Assessment of impacts of options to reduce the use of single-use plastic carrier bags

FINAL REPORT

European Commission – DG Environment
12 September 2011

bio Intelligence Service

Document information

CLIENT	European Commission – DG Environment
CONTRACT NUMBER	ENV.G.4/FRA/2008/0112
REPORT TITLE	Final Report
PROJECT NAME	Assessment of impacts of options to reduce the use of single-use plastic carrier bags
BIO PROJECT CODE	SP-0128 / CEENVFWCSMR_1101
PROJECT TEAM	BIO Intelligence Service,
PROJECT OFFICER	Ms. Diana Oancea, DG Environment
DATE	12 September 2011
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ACKNOWLEDGEMENTS	See Annex A.
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Please cite this publication as:
BIO Intelligence Service (2011), Assessment of impacts of options to reduce the use of single-use plastic carrier bags, Final Report prepared for the European Commission – DG Environment

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Executive Summary

The plastic carrier bags used by shoppers across Europe are light, inexpensive and convenient. However, the use of plastic carrier bags entails negative environmental externalities (littering, ocean contamination, other environmental pollution, health hazards, etc.) that are not taken into account in the prices paid by retailers or end users.

Plastic carrier bags are used in huge numbers in Europe, sometimes only once each, and are often given away free by supermarkets and other shops. This leads to excess use. The lightness and mobility of plastic carrier bags also makes them more likely to end up as litter, and once littered they are visually intrusive and persistent, particularly in the marine environment. As well as environmental impacts on biodiversity, littered plastic carrier bags have a high economic cost for industries such as tourism and for municipalities charged with clean-up operations.

- **Nature of the problem**
  - Main types of plastic carrier bag

The vast majority of plastic carrier bags in Europe today are made from naphtha, a by-product of oil refining. Plastic carrier bags can also be made of bio-based materials or a blend of bio-based and oil-based polymers. Bio-based plastics can be either biodegradable or non-biodegradable. Plastic carrier bags can also contain nitrocellulose resin or polyamide resin, organic pigments, plasticisers, additives, pigments and glue.

In this study, "single-use" plastic carrier bags are the thin-walled, lightweight plastic carrier bags used to carry goods from supermarkets and other shops and often provided free of charge. They are single-use in the sense that they are usually only used for one shopping trip, though they are often reused for some other purpose such as to hold household waste. Single-use plastic carrier bags are usually made of high-density polyethylene (HDPE).

Some plastic carrier bags are designed to encourage high levels of reuse by incorporating greater thickness and/or more robust, durable materials. Such "multiple-use" or reusable plastic carrier bags are usually made of low-density or linear low-density polyethylene (LDPE/LLDPE), with a glossy appearance, or polypropylene (PP), a polymer that resembles canvas in appearance. Multiple-use plastic carrier bags are sold at supermarket cash registers rather than given away.

  - Environmental aspects

A number of life-cycle assessments (LCAs) of plastic carrier bags have been carried out, the main conclusions of which are that the overall life-cycle balance of plastic carrier bags depends on their thickness, whether and how often they are reused and what happens to them at end of life:

- The environmental impact (excluding litter) of plastic carrier bags is dominated by the resource use and production phases.
- At end of life, energy recovery can be as environmentally friendly as recycling while landfill is generally the worst option. Recycling can avoid the need for virgin material, while energy recovery allows the energy stored in plastics to be

used for electricity or heat. Plastic carrier bags in landfill can take decades or longer to degrade, depending on the type of bag and conditions.

- There is no ideal type of carrier bag for all impact categories. Each has advantages and disadvantages and there is considerable overlap, from a greenhouse-gas emissions perspective at least, between bag types and studies.
- Whether bio-based polymers are an improvement depends on the situation; it is important that any shift to new materials is combined with a behavioural shift and improved end-of-life management. Recycled content does generally represent a significant improvement.
- Biodegradable plastic carrier bags do not last as long in the environment as non-biodegradable bags. However, they will still only degrade within a reasonable time if disposed of in appropriate conditions. On most indicators, biodegradable bags do not present a clear improvement.
- Due to their light weight and cheap price (often given away for free), single-use plastic carrier bags are far more likely to be littered than multiple-use bags, and they cause by far the biggest litter impact.
- Reuse is key to reducing the environmental impacts of any kind of bag. As long as multiple-use plastic carrier bags are used a sufficient number of times, they may be the best environmentally.

The results of LCAs must be treated with a degree of caution as a variety of methodologies and environmental parameters are used. That said, the conclusions above seem robust across studies and reinforce the waste hierarchy set out in the Waste Framework Directive: Prevention, Reuse and Preparation for Reuse, Recycling, Recovery and Disposal. All bags can be optimised at each level of the hierarchy over their life cycle: increased reusability, reduced materials and energy consumption in production, use of recycled and (some) bio-based materials, suitability for recycling, measures to reduce litter etc.

Litter is perhaps the most important environmental impact associated with the use of plastic carrier bags, and it is not always taken into account in LCAs. Plastic carrier bags are very mobile due to their lightness so they can easily escape containment. They persist in the environment for a long time and substantial quantities are accumulating in natural habitats worldwide.

On land, conventional plastic carrier bags can last as litter for two years or longer before disintegrating, depending on product composition and environmental conditions. Additives in plastic carrier bags can contaminate soil and waterways, and if ingested by animals can enter the food chain. Of particular concern are emerging problems in the marine environment such as the giant masses of plastic waste known as "plastic soup" that have been discovered in the oceans, though the share of the problem that can be attributed to consumption of plastic carrier bags in the EU is as yet unclear.

▷ Employment and competitiveness aspects

Most EU plastic carrier bag producers are privately owned SMEs. It is estimated that there are around 250-300 producers of plastic carrier bags in the EU, employing around 15 000-20 000 workers. There are producers of plastic carrier bags present in the majority of Member States. As

there are no commonly accepted definitions, and since many producers manufacture a range of bags, it is not possible to break down the number of producers by bag type.

European producers face competitive pressure from cheaper producers in China and elsewhere for all types of carrier bag, especially for the thinnest single-use plastic carrier bags but also for multiple-use plastic and even paper and textile bags. Still, European producers are more competitive in the production of some types of carrier bag than others.

For the production of thinner HDPE bags, less material is needed, a simpler production process is possible and cheaper prices can be offered by Asian producers. At the other end of the scale, the production of PP bags involves weaving and sewing, which is done manually. EU producers cannot compete with the labour costs of their Asian counterparts in this domain. LDPE plastic carrier bags, on the other hand, are produced almost entirely by machines, which keeps labour costs relatively low. In addition, as most machines used for the production of LDPE bags are developed and manufactured in Europe, European manufacturers have a strategic and competitive advantage over Asian producers, who need to buy these machines.

The EU may also have a comparative advantage in bio-based and biodegradable plastics. Biodegradable plastic carrier bags are currently produced in a number of European countries including Italy.

- Other economic and social aspects

Most people consider even small amounts of litter unpleasant. Litter impairs quality of life, contributes to a feeling of insecurity, and damages the image and reputation of urban areas, countryside, beaches and seas.

Plastic carrier bags have arguably facilitated a more convenient shopping experience for consumers. Yet in countries and regions that have introduced strong policies to reduce single-use plastic carrier bag use, such initiatives have proved popular. Indeed, many people prefer to use multiple-use carrier bags made of plastic or other materials and few are willing to pay for single-use plastic carrier bags in countries where levies have been introduced.

The market value of EU plastic carrier bag production is estimated at around €2 billion. Plastic carrier bags are also a valuable material for recyclers. However, use of plastic carrier bags also imposes high economic costs.

In many countries, tourism is vital to the livelihoods of local people and the revenues of national administrations. The negative economic impact of visible plastic carrier bag litter on coastal and inland areas in terms of lost tourist revenue is one of the main motivations for municipalities to remove beach litter and for policy makers to limit use of plastic carrier bags. Regularly removing beach litter can cost municipalities less than the reduction in revenue that would result from taking no action.

Discarded plastic carrier bags may also represent a cost to fishing and other maritime activities based on time and money wasted cleaning, disentangling, etc. Tourism and fishing are especially important to economic development in peripheral regions and areas where there are relatively few employment opportunities.

Scale of the problem

Single-use plastic carrier bags have been widespread in large retailers since the 1970s. However, there are no separate Eurostat figures for plastic carrier bags, so industry and other stakeholders were consulted in order to inform our estimates. Some trends and shares can also be estimated based on data available in PRODCOM at the aggregated level of all plastic sacks and bags, which includes plastic carrier bags but also bin liners, sacks for garden or commercial waste, laundry bags, bags for use in agriculture, fruit and vegetable bags, freezer bags and others.

On that basis we estimate that over 2003-2010, production of single-use non-biodegradable plastic carrier bags declined, while single-use biodegradable and multiple-use plastic carrier bags increased, leading to a small overall reduction in production of plastic carrier bags by weight, from 1.14 Mt in 2003 to 1.12 Mt in 2010. Significant production has been moving outside the EU-15 and outside the EU-27 altogether. In general, imports from Asia tend to be HDPE and PP bags, while EU production tends to be LDPE bags.

Taking into account trade, we can calculate the quantity of bags actually used, in tonnes. The *number* of plastic carrier bags used is then found by dividing by typical weights per bag. BIO estimates that in 2010, 98.6 billion plastic carrier bags were used, of which 89% were the single-use type, the vast majority non-biodegradable. Based on an EU population size of around 500m, 198 plastic carrier bags were used per person in 2010, of which 175 were the single-use type. There is high diversity among Member States but consumption of single-use plastic carrier bags in the EU is still high overall.

Quantitative EU estimates for recycling, energy recovery and landfill are uncertain because plastic carrier bags make up only a relatively small share of total waste streams: according to Eurostat, municipal waste was 251 Mt in the EU in 2008, which would mean that plastic carrier bags accounted for 0.7% of that by weight.

Although they are recyclable, the thinness and light weight of plastic carrier bags mean they do not have a high recycling value. Transportation is expensive even if bags are compacted and washing requires large volumes of water. In a context of high and volatile oil prices, and thanks to supportive policy in some Member States, EU recycling of plastic carrier bags seems to be growing. BIO estimates that the EU recycling rate for plastic carrier bags is 6.6%.

Plastic carrier bags have a high calorific value and this energy can be recovered for example in waste-to-energy plants for use in district heating and electricity generation. BIO estimates that the share of plastic carrier bags going to energy recovery in the EU is 39%.

A substantial fraction of plastic carrier bags is still sent to landfill in many countries, despite it being a very poor alternative to recycling or energy recovery. BIO estimates that 50% of plastic carrier bags in the EU are either landfilled or (a small amount) incinerated without energy recovery.

Estimates of the share of plastic carrier bags that are littered vary widely – from less than 1% to as high as 10%. We estimate that at EU level, 4.6% of plastic carrier bags (74.4 kt) were littered in 2010. That is 4.5 billion plastic carrier bags, of which 4 billion were the single-use type. The problem is most severe in countries with larger economies, longer coastlines and less restrictive policies on plastic bags.

Policy context

Plastic carrier bags are considered packaging following a ruling of the European Court of Justice and are therefore covered by the Packaging and Packaging Waste Directive. Plastic carrier bags can be put on the market only if they comply with essential requirements for packaging minimisation, limitation of hazardous substances and suitability for reuse and recovery, including recycling, energy recovery, composting and biodegradation. Member States must also regulate packaging and packaging waste without introducing measures that prejudice the free movement of goods on the internal market. The introduction of an outright ban by a single state would be an unlawful distortion of the market unless justified on specific grounds. However, there are no specific provisions related to plastic carrier bags in EU legislation.

At Member State level, policies to reduce landfill use may be poorly enforced and appropriate infrastructure is often lacking. National measures implementing the Packaging Directive fail to address the specific issue of plastic carrier bag litter and improper treatment since in some countries no collection and waste treatment schemes specific to plastic carrier bags are in place. Nevertheless, Member States have implemented various actions to reduce the use of plastic carrier bags, ranging from voluntary agreements (e.g. UK) to fiscal measures (Belgium, Ireland, Denmark), to the outright ban of non-biodegradable carrier bags, as seen in Italy.

Baseline Scenario

The baseline scenario describes how the situation is expected to develop over the period to 2020 based on trends and policies in place as of mid-2011. The scenario is subject to significant uncertainty due mainly to the incompleteness of the available data. Nevertheless, it shows that while several countries have made good progress in reducing use of plastic carrier bags, the situation at EU level is not improving fast enough to avoid significant environmental impacts over the coming years.

Production of plastic carrier bags is projected to increase slightly, from 1.12 Mt in 2010 to 1.13 Mt in 2020. Similarly, production of single-use non-biodegradable plastic carrier bags rises only very slightly over the projection period from 0.38 Mt to 0.39 Mt. Production of biodegradable plastic carrier bags is projected to increase from 11 kt to 28 kt. The remainder of plastic carrier bag production is multiple-use bags, EU production of which declines very slightly from 0.73 Mt in 2010 to 0.72 Mt in 2020.

Both imports and exports of plastic carrier bags are projected to rise over the scenario period. The share of EU production of single-use plastic carrier bags exported rises from 6% in 2010 to 7% in 2020. Exports are 25% higher in 2020 than in 2010, at 0.03 Mt. The share of single-use plastic carrier bags used in the EU that are imported rises from 50% in 2010 to 54% in 2020. Imports are 22% higher in 2020 than in 2010, at 0.46 Mt. Note that the 50% share in 2010 is an assumption made due to the lack of data; the thinnest HDPE plastic carrier bags are said to be almost all imported, while many LDPE bags are made in Europe.

The volume of single-use plastic carrier bags placed on the market is projected to rise from 0.75 Mt in 2010 to 0.84 Mt in 2020. Single-use non-biodegradable bags increase from 0.73 Mt to 0.78 Mt, while consumption of single-use biodegradable bags rises fast but from a very small base, from around 21 kt in 2010 to 58 kt in 2020. Finally, consumption of multiple-use plastic carrier bags rises from 0.87 Mt to 0.93 Mt.

The plastic carrier bag market is dominated by single-use non-biodegradable bags in terms of number of bags. At EU level, the number of plastic carrier bags used is projected to rise from 99 billion in 2010 to 111 billion in 2020. Over the same period, the EU population is projected to rise from 499 million to 510 million. The number of single-use bags used per person thus increases by a smaller proportion, from 198 bags in 2010 to 217 bags in 2020.

It is difficult to identify clear trends in plastic carrier bag litter but there is little or no evidence of a long-term decline. The picture is complicated by inadvertent littering (e.g. escape from landfill), clean-up activity, sinking, ingestion and break-up into microplastics. The share of plastic carrier bags that end up as litter is projected to remain stable at 4.6%. However, this means the number of bags littered grows from 4.5 billion in 2010 to 5.1 billion in 2020.

As most of the environmental impacts of plastic carrier bags (except litter) occur during the material extraction and production phases, those environmental impacts will also remain relatively stable. Nevertheless, in some Member States, consumption of single-use plastic carrier bags is expected to increase because of stronger GDP growth and a lack of strong policies – those countries may experience greater environmental impacts as a result. Consumption of multiple-use plastic carrier bags will also rise slightly at EU level due to policies already in place in some Member States. At the EU level, the rate of recycling is expected to increase. The overall impact of that will be positive, especially in terms of resources saved.

Although the share of plastic carrier bags in the EU that ends up as litter is expected to remain stable, due to their persistence in the environment, especially the marine environment, the environmental impacts of littered plastic carrier bags are expected to continue to worsen. More fish, birds and other wildlife species will be entangled and undergo external and internal injuries, although the number is difficult to estimate. Leakage of chemical components will also continue. Particles will reduce in size as weathering and disintegration takes place, increasing the surface area and the possibility of chemical transport and the potential for ingestion by a wider range of biota. The economic cost to tourism will continue to mount, and the increase in the stock of plastic carrier bag litter implies higher public spending on clean-up activities and losses to the tourism industry.

- **Identification of policy options**

After an initial screening, five policy options are analysed in more detail:

  - Option 1: Baseline Scenario

In the "do nothing" option, there would be no additional policies and measures aiming to limit the use of plastic carrier bags, either at Member State or EU level, beyond those already in place or decided by mid-2011. For example, the effect of a tax at Member State level decided in 2010 is taken into account but no new taxes, bans or voluntary agreements are assumed. This option is identical to the baseline scenario.

  - Option 2: Voluntary commitment of a significant share of the retail sector not to provide single-use plastic carrier bags

Voluntary approaches developed by policy makers and industry can be a pragmatic response to policy problems, as they aim to achieve sustainability in a more flexible way while taking into account concerns about industrial competitiveness and administrative burden. However, political

will is needed and there is a significant risk that such agreements are later abandoned. Clear targets and good reporting are key, as well as consequences if targets are not met.

Some voluntary approaches focus on reducing environmental impacts indirectly, for example by increasing the recycled or bio-based content of bags. However, a more direct approach is to focus on reducing the number of plastic carrier bags used. Option 2 is thus a voluntary agreement by a significant share of the retail sector to stop providing single-use plastic carrier bags by 2015.

Large retailers such as supermarkets are responsible for a large proportion of the consumption of plastic carrier bags and are more likely to be able to agree a voluntary approach than smaller shops, which are diverse and hard to monitor. The Retail Forum may be the appropriate framework for such a commitment. It counts twenty major retailers and seven retail associations among its members. For the purpose of this study, it is assumed that 46.5 billion single-use plastic carrier bags are distributed by the members of the Retail Forum, representing a 55% share of the European retail market.

- Option 3: Setting an EU level prevention target for single-use plastic carrier bags

The target assessed in this study is a number of single-use plastic carrier bags used per person, as the simplest and most direct way to reduce environmental impacts. The rationale for a target at EU level lies in the transnational aspect of plastic carrier bag litter and pollution and the need to raise awareness of the problem. Although the target would be set at EU level, it would be up to Member States to select and implement appropriate measures (short of a ban, to avoid conflict with EU law) to induce the necessary behaviour change by industry, retailers and consumers.

Based on progress already achieved in some EU Member States, a reduction of 80% in the number of single-use plastic carrier bags used in the EU by 2020 compared to 2010 would be an appropriate level of ambition. That is 35 single-use plastic carrier bags used per person in 2020. An EU target would provide a clear objective while leaving flexibility for Member States as to the means of achieving the target and taking into consideration progress already achieved.

