

Study on an increased mechanical recycling target for plastics

FINAL REPORT

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Foreword by Mr. Shailendra Mudgal



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You can tell how high a society is by how much of its garbage is recycled." D. Ywahoo

The use of natural resources in the world is expected to quadruple by 2050 and at the current rate of depletion, the world cannot satisfy demand for resources from virgin materials alone. Recycling has been at the centre stage of the environmental policy for several decades and the use of waste as resource has been highlighted again by the EU Resource Efficiency roadmap.

The nature and amount of recycling in a given geographical area depend on different factors such as material composition of products, waste collection schemes, and different technologies of recycling. The overall success of a recycling stream is driven by appropriate public policies, efficient and well organised value chain, and conscious consumers. In the case of plastics, some progress has been made in the last years but the amount of the collected plastics which was recycled in the EU is only 24%. This report examines the trends in plastics recycling in Europe and makes a case for increased plastics recycling which will bring additional environmental, social and economic benefits.

I hope that this study will contribute in developing new ideas and an ambitious strategy for plastics recycling in the EU and help the EU in moving forward towards a resource efficient society.



Shailendra Mudgal

Executive Director

BIO Intelligence Service

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Executive summary

Although there has been a significant increase in the volume of plastics being collected for recycling in recent years, there is still a perception among citizens, public authorities and businesses that more plastics can and should be recycled. Plastics are very visible in our rubbish bins or as litter on our streets or in our waters. The view that we should recycle more would seem to be confirmed by the very fact that only 24% of all plastics in the EU were collected for recycling in 2012.

Low recycling rates for plastic materials are no longer acceptable. In the long run, growing scarcity of raw materials will not allow Europe the luxury of continuing to waste 76% of all plastic used. Urgent action is needed in order to increase recycling rates for plastics. This study describes scenarios to further improve the sustainability of plastics via recycling in Europe by 2020. Enhancing plastics recycling could help save scarce resources, create jobs and reduce environmental impacts. This study proposes crucial measures that should be taken in order to achieve that.

First, we analyse the current plastics recycling situation. Recent changes at the waste collection stage, technological innovation by recyclers and behavioural change by households have enabled volume growth in plastics recycling over time. Yet despite this trend, plastics still have low recycling rates compared to other materials. Action should be taken now in order to push plastics recycling to higher levels.

Next, we develop three scenarios in order to analyse the best pathway to increased plastics recycling. The preferred path should be the one that maximises environmental, economic and social benefits. The scenarios are:

- **Scenario 1 – Baseline:** No further major changes in waste management systems in the period to 2020.
- **Scenario 2 – Implementation:** Full implementation of all existing EU waste legislation including a 50% municipal solid waste plastics recycling rate by 2020.
- **Scenario 3 – Vision for Resource Efficiency:** All recyclable plastics are made available to recyclers, a 62% recycling rate is achieved, residuals are recovered for energy production and landfilling is prohibited for any recyclable plastics by 2020.

Based on the results of these scenarios, the best strategy to move Europe towards sustainability for plastics is clearly Scenario 3. Moving to the Vision for Resource Efficiency would:

- Efficiently use all plastic waste generated by putting 11 million tonnes (Mt) of plastic recyclates on the market;
- Divert more than 24 Mt of plastic waste from landfill;
- Recover energy from 7.5 Mt of residual waste;

- Support around 360 000 jobs (of which 120 000 directly employed by recyclers);
- Save more than EUR 4.5 billion by substitution for virgin plastics; and
- Avoid emissions of more than 26 MtCO₂.

All stakeholders need to take action to realise this vision and make plastics one of the most sustainable materials by 2020. In order to achieve this objective Europe should:

First

- Ban landfilling of plastic waste; and
- Improve the ecodesign of products by taking more account of recyclability and recycled content.

Next

- Collect all plastic waste separately;
- Efficiently sort all collected plastic waste in order to create appropriate quality for recycling; and
- Send all sorted plastic waste to certified plastics recyclers.

Finally

- Direct plastics that are left over from recycling processes to energy recovery.

Europe has the means to significantly increase its plastics recycling rates and reap very large benefits in resource savings, job creation and environmental conservation. All that is needed now is enough political will to support the transition.

Chapter 1: Introduction

“ Recycling contributes to a green economy in numerous ways, including enhancing resource efficiency, reducing environmental impacts from raw material extraction, generating jobs and business opportunities, and ensuring secure supplies of essential resources.

European Environment Agency (2011)¹

The priority that recycling receives in statements such as the one above, in policy documents and in the waste hierarchy itself, is not always matched by political commitment. Policy makers need to become more aware of both the great potential of recycling and the remaining challenges to be addressed. That is the key motivation of this study: plastics are recyclable and substantial plastics recycling capacity is available in Europe; there is great potential for growth but an appropriate policy framework is needed.

Targets are key to ensuring good implementation of any policy but targets need to be well defined and quantified and should take into account the ability to comply of the sector concerned. This study assesses the policy and market implications of meeting and exceeding an increased mechanical recycling target for plastics.

The report is divided into four chapters including this introduction. The second chapter describes the current status and trends along the plastics recycling value chain. It also outlines the main policy drivers because they have a direct influence on the market. The third chapter presents a baseline scenario and scenarios with increased recycling rates and assesses the impact of these scenarios on the economy, environment and employment. Finally, the fourth chapter describes the actions that would be necessary to bring about positive change.

This study can be seen in the context of a European plastics recycling sector that is decentralised and highly segmented. The establishment of Plastics Recyclers Europe a few years ago has thus been key to raising the visibility of the sector at European level. The role of Plastics Recyclers Europe is to promote plastics recycling and the creation of conditions that enable profitable and sustainable business. The sector consists of 1 000 companies, mainly SMEs, employing around 30 000 people, processing more than 3 million tonnes (Mt) of plastics and generating annual turnover of EUR 2 billion. Plastics Recyclers Europe members represent around 80% of the European market.

¹ European Environment Agency (EEA) (2011) *Earnings, jobs and innovation: the role of recycling in a green economy*.

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Chapter 2: Status and trends in plastics recycling in Europe

2.1 Policy context

Recycling can be a key action to implement the Europe 2020 strategy, in particular the flagship initiative on shifting to a resource-efficient, low-carbon economy to achieve sustainable growth. The 2008 Action Plan on Sustainable Production and Consumption and Sustainable Industry stated the need to reduce dependence on raw materials and encourage efficient resource use and recycling. Even before that, the 2005 Thematic Strategy on the Prevention and Recycling of Waste set a long-term goal for the EU to become a “recycling society”, and recycling is also key to the overarching 2005 Thematic Strategy on the sustainable use of natural resources.²

The Waste Framework Directive,³ revised in 2008, introduced a target to recycle 50% of total municipal solid waste⁴ by 2020 including plastic, paper, metal and glass. This enforceable target created an important stimulus for Member States to increase their recycling rates. There are also specific recycling targets for waste electrical and electronic equipment (WEEE), end-of-life vehicles (ELVs), packaging, household waste, construction and demolition, and batteries. Importantly, the Waste Framework Directive also requires separate collection of plastics and the other materials by 2015.

However, although plastics recycling is influenced by several areas of European policy, regulations usually do not target plastic waste or plastic waste recycling specifically. This weakens the impact of policy and makes it more difficult to monitor progress.

There is one target specific to plastics recycling but it is limited to packaging. The Packaging and Packaging Waste Directive⁵ set a recycling target for plastic packaging of 22.5% by weight by 2008, counting only material recycling, i.e. recycling back into plastics. This target has already been achieved by some Member States: in 2009, 30.3% of plastic packaging was recycled in Europe (EU-27, Norway and Switzerland). Some Member States recycled a greater share than that,⁶ while several others did not even reach the target.⁷ Some countries have been granted extended deadlines – as late as 31 December 2015 for Latvia. However, claims that particular Member States have achieved the 22.5% target must be treated with caution as different methods of calculation, monitoring, and reporting etc. are used.

² See BIO et al. (2010) *Preparatory Study for the Review of the Thematic Strategy on the Sustainable Use of Natural Resources*, DG Environment and BIO et al. (2010) *Supporting the Thematic Strategy on Waste Prevention and Recycling*, DG Environment.

³ 2008/98/EC.

⁴ Post-consumer waste collected by local authorities; can include household waste and waste collected from public institutions and spaces.

⁵ 1994/62/EC.

⁶ CZ, DE, EE, SE, BE, AU, NL, SK, IT, LV, SI.

⁷ FR, BG, RO, CY, EL, MT.

The 22.5% target is based on the amount of plastic waste collected rather than the amount of plastics finally recycled. Basing it on collected rather than recycled quantities is not an effective way to promote the recycling of plastic waste in Europe. Furthermore, the Packaging Directive does not provide a definition to estimate the quantity of packaging put on the market, or an approach to calculating the recovery and recycling rates in more detail to ensure data comparability.⁸ Methodologies are not uniform across Member States, so data on packaging waste are not always comparable.

The Landfill Directive (1999) set targets for diversion of waste from landfill to either recycling or energy recovery (use of plastic waste as a fuel to generate energy). In general, tightening of environmental requirements on landfill and incineration has made those waste management options relatively more expensive, resulted in closures of sub-standard landfills and incineration plants, and increased the quantities of plastic available for recycling.

In order to achieve targets, new processes and technologies are also essential. There are some initiatives at EU level in this area that can be built upon. For example, recycling is one of the main funding areas of the Eco-innovation programme, which is making a total of nearly EUR 200 million available to finance projects over the period 2008-2013. There is also the Lead Market Initiative on recycling, which aims to support the implementation of the Waste Framework Directive, stimulate demand for recycled products through public procurement, set up eco-innovation projects to develop new recycling techniques and support best practice networks.

