

In the opinion of EuPR:

- The accountability of the producer should be enforced by legislation defining recycling requirements depending on the type of product and system in place;
- An independent assessment and rating of recyclability should be supported by a variable eco-tax system (e.g. via green dot systems); and
- A system of positive marking for recyclability, combined with a material identification system (e.g. SPI coding), should also be part of legislative measures to facilitate sorting and to improve awareness amongst the value chain.

The sustainability of mechanical recycling would also improve if new products used compatible recyclable resins. New recycling opportunities could emerge, and inter-polymer substitution would not endanger established recycling schemes.



4.2.2 *THINNER PRODUCTS*

The average thickness of polyethylene films has been gradually decreasing over the years. This development is mainly caused by cost reduction and new technologies. Moreover, this trend is supported by the prevention objective of the Waste Framework Directive, which can also be observed for the thickness of PET bottles.

These thinner products create several problems for the plastics recycling industry, since they:

- are more difficult to cut and grind;
- have relatively higher contamination levels (higher surface areas) and need more intensive washing and rinsing;
- are more difficult to handle and transport after grinding (low bulk density);
- require more energy for drying (higher moisture level);
- are often multi-layered; and
- can be made of various polyolefin polymers which are difficult to recognise and sort.

A better 'design for recycling' and stronger cooperation with all the value chain actors should therefore be promoted.

4.3 *BIOPLASTICS AND OXO-DEGRADABLES JEOPARDISE MECHANICAL RECYCLING*

Bioplastics (also known as organic plastics) are a form of plastics derived from renewable biomass sources, such as vegetable oil, corn starch, pea starch or microbiota, rather than fossil-fuel plastics which are derived from petroleum.[6]

Oxo-degradable plastics are polyolefin plastics to which very small (catalytic) amounts of metal salts have been added. These catalyse the natural degradation process to speed it up, thus the Oxo-degradable plastics degrade subject to environmental conditions to produce water, carbon dioxide and biomass.[7]

These materials aim to substitute the conventional polymers in various applications, namely bags, spoons and cups. However, the different properties of the aforementioned materials render them impossible to recycle simultaneously in the same process.

The joint efforts made by all stakeholders in order to achieve the European recycling targets are currently at risk. Bioplastics and Oxo-degradable plastics will jeopardise mechanical recycling, as they are likely pollute the existing waste streams. As a matter of fact, there is a high probability that consumers will not differentiate between the different types of plastics and will throw everything in the same bin.

A lack of accepted recyclability standards and an overkill in labelling are not presenting a clear message to consumers. Consequently, the presence of these new materials is expected to give rise to an uncontrolled quality of recycled material as they cannot be eliminated or detected.

EuPR demands that:

- The industry be watchful so as not to obliterate the achievements of the past years in plastics recycling by using unsustainable technologies for plastics; and
- The collection systems create separated streams for these new materials.

[6] http://en.wikipedia.org/wiki/Bioplastic
[7] http://en.wikipedia.org/wiki/Oxo_Biodegradable

4.4 LIMIT THE EXPORT OF PLASTICS WASTE

Various sources indicate that important volumes of post-consumer plastics waste are being exported outside Europe, mainly to China. The export of waste is financially more attractive (e.g. low transport and labour costs) than sorting and selling it to European recyclers.

As a result:

- European recycling lines are running below capacity due to a lack of suitable material;
- Further investments in sorting and recycling capacities are discouraged;
- Cheep recyclates of uncontrolled quality are (re)imported from Asia; and
- Taxpayers' money is misused to subsidise non-EU companies, instead of supporting European recycling initiatives.

EuPR strongly demands that:

- The European legislator prevent export of plastics waste in order to secure the supply for European recyclers; and
- The European collection systems act in a sustainable way by reducing the export of plastics waste to the Far East and by supporting their local treatment.

4.5 *FAVOURABLE TAX SYSTEM*

EuPR welcomes legislation that protects the environment. Nonetheless, recyclers should be helped to support the increasing additional costs generated by these legislations.

For instance, in a recycling plant, the washing of the used plastics is a critical step for producing high-quality recyclates. With legislative requirements for quality of effluent water becoming more stringent, the cost for wastewater treatment is also significantly increasing.

EuPR asks:

- For a more favourable fiscal system for the European recycling industry.