- Option 4: Introduction of a legal requirement for Member States to take measures to ensure that plastic carrier bags are not provided for free to end users

Pricing measures encourage reuse and help reduce littering by applying an economic incentive and raising consumer awareness. Under this option, Member States would be obliged to implement pricing measures for plastic carrier bags. The free provision of plastic carrier bags to customers would no longer be allowed.

Levies should be passed on in full to the consumer as consumer-based levies are expected to yield bigger reductions in the number of plastic carrier bags used and littered than supply-side weight-based taxes. Member States would be free to set the price level and to use the funds to enhance the environmental benefit by ringfencing funds for litter clean-up activities, recycling and other environmental projects.

In principle, the levy should be high enough to cover the environmental and social costs generated over the life cycle of a plastic carrier bag (including end-of-life management). In addition, in light of the principles of producer responsibility, the costs of collection and treatment of plastic carrier bags should be reflected in the price of the product. However, even a low price

can have a big impact if customers see payment as a hassle or if use of plastic carrier bags becomes socially undesirable.

As well as setting an appropriate level, the price needs to be increased over time to avoid usage creeping back up. The primary goal should be to reduce the consumption of single-use plastic carrier bags by influencing consumer behaviour, rather than to raise revenue.

This option would apply to all plastic carrier bags not just single-use, in order to encourage reduced use and greater reuse of all bag types and because in practice multiple-use plastic carrier bags are rarely distributed for free anyway.

- Option 5: EU ban on single-use plastic carrier bags

Under this option, the provision of single-use plastic carrier bags would be prohibited at EU level. A transitional period, for instance 18-24 months, would enable producers and distributors to adapt to the new rules. Bans usually specify a minimum thickness, ensuring that heavier, more durable (and therefore more likely to be reused) bags are still permitted.

Bans on single-use plastic carrier bags have been discussed in several Member States. Italy is the only Member State to have imposed a national ban on (non-biodegradable) single-use plastic carrier bags. However, a number of non-EU countries have also put in place similar bans. It appears that less developed countries in particular favour bans and minimum thickness standards rather than market-based instruments, most likely due to ease of enforcement, inadequate waste collection and treatment systems, and the need to address chronic litter problems.

Bans are effective in terms of environmental impact but raise difficult legal issues. This option requires a change in the legal basis of the Packaging Directive in order to allow for preventive measures at source in cases of non-essential packaging products, with a high environmental impact and for which more sustainable alternatives are available.

- Potential exemptions

Policies to reduce the use of plastic carrier bags should be limited to cases where there will be a positive environmental impact and where practical alternatives are available. The main potential exemptions to consider here are for biodegradable plastic carrier bags and multiple-use plastic carrier bags.

In some countries where bans or other policies are in place, biodegradable bags are exempt. However, the LCA evidence for a blanket exemption of biodegradable plastic carrier bags at EU level is weak. The merits of such an exemption in a particular context depend on a range of factors including the source of any bio-based polymers and the existence of appropriate waste management. Furthermore, a shift to biodegradable bags would not reduce the number of bags discarded as litter or their associated impacts.

In most countries, the policy framework in place does not distinguish between biodegradable and other plastic carrier bags. The options considered in this report take the same approach and do not exempt biodegradable plastic carrier bags. Member States may or may not decide to promote these kinds of bags depending on their national circumstances.

In order to change consumer behaviour and reduce the overall impact of waste plastic carrier bags on the environment, it would be appropriate to exempt multiple-use plastic carrier bags

from most policy options. LCA results are much more positive for multiple-use plastic carrier bags than for single-use ones. However as mentioned earlier, pricing measures would apply to all plastic carrier bags, mostly because in practice retailers already charge their customers for multiple-use bags.

One way to distinguish multiple-use from single-use plastic carrier bags is by wall thickness. For example, a threshold of 49 microns could be an appropriate level in order to discourage use of single-use plastic carrier bags without adversely affecting multiple-use plastic carrier bags. More detailed analysis would be required to determine the optimal level from environmental and economic points of view.

- Effects of policy on consumer behaviour

With single-use plastic carrier bags no longer available for free (or at all), consumers either come up with their own alternatives or use those proposed by retailers. In theory, policies to reduce the use of plastic carrier bags could lead to the use of less sustainable alternatives, which depending on the circumstances may include paper bags or cotton bags. However, such bags tend not to be distributed by supermarkets or other large retailers in Europe though paper bags are used by high-street boutiques such as clothing retailers. The most common response in Member States has been to switch to multiple-use plastic carrier bags.

Apart from switching, consumers find other solutions: filling bags closer to their capacity, shopping more locally, buying products with less packaging, using trolleys, backpacks or handbags to carry small numbers of items, etc. As well as reduced overall use, the policies assessed in this report would increase levels of primary reuse (reuse of plastic carrier bags for a second or third shopping trip).

Many single-use plastic carrier bags also undergo secondary reuse such as to replace bin liners. Policies to reduce the use of single-use plastic carrier bags can thus potentially result in increased bin liner sales. However, any increase in bin liner sales would be very small in comparison to the reduction in single-use plastic carrier bags.

In this report, it is assumed that consumers either switch to multiple-use plastic carrier bags or reduce their consumption of carrier bags altogether. Therefore, reductions in the number of single-use plastic carrier bags are accompanied by a (smaller) increase in the use of multiple-use plastic carrier bags. As multiple-use bags are reused several times there will still be a significant net reduction in environmental impacts.

- **Impacts of policy options**

It is assumed that a voluntary agreement that involves the Retail Forum would result in a 55% reduction of the total amount of single-use plastic carrier bags used in the EU by 2015 compared to the base year 2010. From 2015 onwards, Retail Forum members no longer distribute single-use plastic carrier bags. A 55% reduction in the number of single-use plastic carrier bags used in the EU by 2015 translates to a 13% (0.2 Mt) reduction in tonnes of plastic in 2020 because there is some switching to multiple-use bags. The overall number of plastic carrier bags used decreases by 46%. Litter and other environmental impacts would be significantly reduced: oil savings of 463 kt (assuming 2 kg of oil for 1 kg of plastic produced), avoidance of 81 $MtCO_2eq$ of life-cycle

greenhouse-gas emissions (assuming 1.58 kgCO_2eq per bag) and a reduction of 2.4 billion in the number of plastic carrier bags littered each year.

In Option 3, Member States would have to achieve a level of 35 (or fewer) single-use plastic carrier bags used per person, using policies of their choice. This is an 80% reduction in the number of single-use plastic carrier bags in 2020 compared to 2010 and a 70% reduction in the total number of plastic carrier bags (the difference being due to switching from single-use to multiple-use). A 20% reduction in tonnes of plastic used is achieved, with environmental impacts being reduced according to the same assumptions as for Option 2.

Option 4 results in a reduction of 379 kt of plastic or 84 billion plastic carrier bags in 2020. In other words, a 90% reduction in the number of single-use plastic carrier bags leads to a 21% reduction in tonnes of plastic used for carrier bags and a 76% reduction in the total number of plastic carrier bags. Again, environmental impacts are reduced to the same degree.

In Option 5, the number of single-use bags goes to zero during 2013 and remains zero from 2014 to 2020. A 100% reduction in the number of single-use plastic carrier bags corresponds to an 85% reduction in the total number of plastic carrier bags after taking into account switching to multiple-use. This is the most effective of the five Options in reducing the use of plastic carrier bags and associated environmental impacts.

- Plastic carrier bag producers and employment

The reduction or elimination of single-use plastic carrier bags could entail a significant decrease in activity for SMEs specialised in the production of plastic carrier bags. This implies that in EU countries that still produce single-use plastic carrier bags, companies could have to either close production lines or switch to producing multiple-use plastic carrier bags.

About 250-300 producers of plastic carrier bags in the EU employ 15 000-20 000 people. However, lower quality single-use HDPE bags tend to be imported from outside the EU, while EU producers tend to specialise in higher-value, thicker LDPE bags. Such producers should be well placed to take advantage of a switch away from single-use plastic carrier bags.

Those producers that do not already specialise in LDPE bags could switch after investing in new or adapted machinery. Smaller producers are likely to experience a more negative effect as they have less capacity to adapt. A transitional period would help in this regard.

Member States should have comparative advantage in higher unit value products than in the cheapest plastic carrier bags, for which economies of scale in production are key. However, this may not be true of all types of multiple-use plastic carrier bag. For example, woven PP may be more competitively produced in Asia due to the labour involved.

The specific producers affected by a policy and the extent of the impact will depend on the alternatives chosen by retailers and consumers. Depending on the design of the policy and consumer preferences, there could even be a net gain in employment in the EU.

In the retail sector, small shops might be more severely affected than large ones because placing a price on plastic carrier bags might discourage impulse buying by "walk-up" customers. Such purchases may account for a smaller share of sales in larger retailers, who might also be better able to absorb any administrative burden. On the other hand, consumers are expected to rapidly adapt and find alternative means of carrying their purchased goods.

- Administrative burden and levy revenues

A mandatory pricing measure involves a cost for national authorities in order to research and implement it. This cost could be around €1m while annual administration costs would be of the order of €0.4m, depending on whether the levy is integrated with existing reporting systems such as VAT.

Suppliers and retailers will face some initial costs associated with learning about the levy and stocktaking, or adjusting checkout counters to facilitate the use of alternative or reusable bags. However, the cost savings for retailers in purchase and storage of plastic carrier bags should more than offset any additional costs. There would be also be a small cost to consumers, who would either need to purchase multiple-use bags or (much less often) pay the levy.

In the case of a ban, there would be an administrative burden incurred for monitoring and compliance. A voluntary agreement would be much less of a cost burden for government than a compulsory pricing measure or ban because as the initiative would be voluntary, enforcement and monitoring activities would not be necessary.

In the case of a levy, the amount of revenue generated would depend on the size of the levy and the extent to which it reduces the amount of plastic carrier bags purchased (the elasticity of demand). In the example of Ireland's plastic bag levy, revenue is earmarked to cover administration costs and for an environmental fund used to support waste management, litter cleanup and other environmental initiatives. The levy so was successful in reducing the use of plastic carrier bags that annual revenues from the tax were only around one tenth of the amount initially expected. Administration costs were very low, at about 3% of revenues, because reporting and collection are integrated into the existing VAT system.

- **Comparison of policy options**

Although good progress has been made in some Member States, the use of single-use plastic carrier bags is still very high in Europe. As long as that is the case, litter for example will remain a worsening problem due to the lightweight, mobile nature of plastic carrier bags and their persistence in the environment.

Experience at Member State level does show that effective policy interventions exist. Yet there is no specific policy at EU level. A range of policy options is considered in this report, and each of Options 2-5 is a great improvement over the baseline scenario (Option 1).

The first option, a voluntary approach, would have the significant advantage of being simple to implement, while still achieving a substantial reduction in use. However, it is not an optimal solution in terms of environmental impacts as it would not ensure full market coverage and might not achieve a high level of compliance.

A ban at EU level would be extremely effective in reducing the use of single-use plastic carrier bags. However, it is a blunt instrument that gives little flexibility to producers, retailers or consumers. It could also conflict with internal market rules and international trade law. In any case, the decision would require unanimity and so is unlikely to be adopted.

The fact that many retailers still distribute plastic carrier bags for free is the main driver behind excess use and thus an important lever for change. Pricing measures have an almost immediate

effect on consumer behaviour, while also preserving consumer choice to a greater extent and giving retailers more flexibility. Such measures have been very effective at Member State level.

The available LCA literature suggests that single-use plastic carrier bags are more environmentally harmful than multiple-use plastic carrier bags. Requiring that a price be placed on all plastic carrier bags would result in both a reduction in the use of plastic carrier bags overall and a shift from single-use to multiple-use plastic carrier bags.

A pricing measure allows government revenue to be raised. However, the price should be set high enough that only a modest amount of revenue is raised – enough to cover the administrative costs and fund some environmental projects with the surplus. The aim should be to reduce the use of plastic carrier bags and the price should rise over time to ensure this.

The most effective approach may be to combine a waste prevention target at EU level (Option 3) with pricing measures at national level that would make it obligatory for shops to charge for plastic carrier bags (Option 4). This is our recommended approach. It would combine the political commitment and monitoring of an EU target with the flexibility and efficiency of pricing measures. Pricing measures are most appropriately implemented at national level but an ambitious EU level target is important to help raise awareness and ensure implementation. The reductions in environmental impact brought about by this combination would be at least as high as those of Option 3 on its own.

The combination of Options 3 and 4 is preferable for a number of reasons. Pricing measures are highly effective at reducing the use of plastic carrier bags. However, Option 4 does not specify the level of the price but leaves it up to the Member State. This introduces a risk that the reduction achieved could be lower than expected. The combination of Option 4 with a waste prevention target at EU level, however, would ensure that the prices set by Member States would be at least high enough to achieve the EU target. The greater policy certainty provided by Option 3 also helps producers and retailers to make any investments or changes in business practices that are required. The target would also help raise consumer awareness – a key success factor. Finally, as pricing measures affect consumer behaviour almost immediately, the target set out in Option 3 might be achieved earlier in the project period than if the target were introduced on its own. This means that the cumulative benefits by 2020 would be even more positive.

Based on experiences in Europe and around the world and the analysis in this report, the result of such an approach would be a steep reduction in the use of single-use plastic carrier bags in the EU and associated environmental impacts. There would be an increase in the use of multiple-use plastic carrier bags (with a potential beneficial for EU plastic carrier bag producers to the extent that these are LDPE rather than PP), and only minor increases in other carrier bags such as paper and cotton, and bin liners for domestic waste. Nevertheless, the overall effect would be highly positive on all indicators, including energy use and greenhouse-gas emissions but especially for litter, where the absolute number of bags is a key indicator of the impact.

A co-benefit of policies to reduce the use of plastic carrier bags is greater awareness among consumers about litter and sustainability. Awareness campaigns in advance of the introduction of a policy are important, to ensure that the objective of the measure is well understood by consumers, and to highlight the availability of more sustainable alternatives to single-use plastic carrier bags.

Finally, as there is little official data on use of plastic carrier bags, new data collection procedures should be put in place. Further LCA work would also be helpful in refining the options and monitoring progress over time.

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Chapter 1: Introduction

This chapter gives the background to the study, and defines the objectives and scope.

The plastic carrier bags used by millions of shoppers across Europe are light, inexpensive and convenient. However, they are also durable, and the current litter situation is a cause for concern. The quantities of plastic carrier bags used and the development of new materials is challenging for policy makers and the waste management industry in many countries. The production and consumption of plastic carrier bags is linked to significant environmental impacts. Plastic carrier bags are sometimes seen as symbolic of a "throw-away" society as they are used in large volumes, sometimes only once, are often distributed free of charge, can be visually intrusive and persistent once littered, and in some cases excluded from recycling schemes. One impact of particular concern is the widespread presence of plastic in the marine environment.[1]

Some Member States have implemented a wide range of measures to reduce the use of plastic carrier bags. However, while existing EU policies provide strong drivers to make the EU a resource-efficient society, there is no legislation specifically targeting plastic carrier bags.

The purpose of this report is to contribute to the European Commission's assessment of policy options to reduce the use of plastic carrier bags. The objective is to define the problem, develop a baseline scenario at EU level and carry out a comparative analysis of selected policy options.

In this study, "single-use" plastic carrier bags are the thin-walled, lightweight plastic carrier bags used to carry goods from supermarkets and other shops and often provided free of charge. "Multiple-use" plastic carrier bags are those designed to encourage high levels of reuse by incorporating greater thickness and more robust, durable materials. Unless otherwise specified, the term plastic carrier bag in this report refers to all types of plastic: biodegradable and non-biodegradable, bio-based and fossil-fuel based.

The study analyses five main policy options and identifies their potential impacts:

- Baseline scenario (business as usual)
- Voluntary approach
- Pricing measures
- Waste prevention targets
- EU ban

This study follows the Commission's Impact Assessment Guidelines[2] in assessing the impacts of specific policy options. The report is therefore divided into the following chapters:

- Problem definition

[1] See for example EC (2010) *Joint answer given by Mr Potočnik on behalf of the Commission*, Written questions: E-0825/10, E-0104/10, European Parliament.
[2] European Commission (EC) (2009) *Impact Assessment Guidelines*, SEC(2009)92, accessed at: http://ec.europa.eu/governance/impact/docs/key_docs/iag_2009_en.pdf.

- Identification of policy options
- Impacts of policy options
- Comparison of the impacts

The findings of this study provide a basis for policy developments to reduce the use of single-use plastic carrier bags in the EU.

Chapter 2: Problem definition

This chapter describes the nature of the problem being addressed: First, the main types of plastic carrier bag and the main environmental, economic and social aspects of the problem. Next, the scale of the problem is quantified to the extent possible. Finally, a projection to 2020 is made in order to show how the problem will evolve if current trends and policies continue.

2.1 Most common types of plastic carrier bags

The vast majority of plastic carrier bags in Europe today are made from petroleum by-products. Polyethylene (PE), a gelatinous substance, is forced through holes to create string, which is then cut, heated and moulded to form bags. This process is referred to as blown film extrusion. Most plastic carrier bags contain ink with solvents, but they can also contain nitrocellulosic resin or polyamide resins, organic pigments, plasticisers (e.g. phthalates and bisphenol A (BPA),[3] additives, pigments and glue.[4]

PE is appealing to manufacturers because it can be converted into any shape, size, form or colour. It comes in three types: High Density (HDPE), Low Density (LDPE), or linear low-density polyethylene (LLDPE). The main difference between the three types is the branching of the polymer chain of molecules; the more branched out the molecules are, the thinner the plastic and the less suitable for reuse.

2.1.1 Single-use and multiple-use

In this report, "single-use" plastic carrier bags are the thin-walled, lightweight plastic carrier bags used to carry goods from supermarkets and other shops and often provided free of charge. They are single-use because they are usually only used for one shopping trip, though in reality they are often reused for some other purpose such as to hold household waste. Single-use plastic carrier bags are usually made of HDPE, which has more branched molecules and consequently lower tensile strength and crystalline form.