However, despite the existing set of policies and measures in place, a number of Member States still resort to landfill, especially for household waste. Some also still employ incineration without energy recovery, though this is becoming less common. Gaps in implementation and enforcement of waste policy can give rise to significant problems of illegal waste dumping, landfills that do not meet EU requirements and a high level of illegal waste shipments. There is thus still significant unexploited potential for recycling, which would create business opportunities, export potential and employment, and would enhance resource efficiency and other environmental indicators.

The urgency for stronger and more coherent action by policy makers is thus clear.⁹ The European Commission launched a consultation process and study for the review of recycling and reuse targets in 2012. An ex-post evaluation of EU waste legislation, which will contribute to the preparatory work for the revision of recycling and recovery targets, is expected to be completed in early 2014.¹⁰ The EC is required to present a review of the implementation of the Waste Framework Directive by 12 December 2014. That might include or be accompanied by other measures including a report on reuse and recycling targets. Meanwhile, in April 2012 the

⁸ EEA (2006) *CSI 017 Specification - Generation and recycling of packaging waste*.

⁹ See also BIO (2011) *Study on coherence of waste legislation*, DG Environment.

¹⁰ The ex-post evaluation of five waste stream Directives is currently being carried out by BIO Intelligence Service, IEEP and Arcadis. The review of targets is being carried out by Eunomia.

Committee on the Environment of the European Parliament called for a ban on landfilling of waste in Europe among other measures in its report on the Resource Efficiency Roadmap.¹¹

2.2 Plastics recycling value chain

The market structure of plastics recycling involves collection, sorting, processing and converting (i.e. incorporation of recycled plastic into new products). Most companies focus on one area of activity, though some larger players are involved in several steps. Figure 1 provides an overview of the recycling value chain with the main actors, functions and outputs at each stage.

¹¹ The compromise text including amendments can be accessed at www.europarl.europa.eu/meetdocs/2009_2014/documents/envi/dv/899/899789/899789en.pdf.

Figure 1: Overview of the plastics recycling chain



2.2.1 Plastic waste generation and trade

Most plastics in Europe are made from petroleum although plastic can be also be produced from gas. There are many different production methods, and this variety results in several broad categories of plastics and hundreds of individual types. Almost all plastic types can be recycled.¹² However, as recycling mixed materials is more difficult, in practice the EU plastics recycling market is dominated by five main categories, which account for around 75% of the demand from converters:

- Polyethylene (PE, including low density-LDPE, linear low density-LLDPE and high density-HDPE);
- Polypropylene (PP);
- Polystyrene (solid-PS and expandable-EPS);
- Polyvinyl chloride (PVC); and
- Polyethylene terephthalate (PET).¹³

Each type of plastic has different physical and chemical properties and thus different applications in products. The packaging sector is by far the biggest contributor to the plastic waste stream, at around 62% compared to only 5% or less for each of construction, automotive, WEEE and agriculture. This is partly because packaging tends to have a shorter lifetime than other plastic products.

In 2012, around 25.2 Mt of plastic waste was generated in Europe and 6.3 Mt of it was collected for recycling. However, much of that tonnage is then traded on the market and exported for recycling or disposal.

We estimate that 2.0-3.5 Mt of the plastic collected in the EU is exported legally (e.g. via ports in the Netherlands or Belgium), mostly for recycling in Asia, especially China. Much is also exported illegally (e.g. incorrectly classified or unclassified). Member State reporting of illegal waste shipments is very incomplete and thus it is not possible to be precise about quantities.

What is clear is that plastic waste exports have increased dramatically in recent years, both within the EU and even more so to third countries. This is due to demand from fast-growing Asian economies (driving higher prices), lower transport costs by ship, and the importing of huge volumes of consumer goods from Asia to the EU, facilitating the exporting of EU waste back to Asia for recycling. At the same time, the supply of plastic waste has increased due to EU and national waste legislation diverting it from landfill.

In general, quantification of waste streams, volumes and management systems across the EU is difficult because of the lack of reliable data. PlasticsEurope makes some data on virgin plastics

¹² Types that cannot be recycled may include thermosets used to make electrical fittings or to bind composite materials for example, but these are a very small share.

¹³ Other significant categories of plastics include acrylonitrile butadiene styrene (ABS), polymethylmethacrylate (PMMA), polyamide (PA), polyurethane (PUR).

publically available (in a joint initiative with Plastics Recyclers Europe, European Plastics Converters and the European Association of Plastics Recycling and Recovery Organisations (EPRO)) but there is no comprehensive public database containing authoritative data on plastics recycling. What research and data collection there is tends to focus on plastic packaging.

2.2.2 Collection and sorting

Household waste collection schemes in Member States include kerbside collection, drop-off locations and refill/deposit systems. The “bring”-type schemes tend to result in lower collection rates unless the public is highly committed or has a direct economic incentive to participate, as in the case of a deposit refund. Hence, the general trend is towards collection of recyclable materials through kerbside collection alongside other municipal solid waste. In order to keep costs down, most kerbside collection is of mixed recyclables (some combination of paper, board, glass, aluminium, steel and plastic). Kerbside collection schemes have been successful although to take the example of plastic bottles,¹⁴ typically only 30-40% are recovered because much of this kind of packaging is consumed outside the home.¹⁵

Extended Producer Responsibility (EPR) systems have been put in place in response to EU Directives for packaging, WEEE, ELVs and other products. EPR actively contributes to meeting EU recycling targets and is an important tool for improving the recycling and recovery rates of under-performing waste streams. However, until now separate collection ratios have often been rather low, as shown in the table below.

Table 1: Separate collection ratios estimated by packaging application, 2007 (EU-25)¹⁶

Packaging application	Collection ratio
Bottles, containers and closures	25%
EPS	10%
HDPE boxes	100%
Shrink wrap	10%
Stretch wrap	10%
LLDPE shrink wrap	10%
Film	10%
Sacks	5%

¹⁴ See for example WRAP (2012) *Kerbside Collection of Plastic Bottles Guide*, www.wrap.org.uk/downloads/Kerbside_collection_of_plastic_bottles_guide.6dfo4b66.11686.pdf.

¹⁵ Source: <http://rstb.royalsocietypublishing.org/content/364/1526/2115.full>.

¹⁶ JRC IPTS (2007) *Assessment of the environmental advantages and drawbacks of existing and emerging polymers recovery processes*.

Packaging application	Collection ratio
Bags	5%
Trays	10%
Other small packaging	3%

HDPE boxes exhibit a very high rate of collection because they are mainly used in the industrial and commercial sectors where recovery pathways are well established. Bottles and containers are mainly made out of HDPE/PP and can be recycled back into their previous use. However, most other types of plastic waste are not collected to the same extent (10% or less) so there is still great potential for growth.

The standard EN 15347 classifies types of plastic waste material. Some codifications have been implemented in Member States to specify limits and categorise waste plastic, in order to facilitate trade between collectors, brokers and recyclers. National and voluntary initiatives focus on parameters such as colour, content, additives, foreign material and density. For plastic bottles, the European PET Bottle Platform's guidelines provide methods to test suitability for recycling.¹⁷

A major challenge in producing recyclate¹⁸ is that most plastic types are inherently immiscible at the molecular level and have different processing requirements. For example, a small amount of PVC contaminant present in a PET stream will degrade the recycled PET resin and vice versa.¹⁹ Therefore, for efficient mechanical recycling, discarded plastics should be collected and sorted as far as possible into single types. When plastic is contaminated, in limited quantity or with a varied composition, recycling is more difficult. The cleaner and the fewer different types of plastic, the less mechanical treatment is required and the higher the quality of the recycled plastic products.

Sorting and separation thus affect the cost of recycling and the quality of recyclate.²⁰ Indeed, sorting plastic waste at an early stage may be the most significant activity in the recycling loop,²¹ raising the quality of the waste by grouping types and colours. The sorting process first separates plastics from fibres, then films from other plastics, then PVC, PP, PS etc. from PE. Automatic sorting techniques have emerged and are becoming more widespread, though manual sorting is still used by some recycling facilities.²² Automatic techniques are continuously being improved; the most common currently is near-infrared detection.²³

¹⁷ See www.petbottleplatform.eu.

¹⁸ Materials resulting from the processing of plastic waste (pellets, granules, flakes, etc.).

¹⁹ JRC IPTS (2007) *Assessment of the environmental advantages and drawbacks of existing and emerging polymers recovery processes*.

²⁰ Quality is a subjective term, which varies among recyclers depending on the equipment and processes used and the markets sold into. It can be understood as the level of impurities in the waste stream, which can affect mechanical and visual properties.

²¹ Al-Salem et al. (2009).

²² European Commission (2008).

²³ Near-infrared detectors use a spectroscopic identifier to help separate plastics from non-plastics and identify different classes of plastic. Optical devices then enable the plastics to be sorted by colour. Further technologies separate plastics from other waste fractions and differentiate plastic by density.

Efficient collection and sorting enables high quality recycling. By increasing the value of waste, the recycling sector in turn makes collection schemes more economically feasible.

2.2.3 Mechanical recycling and the alternatives

Recycling of plastic waste almost always refers to mechanical recycling, which is the processing of waste plastics by physical means (grinding, shredding, washing, drying and melting) back into plastic products.²⁴ The “efficiency” of this process for a given amount of plastic varies but 60% on average can be used as a rough estimate. The remaining 40% cannot be recycled and ends up as waste (side products) that can be sent for energy recovery, reuse by other industries or, as a last resort, to landfill. If the collection and sorting of plastics waste improves, the efficiency of recycling lines will also increase (see Chapter 3).