4.6 *TRANSPARENT PRICING SYSTEM*

The price of plastics recyclates is correlated to the price of virgin polymer, which is directly linked to the oil price. Contrary to the price virgin polymer producers pay, the price of the materials the recyclers buy does not follow the oil price.

Moreover, the price paid by recyclers is often set in a discretionary way brought about by financial profit instead of environmental considerations.

The price for sorted industrial waste and post-consumer material appears to increase due to:

- the export of (unsorted) materials to e.g. Asia;
- high demand for relatively high-quality waste materials;
- collection/sorting organisations trying to raise their income; and
- companies that also obtain materials with green dot contributions, which can afford to pay high prices for relatively good-quality materials from other streams.

In addition, the trend towards tender systems for acquiring materials from (national) sorting organisations will not only result in higher costs but also reduce the security of supply for the recycling

companies. Moreover, collection agencies are non-profit organisations that should not aim to make money.

It is clear that margins for recycled polymers will therefore become extremely small or negative. If such a 'constricting' situation lasts, it is inevitable that the future of this recycling industry will be at stake.

EuPR asks:

- European policy makers to create financial/fiscal instruments to protect the recycling industry when virgin price mechanisms threaten the efforts and progress achieved over the past years; and
- Collection systems for more transparency regarding their pricing systems.

4.7 Allow Recyclers to Comply With REACH

EuPR welcomed the REACH[8] Regulation as it will bring transparency and increased safety to the relevant markets. However, although waste is outside the scope of REACH, the recycling industry – as a producer of raw material – has to fulfil some obligations in order to comply with the regulation.

One of these obligations is the creation of Safety Data Sheets (SDS) for recyclates produced by plastics recyclers. Two main reasons make this obligation impossible to fulfil:

- Recyclers do not receive the necessary REACH-related information when buying their input material because waste is out of the scope of REACH; and
- The input stream constantly varies in composition, rendering the creation of the obligatory SDS practically impossible.

EuPR requests that:

- The European Commission, together with the European Chemical Agency, provide immediately a workable solution for plastics recyclers to comply with REACH;
- ECHA publish as soon as possible their guidelines on 'Recovered Substances' under REACH; and
- All stakeholders support recyclers in creating REACH-compliant Safety Data Sheets.

[8] REACH Regulation 1907/2006

4.8 PROMOTE THE USE OF RECYCLATES

Without approved applications for recyclates and a market demand there would be no future for plastics recycling. Many of the present applications are the result of a market pull, since recyclates can offer a fit-for-use performance.

European, national and local authorities could take the lead in promoting the use of recycled content products, i.e. 'green' purchasing. Improving public awareness for plastics recycling and fostering a positive consumer attitude towards buying recycled products will increase the use of recyclates.

EuPR demands:

- The revision of discriminating legislation or standards prohibiting the use of recyclates;
- A substantial increase of green public procurement;
- Economic instruments to promote recyclates such as the inclusion of the waste and recycling sectors into the ETS.[9]
- Eco-Label scheme to promote the use of minimum mandatory recycled content in products.

[9] Emission Trading System - Directive 2003/87/EC

5 CONCLUSION

If Europe wants to move closer to a sustainable 'recycling society', the long-term commitment of every actor in the value chain is compulsory.

Commitment and responsibility may not even be enough. Experience of the past years has shown that legislation is required to enforce this responsibility. Manufacturers and/or marketers of a product need to be accountable for the impact of that product on the environment.

Actions needed to stimulate and increase the mechanical recycling of plastics in Europe include:

1. **Close monitoring of the national collection systems and better harmonisation of the different European collection systems;**
2. **Stop the use of unsustainable technologies (bioplastics and Oxo-degradables) for plastics. Collection systems should create separate streams for these new materials;**
3. **Specific mechanical recycling targets for plastics in the Waste Framework Directive;**
4. **Limit the export of plastics waste to secure supply for European recyclers;**
5. **Favourable fiscal system for the European recycling industry;**
6. **Effective solution offered to plastics recyclers to comply with REACH. All stakeholders should support recyclers in creating REACH-compliant Safety Data Sheets;**
7. **Elimination of discriminating legislation or standards prohibiting the use of recyclates;**
8. **Substantial increase of green public procurement and a mandatory minimum recycled content for eco-labels;**
9. **Economic instruments to promote recyclates similar to the inclusion of the waste and recycling sectors into the ETS; and**
10. **Reinforced communication and cooperation with the whole value chain.**

Notes

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