Some plastic carrier bags are designed to encourage high levels of reuse by incorporating greater thickness and/or more robust, durable materials. Such "multiple-use" or reusable plastic carrier bags are usually made of LDPE/LLDPE, which has a glossy appearance, or even thicker polypropylene (PP), a thermoplastic polymer that resembles canvas in appearance and is even more durable. Multiple-use plastic carrier bags are usually sold at supermarket cash registers for around €1 and some supermarkets will exchange them for a new bag without charge when they are damaged.

[3] Plasticisers work by reducing the chemical affinity between molecules when embedded between chains of plastic raw materials (or act as monomers in polycarbonate plastic). They are added to plastics to increase their flexibility, transparency, durability, and longevity.
[4] PwC/Ecobilan (2004) *Impact assessment of Carrefour plastic carrier bags,* Carrefour, France.

There is no widely accepted definition of a single-use plastic carrier bag but the most common approach is according to wall thickness. Single-use HDPE plastic carrier bags tend to have wall thicknesses of around 15 microns (1 micron = 0.001 mm). Plastic carrier bags are described as "robust" or "reusable" from around 25 microns.[5] LDPE bags tend to be around 20-50 microns and other multiple-use bags such as PP can be much thicker still.

From a policy perspective, Bulgaria has imposed a tax on plastic carrier bags thinner than 15 microns, a threshold that will increase to 23 microns in 2012. South Africa banned plastic bags thinner than 30 microns in 2003.[6] In Australia in 2008, a ministerial council defined a plastic bag as "a carry bag, the body of which comprises polymers in whole or part, provided by the retailer for the carrying or transporting of goods". Any bag meeting one or more of the following design criteria was excluded:

- Has a thickness greater than 45 microns;
- Has no handles;
- Is the product's integral packaging; and
- Is designed for multiple uses as a carry bag (i.e. more than ten reuses).

Based on the above and discussions with European stakeholders, true multiple-use plastic carrier bags can thus be defined as those with wall thickness of 50 microns or more, though a precise definition would have to be determined in the context of a given policy proposal.

2.1.2 Biodegradable and non-biodegradable

Plastic carrier bags can be made of bio-based materials. There are three main categories of bio-based plastics: natural polymers from renewable sources such as cellulose, starch and plant-based proteins; polymers synthesised from renewable sources, e.g. polylactic acid (PLA); and polymers produced by micro-organisms such as polyhydroxyalkanoates (PHAs). Bio-based plastics can be either biodegradable or non-biodegradable (e.g. PLA).

Biodegradability refers to the ability of materials to break down by biological action. Whether biodegradable or not, plastic carrier bags can also break down by oxidative (in the presence of oxygen)[7] or ultraviolet (photodegradable) action. Usually, a combination of these processes causes biodegradation and the rate of degradation varies widely depending on the material and environmental conditions.

Compostable polymers are biodegradable and meet certain conditions relating to the rate of biodegradation and impact on the environment. Compostable bags have to be collected and

[5] Note that sacks and bags used for fresh food such as fruit and vegetables or in butcher shops are not included in this definition. They usually do not have handles and are placed inside other bags. They are generally excluded from plastic carrier bag policies for reasons of practicality (lack of suitable alternatives), food safety (especially when used for raw meat) etc. Likewise, national data sources and stakeholder estimates do not include them. PRODCOM data, however, would include them since it covers all plastic sacks and bags.

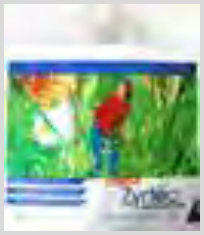
[6] See http://news.bbc.co.uk/2/hi/africa/3013419.stm.

[7] Oxo-biodegradable plastics are made from by-products of oil refining and degrade oxidatively at first, with the aid of additives containing metal salts of cobalt, manganese, iron, etc. They then degrade further by the action of micro-organisms.

disposed of in a responsible manner in order to be recovered in industrial composting facilities. Thickness of the bag is an essential criterion for composting, as well as the type and amount of printing inks.

Bio-based and biodegradable plastics can potentially be used for a wide range of applications but cannot yet replace all types of traditional plastics for all applications, for reasons such as resistance and durability. Single-use plastic carrier bags are one of the main applications today. Table 1 provides a summary of the types of plastic carrier bag mentioned in this report.

Table 1: Types of plastic carrier bag

Type	Materials	Weight (g)[8]	Image	
Single-use non-biodegradable	Mostly HDPE, can also be LDPE	8.5	 Source: http://printed-bags.net/products/index.php?lg=en	
Single-use biodegradable	Can be fully bio-based, usually a starch-polymer blend	8.9	 Source: myzerowaste.com	 Source: www.alibaba.com
Multiple-use	Non-woven PP, woven PP	78.9	 Source: apaperblog.com/what-are-non-woven-bags	 Source: www.momgoesgreen.com
	LDPE		 Source: http://printed-bags.net/products/index.php?lg=en	

[8] Typical weights, estimated by BIO based on recent values found in the LCA literature and feedback from stakeholders. Multiple-use is a representative value reflecting the full range of multiple-use bags found on the market, from LDPE to PP.

2.2 Environmental aspects of plastic carrier bags

The environmental impacts of plastic carrier bags over their life cycle depend on their thickness, whether and how often they are reused and what happens to them at end of life. If not treated appropriately, the resources embedded in them are lost and they have negative impacts as litter. During the use phase, plastic bags can deliver environmental gain as they may prevent spillage of food and goods and make possible the use of thinner packaging of packaged products.

Around 4% of world oil and gas production is used as feedstock for plastics and a further 3-4% is expended to provide energy for the manufacturing of plastic products.[9] However, plastic carrier bags in the EU account for only a small share of that (around 1% or less). For example, in Germany, PE carrier bags account for less than 0.2% of total oil and gas use.[10] In Europe and Asia, plastic tends to be made from naphtha. In the United States, ethylene extracted from natural gas is more commonly used.[11]

A rule of thumb is that production of 1 kg of plastic needs around 2 kg of oil.[12] Plastic carrier bags have been getting steadily lighter (i.e. thinner) over the years but there is a limit: the risk of tearing, which for example could lead some users to "double bag" fragile groceries such as glass bottles. Recycling plastic carrier bags can avoid the need for virgin material to make bags or other products, while energy recovery can allow the energy stored in plastics to be used for electricity or heat. Whatever type of bag is used, however, the key to reducing the impacts is to reuse it as many times as possible.

2.2.1 Life-cycle assessment

It has been recognised by industry and policy makers alike that a life-cycle approach to environmental assessment is necessary, whether to inform the public or as the basis for policy making. LCAs provide a lot of useful information and some general conclusions as to which products and life-cycle phases are responsible for the most significant environmental impacts.

A number of recent LCAs of plastic carrier bags are available. Their results vary widely due to differences in functional unit, system boundaries, the country concerned, etc. Assumptions as to how many times carrier bags are reused and the end-of-life options in a particular country particularly influence the results. Nevertheless, some overall conclusions can be drawn as presented below.

[9] Hopewell Jefferson et al. (2009) "Plastics recycling: challenges and opportunities" in *Royal Society Journal,* http://rstb.royalsocietypublishing.org/content/364/1526/2115.full.pdf.
[10] IK Industrievereinigung Kunststoffverpackungen (2011) *Plastic carrier bags – Germany is not Italy*, Press Release, 18 January 2011, Bad Homburg.
[11] OPA (2011) *Briefing Note*.
[12] Mepex Consult (2008) *Plastic carrier bags, sustainable trade and recovery*.

2.2.1.1 *Resource use and production*

The environmental impact (excluding litter) of all types of carrier bag[13] is dominated by resource use and production (Figure 1).[14] The electricity consumed to produce 1 000 conventional HDPE bags is 6.15 kWh (22.14 MJ). The production of that number of bags, weighing 8.12 kg, generates 0.42 kg of waste. The production of plastic carrier bags can also be a significant source of photochemical oxidants when the inks contain solvents. The fact that the production of raw materials is the most impacting life-cycle phase for all bags means that for the same technical properties, any reduction of the mass per bag and reuse will reduce the environmental impact.

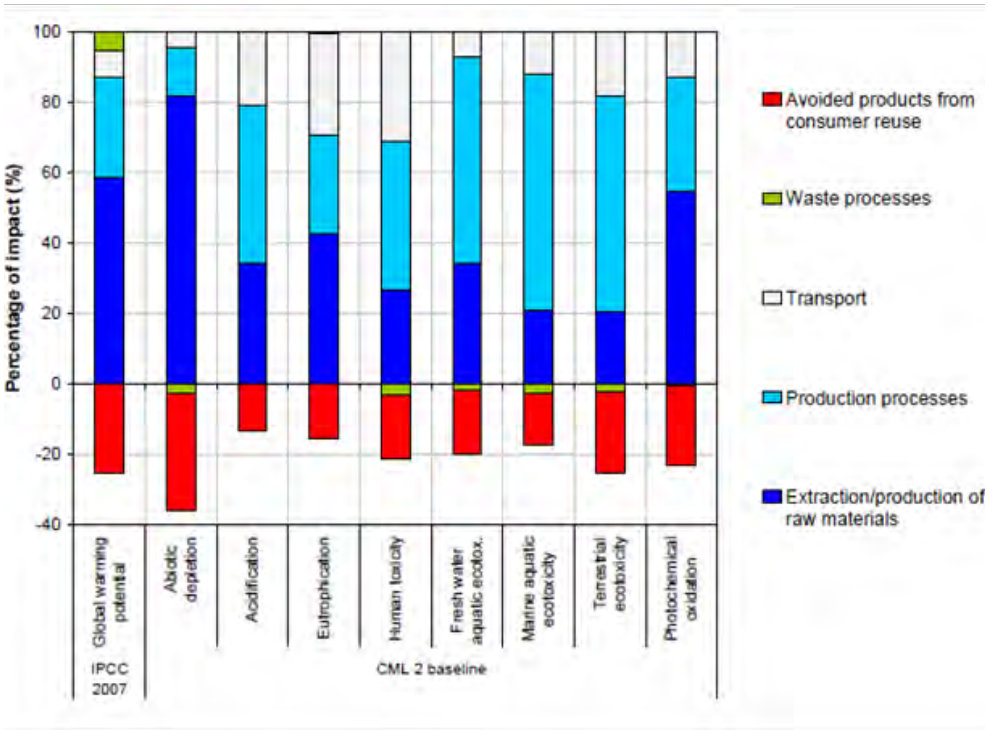


Figure 1: Relative contribution of different environmental impacts of a HDPE bag[15]

Secondary packaging and end-of-life management have only a minimal influence on environmental performance.[16] Transport also has a low impact in comparison with other life-cycle phases. The distance and mode of transport does however contribute significantly to eutrophication and human toxicity due to the emission of nitrogen oxides and polycyclic aromatic hydrocarbons respectively from shipping.

[13] The bags studied were: single-use HDPE, single-use HDPE with a pro-degradant additive, starch-polyester blend biodegradable, paper, "bag-for-life" LDPE, durable polypropylene (PP) and cotton. It was assumed that all HDPE bags are imported to the UK from China.

[14] UK Environment Agency (2011) *Life cycle assessment of supermarket carrier bags: a review of the bags available in 2006*.

[15] Ibid.

[16] Ibid.

2.2.1.2 *Reuse*

The more any kind of bag is reused, the lower the environmental impacts.[17] When single-use plastic carrier bags are reused, e.g. for shopping (primary reuse) or for collecting domestic waste (secondary reuse), their environmental performance is vastly improved. Thus, assumptions as to whether and how many times a bag is reused are decisive in any LCA.

Assuming single-use HDPE bags are reused as bin liners in 40% of cases, paper, LDPE (thicker glossy plastic carrier bag), non-woven PP (thick multiple-use plastic carrier bag) and cotton bags should be reused at least 3, 4, 11 and 131 times respectively to have a lower GWP.[18] Thus, depending on consumer behaviour, multiple-use carrier bags can be the best environmentally.[19]

Table 2: Performance of different types of carrier bag against environmental indicators, relative to a lightweight HDPE bag[20]

Indicator of environmental impact	HDPE bag (lightweight)	Reusable LDPE bag (used X2)	Reusable LDPE bag (used X4)	Reusable LDPE bag (used X20)	Paper bag (single use)
Consumption of non-renewable primary energy	1.0	1.4	0.7	0.1	1.1
Consumption of water	1.0	1.3	0.6	0.1	4.0
Emission of greenhouse gases	1.0	1.3	0.6	0.1	3.3
Atmospheric acidification	1.0	1.5	0.7	0.1	0.9
Ground level ozone formation	1.0	0.7	0.3	0.1	1.3
Eutrophication	1.0	1.4	0.7	0.1	14.0
Solid waste production	1.0	1.4	0.7	0.1	2.7
Risk of litter	1.0	0.4	0.4	0.4	0.2

Impacts are severe for cotton bags because they require large quantities of water and chemicals to produce. Non-woven multiple-use PP bags need to be used many more times to compensate

[17] Fullana (2008) *LCA including risk of littering (animal mortality, visual impact, etc.)*, ESCI, University PompeuFabra Barcelona.
[18] UK Environment Agency (2011) *Life cycle assessment of supermarket carrier bags: a review of the bags available in 2006*.
[19] Packaging Recovery Organisation Europe (2010) *Position Paper, Plastic bags*, available at: http://pro-e.org/files/10-02_Plastic-bags.pdf.
[20] PwC/Ecobilan (2004) *Impact assessment of Carrefour plastic carrier bags*, Carrefour, France, as cited in www.scotland.gov.uk/Publications/2005/08/1993259/33039.

for their greater weight.[21] Furthermore, they often include product features such as metal eyelets that make them difficult to recycle.

Paper carrier bags have a more severe environmental impact than single-use plastic carrier bags in most impact categories except litter, where they may be preferable in some situations because they can degrade over a period of months. If a paper bag is reused at least once, it has better performance as regards to risk of abandonment, energy consumption and generation of photochemical oxidants. Regarding other indicators, its performance remains equivalent or worse than the single-use PE plastic carrier bag.[22]

In short: "Whatever type of bag is used, the key to reducing the impacts is to reuse it as many times as possible and where reuse for shopping is not practicable, other reuse, e.g. to replace bin liners, is beneficial."[23]

2.2.1.3 End-of-life

Recycled bags generally have lower environmental impacts than those made from virgin materials. A comparative LCA in Finland found that recycled plastic bags were best, followed by conventional plastic bags then paper and bioplastics.[24] However, the thinness and composition (mix of polymers) of plastic carrier bags makes them harder and more expensive to recycle and collect compared to other plastic products. Closed-loop recycling of plastic bags requires a separate collection system and sufficient tonnage available for recycling. This represents the loss of a potential source of raw materials for recycling and therefore revenues. Recycling might be easier for bags that are collected directly by retailers and therefore less likely to be contaminated with other substances. Also, recycling or composting generally results in a rather small reduction in GWP and abiotic depletion.[25]

Energy recovery has environmental benefits because the impacts of incineration, such as a small amount of dioxin emissions, are offset by the impacts avoided due to the displacement of electricity produced from conventional fossil fuels. The balance is even more positive if heat is captured and used. Plastic carrier bags have high calorific values – around 43 MJ/kg (0.37 MJ per bag) for conventional PE and around 20 MJ/kg for biodegradable PE (depending on the share and type of bio-based material). The efficiency of the incineration process itself is around 80%. However, energy recovery does not reduce the demand for virgin plastic and hence is generally considered less efficient than recycling.[26]

The worst end-of-life option is landfilling. Plastic persists in landfill and if sites are not properly managed, plastic carrier bags can escape to become litter or chemicals from plastic carrier bags

[21] GHK (2007) *The Benefits and Effects of the Plastic Shopping Bag Charging Scheme*, available: www.epd.gov.hk/epd/tc_chi/environmentinhk/waste/prob_solutions/files/GHK_study.pdf.
[22] PwC/Ecobilan (2004*) Impact assessment of Carrefour plastic carrier bags*, Carrefour, France.
[23] UK Environment Agency (2011) *Life cycle assessment of supermarket carrier bags: a review of the bags available in 2006*.
[24] Optikassi/SUM (2009).
[25] UK Environment Agency (2011) *Life cycle assessment of supermarket carrier bags: a review of the bags available in 2006*.
[26] Thomson et al. (2009) "Plastics, the environment and human health: current consensus and future trends" in *The Royal Society Journal*.

can leach.[27,28] More importantly, landfill represents a massive resource loss. A rough estimation is that the plastic carrier bags landfilled in the EU each year are equivalent to the electricity production of 1.67 average nuclear power plants and 77.42 $MtCO_2$.[29]

2.2.1.4 *Biodegradable plastic carrier bags*

Bio-based and biodegradable polymers are marketed as replacements for traditional HDPE carrier bags due to their claimed environmental benefits: reduction in non-renewable resource use by replacement with renewable resources (e.g. wheat, potato, maize), and degradability in the environment, which would reduce litter and landfill quantities.[30]

Despite the name, however, biodegradable plastic carrier bags do not degrade rapidly in the environment, as the required conditions are generally not present in the natural environment. PHAs do demonstrate some disintegration in ocean water[31] but their market penetration is still low. Other types of biodegradable plastic carrier bag are only designed to biodegrade in a composting process under certain conditions (presence of micro-organisms, appropriate temperature, and humidity level) and are not at all suitable for marine biodegradation.

LCA results concerning the environmental impact of replacing plastic carrier bags (made of PE) with biodegradable plastic bags are far from conclusive.[32] Any use of biodegradable polymers should consider where and how products would degrade, life-cycle environmental impacts and cost. Key considerations are the amount of non-renewable energy, fertilizer, land and water used in production of the raw materials. Typical sources are sugar cane, corn, wheat, potato starch, and plant oil. One promising alternative to traditional feedstock is algae, which can have a high yield and negligible land footprint, but the technology is not yet widely deployed.

The environmental impact of a particular biodegradable plastic carrier bag depends on the mix of plastics used in its manufacturing. For example, a bag may contain two-thirds petroleum-based plastic (perhaps of a more sturdy type than usual) and one third bio-based plastic. Shares of anywhere up to 100% bio-based are possible. Biodegradable plastic carrier bags tend to have 30-50% bio-based content.