Around 3.2 Mt of post-consumer plastic is recycled in Europe. The final recycling output is thus around 1.9 Mt (60%). By way of comparison, that amount of output could only meet around two weeks of plastics demand if the supply of virgin plastics dried up: in 2011, demand for plastics in Europe was 47 Mt,²⁵ or 0.9 Mt per week. Recycling currently only meets around 4% of demand.

Bio-based plastics (i.e. those derived from renewable sources) are generally not a problem for mechanical recycling as they are designed to keep their properties. Biodegradable plastics on the other hand, lose their properties and create a lower melt flow index (i.e. the degradation of the organic part), which lowers the quality of the recyclate. Greater penetration of biodegradable products in non-biodegradable plastic streams is thus a threat to plastics recycling.

The alternatives to recycling for treatment of plastic waste are energy recovery (incineration) and landfill. Incineration capacity is quite high in the EU – around 8.6 Mt currently goes to energy recovery.²⁶ Significant amounts of energy can be recovered from plastics for use in heating or power generation but ideally energy recovery should be reserved for non-recyclable materials.²⁷

Figure 3 shows rates of recycling and energy recovery by country, which vary greatly in Europe. There is a group of nine countries that are clear leaders in this area, sending less than 10% of plastic waste to landfill. At the other end of the scale, 11 Member States still landfill more than 60% of their plastic waste.

²⁴ Direct re-extrusion is only suitable for recycling process scrap, while feedstock (pyrolysis) recycling is technically feasible but prohibitively expensive and energy-consuming (Allwood, Cullen et al., 2012).

²⁵ PlasticsEurope (2012) *Plastics – The Facts 2012*.

²⁶ PlasticsEurope (2012) *Plastics – The Facts 2012*.

²⁷ Plastics may actually be less suitable for incineration than other waste types as their high calorific values (CVs) may pose a problem for incinerators designed for low CV, high tonnage.

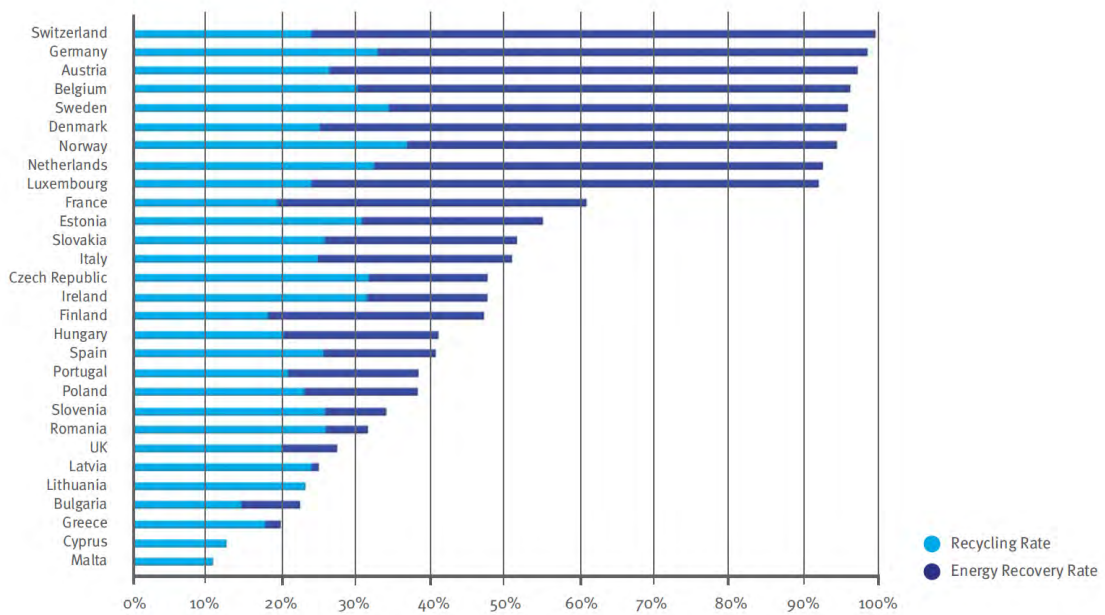


Figure 2: Total recovery rate by country (post-consumer plastic waste), 2011²⁸

As packaging has long-standing systems for recovery and recycling of plastic waste, recycling rates are higher than for other streams. Packaging is followed by agricultural waste, which although not under direct legislative obligation, has the advantage of being a relatively homogenous material.²⁹

2.2.4 Recycled plastic products

Recycled plastic products today range from water bottles to various types of packaging and bin liners, food packaging, and plastics combined with other materials in toys and tools. Well-established markets for recycled plastic include:

- LDPE for bin liners, carrier bags, agricultural film mulch, agricultural film sheet, construction film, tubes, cling-film, flexible packaging, heavy duty sacks, etc.;
- HDPE in various applications: tubes, sewer pipes, pallets, boxes, buckets, bottles for detergents, construction, food products, toys, cable insulation etc.;
- PP to make pipes, pallets, boxes, buckets, furniture, car parts, pots of yoghurt, butter, margarine, fibres, milk crates, etc.;
- PVC in sewer pipes, window frames, construction, flooring, wallpaper, bottles, car interiors, medical products, etc.;
- PET for bottles, sheets, strapping (e.g. carpets, clothing automotive parts), food and non-food packaging, films and fibres;

²⁸ Consultic in PlasticsEurope (2012) *The Facts 2012*, available at: www.plasticseurope.org.

²⁹ BIO et al. (2011) *Plastic Waste in the Environment*, European Commission DG Environment.

- PS for clothes hangers;
- Mixed plastics for pallets, floors, roofs, furniture and benches.

The figure below shows a breakdown of the 47 Mt of plastic demanded from converters in 2011 by polymer type.

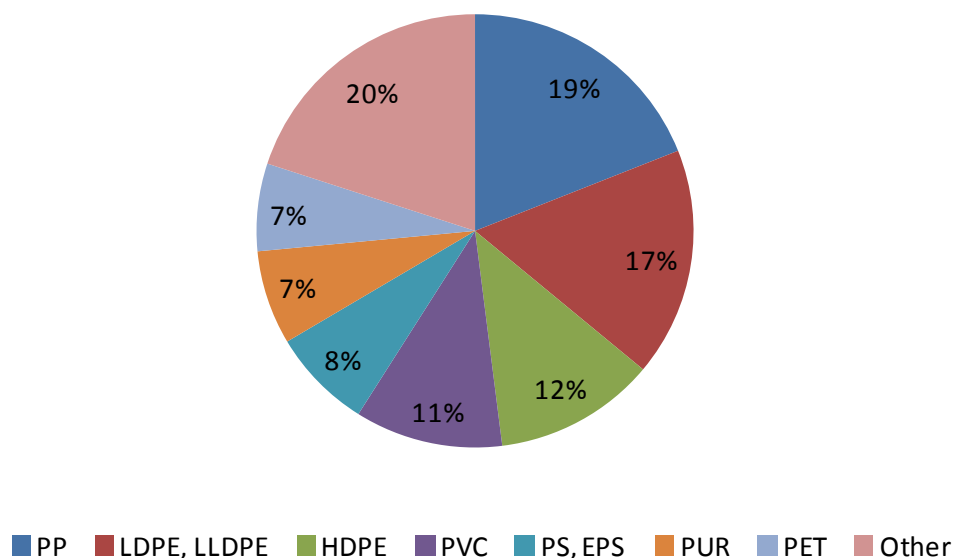


Figure 3: Plastics demand by type (EU-27+CH+NO), 2011³⁰

Recycled plastic is either used in the same application in a closed loop or is used in a different application. Many if not most plastic applications are in effect “over-engineered” if made from virgin plastics: in other words, virgin plastic could be substituted by recycled material and product functionality would not be affected. The aim should therefore be for recyclates to remain within plastic products applications – there are more than enough markets available. Substantial growth in plastics recycling will also depend on adding new applications to the existing ones. Recycled plastic can even be a solution for some food packaging applications, by sandwiching recycled plastic between layers of virgin polymer for example.

The challenge for plastics recyclers is that their customers (plastics converters), demand large quantities of recycled plastics, manufactured to strict specifications at a price that has to be competitive with virgin plastic. Technical requirements can vary greatly depending on the end use required by the buyer. Meanwhile, quantities available to recyclers and tonnages of recyclate produced can be of varying quality as there is no EU-wide certification in place. The market for recovered plastics is still small in comparison with virgin plastics, and subject to the broader economic climate as well as several other factors that can be volatile in nature.

Since recyclates aim to partly replace virgin polymers in existing applications, their market value is directly linked to virgin plastic prices, which depend heavily on volatile oil prices. The price of oil has increased significantly in the last few years, from a range of around USD 20-40 per barrel

³⁰ PlasticsEurope (2011) *The Facts 2011*, available at: www.plasticseurope.org.

prior to 2004 to around USD 100-120 in recent years. Hence, although higher oil prices also increase the cost of collection and recycling to some extent, recycle has become more attractive relative to virgin plastics.

If demand from Asia (the principal importer of waste plastics from the EU) decreases, or if there is excess capacity in the virgin polymer industry, recycled plastic will only compete with virgin plastics to the extent that it can match virgin quality at the same or lower cost, or provide a level of quality that is lower but acceptable at a lower price. In many cases today, recycled plastic has a price advantage.

Consumer perception also plays a role in the market for recycled plastics. The use of recycled plastics in some sectors, e.g. construction, is limited by a negative perception of the robustness of recycled material that could lead to a premium being put on virgin plastics. This effect is reduced when the recycled plastic is an intermediate product, as end users are less (or not at all) aware of its presence. However, as mentioned above some cases of negative perception are due to a lack of information, which can be overcome through market signals, while others (e.g. colour) are likely to be resolved with the next few years as technology advances.

2.3 Technological and market trends

Technological advances in recycling have decreased the cost of recycling (by improving efficiency) and closed the gap between the value of recycled plastic and virgin plastic. For example, one way to enhance the value of recycled plastic is via technologies that turn recovered plastic into food-grade polymer by removing contamination. This technology has been proven for clear PET bottles and, more recently, HDPE milk bottles.³¹ Thus, although having clean monostreams is still very important, sorting technologies have greatly improved and washing technologies allow waste plastics to be cleaned more efficiently. For example, PP was formerly hand-sorted but in Germany is now commonly sorted by machine.

Down gauging (weight reduction) in plastic applications (e.g. thinner film for bags) is a common trend among converters, both for cost and waste prevention reasons. This has triggered a need for technological innovation in recycling operations to limit the cost increase per unit of weight and to maintain or improve quality (down gauging worsens the product-contamination ratio). Other market trends in plastic applications are towards more complex multi-layer and multi-material products (which are more difficult to recycle); demand for greater recycled content in products; and a larger share of biodegradable and bio-based plastics, though not large enough to sort and recycle separately.

Recycling of post-consumer plastics in most locations is now increasingly viable. The rate of mechanical recycling is set to continue increasing, keeping pace with rising volumes of plastic waste generated and leading to greater volumes being collected. Table 2 below adds estimates for 2015 to the collection ratios for 2007 shown in Table 1.

³¹ Source: <http://rstb.royalsocietypublishing.org/content/364/1526/2115.full>.

Table 2: Separate collection ratios estimated by packaging application (EU-25)³²

Packaging application	2007	2015
Bottles, containers & closures	25%	37.5%
EPS	10%	15%
HDPE boxes	100%	100%
Shrink wrap	10%	15%
Stretch wrap	10%	15%
LLDPE shrink wrap	10%	15%
Film	10%	15%
Sacks	5%	7.5%
Bags	5%	7.5%
Trays	10%	15%
Other small packaging	3%	4.5%

There are many product types that are currently not widely collected but could be in future. For example, advanced sorting technologies for PP are now available but not yet fully implemented as collection is not in place. Most current facilities have difficulty handling flexible plastic packaging because its characteristics are different to rigid packaging. The low weight-to-volume ratio of films and plastic bags also makes it less economically viable to invest in the necessary collection and sorting. However, plastic films are currently recycled from sources including secondary packaging such as shrink-wrap of pallets and boxes and some agricultural films, thus this is feasible under the right conditions.³³

The continuous appearance of new plastic applications as a result of innovation and competition is an important driver for the development of plastics consumption and waste generation. However, investment in recycling is financially less viable for products that are less common. This means that although the product mix will change over the coming years, the variety of plastics recycled will not necessarily change to the same degree.

Because of its abundant use in packaging, LDPE is the most recovered polymer in plastic waste. The most significant change expected over the next few years is the growth of PP and PET volumes, partly because of their increasing use in packaging. Expansion of plastic recycling capacity can also be expected to shift towards recycling mixed polyolefin packaging waste, ELVs,

³² JRC IPTS (2007) *Assessment of the environmental advantages and drawbacks of existing and emerging polymers recovery processes*.

³³ See <http://rstb.royalsocietypublishing.org/content/364/1526/2115.full>.

WEEE and construction plastics, driven by legislation. Volumes of technical plastic waste (ABS, PA and PU) are not expected to grow very substantially.

For products with long lifetimes such as PVC in construction applications (see figure below), there is a gap ranging from 15 to 50 years between the production phase and the end-of-life phase. Therefore, substantial amounts of PVC produced in the 1970s and 1980s are only reaching the market now and will need to be recycled in the medium term. This is also true of HDPE pipes for example. There has already been a significant increase in PVC recycling volumes through the Recovinyl initiative.³⁴

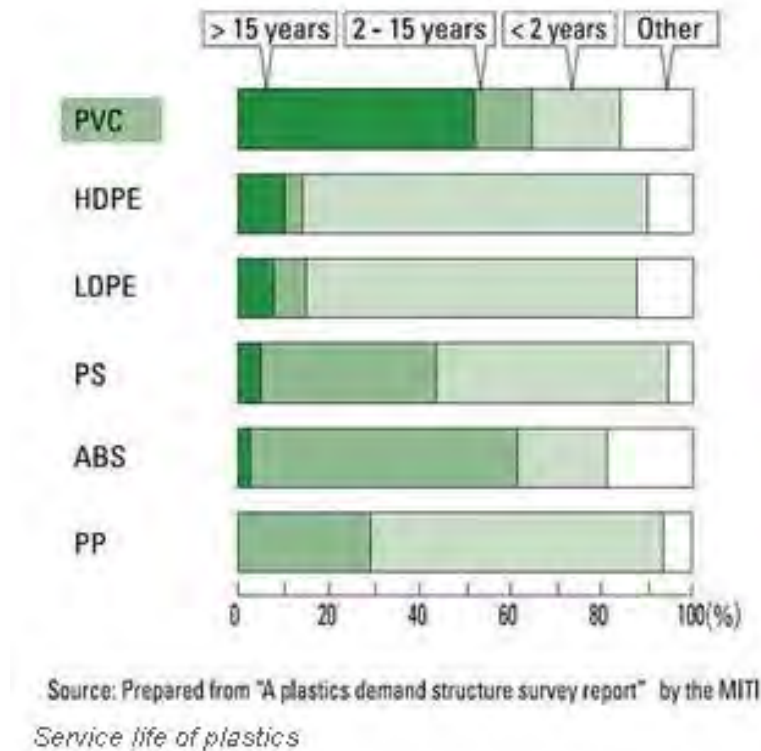


Figure 4: Service life by plastic type³⁵

An important market trend in recent years has been the growth in exports of plastic waste for treatment outside the EU. This is particularly evident in data for the UK:

³⁴ See www.recovinyl.com.

³⁵ See www.pvc.org/en/p/sustainability.

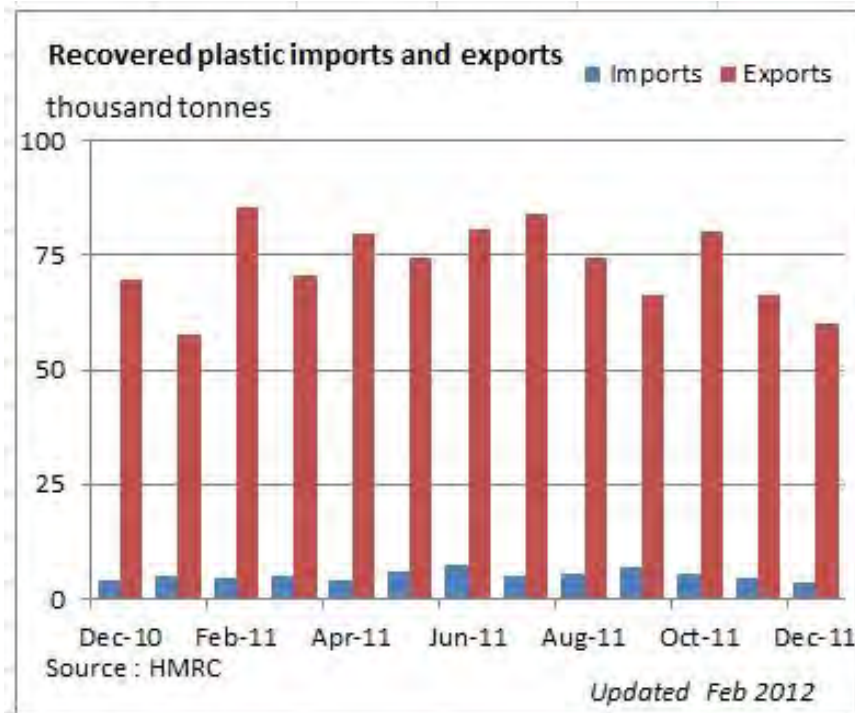


Figure 5: UK recovered plastic imports and exports, December 2010 - December 2011³⁶

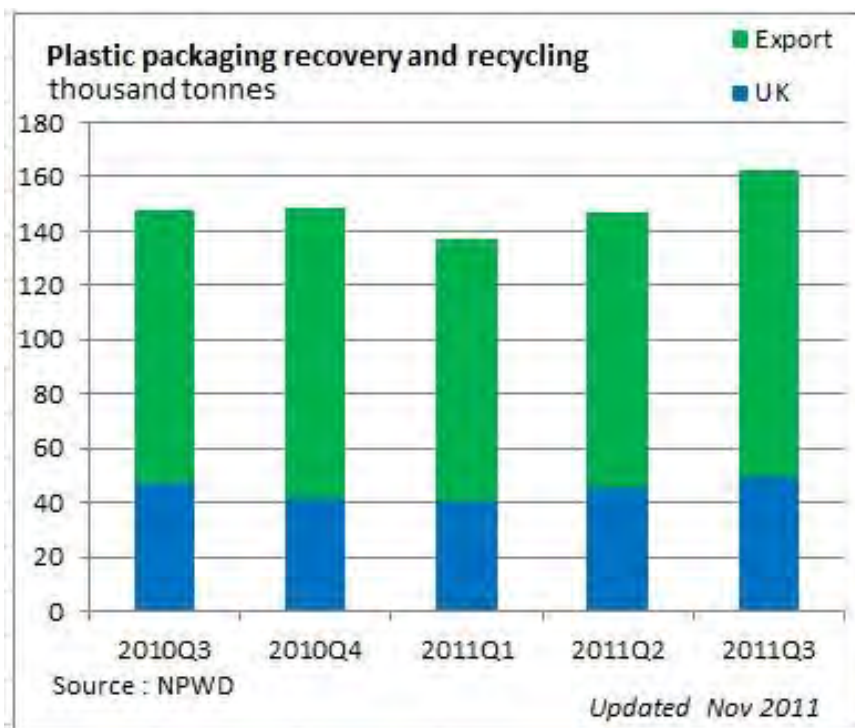


Figure 6: UK plastic packaging recovery and recycling, 2010Q3 - 2011Q3³⁷

³⁶ Source: WRAP, accessed at www2.wrap.org.uk/recycling_industry/market_information/market_knowledge_portal/materials_markets/plastic.html#recoveredplas.