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[27] This is of even greater concern in less developed countries where landfill management is less closely monitored.

[28] David K.A. Barnes et al. (2009) "Accumulation and fragmentation of plastic debris in global environment" in *The Royal Society Journal*.

[29] Estimate based on 0.8 Mt of plastic carrier bags (49 billion bags) landfilled each year. That is 19 billion MJ or 5 276 GWh (0.28 kWh/MJ). Power generation per nuclear power plant is estimated as 3 161 GWh based on www.world-nuclear.org/info/reactors.html. Emissions are 1.58 $kgCO_2$ per bag based on UK Environment Agency LCA, which assumes 40% secondary reuse. Landfill methane is not included, so the actual greenhouse gas emissions avoided are even higher.

[30] Norfolier claim that their GreenTec bag has life-cycle emissions of 38.9 gCO_2, 63% lower than a virgin bag made in China (104.5 gCO_2). See www.norfolier.com/index.php?page=73&.

[31] Bowmer, T. And P.J. Kershaw (Eds.) (2010) *Proceedings of the GESAMP International Workshop on plastic particles as a vector in transporting persistent, bio-accumulating and toxic substances in the oceans*, GESAMP Rep. Stud. No. 82, 68pp, GESAMP (IMO/FAO/UNESCO-IOC/UNIDO/WMO/IAEA/UN/UNEP Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection).

[32] Boustead Consulting & Associates (2007) *Life Cycle Assessment for Three Types of Grocery Bags – Recyclable plastic; Compostable, Biodegradable Plastic; and Recycled, Recyclable Paper*. The bags studied were: a traditional grocery bag made from PE, a grocery bag made from compostable plastics (a blend of 65% EcoFlex, 10% PLA and 25% calcium carbonate), and a paper grocery bag made using at least 30% recycled fibres.

Biodegradable plastic carrier bags perform poorly in LCA because of their raw material content (increased thickness and weight of material per bag), higher material production impacts, methane emissions[33] and the potential difficulties in recycling. If mixed with conventional plastic carrier bags for recycling, they can raise the cost of waste separation and disposal. Other potential barriers are their lower energy recovery value and higher production costs. Overall, such bags can have similar GWP and eutrophication impacts to conventional ones,[34] or in some cases even higher impacts.[35]

It is sometimes claimed that the increased use of biodegradable plastic bags could potentially add to the litter problem as consumers might think it harmless to litter them.[36] However, other stakeholders question this point of view and there is little solid evidence yet of how consumers would behave.

2.2.1.5 Summary of LCA review

The main conclusions based on the review of LCAs are the following:

- The environmental impact (excluding litter) of all types of carrier bag studied[37] is dominated by resource use and production.
- At end of life, energy recovery can be as environmentally friendly as recycling while landfilling is generally the worst option.
- There is no ideal type of carrier bag for all impact categories. Some have lower material consumption, others lower risk of littering, etc. Each of the alternatives has advantages and disadvantages and there is considerable overlap, from a GWP perspective at least, between bag types and studies.[38]
- Whether alternative materials are appropriate depends on the situation; it is important that any shift to new materials is combined with a behavioural shift and improved end-of-life management. On most indicators, biodegradable bags are not better but greater recycled content does produce an improvement. Biodegradable plastic carrier bags are therefore included along with other single-use plastic carrier bags in the assessment of policy options later in this study.
- Due to their light weight and cheap price (often given away for free), single-use plastic carrier bags cause the biggest litter impact. Litter impacts are lowest for

[33] Although the CO_2 balance of bio-based biodegradable plastics may be neutral, they may cause an increase in methane emissions when they biodegrade anaerobically (as in landfill). Methane has a GWP that is 23 times that of CO_2.
[34] James, K. and T. Grant (2005) *LCA of Degradable Plastic Bags*, Centre for Design at RMIT University.
[35] UK Environment Agency (2011) *Life cycle assessment of supermarket carrier bags: a review of the bags available in 2006*.
[36] Packaging Recovery Organisation Europe (2010) *Position Paper, Plastic bags*, available at: http://pro-e.org/files/10-02_Plastic-bags.pdf.
[37] The bags studied were: single-use HDPE, single-use HDPE with a pro-degradant additive, starch-polyester blend biodegradable, paper, "bag-for-life" LDPE, durable polypropylene (PP) and cotton.
[38] Mattila, T., Kujanpää, M., Dahlbo, H., Soukka, R. and T. Myllymaa (2011) "Uncertainty and Sensitivity in the Carbon Footprint of Shopping Bags" in *Journal of Industrial Ecology*, Yale University.

multiple-use bags,[39] which is unsurprising. Countries where multiple-use plastic carrier bags are the most common tend not to report significant littering issues.

- Reuse is key to reducing the environmental impacts of any kind of bag. As long as thick polymer-based multiple-use bags are used a sufficient number of times, they may be the best environmentally. Multiple-use plastic carrier bags are thus excluded from all the policy options considered later in this study except Option 4.
- The results of LCAs must be treated with a degree of caution as a variety of methodologies and environmental parameters are used. Some environmental parameters figure only to a small extent in the analyses: litter, water consumption, the use of chemicals, hygiene and safety issues, and implications for collection and recycling systems.[40]

These conclusions largely reinforce the concept of waste hierarchy set out in the Waste Framework Directive (WFD): Prevention, Reuse and Preparation for Reuse, Recycling, Recovery and Disposal. All bags can be optimised at each level of the hierarchy over their life cycle: increased reusability, reduced materials and energy consumption in production, use of recycled and (with some caveats) bio-based materials, suitability for recycling, measures to reduce litter, etc.

2.2.2 Litter

Litter is defined as the pollution of roads, car parks, beaches, parks, other public spaces, public transport, etc. with carelessly or deliberately dropped or ignored waste.[41] It can also refer to waste that is released to the environment during transport or blown from landfill by the wind.

LCA studies often do not consider litter and there is no consistent approach to quantification among those that do. However, it is clear that some types of plastic carrier bag create more of a litter problem than others. Due to their light weight and low price (they are often given away for free), single-use plastic carrier bags are considered the biggest source of litter. Multiple-use LDPE bags are relatively rare in litter surveys.

In general, the likelihood of a littered bag being of a particular type depends on:[42]

- volume of bags to be treated at the end-of life stage;
- probability of abandonment: higher for bags given away for free;
- probability that bags escape waste management: higher for thinner bags; and
- persistence of bags in the environment: lower for bags that biodegrade more rapidly.

[39] James, K. and T. Grant (2005) *LCA of Degradable Plastic Bags*, Centre for Design at RMIT University.
[40] Mepex Consult (2008) Plastic carrier bags, sustainable trade and recovery.
[41] Switzerland Federal Office for the Environment (2011) *Litter-dropping costs money: Component-specific cleaning costs produced by litter-dropping in Switzerland*, Summary of the publication "Littering Kostet", www.bafu.admin.ch/uw-1108-d, FOEN, Bern.
[42] PwC/Ecobilan (2004*) Impact assessment of Carrefour plastic carrier bags*, Carrefour, France.

On land, conventional plastic carrier bags can last as litter for two years or longer before disintegrating, depending on product composition and environmental conditions. Additives in plastic carrier bags can contaminate soil and waterways, and if ingested by animals can enter the food chain.

Plastic litter in the marine environment is a growing problem that has significant impacts on the environment and biodiversity. Of particular concern are the giant masses of plastic waste known as "plastic soup" that have been discovered in the oceans, though the share of the problem that can be attributed to consumption of plastic bags in the EU is unclear.

There is clear evidence that plastic litter causes harm to marine life. The box below provides some figures related to plastic ingestion, collected during studies focusing on specific marine species.

Box: Plastic ingestion

Birds, fish, whales and other animals accidentally ingest plastic carrier bags because they confuse them with prey species. Ingestion of plastic carrier bags can result in gastrointestinal obstruction, pain, trauma, stomach ulceration, rotting of food in the stomach, shrinking of organs including the liver and spleen, atrophy of fat, absence of cardiac fat, toxic effects, starvation and emaciation. In some surveys, almost all individuals of certain species were found to contain ingested plastic.[43]

The list of marine species known to be affected by ingestion of plastic debris is long. It includes at least 267 species worldwide, including 86% of all sea turtle species, 44% of all seabird species, and 43% of all marine mammal species. The problem might have been highly underestimated, as most victims are likely to go undiscovered over vast ocean areas, as they either sink or are eaten by predators.[44]

Among cetaceans (mammals best adapted to aquatic life), at least 26 species have been documented with plastic debris in their stomach. A study on dolphins that were accidently captured by fisheries in Argentina found that 28% of the sample had plastic debris in their stomachs. Packaging debris (including bags) was found in about two-thirds of these dolphins.[45]

PE bags drifting in ocean currents look like the prey items targeted by turtles.[46] There is evidence that their survival is being hindered by plastic debris. Young sea

[43] Ryan et al. (2009).
[44] Jose G.B. Derraik (2002) "The pollution of the marine environment by plastic debris: a review" in the *Marine Pollution Bulletin*.
[45] Denuncio et al. (2011).
[46] ARPAT (2011) *L'impatto della plastica e dei saccheti sull' ambiante marino*, see www.arpa.emr.it/dettaglio_notizia.asp?id=2146&idlivello=90.

turtles are particularly threatened. Balazs (1985) listed 79 cases of turtles whose guts were full of various sorts of plastic debris.[47]

A study done in the North Pacific (Blight and Burger, 1997) found plastic particles in the stomachs of 8 of the 11 seabird species caught as bycatch.

Many species of fish are also affected. Indeed, to some extent, ingestion by marine mammals may occur indirectly as a result of ingesting fish that have eaten plastic. Ingestion of plastic debris by small fish can reduce food uptake and cause internal injury or death.[48]

Since 2010,[49] the presence of plastic particles in the stomachs of seabirds is an indicator to monitor environmental status in the implementation phase of the Marine Framework Strategy Directive. The MSFD requires Member States to ensure that "properties and quantities of marine litter do not cause harm to the coastal and marine environment". Member States will therefore require scientific support and assessments.

A set of Ecological Quality Objectives (EcoQOs) has been set up by OSPAR parties. Member States are expected to apply the EcoQO approach whereby trends are deduced from the stomach contents of northern fulmars in the North Sea. The fulmar is a bird that eats almost anything that floats on the sea surface and unlike other birds does not regurgitate what it has ingested.[50] The EcoQO question is formulated as follows: 'There should be less than 10% of northern fulmars having more than 0.1 g of plastic particles in the stomach in samples of 50 to 100 beach-washed fulmars found from each of 4 to 5 areas of the North Sea over a period of at least five years'. According to the Quality Status Report compiled by the OSPAR Commission in 2010, achieving this objective will be a challenge: only the Arctic populations are expected to succeed.[51]

The share of plastic carrier bags in this problem is not known. Fish for example may be most affected by plastic resin pellets, which can resemble fish eggs.

Entanglement of wildlife (including seals, whales and marine turtles) in plastic carrier bags is also occurring. Entanglement prevents feeding, swimming and reproducing and can cause drowning. The 2011 ICC report indicates that over the past 25 years, 404 animals around the world were

[47] Cited in Jose G.B. Derraik (2002) "The pollution of the marine environment by plastic debris: a review" in the *Marine Pollution Bulletin*.
[48] Jose G.B. Derraik (2002) "The pollution of the marine environment by plastic debris: a review" in the Marine Pollution Bulletin.
[49] In a few years' time, Member States must complement these assessment and monitoring exercises with action designed to prevent and reduce marine litter as part of the required programmes of measures. These measures must become operational in 2016 at the latest, and are expected to produce results by 2020.
[50] Alterra, FEE Norway, Keep Scotland Beautiful, Keep Sweden Tidy Foundation, KIMO International, Skagen Uddannelsescenter, Swedish EPA *Reduce Marine Litter: Save the North Sea Project Results*, EU INTERREG IIIB.
[51] A.Trouwborst (2011) "Managing Marine Litter: Exploring the Evolving Role of International and European Law in Confronting a Persistent Environmental Problem" in *Merkourios – the Utrecht Journal of International and European Law*.

found entangled in plastic bags on coastlines. This means that of all animals found entangled over that period by the ICC, 10% were entangled in plastic bags (Table 3, Figure 2).[52]

Table 3: Entangled wildlife in plastic bags, 1985-201052

	Birds	Fish	Others[53]	Total
Beverage bottles	8	27	65	100
Beverage cans	2	15	19	36
Crab/Lobster/Fish traps	11	48	114	173
Fishing hooks	76	54	21	151
Fishing line	722	553	361	1 636
Fishing nets	153	249	270	672
Bags (Plastic)	102	142	160	404
Ribbon/String	91	37	38	166
Rope	160	114	152	426
6-pack holders	63	52	31	146
Plastic straps	30	34	24	88
Wire	31	16	28	75
Total	**1 449**	**1 341**	**1 283**	**4 073**

[52] ICC (2011) *Tracking Trash*, 25 years of Action for the Ocean, http://act.oceanconservancy.org/pdf/Marine_Debris_2011_Report_OC.pdf.
[53] Amphibians, corals/sponges, invertebrates, mammals, reptiles.

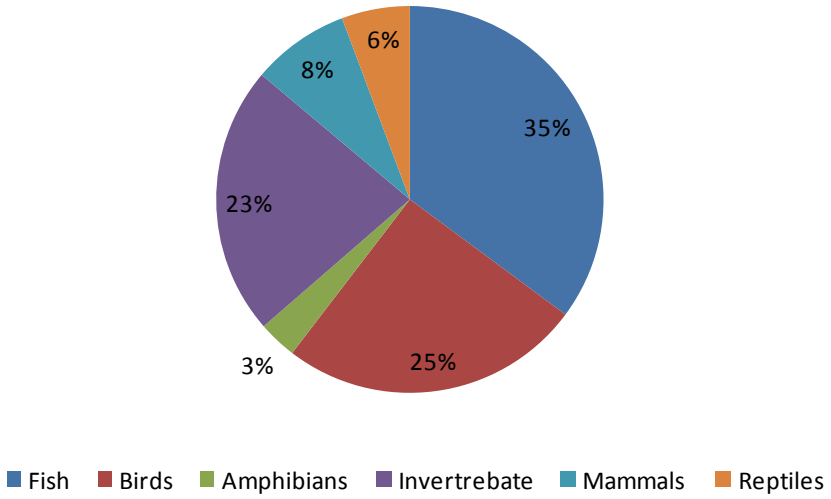

Figure 2: Entanglement of animals in plastic bags by species type, 1985-2010

Plastic debris can transport persistent organic pollutants (POPs) and non-indigenous species to new locations and distribute algae associated with red tides.[54] The possibility that pelagic plastics may be potential vectors in the dispersal of aggressive and invasive species (bacteria, algae or invertebrates) that could endanger endemic biota now warrants serious attention and further research.[55]

The accumulation of plastic debris on the seabed can inhibit gas exchange between the overlying waters and the pore waters of the sediments. The resulting hypoxia or anoxia[56] in the communities of organisms that live on or near the seabed can interfere with normal ecosystem functioning and alter the make-up of life on the sea floor.[57]

After a certain amount of time, plastic debris may simply end up as microplastics,[58] continuing to harm the environment, for example through ingestion by marine organisms or leaching of chemicals such as plasticisers and flame retardants. Plastic particles tend to accumulate persistent bioaccumulating and toxic contaminants such as PCBs, DDT and PBDEs.[59] Microplastics have low surface-to-volume ratios, potentially facilitating contaminant exchange, and they have been shown to be ingested by a range of organisms. Increased consumption of

[54] D.K.A. Barnes et al. (2009) "Accumulation and fragmentation of plastic debris in global environment" in *The Royal Society Journal*.
[55] Murray R. Gregory (2010) "Environmental implications of plastic debris in marine settings - entanglement, ingestion, smothering, hangers-on, hitch-hiking and alien invasions" in *The Royal Society Journal*.
[56] Hypoxia occurs when oxygen concentrations fall below the level necessary to sustain most animal life. Anoxia is a condition characterised by an absence of oxygen supply to an organ or a tissue.
[57] J.G.B. Derraik (2002) "The pollution of the marine environment by plastic debris: a review" in the *Marine Pollution Bulletin*.
[58] NOAA defines microplastics as plastic debris pieces in the size range 0.3-5 mm. See http://marinedebris.noaa.gov/info/plastic.html.
[59] Bowmer, T. And P.J. Kershaw (Eds.) (2010) Proceedings of the GESAMP International Workshop on plastic particles as a vector in transporting persistent, bio-accumulating and toxic substances in the oceans, GESAMP Rep. Stud. No. 82, 68pp, GESAMP (IMO/FAO/UNESCO-IOC/UNIDO/WMO/IAEA/UN/UNEP Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection).

plastics is known to elevate PCB levels in seabirds for example.[60] PCBs do not break down naturally and accumulate in body tissue, causing serious health effects.

Substances such as BPAs and phthalates that are used as plasticisers can leach out of plastics. Phthalates are not classified as persistent compounds but their presence in the environment has been widely reported. BPA is easily degraded but regularly detected in aquatic ecosystems owing to its continuous release into the environment. Both phthalates and BPA have been shown to bioaccumulate in organisms. They are endocrine disruptors and as such can affect both development and reproduction in animals and humans.[61] Molluscs, crustaceans and amphibians appear to be more responsive to phthalates and BPA, while fish seem less responsive. More research is needed in order to assess the effect of plasticisers on different marine populations.[62]

Research into the full environmental impacts of plastic litter (causes, effects and possible solutions) is ongoing. The available figures on the share of plastic carrier bags in the problem are given later in the report (see 2.5) but the precise share is not known. As 80% of marine litter comes from land-based sources, however, a focus on preventing litter at source is important.[63] Mechanical beach clean-up operations themselves can result in disturbance and removal of natural habitats such as driftwood and seaweed.[64]

2.3 Economic aspects

2.3.1 Value of manufacturing

According to PRODCOM (the official Eurostat database containing statistics on manufactured goods), the production value of all plastics sacks and bags increased by 2-9% per year from 2003 to 2008. In 2009, there was an 11% decrease compared to 2008. This was most likely due to the economic crisis as total quantities of household waste decreased in many Member States.