³⁷ Ibid.

The figure below shows the increase in legal waste plastic exports between 1995 and 2007, a trend that is continuing today. It also shows that intra-EU trade has been increasing much less rapidly than exports to non-EU countries. Finally, it can be seen that almost all extra-EU exports go to Asia.

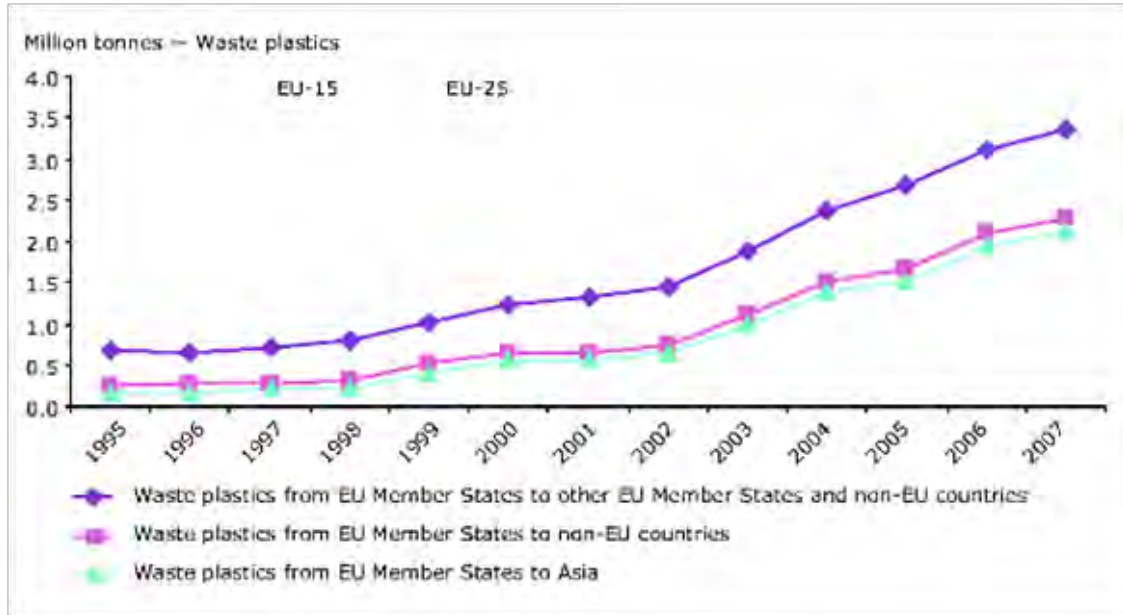


Figure 7: Shipments of waste plastics out of and within the EU, 1995-2007³⁸

Recent Eurostat data (Figure 7) show the volatility of prices and the strong increase in total trade (intra- and extra-EU) over the last decade:

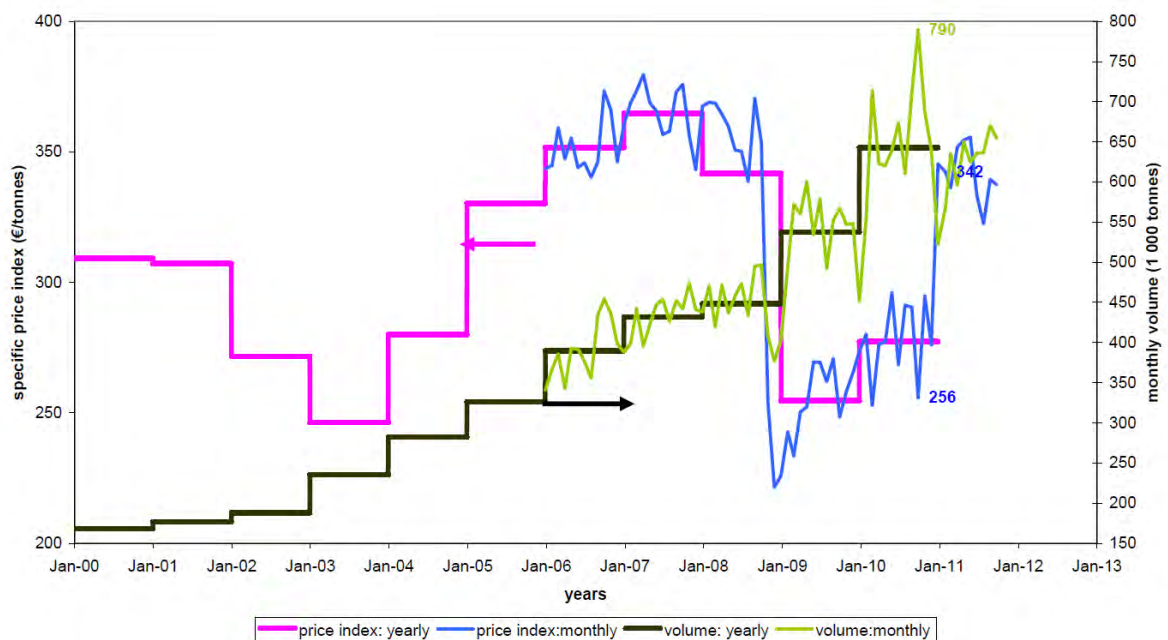


Figure 8: Price developments and traded volume (intra- and extra-EU) of waste plastics until October 2011³⁹

³⁸ EEA (2009) *Waste without borders in the EU?*, EEA report No. 1/2009.

Thus, collection of plastic waste is increasing but more and more of it is being sent outside the EU as a secondary raw material for processing. This trend has several negative impacts: lack of a secure supply for European recyclers leads to unused capacity and low investment, difficulty in monitoring the quality of imported recyclate, and support for collection and sorting in Europe benefiting recyclers outside Europe. A closely related market trend is that production of virgin plastics is increasingly taking place in emerging economies especially in the Far East, with knock-on effects for the rest of the value chain.

The recent Chinese “Green Fence” policy has limited the export of waste plastics to China and this has caused a build-up of waste materials in Europe. The implications of Europe’s substantial exports of plastics waste are now becoming more clear as issues arise from the Green Fence. Europe needs a resolution in order to allow new investments in plastic waste recycling and to deal with the plastic waste we used to export.

³⁹ Eurostat Environmental Data Centre on Waste, see <http://epp.eurostat.ec.europa.eu/portal/page/portal/waste/data/wastemanagement/recycling>.

Chapter 3: Scenario analysis of the impacts of an increased target

3.1 Scenario analysis

The scenarios presented here draw on two previous reports that projected baseline and policy scenarios for plastic waste.⁴⁰ We adapt those scenarios here as the Baseline Scenario and the Implementation Scenario. We then add a third, more ambitious, scenario: Vision for Resource Efficiency.

The Baseline Scenario is a business-as-usual scenario describing an EU waste management system in 2020 with no further implementation of waste legislation beyond what was in place in 2006. The table below provides the detail of the scenario for 2012 and 2020.

Table 3: Plastics recycling Baseline Scenario

	2012			Waste generation annual growth, 2013-2020 (%)	2020
	Waste generated (Mt)	Recyclable (%)	Not recyclable (Mt)		Waste generated (Mt)
PUR	717	0	717	5	1 059
Other thermoplastics	509	0	509	5	752
Medical	600	0	600	5	886
Packaging	15 663	60	6 265	1	16 961
Automotive	1 234	40	740	3	1 563
WEEE	717	40	430	5	1 059
House, leisure, sports	877	40	526	3	1 111
Building & construction	683	40	410	5	1 009
Other (furnitures)	1 783	40	1 070	5	2 634
Agriculture	1 315	80	263	5	1 943
Other	1 066	0	1 066	2	1 249
Total	25 164	50	12 597	-	30 227

⁴⁰ BIO et al. (2010) *Plastic Waste in the Environment*, European Commission DG ENV; BIO et al. (2011) *Implementing EU Waste Legislation for Green Growth*, European Commission DG ENV.

In the Implementation Scenario, all waste legislation currently in place is fully implemented in all Member States, there is effective waste prevention, 50% recycling of municipal solid waste plastics is achieved and all waste is treated within the EU. The 50% rate comes from the Waste Framework Directive, which sets a general target for recycling (paper, metals, glass and plastic) of 50% by 2020. Taking into account the capacity for growth in the plastics recycling sector, a 2020 target of 50% should be very feasible. Recycling systems for metals and glass were not established overnight; in time and with the appropriate policy framework it is reasonable for plastics to achieve similar recycling rates to those materials. Indeed, best practice examples around Europe provide evidence that rates even higher than 50% are feasible.

Waste generation is slightly lower in the Implementation Scenario (30.2 Mt in 2020) than in the Baseline Scenario (34.8 Mt) due to significant waste prevention efforts, but still higher than in 2012 (25.2 Mt). Under Implementation, 19.8 Mt less would be landfilled or incinerated without energy recovery in 2020 than in the Baseline. Additional CO₂ savings from recycling in Implementation compared to Baseline would be 5.6 Mt (assuming 1.75 tonnes per tonne of recycling), which at a carbon price of EUR 20 would be worth EUR 112 million.⁴¹ Some estimates of the full social cost of carbon including externalities are much higher.