[60] C. J. Moore, G.L. Lattin, A.F. Zellers *A Brief Analysis of Organic Pollutants Sorbed to Pre and Post-Production Plastic Particles from the Los Angeles and San Gabriel River Watersheds*.
[61] Talsness, C.E., Andrade, A.J.M., Kuriyama, S.N., Taylor, J.A. and F.S. vom Saal (2009) "Components of plastic: experimental studies in animals and relevance for human health" in *Philosophical Transactions of the Royal Society*, Phil. Trans. R. Soc. B 27 July 2009 vol. 364 no. 1526 2079-2096.
[62] J. Oehlmann et al. (2010) "A critical analysis of the biological impacts of plasticisers on wildlife" in *The Royal Society Journal*.
[63] Sheavly, S.B. (2005) *Marine debris – an overview of a critical issue for our oceans*, at Sixth Meeting of the UN Open-ended Informal Consultative Processes on Oceans & the Law of the Sea, 6-10 June 2005, www.un.org/Depts/los/consultative_process/consultative_process.htm.
[64] OSPAR Pilot Project on Monitoring Marine Beach Litter, see www.ospar.org/html_documents/ospar/html/marine_litter_unep_ospar.pdf. See also NOAA Marine Debris Program, http://marinedebris.noaa.gov/info/plastic.html.

Table 4: Value of plastic sacks and bags (including cones) produced in EU-27, 2003-2010 (€m)[65]

	2003	2004	2005	2006	2007	2008	2009	2010
PE	5 472	5 743	6 137	6 625	6 816	6 972	6 100	6 612
Other	1 580	1 555	1 574	1 818	1 801	1 937	1 637	1 678
Total	7 052	7 298	7 711	8 443	8 617	8 910	7 738	8 291

There is no PRODCOM data on plastic carrier bags specifically. However, the market value of European plastic carrier bag production is estimated at €1.5-2.5 billion.[66]

2.3.2 Recycling and collection costs

Plastic carrier bags are a valuable material for recyclers, though PE film is worth less in the market than PET or HDPE bottles. Promotion of biodegradable and other new types of plastic carrier bags, e.g. in Italy, creates a need for investment in new and upgraded recycling facilities. At higher shares of biodegradables or with lower levels of separation, many countries would also need to invest in waste-to-energy capacity.

According to a WRAP study in the UK, the costs of adding mixed plastics packaging to kerbside sort systems are driven primarily by the modelled increase in loading time.[67] Additional costs are also generated by volume constraints on some of the vehicle types modelled – significantly higher costs could be incurred if mixed plastics packaging was collected in less optimal vehicles. The costs of collecting mixed plastics packaging using kerbside sorting systems (excluding any savings from avoided disposal costs) were found to be:

- Rigid plastic packaging only: €1.96[68] to €2.21 per household served (€270 to €302.5 per tonne) for collections on a fortnightly basis and €3.40 to €3.93 per household per year (€324 to €377 per tonne) for collections on a weekly basis; and
- With plastic film, a further €0.30 to €2.48 per household per year (€49.6 to €244.8 per tonne).67

For bring schemes, the indicative incremental costs of collecting mixed plastics packaging using bring schemes (excluding any savings from avoided disposal costs) are:

[65] Eurostat, PRODCOM database.
[66] Alber & Geiger based on internal estimates provided by European industry for 2010.
[67] WRAP (2009) *The financial costs of collecting mixed plastics packaging*, accessed at www.wrap.org.uk/downloads/The_Financial_Costs_of_Collecting_Mixed_Plastics_Packaging.9e67a169.7205.pdf.
[68] Prices converted 26 August 2011 on www.xe.com.

- Rigid plastic packaging only: €36.52 to €249.35 per tonne; and
- With plastic film, a further €47.88 to €169.82 per tonne.[69]

In France, when carrier bags are collected in household waste, the total cost of treatment of this fraction is estimated at €180/tonne. Concerning the current scheme in France, which aims to extend collection to all kinds of plastic packaging, the total cost of treatment is €600/tonne.[70]

2.3.3 Economic cost of litter

In many countries, tourism is vital to the livelihoods of local people and the revenues of national administrations. Tourism is negatively impacted by plastic carrier bag litter, both in terrestrial and marine environments. For instance, Ireland's and the French island of Corsica's economies depend heavily on tourism.[71] The negative economic impact of visible plastic carrier bag litter on their coastal and inland areas was one of the reasons leading them to limit their use.[72] Today, visual pollution is still a problem in many areas of Europe, for example the Azores.[73]

Discarded plastic carrier bags also represent a cost to fishing and other maritime activities based on time and money wasted cleaning, disentangling etc. and because they may damage fish stocks. For example, a study of fishermen in the Shetlands found that fishermen spend an average of 1-2 hours per week cleaning debris from nets but it is not known whether and to what degree plastic carrier bags contribute to this. Each boat could lose between €7 800 and €38 000 per year due to the effects of marine litter.[74] Plastic bags are also a common cause of blocked water intakes in recreational vessels.[75]

Tourism and fishing industries are especially important to economic development in peripheral regions and areas where there are few other employment opportunities. The marine environment is also often the focus of various creative arts and sports. Litter negatively affects both of these characteristics.[76]

A recent study of the economic costs of marine litter in the North East Atlantic found that for most municipalities, the potential economic impact of marine litter, particularly in terms of lost tourist revenue, provides the principal motivation for removing beach litter.[77] Regularly removing

[69] WRAP (2009) *The financial costs of collecting mixed plastics packaging*, accessed at www.wrap.org.uk/downloads/The_Financial_Costs_of_Collecting_Mixed_Plastics_Packaging.9e67a169.7205.pdf.
[70] Source: National authority communication.
[71] The Irish tourist industry contributes nearly €3 billion in tax revenues and supported 250 000 full, part-time and temporary jobs according to An Taisce (2009).
[72] Scottish Government (2005) *Proposed Plastic Bag Levy - Extended Impact Assessment Volume 2, Appendix 1, International Context – Experience Elsewhere - Republic of Ireland*, available at: www.scotland.gov.uk/Publications/2005/08/1993259/33019.
[73] KIMO International (2009) *Marine litter in the North-East Atlantic Region: Assessment and priorities for response*, OSPAR/UNEP/KIMO International, http://qsr2010.ospar.org/media/assessments/p00386_Marine_Litter_in_the_North-East_Atlantic_with_addendum.pdf.
[74] KIMO International (2009) *Marine litter in the North-East Atlantic Region: Assessment and priorities for response*, OSPAR/UNEP/KIMO International, http://qsr2010.ospar.org/media/assessments/p00386_Marine_Litter_in_the_North-East_Atlantic_with_addendum.pdf.
[75] Mouat, J., Lopez Lozano, R. and H. Bateson (2010) *Economic impacts of marine litter*, KIMO International.
[76] Ibid.
[77] Ibid.

beach litter cost municipalities less than the potential reduction in revenue that would result from taking no action. There are several estimates available of clean-up costs of beach litter:

- UK municipalities spend around €18m each year removing beach litter, which is a 37% increase in cost over the past ten years;[78]
- Research in Poland found that the cost of removing marine litter from the shoreline of five municipalities and two ports amounted to €570 000;[79]
- A 2009 estimate for Ireland is that litter clean-up costs local authorities €10 000 per beach each year;[80]
- In 2007-2008, ten Belgian fishing vessels participated in a "fishing for litter" project. Fishermen received €5 per bag recovered. The annual cost of the project is estimated at €21 700;[81]
- Cleaning of the Swedish Skagerrak coast in 2006 was estimated to cost about €1.5m and took approximately 100 people four months to complete;[82]
- Voluntary clean-up activities also have an economic cost in terms of the value of the time each volunteer contributes – the total cost could thus be considerable.[83]

2.4 Social aspects

Most people consider even small amounts of litter unpleasant. Litter impairs quality of life, contributes to a feeling of insecurity, and damages the image and reputation of urban and rural areas, beaches and seas.[84]

Plastic carrier bags have arguably facilitated a more convenient shopping experience for consumers. Yet in countries and regions that have introduced strong policies to reduce single-use plastic carrier bag use, such initiatives have proved popular. Indeed, many people prefer to use multiple-use carrier bags made of plastic or other materials, as such bags are widely considered to be of higher quality.

Two key social aspects to be examined in any impact assessment are employment (particularly in SMEs), and human health and safety. These are examined in more detail in the sections below.

[78] Mouat, J., Lopez Lozano, R. and H. Bateson (2010) *Economic impacts of marine litter*, KIMO International.
[79] Directorate for Environment and Sustainability, Wales (2010) *Explanatory Memorandum to the Single Use Carrier Bag Charge (Wales) Regulations 2010*.
[80] An Taisce (2009) *Ireland's Marine Litter Survey Report 2008-2009*.
[81] OSPAR Pilot Project on Monitoring Marine Beach Litter, www.ospar.org/html_documents/ospar/html/marine_litter_unep_ospar.pdf.
[82] Ibid.
[83] Mouat, J., Lopez Lozano, R. and H. Bateson (2010) *Economic impacts of marine litter*, KIMO International.
[84] Switzerland Federal Office for the Environment (2011) *Litter-dropping costs money: Component-specific cleaning costs produced by litter-dropping in Switzerland*, Summary of the publication "Littering Kostet", www.bafu.admin.ch/uw-1108-d, FOEN, Bern.

2.4.1 Employment and SMEs

During the early days of plastic carrier bags, there were large, vertically-integrated producers. However, large manufacturers exited plastic bag production decades ago as the market became too complex for them. Today, most (80% or more) EU plastic carrier bag producers are family-owned SMEs.[85] Big granulate manufacturers only function as suppliers for these businesses.

It is estimated that there are around 250-300 producers of plastic carrier bags in the EU, employing around 15 000-20 000 workers,[86] or as many as 50 000 workers if the entire supply chain is included.[87] There are producers of plastic carrier bags present in at least 19 Member States: Austria, Belgium, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Hungary, Italy, Lithuania, the Netherlands, Poland, Portugal, Slovenia, Slovak Republic, Spain, Sweden and the UK. In some Member States, there are national organisations of plastic bag producers; others are not organised in any way. As there is no commonly accepted definition of "single-use plastic carrier bag" and "multiple-use plastic carrier bag", and since many producers manufacture a range of bags, it is not possible to break down the number of producers according to these categories.

European producers face significant competitive pressure from cheaper producers in China and elsewhere for all types of carrier bag, especially for the thinnest single-use plastic carrier bags but also for multiple-use plastic and even paper and textile bags. An anti-dumping duty on imports of certain plastic sacks and bags originating in China and Thailand was imposed by the EU in 2007.[88] Despite this measure, China exports an estimated €350m worth of plastic bags (shopping bags, bin liners and others) to the EU every year.[89]

European producers are more competitive in the production of some types of carrier bag than others. An industry source estimates that European producers are competitive in the production of bags thicker than 18 microns. Below this level, less material is needed, a simpler production process is possible and cheaper prices can be offered by Asian producers.

At the heavier end of the scale, the production of PP bags involves weaving and sewing, which is done manually. EU producers cannot compete with the labour costs of their Asian counterparts in this domain. LDPE plastic bags, on the other hand, are produced almost entirely by machines, which keeps labour costs low. In addition, as most machines used for the production of LDPE bags are developed and manufactured in Europe, European manufacturers have a strategic and competitive advantage over Asian producers, who need to buy these machines.

The EU may also have a relative competitive advantage in biodegradable plastics. Thus, promotion of such materials could lead to better prices for producers, especially if consumers were willing to pay more for such bags and/or products contained by them. Estimates of the job

[85] Source: industry stakeholder.
[86] Alber & Geiger estimate.
[87] EuPC (2006) *EU duties on plastic bag imports applauded by EuPC*, press release available at: www.europeanplasticfilms.eu/docs/antidumping.pdf.
[88] Council Regulation (EC) No 1356/2007 of 19 November 2007 amending Regulation (EC) No 1425/2006 imposing a definitive anti-dumping duty on imports of certain plastic sacks and bags originating in the People's Republic of China and Thailand, and terminating the proceeding on imports of certain plastic sacks and bags originating in Malaysia.
[89] Reuters (2010) *EU concerned Chinese bag makers avoiding EU import tariffs*, available at: www.reuters.com/article/2010/08/20/eu-trade-bags-idUSLDE67J1ED20100820.

impact of biodegradable plastics range from 3 000 to 6 000 jobs directly and indirectly for a production capacity of 0.1 Mt of biopolymers. This includes all stages of the value chain and all products: from agriculture and related activities, through engineering and plant construction to conversion, sales, etc. Manufacturers of bio-resins include very large companies such as BASF, while companies such as Novamont in Italy are involved in the manufacture of the bags themselves.

2.4.2 Health and safety impacts

Some plastics contain potentially harmful monomers and additives such as plasticisers. Adverse effects have been observed in laboratory animals and measurable levels of such chemicals have been found in humans.[90] Depending on the toxicity of chemicals used and the level of exposure, there could be a risk to vulnerable groups such as children and pregnant women. Health impacts in turn have economic impacts on health care systems and social impacts for society.

2.4.2.1 Litter

Polymers are large molecules and thus not very reactive. However, additives, unreacted monomers and degradation products are small and can be more readily released into the environment over time.

Living organisms can ingest the microscopic plastic particles floating in the ocean and contaminating the soil. As a result, harmful compounds such as endocrine disruptors that are present in plastic carrier bags may be passed along the food chain or accumulated in a process of biomagnification. Humans are then subject to health risks from these accumulated chemicals. The ingestion of plastic fragments by organisms such as barnacles or lugworms could result in health effects on the human being at the other end of the food chain.

Some species of vibrio bacteria, which are potentially pathogenic, have been shown to grow preferentially on plastic particles in the ocean. While it is unknown whether those found can cause disease, the finding is of potential concern. More directly, there is a risk of children ingesting plastic fragments on beaches.

By clogging sewer pipes, plastic carrier bags also create stagnant water, which produces the ideal habitat for mosquitoes and other parasites, which have the potential to spread disease. They can also block storm drains, exacerbating flooding events. This is considered more of a problem in less developed countries, where flooding may be more intense and impacts on public health[91] and the environment more severe.

[90] Thompson, R.C., Moore, C.J., vom Saal, F.S., Swan, S.H. (2009) "Plastics, the environment and human health: current consensus and future trends" in *Phil. Trans. R. Soc. B* 2009 364., Royal Society Publishing.

[91] Floods can potentially increase the transmission of water-borne diseases, such as typhoid fever, cholera, leptospirosis and hepatitis A, and vector-borne diseases, such as malaria, dengue and dengue haemorrhagic fever, yellow fever, and West Nile Fever. Source: www.who.int/hac/techguidance/ems/flood_cds/en/.

2.4.2.2 End-of-life

For plastic waste in general, recycling is the best option in terms of potential impacts on human health, followed by energy recovery, with landfill or incineration without energy recovery likely to be the worst options. Plasticisers and other additive chemicals have been shown to leach from landfills and can affect the aquatic environment.[92,93] When incinerated, plastic carrier bags can release toxic chemicals. Among the chemicals contained in plastic bags that can have adverse affects on human health are lead, cadmium, mercury and phthalates. However, there are technologies available that can limit or eliminate the release of these substances. Apart from the temperature in the combustion chamber, chemical composition is the predominant impact parameter for the composition of gases.[94] The composition of combustion gases from biodegradable or bio-based plastics does not deviate significantly from that of conventional plastics.

2.5 Quantities of plastic carrier bags in the EU

2.5.1 Production data

Plastics have been used to make lightweight single-use plastic bags since the 1950s for applications such as laundries and bread packaging. By the 1970s, single-use plastic carrier bags were widespread in large retailers.[95]

Figures on the production of plastic sacks and bags are collected annually by Member States and are available from the Eurostat PRODCOM database for the years 1995 to 2010 in two categories: "Sacks and bags of polymers of ethylene (including cones)" and "Plastic sacks and bags (including cones) (excluding polymers of ethylene)". According to Eurostat User Support, "a cone would be a container shaped as a cone, e.g. to hold sweets". However, a more detailed list of the products included under these headings is not available. A comprehensive definition of bags and sacks would include plastic carrier bags but also bin liners, sacks for garden or commercial waste, laundry bags, bags for use in agriculture, fruit and vegetable bags, freezer bags, etc.

The available PRODCOM data show that the total volume of production in the EU was 3.37 Mt in 2010, of which 2.86 Mt was PE and 0.52 Mt was Other (Table 5). EU production for these categories is concentrated in Italy, Germany, France, Spain, the UK and Poland.

[92] WRAP (2010) *Environmental benefits of recycling – 2010 update*.
[93] Thomson et al (2009) "Plastics, the environment and human health: current consensus and future trends" in *The Royal Society Journal*.
[94] Source: Stakeholder communication.
[95] Strange, K. (2011) *Plastic Bags: National Policies & Practices*, PlasticsEurope.

Table 5: PRODCOM data on "plastic sacks and bags (including cones)" produced in EU-27, 2003-2010 (Mt)[96]

	2003	2004	2005	2006	2007	2008	2009	2010
PE	2.94	3.07	3.05	3.06	3.06	2.91	2.78	2.86
Other	0.49	0.50	0.48	0.52	0.50	0.55	0.52	0.52
Total	3.43	3.57	3.52	3.56	3.57	3.46	3.30	3.37

In the absence of more detailed PRODCOM data, industry and other stakeholders were consulted. BIO estimates based in part on their feedback are provided in Table 6. According to PRODCOM, production of all plastic sacks and bags declined over 2003-2010. We estimate that production of single-use non-biodegradable plastic carrier bags also declined, while single-use biodegradable and multiple-use plastic carrier bags increased, leading to a small overall reduction in production of plastic carrier bags by weight.

Table 6: EU-27 plastic carrier bag production by type, 2010 (Mt)[97]

	2003	2004	2005	2006	2007	2008	2009	2010
Total plastic carrier bags	1.14	1.19	1.18	1.20	1.19	1.15	1.10	1.12
Single-use non-biodegradable	0.50	0.52	0.51	0.52	0.52	0.50	0.44	0.38
Single-use biodegradable	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Multiple-use	0.64	0.67	0.66	0.67	0.66	0.64	0.65	0.73

Biodegradable plastic carrier bags are currently produced in several countries, notably Italy. The EU has potential production capacity of approximately 0.3 Mt of biodegradable polymers potentially suitable for making carrier bags. The production capacity for bio-based but non-biodegradable polymers is estimated at 0.2 Mt.[98] Depending on the policy framework and economic conditions, this capacity could rapidly increase.