The Vision for Resource Efficiency is different from the other two in its level of ambition: it describes a scenario in which all recyclable post-consumer plastic waste is first collected, sorted and sent for recycling in Europe. Landfill is banned and so plastic that is not recyclable, for example medical devices, is sent directly to energy recovery (11.6 Mt). Sorting efficiency is 80% and the remaining 3.7 Mt is also sent for energy recovery. This 14.9 Mt is then recycled at 75% efficiency (this higher efficiency relies on better sorting and improved product design) to provide 11.2 Mt for converters. In this scenario, the overall plastics recycling rate can reach 62% in 2020.

Table 4: Plastics recycling Vision for Resource Efficiency, 2020

	2020		
	Waste generated (Mt)	Recyclable (%)	Not recyclable (Mt)
PUR	1 059	0	1 059
Other thermoplastics	752	0	752
Medical	886	0	886
Packaging	16 961	80	3 392
Automotive	1 563	50	782
WEEE	1 059	50	530
House, leisure, sports	1 111	50	555
Building & construction	1 009	60	404

⁴¹ The current EUA price is at a historical low of only around EUR 4.50 but it is expected to rise over the scenario period.

	2020		
	Waste generated (Mt)	Recyclable (%)	Not recyclable (Mt)
Other (furnitures)	2 634	40	1 581
Agriculture	1 943	80	389
Other	1 249	0	1 249
Total	30 227	62	11 579

This would mean that recycle meets more than 24% of all plastics demand in Europe (compared with 4% today). The remainder that cannot be recycled, sorted and sold (which could include for example some multilayer plastics) would be suitable for energy recovery (a further 3.7 Mt). The base year (2012) data and all three 2020 scenarios are summarised in the table below.

Table 5: Plastics recycling scenarios, 2020 (Mt)

	2012	2020		
		Baseline	Implementation	Vision for Resource Efficiency
Plastic waste generated	25.2	34.8	30.2	30.2
<i>Disposal rate</i>	<i>50%</i>	<i>69%</i>	<i>14%</i>	<i>0%</i>
Disposal	12.6	24.1	4.3	0.0
<i>Collection for recycling rate</i>	<i>25%</i>	<i>13%</i>	<i>36%</i>	<i>62%</i>
Collected for recycling	6.3	4.5	10.9	18.6
Recycled in Europe (input)	3.2	2.3	5.5	14.9
Recycled in Europe (output)	1.9	1.4	3.3	11.2
<i>Energy recovery rate</i>	<i>34%</i>	<i>27%</i>	<i>74%</i>	<i>25%</i>
Energy recovery	8.6	9.3	22.5	7.5
CO ₂ eq savings from recycling in Europe	5.5	3.9	9.5	26.1
Value of savings (EUR 20/tCO ₂ eq)	110.5	78.8	190.8	522.2

Baseline: No further development of waste management system as compared to 2008;

Implementation: Full implementation of all waste legislation including a 50% municipal solid waste plastics recycling rate.

Vision for Resource Efficiency: All recyclable plastic waste is collected for recycling in Europe; landfill is banned and plastic that cannot be collected, sorted and/or sold goes to energy recovery.

3.1.1 Applications

Moving towards the Vision for Resource Efficiency would be a move from a “Push” market (landfill bans and other legislation pushing actors to recycle more) to a “Pull” market (driven by demand for recycled content in products). The scenario implies a very significant increase in the volume of plastics available to converters. As mentioned in the previous section, recyclate would meet over 24% of all plastics demand in Europe in 2020 compared with 4% today. What products would be the likely applications of the recycled plastic?

Section 2.2.4 gives an overview of the main recycled plastic products. Table 4 below provides an example breakdown by polymer type of how the recyclate produced in the Vision for Resource Efficiency could be used. Note that the products listed are examples – some level of recycled content can and should be used in all applications.

Table 6: Example breakdown of recyclate by polymer type in the Vision for Resource Efficiency⁴²

Polymer type	Share of demand for plastics (%)	Demand (Mt)	Products	Potential recycled content (%)	Recyclate (Mt)
PP	19	8.9	Pipes, pallets, boxes, buckets, furniture, car parts, pots of yoghurt, butter, margarine, fibres, milk crates	22	2.0
LDPE, LLDPE	17	8.0	Bin liners, carrier bags, agricultural film mulch, agricultural film sheet, construction film, tubes, cling-film, flexible packaging, heavy duty sacks, etc	22	1.8
HDPE	12	5.6	Tubes, sewer pipes, pallets, boxes, buckets, bottles for detergents, construction, food products, toys, cable insulation	22	1.2
PVC	11	5.2	Sewer pipes, window frames, construction, flooring, wallpaper, bottles, car interiors, medical products	30	1.6
PS, EPS	8	3.5	Clothes hangers	22	0.8
PUR	7	3.3	-	0%	0.0
PET	7	3.1	Bottles, sheets, strapping (e.g. carpets, clothing automotive parts), food and non-food packaging, films and fibres	50	1.5
Other	20	9.4	Pallets, floors, roofs, furniture and benches	25%	2.4
Total	100	47	-	24%	11.2

⁴² JRC IPTS (2007) *Assessment of the environmental advantages and drawbacks of existing and emerging polymers recovery processes.*

3.2 Assessment of the impacts of an increased target

European policy initiatives to encourage recycling are to a large extent driven by the environmental benefits they can achieve. Recycling diverts waste from landfills, thereby avoiding greenhouse gas emissions. It also replaces virgin plastic, thereby avoiding environmental impacts associated with extraction and refining. At the same time, recycling offers other economic and social benefits: economic activity, innovation, employment – in short, helping to make the green economy a reality. As plastics are so varied, it is hard to estimate these effects with great precision. Sections 3.2.1-3.2.3 provide general information on the nature of the impacts of raising plastics recycling rates. In addition, we can identify a few particularly promising examples of polymers and applications:

First, total EU production of all plastic bags (bin liners, feed bags, carrier bags) is estimated at between 1.2 Mt/year (based on industry estimates) and 3.4 Mt/year (Eurostat, a broader definition including sacks). If all of that was made of recyclate, the EU would save EUR 0.5 billion and 1.8-6.8 MtCO₂. Second, PET is an attractive material for recycling, as it can be used in a wide variety of applications including food. Third, the durable and fireproof nature of PVC give it an advantage over other types of plastics, particularly in the construction sector where 38% of global production is used for pipes and 20% is used for window profiles. PVC consumption is projected to grow from 34 Mt in 2007 to more than 40 Mt in 2016, i.e. around 2% per year.⁴³

3.2.1 Economic impacts

Recycling is increasingly important for the European economy, contributing to GDP and Europe's internal and external trade. It also provides material inputs to the economy, substituting for virgin raw materials and thereby improving the resource efficiency of production.

Direct revenues from plastics recycling make a substantial and growing contribution to the European economy. Turnover declined due to the recession but seems to be recovering now for most recyclers. As an economic activity, recycling has roughly twice the impact of landfilling.⁴⁴ Specifically, recycling a tonne of waste will pay around EUR 78 more in salaries and wages than disposing of it in landfill.⁴⁵

An increased plastics recycling target would provide a more stable investment climate for the sector. It would promote investment in new machines and logistics, upgrading of current waste management infrastructure and enhancement of collection systems, i.e. separate collection. It is not possible in this study to quantify the investment required but the revenues from increased recycling should lead to short payback periods, thanks to more efficient technologies and economies of scale.⁴⁶

⁴³ Ceresana Research, as cited in www.plastemart.com/upload/Literature/China-to-drive-global-growth-of-%20PVC-polyvinyl-chloride.asp.

⁴⁴ European Environment Agency (EEA) (2011) *Earnings, jobs and innovation: the role of recycling in a green economy*.

⁴⁵ CIWMB (2003) cited in EEA (2011).

⁴⁶ BIO et al. (2011) *Implementing EU Waste Legislation for Green Growth*, European Commission.

As much of the equipment, machinery and services used by European plastics recyclers are provided by European suppliers, a large part of the investment associated with a high recycling rate would be captured within the European economy. Numerous opportunities exist for eco-innovation and development of new technologies in plastics recycling, potentially creating markets for new products and services both within Europe and for export (growth in demand for plastic products shows little sign of slowing down, especially in emerging economies).

Recycling also helps businesses, other organisations and communities avoid the costs associated with landfill and incineration – both in terms of financial expenditure (including future containment and clean-up costs associated with landfill) and environmental impacts (externalities to human health, biodiversity, etc.). A crackdown on illegal waste shipments would also help level the playing field for law-abiding businesses.

Depending on market conditions, recyclates represent an estimated saving of 25-50% (EUR 400-700/tonne) compared to virgin plastics in terms of the market price alone (i.e. even without taking into account all the other associated benefits). In mixed plastics, the difference compared to injection-grade virgin PP can be 50% or even more. At 1.9 Mt/year of recyclates, the plastics recycling sector is currently saving the EU at least EUR 758 million. If all plastics were sent for recycling (Scenario 3), savings would increase to over EUR 4.5 billion.

3.2.2 Environmental impacts

Recycling ranks third in the waste hierarchy set out in the Waste Framework Directive. After prevention and reuse, it is preferred over energy recovery and disposal. Its environmental benefits compared to the alternatives have been studied at length, including reductions in energy consumption, greenhouse gas emissions, resource depletion (and land use), particulate emissions, acidification, noise, odours and visual disturbance. In most cases, recycling also has lower environmental impacts than producing virgin materials. And in many cases, notably in the vehicles (lightweight parts) and buildings (insulation) sectors, recycled plastics products enable energy and CO₂ savings that should not be ignored.

The energy required to make plastics does not vary greatly by type and is around 70-80 MJ/kg. The energy content of plastic waste is of the order of 30-40 MJ/kg.⁴⁷ Energy savings from recycling plastic are of the order of 80-90%.⁴⁸ Plastics in Europe are usually made from petroleum and their associated emissions vary little at around 2-3 kgCO₂.⁴⁹

There is now a clear consensus that recycling offers more environmental benefits and lower environmental impacts – especially in terms of resource efficiency – than other waste

⁴⁷ IEA (2006) www.iea.org/work/2006/petrochemicals/Discussion_Paper.pdf.

⁴⁸ UNEP (2011) *Towards a Green Economy*.

⁴⁹ Allwood, Cullen et al. (2012) *Sustainable Materials with both eyes open*, UIT Cambridge, available at www.withbotheyesopen.com.

management options. In addition, the costs of recycling plastic are of the same order of magnitude as the most cost-efficient alternative greenhouse gas mitigation options.⁵⁰

The recycling process itself is constantly being improved: for example, recycling uses water, which can necessitate effluent treatment, but closed-loop water use results in great efficiency gains. However, it is essential for environmental performance that recycling be carried out in Europe.⁵¹

The environmental impact of recycling can be compared to energy recovery and disposal using life-cycle assessment (LCA). An LCA of a complex waste management option like recycling is highly dependent on the assumptions made, the system boundaries, etc. PlasticsEurope has prepared “eco-profiles” for the most important categories of plastics in order to facilitate the inventory phase of carrying out an LCA.

In 2006, WRAP in the UK carried out a major review of LCAs that included a variety of polymers (PVC, PP, PE, PET), and concluded that recycling was environmentally better than both incineration and landfill for all environmental impact indicators, with recycling being around 50% better on average.⁵² The net CO₂ savings from recycling were found to be 1.5-2.0 tCO₂eq per tonne of plastics on average. This value has been used to estimate the impact of an increased target, in terms of CO₂ savings.

A 2010 update of that WRAP report added new waste management technologies (pyrolysis, composting, anaerobic digestion) and materials (biopolymers).⁵³ The results confirm that mechanical recycling is the best option in terms of Global Warming Potential (GWP), depletion of natural resources and energy demand. The analysis reinforces the point that the key driver of these benefits is the amount of virgin plastic production that is avoided. The environmental benefits can be maximised by collecting good quality material with high purity (to limit the share that is rejected) and by replacement of virgin plastics at a high ratio (1:1). Results from Prognos et al. (2008) reinforce these conclusions:

⁵⁰ EC (2006) *Report from the Commission to the Council and the European Parliament on the implementation of Directive 94/62/EC on Packaging and Packaging Waste and its impact on the environment, as well as on the functioning of the internal market*, COM(2006) 767 final.

⁵¹ See www.plasticseurope.org/what-is-plastic/types-of-plastics/pet/eco-profiles-pet-lca-studies.aspx.
of life cycle comparisons for key materials in the UK recycling sector.

⁵² BIO and Copenhagen Resource Institute (2010) *Environmental benefits of recycling – 2010 update*, WRAP.

⁵³ Astrup, T., Fruergaard, T. and T.H. Christensen (2009) *Recycling of plastic: accounting of greenhouse gases*

Table 7: Greenhouse gas emissions benefit of recycling (tCO₂eq)⁵⁴

Waste treatment option	Emissions	Benefit/burden
Production of PE/PP flakes from plastic waste and energy (SF=0.7)	1.04	0.16
Production of primary PE/PP and energy	1.20	
Production of R-PET from plastic waste and energy (SF=1)	0.96	1.64
Production of primary PET and energy	2.60	
Production of R-PS from plastic waste and energy (SF=0.9)	1.10	1.70
Production of primary PS and energy	2.80	
Production of secondary PVC from plastic waste and energy (SF=0.9)	0.79	0.74
Production of primary PVC and energy	1.53	
Co-incineration of mixed plastic waste in a cement kiln	2.89	0.52
Substitution of fossil fuels	3.41	

There is limited data on biopolymers but mechanical recycling shows good environmental performance (energy, resources and GWP) compared to other waste treatment options. However, composting of compostable biopolymers does not appear beneficial in terms of either of the indicators analysed (energy and resources).

From a resource efficiency perspective, by substituting for virgin plastic, recycling reduces raw material extraction, ensures that resources remain in the economy and helps to decouple material use from economic growth. It can be noted here that closed-loop recycling is not an end in itself. Closed-loop recycling will only be possible for small quantities of plastics and will not satisfy the growing demand in all plastic applications.

Plastic is one of the predominant materials found in marine litter.⁵⁵ An important benefit of a substantial increase in plastics recycling would be the reduction of marine litter, in particular insofar as recycling replaces landfill. This would be an environmental benefit but also a social benefit (improved aesthetics) and economic benefit (increased tourism revenues, etc.). The recycling sector is already taking action in this area through initiatives such as Waste Free Oceans (www.wastefreeoceans.eu).

⁵⁴ Prognos et al. (2008) *Resource savings and CO₂ reduction potentials in waste management in Europe and the possible contribution to the CO₂ reduction target in 2020*, summary, accessed at: www.plasticseurope.org/Documents/Document/20100430141809-PROGNOS_Summary_Report_CO2_wasteproject-20080701-007-EN-v1.pdf.

⁵⁵ For a recent overview of this topic, see Öko-Institut (2012) *Study on Land-Sourced Litter (LSL) in the marine environment*. Executive Summary available at www.bkv-gmbh.de/fileadmin/fuerRedakteur/downloads/PDF/Marine_litter/LSLExecSummEN.pdf.

A truly ambitious recycling target would promote greater environmental consciousness among consumers on energy, CO₂ emissions, litter and sustainable consumption more generally. It would also reduce illegal waste dumping and illegal waste shipments and their associated environmental impacts.

3.2.3 Employment impacts

Recycling makes an important contribution to the creation of new green jobs.⁵⁶ It creates more jobs at higher incomes than either landfill or incineration. An increased mechanical recycling target for plastics would therefore have a very positive effect on job creation and skills development.

Although official data is not available for plastics separately, employment related to the recycling of *all* materials in European countries increased steadily from 422 jobs per million inhabitants in 2000 to 611 jobs in 2007.⁵⁷ At that growth rate, employment today would be 864 jobs per million inhabitants, or around 426 000 jobs, though employment growth will have been dampened somewhat by the wider economic circumstances in recent years. Plastics recyclers account for a significant share of that, an estimated 30 000 jobs. If all plastics were recycled, the recycling industry could directly employ more than 120 000 people in the EU (based on a six-fold increase in tonnes recycled, taking into account economies of scale). Indirect jobs throughout the economy would be around three times that amount. In the Vision Scenario, that is 10 725 jobs per Mt recycled, or 32 174 jobs/Mt including indirect employment.

From a public investment perspective, it is estimated that EUR 1 billion invested as capital expenditure in new waste recycling plants (no separate figures for plastic are provided) would create 9 200 jobs in the supply chain providing plant, machinery and construction services, and by spending in the economy by people indirectly employed. Taking a capacity approach, an estimated 21 300 jobs would be created on site to operate the plant, in the supply chain providing goods and services and by spending in the economy by people indirectly employed. Furthermore, as mentioned earlier much of the machinery used in plastics recycling is manufactured in Europe. Finally, as the production of virgin plastics is increasingly taking place outside Europe, jobs in recycling become ever more important.

Employment in the plastics recycling sector includes traditional low-skilled hand-sorting work but also increasingly high-skilled jobs, from collection and sorting to materials handling and processing to manufacturing products. Lower-skilled jobs may be performed by workers who may have fewer options elsewhere in the economy, which is an important factor in poverty alleviation. The recycling sector provides great employment potential in all Member States, regardless of economic circumstances. The high value of the contribution made by these workers to climate policy and social value-added should also be more widely recognised.⁵⁸

⁵⁶ EEA (2011) *Earnings, jobs and innovation: the role of recycling in a green economy*.

⁵⁷ Eurostat only provides data on employment in the recycling sector (all materials) up to 2008. From 2008 onwards it is even more highly aggregated, to the level of all waste collection, treatment and disposal activities.

⁵⁸ UNEP (2011).

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Chapter 4: Actions needed to achieve an increased plastics recycling target

4.1 Identification of actions needed

Three of the most important challenges facing Europe today are reducing environmental burdens, creating new jobs and enhancing the resource base for the economy. Recycling can make a substantial contribution to addressing all three challenges: a win-win-win opportunity. As shown in the previous chapter, moving to a scenario of very high recycling rates is desirable. The plastics industry, including Plastics Recyclers Europe and European Plastics Converters but also PlasticsEurope, is united behind the recycling of all plastics that can be recycled, supported by legal and financial restrictions on landfill.⁵⁹ Policy makers should therefore engage more closely with them and other stakeholders to effect change.

An increased target under the Waste Framework Directive specific to mechanical recycling of plastics is the essential driver of change that is required. However, all stakeholders (see Figure 4) will need to take actions in order to meet the target. These actions span all stages of the product value chain, from production (design for recyclability) to end of life (landfill bans).

In addition to that new impetus, implementation and enforcement of current EU waste legislation needs to be improved urgently. Implementation gaps, illegal waste shipments and waste management practices that contravene EU legislation continue to prevent these win-win opportunities from being achieved.