[96] Eurostat, PRODCOM database, http://epp.eurostat.ec.europa.eu/portal/page/portal/prodcom/introduction.
[97] BIO estimates based on stakeholder contacts. Total production of plastic carrier bags is assumed to be one third of all plastic sacks and bags. Production of single-use non-biodegradable plastic carrier bags is based on an estimate that 0.73 Mt are placed on the market, adjusted for trade. Production of single-use biodegradable plastic carrier bags is 2.5% of the single-use total in 2009, based on a small number of estimates at Member State level, e.g. 1% in the UK and 3% in Spain. Production of multiple-use plastic carrier bags is calculated as the difference between total and single-use.
[98] Source: Industry stakeholder.

2.5.2 Trade data

As with production, Eurostat databases only contain trade data aggregated at the level of all plastic sacks and bags.

Table 7: PRODCOM data on exports and imports (extra-EU) of "plastic sacks and bags (including cones)", 2010 (Mt)[99]

	Exports	Imports
PE	0.09	0.55
Other	0.04	0.12

There are no separate figures for plastic carrier bags. Industry estimates that around one-third of plastic carrier bags in the EU-27 are imported and we use that assumption for 2010 in this report. For single-use non-biodegradable plastic carrier bags, we assume the share to be 50% (for the lightest single-use bags it would be even higher).

It is clear that significant production has been moving outside the EU-15 or outside the EU-27 altogether. For example, a 2006 LCA estimated that more than 98% of HDPE and PP bags imported into the UK are produced in Far East countries such as China, Indonesia and Malaysia. Within the EU, production has also shifted towards newer Member States.[100] In general, imports from Asia tend to be HDPE bags, while EU production tends to be slightly thicker LDPE bags.

Based on PRODCOM, BIO estimates that 5% of EU production of plastic carrier bags is exported outside the EU. Italy for example exports biodegradable plastic carrier bags to countries such as Australia.

There is also a significant amount of plastic carrier bags exported at end of life, usually for recycling and often to China or other Asian countries. This varies greatly from country to country. For example, Luxembourg exports its separately collected plastic carrier bags, while exports of waste plastic carrier bags from Finland are minimal or zero.

There may also be some illegal exporting of plastic waste including plastic carrier bags to less developed countries, sometimes with inadequate waste management systems. Illegal exports involving plastic bags may contain:[101]

- Household waste including plastic carrier bags;
- Poorly sorted or unsorted plastic waste including plastic carrier bags; and
- Plastic waste including bags contaminated with hazardous substances.

[99] Eurostat PRODCOM data for 2009 extrapolated for 2010.
[100] See for example www.baltictimes.com/news/articles/5051/, which describes Belgian and French plastic bags producers moving to Latvia.
[101] BIO Intelligence Service (2010) *Environmental, social and economic impact assessment of possible requirements and criteria for waste shipment inspections, controls and on-the-spot checks*, DG Environment.

2.5.3 Consumption of plastic carrier bags in the EU

From PRODCOM data, we can calculate the amount of plastic carrier bags placed on the market, i.e. used, as Production – Exports + Imports.

Table 8: Plastic carrier bags placed on the market in EU-27 by type, 2010 (Mt)[102]

	2003	2004	2005	2006	2007	2008	2009	2010
Total plastic carrier bags	1.51	1.60	1.64	1.65	1.70	1.64	1.56	1.61
Single-use non-biodegradable	0.80	0.83	0.86	0.86	0.90	0.86	0.78	0.73
Single-use biodegradable	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02
Multiple-use	0.70	0.76	0.76	0.77	0.78	0.76	0.76	0.87

Dividing these amounts by average weights per bag of 8.5 g (single-use non-biodegradable), 8.9 g (single-use biodegradable) and 78.9 g (multiple-use)[103] gives the number of plastic carrier bags used. Around 89% of plastic carrier bags used were the single-use type, mostly non-biodegradable. Based on an EU population size of around 500 million, this is 198 plastic carrier bags used per person in 2010 (Table 9), of which 171 are the single-use non-biodegradable type.

Table 9: Number of plastic carrier bags used in EU-27 by type, 2010 (billions)[104]

	billions	%	bags per person
Total plastic carrier bags	98.6	100	198
Single-use non-biodegradable	85.3	87	171
Single-use biodegradable	2.3	2	5
Multiple-use	11.0	11	22

Retail markets differ from country to country as do the types of plastic carrier bag used, how they are distributed and the policy framework in place at national and local levels. Also, data are collected differently in each Member State, if at all. Therefore, at Member State level, estimates of per-capita bag consumption vary widely (Figure 1).

[102] BIO estimates based on PRODCOM and stakeholder contacts.
[103] Average weights of plastic carrier bags are difficult to estimate because of the wide variety of shapes, sizes, wall thicknesses and materials used. These averages are based on examples from the LCA literature.
[104] BIO estimates based on stakeholder contacts.

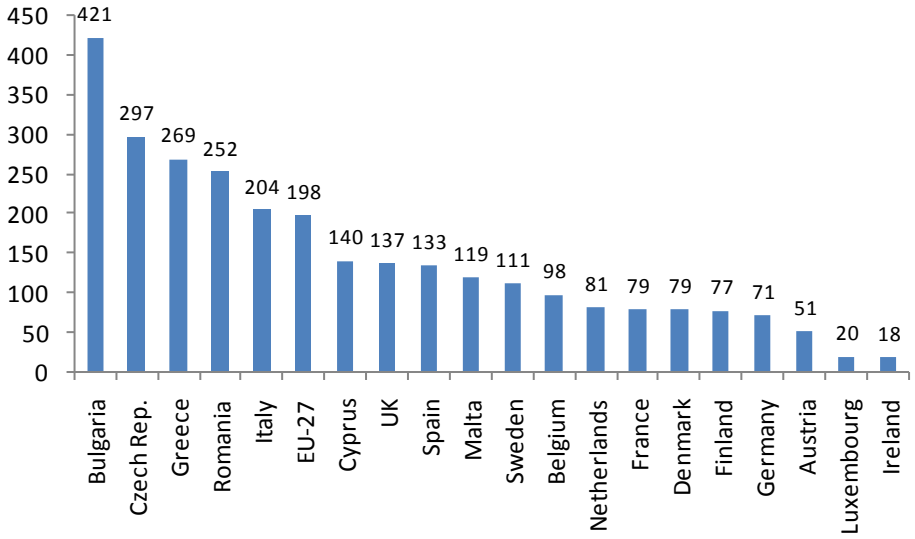

Figure 3: Number of plastic carrier bags used per person per year in selected EU Member States and EU-27[105]

When Member State populations are taken into account, the aggregate ranking is quite different (Figure 4), with Italy alone accounting for 14% of all plastic carrier bags used in the EU (one source puts the share as high as 25%[106]).

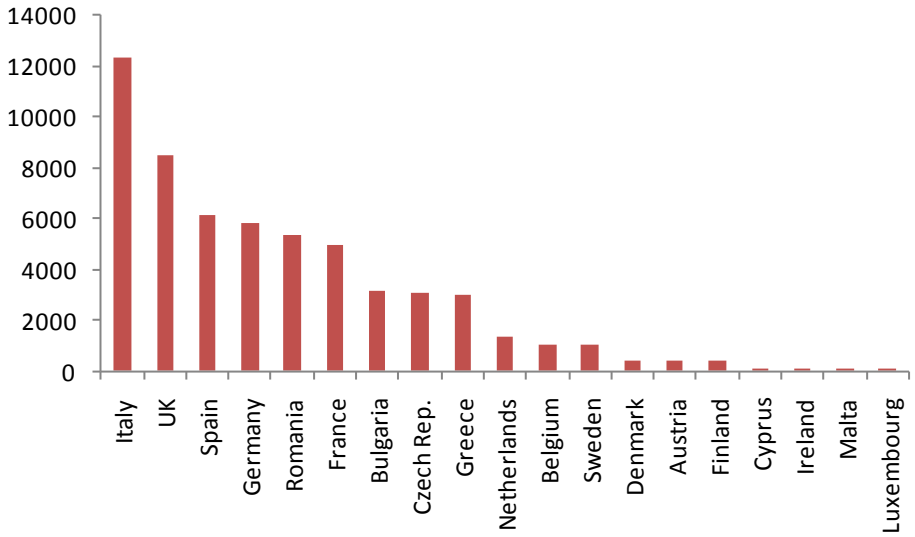

Figure 4: Consumption of plastic carrier bags in selected EU Member States and EU-27 average, 2010 (millions)[107]

[105] For some countries, estimates of bags per person from national authorities, industry and other sources are used. For other countries, and for the EU-27, estimates of total weight are divided by the typical weights for each type of bag to obtain bags per person. Bulgaria is based on estimates by national authorities that 264.4 million single-use bags are used each month, weighing only 6.5 g each. Countries for which no data was found are excluded.

[106] ARPA, Daphne II and ARPAT (2011) *L'impatto della plastic e dei sacchetti sull'ambiente marino*, available at www.arpa.emr.it/cms3/documenti/_cerca_doc/mare/RN_Rapporto_plastica_mare.pdf.

[107] For some countries, estimates from national authorities, industry and other sources are used directly. For other countries, and for the EU-27, estimates are calculated top-down as shares of the PRODCOM totals. Countries for which no data were found are excluded.

Looking at single-use plastic carrier bags separately, the data is even less complete. For some Member States, only the number of single-use bags is available (Ireland) or the vast majority are considered to be single-use (Czech Republic), so the number shown is the same as in Figure 3. The available data does make clear that there is high diversity among Member States and that consumption of single-use plastic carrier bags in the EU is still at a high level.

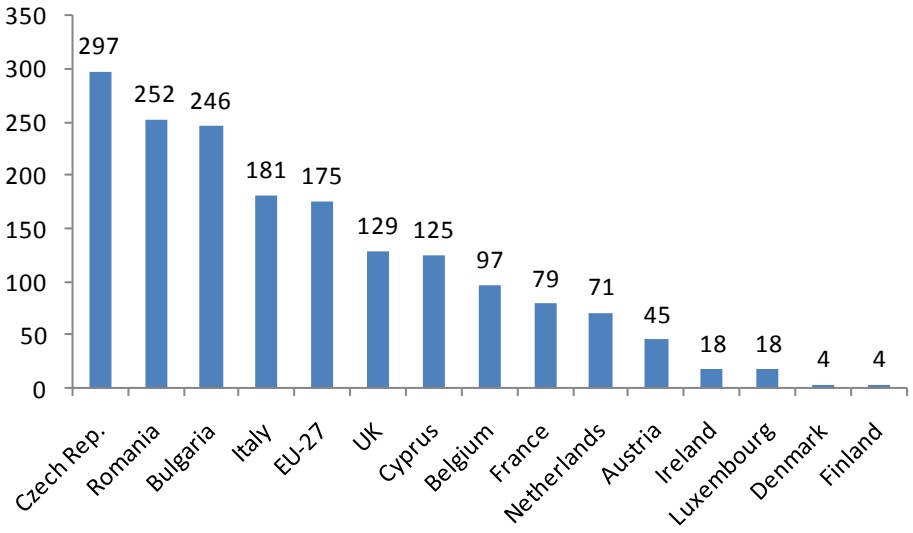

Figure 5: Number of single-use plastic carrier bags used per person per year in selected EU Member States and EU-27 average[108]

As in Figure 4, the aggregate numbers for single-use plastic carrier bags show that a relatively small number of Member States dominate total consumption.

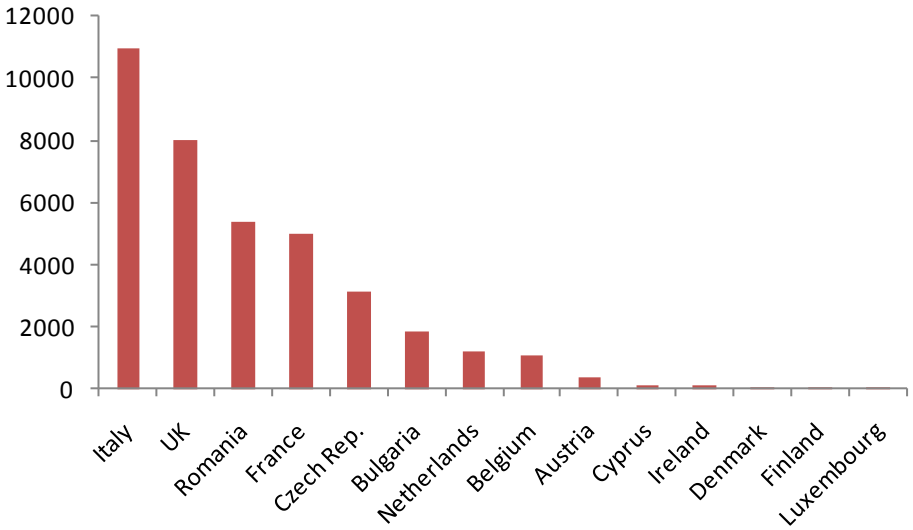

Figure 6: Consumption of single-use plastic carrier bags in selected EU Member States and EU-27, 2010 (millions)[109]

[108] For some countries, estimates from national authorities, industry and other sources are used. For other countries, and for the EU-27, estimates of total weight are divided by the typical weights for each type of bag (non-biodegradable and biodegradable) to obtain bags per person. Countries for which no data was found are excluded.

In the EU, the bulk of plastic carrier bags are distributed by supermarkets and other large retail outlets. Based on data collected in the course of this study, the share of supermarkets is estimated at 68% for the EU, and is expected to rise further over time as supermarkets gain market share at the expense of smaller retailers. Table 10 gives some estimates for a selection of Member States.

Table 10: Share of plastic carrier bags distributed by supermarkets in selected Member States

Member State	Share
Finland	60% of plastic carrier bags are distributed by supermarkets.[110]
France	70% of plastic carrier bags are distributed by supermarkets and 30% by smaller shops.
Ireland	Before the introduction of the levy (2002), it is estimated that the consumption of plastic bags in the grocery sector represented 82% of the total consumption of plastic bags.[111]
Netherlands	It can be estimated that around 50% of single-use plastic carrier bags are distributed by supermarkets.
UK	Can be assumed to be a similar share to Ireland.

Single-use plastic carrier bags are often reused for waste handling or similar uses (bin lining, cleaning up dog waste, sport, etc.). There is no authoritative data on how prevalent these practices are but in many countries reuse is widespread as a result of awareness campaigns, pricing measures, etc.[112] A rough estimate would be that around 80% of single-use plastic carrier bags are reused at least once, either for shopping or more often as bin liners.

[109] For some countries, estimates from national authorities, industry and other sources are used directly. For other countries, and for the EU-27, estimates are calculated top-down as shares of the PRODCOM totals. Countries for which no data were found are excluded.
[110] Source: Stakeholder communication.
[111] Ibid.
[112] Note that here we are referring to conventional HDPE bags being reused for domestic waste or other purposes, as opposed to thick-walled reusable bags that are designed to be used for multiple shopping trips.

Table 11: Reuse of single-use plastic carrier bags in selected countries

Country	Reuse habits
Belgium	Plastic carrier bags cannot be reused as bin liners since special bags are required for collection of domestic waste.
Finland	Most bags are reused as bin liners or for collecting mixed household waste.[113]
Sweden	Most bags are reused as bin liners or for collecting mixed household waste.[114] In some areas, coloured plastic carrier bags are sold for use in sorting waste (blue, green, red, etc.) or distributed by the waste management company FTI.[115]
UK	Around 60-80% of bags are reused for domestic waste.
Norway	60% of all plastic carrier bags are reused for residual waste and 18% are reused to carry bottles or cans back to collection points as part of deposit systems and in turn partly sorted or recycled by shops, while 4% are reused for bringing glass or textiles to collection points.[116]
Switzerland	Plastic carrier bags cannot be reused as bin liners since special bags are required for domestic waste.

2.5.4 End-of-life treatment

Quantitative EU estimates for recycling, energy recovery and landfill are uncertain because plastic carrier bags make up only a relatively small share of total waste streams: according to Eurostat, municipal waste was 251 Mt in the EU in 2008, which would mean that plastic carrier bags accounted for 0.7% of that by weight. There is variation across countries in the share of plastic carrier bags in waste arising. For example:

- In the UK, plastic bags represent 1.3% by weight of the household bin;[117]
- In Ireland, plastic bags and films in dry recyclable waste make up 3.46% of household and 3.05% of non-household waste;[118]
- In Bulgaria however, the 600 tonnes of plastic bags put on the market every year represent about 0.4% of the total amount of municipal waste generated.[119] Single-use plastic carrier bags account for 350 tonnes of that.

[113] Source: Stakeholder communication.
[114] Ibid.
[115] Ibid.
[116] Mepex Consult (2008) *Plastic carrier bags, sustainable trade and recovery*.
[117] WRAP (2008) *Domestic waste plastics packaging - Waste Management options*, available at: www.wrap.org.uk/downloads/Mixed_Plastic_Final_Report.2732ffba.5496.pdf, p 16.
[118] Source: Stakeholder communication.
[119] Ibid.

2.5.4.1 *Recycling*

In a context of high and volatile oil prices, it becomes less expensive to use recycled plastic resins than virgin resins, increasing the incentive to recycle plastic carrier bags. Recycled plastic carrier bag resins are used to make new plastic bags or other products.[120] The recycling rate for plastic carrier bags in the EU is expected to continue to grow in the coming years.[121] BIO estimates that the EU recycling rate for plastic carrier bags is 6.6%.

Plastic carrier bags are not widely recycled in all Member States despite their quite high level of recyclability. Plastic carrier bag recycling depends on technical capacities in waste sorting, which vary widely from one Member State to the next (see Annex C for information on plastics recycling).