4.1.1 How recyclers can take the initiative

Different types of plastics require different treatment options. For example, plastic bottles made of PET cannot be recycled together with transport packaging made of LDPE. Therefore, a greater variety of technologies are needed to recycle plastic compared to other waste types. Recycling technologies and infrastructure are already vastly improved compared with the 1990s, and much of the technology necessary to achieve a further radical improvement in the plastics recycling rate is already on the market. Nevertheless, developing new recycling technologies should continue to be an important focus of recyclers.

The potential varies by sector and polymer type. For example, the gap between the typical and the best recycler from a technological perspective is greater in LDPE than in PET, where significant advances have already been made in optical sorting. Approaches to increasing the recycling of films and flexible packaging could include separate collection, or investment in extra sorting and processing facilities at recovery facilities for handling mixed plastic wastes. In order to achieve successful recycling of mixed plastics, high-performance sorting of the input materials

⁵⁹ PlasticsEurope (2011) *The Facts 2011*, available at: www.plasticseurope.org.

needs to be performed to ensure that plastic types are separated to high levels of purity; there is, however, a need for the further development of end markets for each polymer recyclate stream. There is thus potential for further voluntary initiatives such as Recovinyl, through which the PVC sector (pipes, profiles, etc.) aims to create a “pull” market.

Recyclers should try to engage more closely with other actors along the supply chain, in particular retailers. Retailers can then put pressure on product manufacturers to promote recyclability and recycled content. In some cases, there is also potential for recyclers to deal directly with municipalities or sorters, cutting out dealers, brokers, etc.

EuCertPlast is a project (funded under the Eco-Innovation Programme) aiming to create a European certification scheme for post-consumer plastics recyclers who are recognised for complying with high quality standards. Certification schemes such as this should boost consumer confidence in recycled products and are to be encouraged.

4.1.2 What policy makers can do to support

Local authorities, national administrations and European institutions all have important roles to play in setting appropriate incentives that will help shape optimal outcomes for society regarding plastics recycling. The starting point should be to recognise plastic waste as a valuable resource with the potential to increase resource efficiency and reduce the environmental impacts of extracting raw materials and generating waste, create jobs and boost the European economy. It is to be hoped that this study has helped to demonstrate these points. Up to now, such recognition may exist to a greater extent for PET for example than for PP, HDPE and other plastics that are also easy to recycle.

A higher overall plastics recycling target at EU level is vital. Policy makers could help ensure the overall target is met and exceeded by also setting separate targets for key plastics types and differentiated targets by Member State to reflect recycling rates already achieved (this could be done either at the EU or, failing that, national level). It is this high-level target that should drive change and set the framework for the other actions listed below:

► **Better collection and sorting**

- Key to this is to completely phase out landfilling of plastics by 2020 by extending and enforcing landfill bans. This will stimulate investment in collection, sorting and recycling.
- Promote quality collection and sorting: plastics should not be discriminated against and should have a dedicated bin in order to allow good quality separate collection and sorting. Deposit refund systems are a useful tool for raising monostream collection rates, while collection and sorting at source can be improved by increasing local capacity and consumer awareness.

- Improve input quality through harmonisation of collection and recycling systems using quality standards and certification⁶⁰ and exchange of best practices. Improved harmonisation of standards could also enlarge the range of possible end uses, for example in food applications.
- Local authorities must improve design of recycling schemes and awareness activities in order to promote more favourable consumer attitudes towards recycled plastic.

▶ **Better products**

- Ensure that recyclable plastic is separated from waste for disposal and improve the quality of recyclables by: improving product design to facilitate material separation and recyclability; limit the use of composite materials; prevent the introduction of biodegradable or oxo-fragmentable plastics, which make recycling more difficult, into the traditional plastics stream;⁶¹
- An important way to improve the ecodesign of products on an ongoing basis is to place more emphasis on recyclability and recycled content in the Ecodesign Directive, Packaging Directive etc.;
- Continue to develop and promote recyclability and recycled content labels and Green Public Procurement initiatives (European public authorities spend around 16% of GDP on goods and services);

▶ **Fiscal incentives and producer responsibility**

- At Member State level, favourable fiscal treatment might be considered in some cases. Economic incentives such as landfill gate fees and taxes, penalties on municipalities for missing targets, tax incentives for plastic packaging recovery, reduced VAT rates for recycled materials, etc. would further promote recycling and energy recovery.⁶² In countries that have decided to introduce plastic bag levies, these funds could be ring-fenced to promote plastics recycling or clean up marine litter;⁶³
- Strengthen EPR schemes: the Waste Framework Directive does not contain specific targets for EPR, yet it would internalise the cost of waste management in retail prices, making producers financially responsible and encouraging ecodesign. EPR programmes produce higher collection and recycling rates than purely voluntary programmes.⁶⁴ At the moment such schemes are only in place

⁶⁰ See for example the EuCertPlast project: www.eucertplast.eu/fr/objectives.

⁶¹ Examples cited in PlasticsEurope (2011) are the design guidelines of the European PET Bottle Platform and the guide issued by RECOUP to support a focus on quality at the end-of-life phase.

⁶² <http://rstb.royalsocietypublishing.org/content/364/1526/2115.full>.

⁶³ Further discussion of economic instruments can be found in BIO et al. (2012) *Use of Economic Instruments and Waste Management Performances*, DG Environment, European Commission. Available at http://ec.europa.eu/environment/waste/pdf/final_report_10042012.pdf.

⁶⁴ BIO et al. (2011) *Implementing EU Waste Legislation for Green Growth*, European Commission.

for plastics in a few countries and for a limited range of products.⁶⁵ For example, farmers in Ireland pay a recycling levy when they purchase farm plastic, which is then used to fund and operate bring centres and on-farm collection.⁶⁶

► Focus on individual sectors

- Plastics in the agriculture sector improve production efficiency and reduce consumption of water, pesticides and fertilizers. However, the difference in recycling rates between countries is huge.⁶⁷ Specific measures to encourage recycling of agricultural plastics could include best practice guidelines for farmers on preparation of plastics for collection; an EU-wide network of collectors and recyclers (and identification of any existing networks); and recycling targets.
- PVC already has a voluntary target of 10% recycled content but it could be increased to up to 30% (of recycle in window frames, profiles, etc.). These targets could be either for recyclable or recycled content, as appropriate;
- Build up recycling infrastructure and markets where they do not yet exist, for example by supporting demand for recycled plastic in industry within and outside the EU. Some streams are currently not recycled because they are not yet collected on a large scale.

► Better monitoring and enforcement

- Ensure a level playing field by making sure that no policy encourages exports of plastic waste. This can be done by monitoring export levels and cracking down on illegal exports – a missed opportunity for economic growth – through more robust inspections at Member State level.
- Better monitoring of waste legislation is also needed – for example, the establishment of an auditing capacity at EU level has been proposed, possibly accompanied by common inspection standards; the European Environment Agency or a new specialised waste agency⁶⁸ could play a role in this regard.

► Research and data

- At European level, recycling should be prioritised in funding programmes to encourage development and deployment of new technologies. Demonstrator projects should also be funded.
- There is a pressing need for better data collection and monitoring, ideally with a split between domestic recycling and exports. Data is needed for all plastics, not

⁶⁵ BIO et al. (2012) *Use of Economic Instruments and Waste Management Performances*, DG Environment, European Commission. Available at http://ec.europa.eu/environment/waste/pdf/final_report_10042012.pdf.

⁶⁶ See www.edie.ie/news/news_story.asp?id=22405.

⁶⁷ PlasticsEurope (2011) *The Facts 2011*, available at: www.plasticseurope.org.

⁶⁸ For a discussion, see Bio Intelligence Service et al. (2011) *Implementing EU Waste Legislation for Green Growth*, European Commission.

just packaging. The recently established Eurostat Data Centre on Waste⁶⁹ needs to be adequately resourced and developed, to help compare and monitor Member State progress, and allow harmonisation of legislation and the development of targeted measures of improvement – data transparency is fundamental to encouraging investment and achieving an increased target in an effective manner.

4.2 Conclusions

Plastic is a relatively cheap, durable and versatile material. Plastic products have brought economic, social and in many cases environmental benefits to society. However, plastic waste can also impose negative externalities if not managed appropriately. Plastic waste generation is set to continue growing and the mechanical recycling sector needs to grow even faster to keep up and to replace environmentally harmful landfill.

The challenge for plastics recyclers is that their customers (plastics processors), demand large quantities of recycled plastics, manufactured to strict specifications at a price that is competitive with virgin plastic. Yet fast growth in plastics recycling can be achieved based on current technologies and markets. And there is potential for even higher growth rates if market, legal and technological obstacles are overcome.

Policy and measures targeted specifically at plastic waste recycling are needed, coherent with broader waste policy and with a sufficient level of ambition. Collection rates have to be raised from their current levels but the focus of policy makers should not simply be on increasing collection rates and expecting recyclers to adapt, but rather a more holistic view of the value chain is needed, with targets that focus on recycling output.

A new and more ambitious EU recycling target should be introduced that takes into account the split between domestic recycling and exports and that covers all plastics, not just packaging. Such a target needs to be based on realistic, transparent numbers and so resources should be devoted to that. That said, shortcomings in the currently available data should not be an impediment to the process of setting a new target.

This study demonstrates that an increased recycling rate would provide important environmental, economic and employment co-benefits, which would quickly repay investment in collection schemes. Improved recycling of plastics would also be an important source of material inputs to European production and will contribute to Europe's circular economy.

Technologies are available and capacity is in place, but in order to reap these benefits policy makers need to take strong action during 2012. It is encouraging that many of the recommendations made in this study match the positions of key industry stakeholders and the environment committee of the European Parliament. Policy makers at national and EU levels therefore have a strong evidence base and consensus with which to move forward.

⁶⁹ See <http://epp.eurostat.ec.europa.eu/portal/page/portal/waste/introduction/>.



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