Table 12: Recycling performance in selected Member States

Member State	Recycling performance
Finland	Around one third of plastic bags are recycled.[122]
Germany	Plastic carrier bags are collected and recycled together with other plastic packaging in so-called Dual System collection schemes.[123]
Greece	In 2008, less than 1% of plastic bags used by households were recycled or recovered.[124]
UK	Government targets focus on weight rather than volume, making plastic recycling schemes difficult to operate economically because plastic is so light.[125] Only 5% of plastic bags are recycled,[126] including a proportion sent abroad for recycling

Plastic carrier bags are usually recycled as part of the plastic film category rather than in dedicated plastic carrier bag recycling facilities. A JRC study estimated the rate of separate collection of plastic bags in EU-25 at 5% (in 2005) and projected it to grow to 7.5% in future (2015). As bags and wrap are subcategories of film, the rate for film is higher than that for bags (Table 13).

[120] Food Marketing Institute (2008) FMI Backgrounder: Plastic Grocery Bags — Challenges and Opportunities, *www.fmi.org/docs/media/bg/Plastic_Bag_Backgrounder.pdf.*
[121] Interview with Bruno Gauthier, President of Régéfilms (FR plastic bag recycler), June 2011.
[122] Source: Industry stakeholder.
[123] Source: Communication with national authority
[124] Strange, K. (2011) *Plastic bags: National Policies & Practices 2011*, PlasticsEurope.
[125] UK Parliament (2005) Report number 252, *Recycling Household Waste*, www.parliament.uk/documents/post/postpn252.pdf.
[126] thisismoney.co.uk (2008) *The life cycle of a plastic bag*, accessed at: www.thisismoney.co.uk/consumer/caring/article.html?in_article_id=431217&in_page_id=511.

Table 13: Separate collection ratios estimated for different applications in EU-25[127]

Packaging application	Current (2005) collection ratio	Future (2015) collection ratio
Bottles, containers and 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%

2.5.4.2 *Energy recovery*

Plastic carrier bags have a high calorific value and this energy can be recovered in waste-to-energy plants for use in district heating and electricity generation, or through approaches such as co-fuelling of kilns.[128] BIO estimates that the share of plastic carrier bags going to energy recovery in the EU is 39%.

In general, plastic carrier bags are an easy, safe and hygienic source of fuel for waste-to-energy plants. However, not all countries, notably in southern and eastern Europe, have this capacity in place (Table 14).

[127] JRC IPTS (2007) *Assessment of the Environmental Advantages and Disadvantages of polymer recovery processes*.
[128] Thomson et al (2009) "Plastics, the environment and human health: current consensus and future trends" in *The Royal Society Journal*.

Table 14: Energy recovery in selected Member States

Member State	Energy recovery
Bulgaria	Plastic carrier bags not considered high enough quality for materials recovery and so are incinerated with energy recovery.[129]
Denmark	Plastic carrier bags almost all go to energy recovery.[130,131]
Germany	
Finland	About 10% of mixed municipal solid waste is incinerated with energy recovery and the rest is landfilled. However, from 2015 the majority of municipal waste will be incinerated.
France	Estimates from 2003 in France put the share at around 43%.[132]
Ireland	There is currently no incineration capacity but it is expected to be in place within one to three years. Some waste, including plastics, is sent to cement kilns as solid recovered fuel (SRF).[133]
Netherlands	Plastic packaging that is not recycled is burned with energy recovery in municipal waste incinerators that meet the efficiency requirements of the WFD in order to qualify as a recovery operation. Landfilling of burnable waste is not allowed.

2.5.4.3 *Landfill/Incineration*

A substantial fraction of plastic carrier bags is still sent to landfill in many countries, despite it being a poor alternative compared to recycling or energy recovery. BIO estimates that 50% of plastic carrier bags in the EU are either landfilled or incinerated without energy recovery.

Some plastic carrier bags in landfill can take as little as two years to break down significantly, whereas others can take decades or longer depending on the conditions. Biodegradable plastic carrier bags do not last as long in the environment as non-biodegradable bags. However, they will still only degrade within a reasonable time if disposed of in appropriate conditions.[134]

Estimates from 2004 in France are that 5.9% of thin HDPE bags were incinerated (without energy recovery) and 51% were landfilled.[135] In other countries such as Germany, landfill bans on untreated waste are in place.

[129] National authority communication.
[130] National authorities and Strange, K. (2011) *Plastic bags: National Policies & Practices 2011*, PlasticsEurope.
[131] Ibid.
[132] PwC/Ecobilan (2004) *Impact assessment of Carrefour plastic carrier bags,* Carrefour, France.
[133] National authority communication.
[134] This is true of any degradable plastic, e.g. a photodegradable plastic product will not degrade if it is buried in a landfill site where there is no light.
[135] National authority communication.

2.5.5 Litter

2.5.5.1 *Plastic carrier bags littered*

Films such as carrier bags are a major component of terrestrial plastic litter.[136] They are very mobile due to their lightness so they can easily escape containment. They can persist in the environment for a long time and substantial quantities of plastic bags are accumulating in natural habitats worldwide. Estimates from a small number of Member States put the share of plastic carrier bags in litter in a range of less than 1% (in countries such as Denmark) to as high as 5% (Table 15).

Table 15: Litter in selected countries

Country	Estimated share of plastic carrier bags in litter
Ireland	Plastic carrier bags accounted for 5% of litter before the levy was introduced in 2002 and then dropped almost overnight to around the current level (0.25% in 2010)
Germany	Plastic carrier bag litter is not considered a significant issue in these (and other) countries because waste management systems are highly developed and multiple-use bags are common. Heavier multiple-use bags may be less likely to escape waste management and end up in the environment.[137]
Netherlands	
Switzerland	A study found that carrier bags (plastic and paper) accounted for 5% of litter items in the cities studied.[138]

Looking at the issue from another perspective, estimates of the share of plastic carrier bags that are littered also vary widely – from less than 1% to as high as 10%. BIO estimates that at EU level, 4.6% of plastic carrier bags (74.4 kt) were littered in 2010. That is 4.4 billion plastic carrier bags, of which 4 billion were the single-use type, assuming each type of bag is equally likely to be littered.

2.5.5.2 *Marine litter*

Around 6.4 Mt of litter ends up in oceans and seas worldwide every year, of which around 75% (4.2 Mt) is plastic, much of it packaging, carrier bags, cigarette lighters and other domestic items.[139] In Europe, the share of plastic in marine litter is around 60-80% depending on the sea.[140]

[136] David K.A. Barnes et al. (2009) "Accumulation and fragmentation of plastic debris in global environment", in *The Royal Society Journal*.
[137] Norconsult, (2008) *Environmental Consequences of the use of plastic shopping bags*, see www.klif.no/nyheter/dokumenter/norconsult_plastposer_rapport280808.pdf.
[138] Heeb, J. and W. Hoefellner (2004) *Litteringstudie Zwischenbericht: Auswertung und Synthese aller Datenaufnahmen*, Universität Basel.
[139] Bowmer, T. and P.J. Kershaw (Eds.) (2010) citing United States National Academy of Sciences (1975); the figure is compiled from maritime sources.
[140] KIMO International (2009) *Marine litter in the North-East Atlantic Region: Assessment and priorities for response*, OSPAR/UNEP/KIMO International, http://qsr2010.ospar.org/media/assessments/p00386_Marine_Litter_in_the_North-East_Atlantic_with_addendum.pdf.

Gyres and enclosed seas are worst affected: giant masses of plastic waste known as "plastic soup" have been discovered in the oceans. The Mediterranean Sea, with its densely populated coastline, shipping activity and low tidal flow, is also particularly vulnerable. There are around 500 tonnes of plastic waste in the Mediterranean.[141]

Overall, quantities of debris in the oceans may have stabilised over the last decade. If confirmed, this could indicate that quantities of debris entering the sea are declining but the material already in the sea is progressively being deposited on the shore or sinking to the deep.[142] Further research would be needed in order to confirm this and, if true, to establish the reasons for it, which are likely to include better plastic waste management, sinking, or microbial action.

For much of the oceans there is little or no data available.[143] The characteristics and behaviour of plastic make it difficult to sample and measure. It is transnational in nature and in constant movement in the oceans. It is very difficult to extrapolate from a specific location to EU level, to distinguish plastic bags from other plastic waste, or to identify sources.

All plastic carrier bags are produced on land and although the proportion of marine debris that originates from land-based activities (tourism, sewage, illegal or poorly managed landfill) is not known accurately, it is considered by some sources to be as high as 80%, with significant regional differences.[144]

Monitoring is crucial but beach surveys are complicated by their infrequency and the removal of litter items during beach clean-ups and other beach dynamics. Local authorities usually do not record quantities and categories of litter collected. Monitoring of impacts is another approach but it is difficult to distinguish sources of ingested plastic and entanglement rates are hard to interpret.[145]

2.5.5.3 Coastline

At world level, Table 16 shows the top ten items that were picked up by International Coastal Clean-up (ICC) volunteers over the past 25 years. Table 17 shows the top ten for 2010 and implies a rising share of plastic bags and rising numbers over the period.[146]

[141] Ifremer (forthcoming).
[142] David K.A. Barnes et al. (2009) "Accumulation and fragmentation of plastic debris in global environment" in *The Royal Society Journal*.
[143] Bowmer, T. and P.J. Kershaw (Eds.) (2010) Proceedings of the GESAMP International Workshop on plastic particles as a vector in transporting persistent, bio-accumulating and toxic substances in the oceans, GESAMP Rep. Stud. No.82, 68pp, GESAMP (IMO/FAO/UNESCO-IOC/UNIDO/WMO/IAEA/UN/UNEP Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection).
[144] Sheavly, S.B. (2005) *Marine debris – an overview of a critical issue for our oceans*, at Sixth Meeting of the UN Open-ended Informal Consultative Processes on Oceans & the Law of the Sea, 6-10 June 2005, www.un.org/Depts/los/consultative_process/consultative_process.htm.
[145] Ryan, P.G., Moore, C.J., van Franeker, J.A. and C.L. Moloney (2009) "Monitoring the abundance of plastic debris in the marine environment" in *Phil. Trans. R. Soc. B* 2009 364, Royal Society Publishing.
[146] ICC (2011) *Tracking Trash*, 25 years of Action for the Ocean, http://act.oceanconservancy.org/pdf/Marine_Debris_2011_Report_OC.pdf.

Table 16: Top ten debris items found on beaches worldwide by ICC over past 25 years

Rank	Debris item	Number (millions)	Percentage
1	Cigarettes/cigarette filters	52.9	32%
2	Food wrappers/containers	14.8	9%
3	Caps, lids	13.6	8%
4	Cups, plates, forks, knives, spoons	10.1	6%
5	Beverage bottles (plastic)	9.5	6%
6	**Bags (plastic)**	**7.8**	**5%**
7	Beverage bottles (glass)	7.1	4%
8	Beverage cans	6.8	4%
9	Straws/Stirrers	6.3	4%
10	Rope	3.3	2%
	Top ten total debris items	132.1	80%
	Total debris items worldwide	166.1	100%

Table 17: Top ten debris items found on beaches worldwide by ICC, 2010

Rank	Debris item	Number (millions)	Percentage
1	Cigarettes/cigarette filters	1.893	19%
2	Beverage bottles (plastic)	1.095	11%
3	**Bags (plastic)**	**0.980**	**10%**
4	Caps, lids	0.883	9%
5	Food wrappers/containers	0.854	9%
6	Cups, plates, forks, knives, spoons	0.525	5%
7	Beverage bottles (glass)	0.441	4%
8	Straws/stirrers	0.433	4%
9	Beverage cans	0.429	4%

Rank	Debris item	Number (millions)	Percentage
10	Bags (paper)	0.300	3%
	Top ten total debris items	7.826	79%
	Total debris items worldwide	9.843	100%

ICC also provides a breakdown by country that can give an idea of the countries in which the problem is most severe, i.e. countries with larger economies, longer coastlines and less restrictive policies on plastic bags (Figure 7).

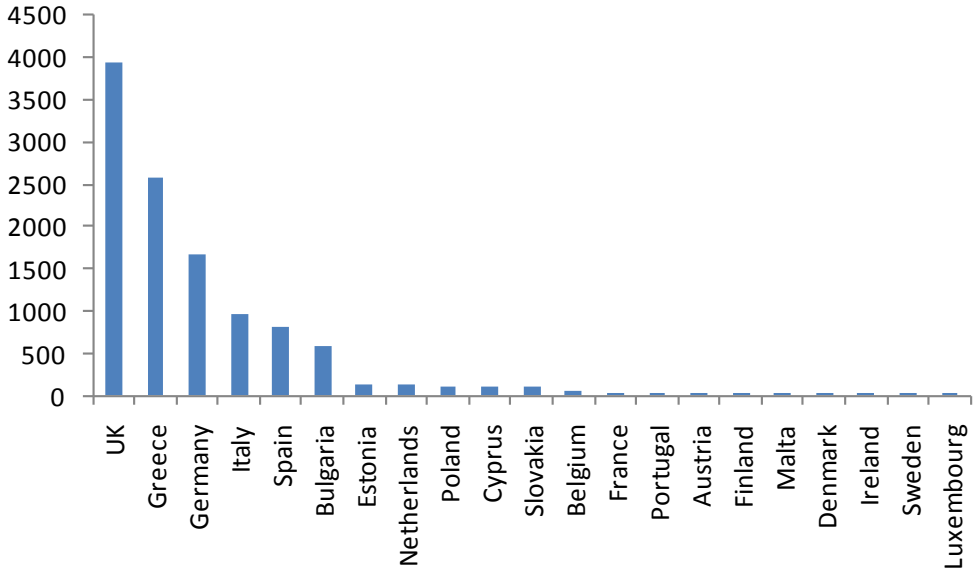

Figure 7: Number of plastic bags found by ICC volunteers by Member State, 2010[147]

Italy has a coastline of nearly 8 000 km and a central location in the Mediterranean basin. It is one of the Mediterranean countries with rich coastal and marine habitats, and at the same time one of the largest consumers of single-use plastic carrier bags, with around 12 billion used per year, corresponding to 200 bags per person. A recent study by the regional environmental agencies of Tuscany and Emilia Romagna highlights that 8.5% of the objects found on Mediterranean beaches by ICC between 2002 and 2006 were plastic bags.[148]

During the Marine Conservation Society "Beachwatch" weekend organised in 2010 in the UK, 7 273 bags including carrier bags were picked up, which is 43.2 items per km. Plastic bags ranked 13th of the top 20 items collected on a total of 376 beaches, covering 167.6 km of coastline in England, Scotland, Wales, Northern Ireland and the Channel Islands.[149]

[147] ICC (2011) *Tracking Trash*, 25 years of Action for the Ocean, http://act.oceanconservancy.org/pdf/Marine_Debris_2011_Report_OC.pdf.
[148] ARPA, Daphne II and ARPAT (2011) *L'impatto della plastic e dei sacchetti sull'ambiente marino*, available at www.arpa.emr.it/cms3/documenti/_cerca_doc/mare/RN_Rapporto_plastica_mare.pdf.
[149] See www.mcsuk.org/downloads/pollution/beachwatch/latest2011/Methods%20&%20Results%20BW10.pdf.

Seasonal variability of marine litter location has been observed. For example in the Bay of Biscay (along France and Spain), there are two items of marine litter per hectare in summer time but seven times that amount in winter.

Taking plastic items separately, the available data does not allow a precise estimate of the share of plastic carrier bags in total plastic litter. However, a rough estimate can be made based on Table 17 that the share is at least 23%.[150]

2.5.5.4 *Sea surface and water column*

Once at sea, plastics become weathered or degraded. However, as a result of their large surface area and low mass, plastic carrier bags can float for around six months before sinking,[151] go on floating in the water column[152] and take between 10 and 30 years to degrade, depending on the type.[153] In 2000, a Japanese hydrographer observed numerous white plastic shopping bags suspended upside down and freely drifting in the ocean at water depths of 2 km. He described it as looking like "an assembly of ghosts".[154]

Even after prolonged exposure to UV light and physical abrasion, plastic carrier bags may simply end up as chemicals and particulates known as microplastics.[155] The abundance of microscopic debris increased significantly in recent decades, although recent studies have revealed no clear trend in the concentration of particles in surface waters in areas of mid-ocean accumulation such as the northwest Atlantic gyre.[156] For example, some recent findings from the Sea Education Association find that, for the North Atlantic at least, the amount of plastic waste in the ocean has not been increasing despite the rise in generation.[157]

2.5.5.5 *Seabed*

A study of the seabed using trawl nets in the North-Western Mediterranean around the coasts of Spain, France and Italy in 1993/1994 reported a particularly high mean concentration of debris at 19.35 items per hectare. Out of these, 77% of the debris was plastics and of this, 92.8% were

[150] Assuming category 3 refers to plastic carrier bags and categories 2, 4, 5 and 6 refer to plastic items.
[151] James, K. and T. Grant (2005) LCA of Degradable Plastic Bags, Centre for Design at RMIT University.
[152] South Carolina Sea Grant Consortium, South Carolina Department of Health and Environmental Control, Centers for Ocean Science Education Excellence and NOAA (2008).
[153] Mouat, J., Lopez Lozano, R. and H. Bateson (2010) *Economic impacts of marine litter*, KIMO International.
[154] Oshima, S. (2000) *Towards a 'Visual Sea'*, cited in Murray R. Gregory (2010) "Environmental implications of plastic debris in marine settings –entanglement, ingestion, smothering, hangers-on, hitch-hiking and alien invasions" in *The Royal Society Journal*.
[155] NOAA defines microplastics as plastic debris pieces in the size range 0.3-5 mm. See http://marinedebris.noaa.gov/info/plastic.html.
[156] Bowmer, T. and P.J. Kershaw (Eds.) (2010) Proceedings of the GESAMP International Workshop on plastic particles as a vector in transporting persistent, bio-accumulating and toxic substances in the oceans, GESAMP Rep. Stud. No. 82, 68pp, GESAMP (IMO/FAO/UNESCO-IOC/UNIDO/WMO/IAEA/UN/UNEP Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection).
[157] Lavender Law, K., Morét-Ferguson, S., Maximenko, N. A., Proskurowski, G., Peacock, E. E., Hafner, J. and Reddy, C. M. (2010) "Plastic Accumulation in the North Atlantic Subtropical Gyre" in Science, DOI: 10.1126/science.1192321. Available at: www.sciencemag.org/cgi/content/abstract/science.1192321.

plastic bags.[158] By around 2005, the figure was 15 items of plastic waste per hectare on average, most of which were plastic bags.[159] This is still higher than other European regions.

2.5.6 Summary of plastic bag flows in Europe

As mentioned in the relevant sections above, BIO estimates for 2010 that about 6.6% of plastic bags are recycled in the EU, about 39.1% go to energy recovery and 49.7% are landfilled or incinerated without energy recovery. Around 4.6% of plastic carrier bags are littered.

Table 18: Summary of EU plastic bag flows by weight, 2010 (Mt)[160]

	Production	Exports	Imports	Consumption	End-of-life			Litter
					Recycled	Energy recovery	Landfill	
Total bags and sacks	**3.37**	**0.13**	**0.67**	**3.91**	**-**	**-**	**-**	**-**
Total plastic carrier bags	**1.12**	**0.05**	**0.54**	**1.61**	**0.106**	**0.631**	**0.801**	**0.074**
Single-use non-biodegradable	0.38	0.02	0.36	0.73	0.048	0.284	0.360	0.033
Single-use biodegradable	0.01	0.00	0.01	0.02	0.001	0.008	0.010	0.001
Multiple-use	0.73	0.03	0.17	0.87	0.057	0.339	0.431	0.040

In terms of numbers of bags, BIO estimates that in 2010, 98.6 billion plastic carrier bags were used, of which 89% were the single-use type. The number of bags littered is estimated at 4.5 billion.

Table 19: Summary of EU plastic carrier bag flows by number, 2010 (billions)[161]

	Consumption	Litter
Single-use non-biodegradable	85.3	3.9
Single-use biodegradable	2.3	0.1
Multiple-use	11.0	0.5
Total carrier bags	**98.6**	**4.5**

[158] Greenpeace (1995) Plastic debris in the world's oceans.
[159] Source: Galgani (2006).
[160] BIO analysis based on available data and stakeholder estimates.
[161] Ibid.

2.6 Underlying drivers

Several factors have led to the current situation in Europe i.e. high amounts of plastic carrier bags consumed yearly by EU citizens and litter resulting from this high level of consumption.

2.6.1 Market failure

Low consumer awareness: Consumer awareness of the problem of litter and the overall environmental benefits of reusing plastic carrier bags and switching to multiple-use plastic carrier bags is still low, especially in Member States that do not yet have strong policies in this area.

Consumer behaviour: Consumer trends towards eating lunch at places of work or education, eating away from the home and greater use of public spaces;[162] light weight and mobility, low (or zero) cost and convenience of plastic carrier bags.

Retail practices: Retailers are not encouraged to limit the use of plastic bags because they are inexpensive and provide a service to their customers (according to some, unilaterally reducing such a service might have a negative impact on their sales).

External costs: The use of plastic carrier bags also entails negative environmental externalities (littering, ocean contamination, other environmental pollution, health hazards for human and animals, etc.) that are not included in the prices paid by retailers and end users.

Low recycling: Even though they are recyclable, the thinness and light weight of plastic carrier bags mean they do not have as high a recycling value as other sources. Transportation is not very profitable even if the bags are compacted and washing them requires large volumes of water.

2.6.2 Regulatory failure

Regulatory failure occurs when the wrong regulation is used to tackle a given type of market failure, or when it is badly implemented. It can occur at both EU and Member State levels. Failures to implement and enforce the existing legislative framework governing packaging and packaging waste are key drivers of the problem.

At **EU level**, plastic carrier bags are considered packaging following a ruling of the European Court of Justice[163] and are therefore covered by the Packaging and Packaging Waste Directive, a 'harmonising' Directive submitted to Article 95 of the Treaty. According to this article, Member States must regulate packaging and packaging waste without introducing measures that prejudice the free movement of goods on the internal market.

This means that the achievement of a high level of protection of the environment and the reduction of the amount or plastic bags on the market is restricted to measures that do not

[162] Switzerland Federal Office for the Environment (2011) *Litter-dropping costs money: Component-specific cleaning costs produced by litter-dropping in Switzerland*, Summary of the publication "Littering Kostet", www.bafu.admin.ch/uw-1108-d, FOEN, Bern.
[163] ECJ, Case C-341/01, available at: eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:62001J0341:EN:HTML.

disrupt the internal market. Therefore, protection cannot be achieved by means of outright bans that hinder the free movement of goods such as that being implemented in Italy, but only by less restrictive measures such as economic instruments.

Additionally, the Packaging Directive adopts a flexible approach to the waste hierarchy: it does not prioritise reuse over recycling and leaves it up to Member States to encourage energy recovery when it is preferable to material recycling for environmental and cost-benefit reasons. Hence, the Packaging Directive is not in total coherence with the hierarchy set out in the Waste Framework Directive (WFD).

At **Member State level**, policies to reduce landfill use may be poorly enforced and appropriate infrastructure is often lacking. The Packaging Directive only states that Member States have to ensure that systems are set up to provide for the return and collection and for the reuse and recovery of used packaging, in order to achieve the set targets. National measures implementing the Packaging Directive fail to address the specific issue of plastic carrier bag litter and improper treatment since in some countries no collection and waste treatment schemes specific to plastic bags are in place.

2.7 Who is affected?

The main stakeholders affected by the problem identified (i.e. loss of resources and littering) are as follows:

- **Citizens in the EU:** Suffer from littering while contributing to the costs of collection, treatment and cleaning up through the payment of taxes.
- **Citizens outside the EU:** A large amount of plastic waste including plastic carrier bags is exported outside the EU for recycling. This stimulates employment in third countries at the expense of employment in the EU. Problems related to plastic carrier bag litter have been observed in several third countries, negatively impacting marine environments and tourism.
- **Retailers:** Retailers are the main points of distribution of plastic carrier bags to consumers. Plastic carrier bags are more easily stored and transported than other carrier bags and can be used by retailers for advertising purposes. On the other hand, their storage still represents a cost to retailers; many of them prefer to sell plastic carrier bags, which is highly profitable for them if they are allowed to keep the revenue. Retailers are sensitive to consumer pressure and negative effects on their image. Many have therefore implemented voluntary initiatives to reduce the use of plastic carrier bags by, for example, providing multiple-use bags instead.
- **NGOs:** Many wildlife and environmental NGOs are involved in actions to reduce the use of plastic carrier bags and associated harmful environmental impacts. For example, every year the Ocean Conservancy organises the International Coastal Cleanup: Nearly nine million volunteers from 152 countries and locations have collected over 65 thousand tonnes of litter, of which plastic carrier bags constitute a significant portion. Such campaigns not only help to reduce plastic

carrier bag litter but also raise awareness among consumers of its harmful effects. NGOs often work at the local and community levels and can be quite effective in raising awareness and implementing local actions.

- **Tourism, fishing and other businesses:** Local businesses, especially the tourism industry, are affected by litter. Although it is not yet possible to quantify, the combined environmental impacts of plastic carrier bags in marine litter are likely to have a negative effect on fish stocks in the EU.
- **Public authorities**: National waste authorities are often responsible for ensuring that EU wide regulations are implemented at the Member State level. They are also responsible for implementing waste collection and treatment schemes and cleanup operations. They are therefore affected by the increased cost and administrative burden associated with plastic carrier bag consumption.
- **Public transport companies:** Both public and privately owned public transport companies share the cost of cleaning up litter.

2.8 How will the problem evolve?

The EC guidelines on Impact Assessments require that the problem definition include a clear baseline scenario as the basis for comparing policy options. The baseline scenario aims to provide information and insights as to how the problem would evolve without any additional policies and measures.

The baseline scenario is the reference to which the other policy scenarios are compared. It is a conservative extrapolation of recent trends in the available data at the EU and Member State levels to 2020, assuming no additional measures are put in place to reduce the use of plastic carrier bags. This requires an in-depth analysis of the approaches already adopted by Member States to reduce the use of plastic carrier bags.

This section therefore describes how the situation is expected to develop over the period to 2020 based on trends and policies in place as of mid-2011. The scenario is subject to significant uncertainty due to the complexity of the issue and the incompleteness of the available data. Nevertheless, it clearly shows that while several countries have made good progress in reducing use of plastic carrier bags, the situation at EU-27 level is not improving fast enough to avoid significant environmental impacts over the coming years.

The historical data series is based on factual evidence and whenever possible quantitative data, completed by interpolation and assumptions where necessary. The main elements are as follows:

- Historical data on production, imports and exports of plastic sacks and bags (aggregated into two categories: PE and non-PE) by Member State and for the EU-27 from the Eurostat PRODCOM database;
- Stakeholder estimates of the level and share of plastic carrier bag (single-use non-biodegradable, single-use biodegradable and multiple-use) production, imports, exports and use;

- Population data (historical and projected) from the IMF by Member State;
- Stakeholder estimates of the number of plastic carrier bags used per person by Member State;
- Historical data on the value of production and trade of plastic sacks and bags (aggregated into PE and non-PE) by Member State and for the EU-27 from Eurostat PRODCOM;
- Estimates from stakeholders and the scientific literature of volumes (tonnes and numbers) of plastic carrier bags littered;
- Member State policies and regulations in place; and
- Voluntary actions in place.

2.8.1 Policies and initiatives currently in place

2.8.1.1 EU level

There is currently no EU legislation specifically targeting plastic waste. According to the Packaging and Packaging Waste Directive, plastic bags can be put on the market only if they comply with the essential requirements defined by Annex II of the Directive. These provisions specify requirements for packaging minimisation, limitation of hazardous substances and suitability for reuse and recovery, including recycling, energy recovery, composting and biodegradation.

Currently, several gaps exist in the policy framework that governs the use of plastic carrier bags. Although plastic carrier bags are regulated by the Packaging Directive, there are no specific provisions related to them in EU legislation. Further, in its current form, the Packaging Directive sets limits to action by Member States to effectively reduce the use of plastic bags: Article 95 of the Treaty on European Union forbids Member States from putting in place measures limiting free movement of goods (such as outright bans on plastic carrier bags) unless they are justified on specific grounds. With regard to Article 18 of the Packaging Directive, the introduction of such a ban by a single state would be an unlawful distortion of the market.

In addition to the Packaging Directive, several other policies could affect plastic carrier bags. The management of plastic waste cuts across a number of policy fields: not only the sustainable management of resources but also climate change, energy, biodiversity, habitat protection, agriculture, and soil protection. However, the other policies and regulations affecting plastic carrier bags do not target them specifically. This could lead to some inconsistency. The table below describes how several different Directives could have possible impacts on plastic carrier bags:

Table 20: Possible interactions with other EU policies and initiatives[164]

Policy	Overall objective	Potential interaction with plastic carrier bags
Waste Framework Directive 2008/98/EC	Aims to protect human health and the environment against harmful effects caused by the collection, transport, treatment, storage and landfilling of waste.	Plastics typically make up a large proportion of the waste streams covered by the Directive. Includes an obligation for Member States to develop national waste prevention programmes.
Thematic Strategy on the Prevention and Recycling of Waste	Sets out guidelines for EU action and describes the ways in which waste management can be improved. The aim of the strategy is to reduce the negative impact on the environment caused by waste throughout its lifespan.	Under this Strategy, there is the potential to increase the recycling of plastic waste and thus its use as a resource and reduce the need for virgin resources.
Landfill Directive 99/31/EC	Sets a combination of intermediate and long-term targets for the phased reduction and pre-treatment of biodegradable waste going to landfill, as well as banning the disposal in landfill of certain materials.	The Directive influences the disposal of biodegradable plastics. The requirement for treatment or sorting of waste boosts recycling of plastics.
REACH Regulation, (EC 1907/2006)[165]	REACH aims to lower levels of pollution and increase safety levels in relation to the use of hazardous chemicals.	Requires recycling firms to provide information on the types of chemicals included in their plastic recyclate. Furthermore, the Regulation requires recycled plastics producers to register chemicals in the European Chemicals Agency database.
Regulation on plastic materials and articles intended to come into contact with food (EU 10/2011)	This is a new regulation, which came into force on 1 May 2011. It brings all six EU Directives and eight amendments on food contact plastics under one umbrella. The regulation includes basic rules of plastic materials and articles, union list of authorised substances and rules of migration testing.	Some types of plastic bag are intended for contact with meat, fresh fruit and vegetables.

[164] Bio Intelligence Service (2009) *Plastic Waste in the Environment*, available at ec.europa.eu/environment/waste/studies/pdf/plastics.pdf.
[165] Registration, Evaluation, Authorisation and restriction of Chemicals.

2.8.1.2 National policies and initiatives

Member States have implemented various actions to reduce the use of plastic carrier bags. These actions illustrate a non-harmonised approach, which could also affect the functioning of the internal market regarding plastic carrier bags.

A variety of different tools are being used, ranging from voluntary agreements with the retail sector (e.g. UK) to the implementation of fiscal measures (Belgium, Ireland, Denmark), to the outright ban of non-biodegradable carrier bags, as seen in Italy. Taxes and charges are sometimes accompanied by a threat of a ban in the event that particular targets for bag use reduction are not met. Charges may also be applied in tandem with voluntary agreements by industry to reduce bag consumption. Sometimes, effective voluntary action by retailers can forestall the need for mandatory legislative interventions.[166] A detailed list of legislation is provided in Annex B, along with information on initiatives in third countries and companies, and the achieved or planned outcomes.

2.8.2 Baseline Scenario projections

2.8.2.1 Production, trade and consumption of plastic carrier bags

As described earlier, production of all plastic sacks and bags (PE and other) in the EU has been relatively stable over the period 2003 to 2010 in terms of weight, from 3.43 Mt in 2003 to 3.37 Mt in 2010. It is projected to grow slightly to 3.39 Mt in 2020 (a slight decline in PE production is more than offset by an increase in production of other polymer types).[167]

Assuming a constant share of plastic carrier bags in total EU production of plastic sacks and bags, production of plastic carrier bags also increases slightly, from 1.12 Mt in 2010 to 1.13 Mt in 2020. Similarly, with constant shares, production of single-use non-biodegradable plastic carrier bags rises only very slightly over the projection period from 0.38 Mt to 0.39 Mt.[168] The market share of biodegradable plastic carrier bags is assumed to grow from 3% to 7% of all single-use plastic carrier bags from 2010 to 2020, and so production is projected to increase from 11 kt to 28 kt.[169] The remainder of plastic carrier bag production is accounted for by multiple-use bags, production of which declines slightly from 0.73 Mt in 2010 to 0.72 Mt in 2020.

[166] Strange, K. (2011) *Plastic Bags: National Policies & Practices*, PlasticsEurope.
[167] A projection was made for each of the EU-27 and summed to reach 3.39 Mt. A shorter historical series was used where appropriate, e.g. 2007-2010 instead of 2003-2010, in order to exclude any once-off policy impact and project a more realistic long-term trend.
[168] Production of single-use non-biodegradable plastic carrier bags was projected assuming a constant share in production of all PE plastic sacks and bags. The projection reflects the trend in PE sacks and bags seen in PRODCOM and the effect of national policies already in place.
[169] The share of biodegradables in single-use is assumed to grow by around 10% per year, i.e. from 3% in 2010 to 7% in 2020. This is a conservative estimate, given that European Bioplastics claims that bioplastics overall are growing by around 20% per year, see http://en.european-bioplastics.org/wp-content/uploads/2011/04/EuBP_image_brochure_2011.pdf.

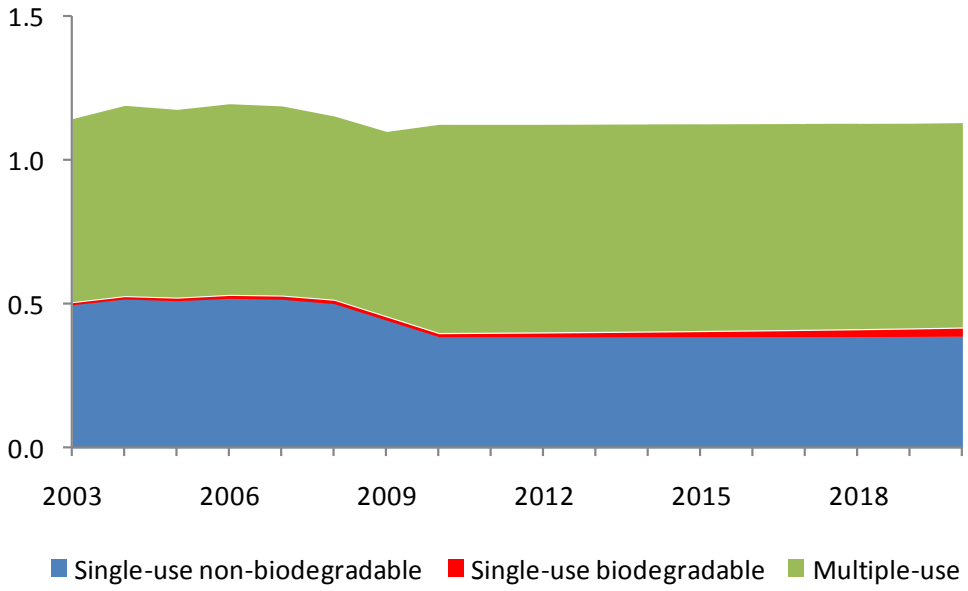

Figure 8: Weight of plastic carrier bags produced in EU-27, 2003-2020 (Mt)

Both imports and exports of plastic carrier bags are projected to rise over the scenario period. The share of EU production of single-use plastic carrier bags exported rises from 6% in 2010 to 7% in 2020. Exports are 25% higher in 2020 than in 2010, at 0.03 Mt. The share of single-use plastic carrier bags used in the EU that are imported rises from 50% in 2010 to 54% in 2020. Imports are 22% higher in 2020 than in 2010, at 0.46 Mt. Note that the 50% share in 2010 is an assumption made due to the lack of data; the thinnest HDPE plastic carrier bags are said to be almost all imported, while many LDPE bags are made in Europe.

The volume of single-use plastic carrier bags placed on the market is projected to rise from 0.75 Mt in 2010 to 0.84 Mt in 2020. Consumption of single-use biodegradable bags rises fast but from a very small base, from around 21 kt in 2010 to 58 kt in 2020. Finally, consumption of multiple-use plastic bags rises from 0.87 Mt to 0.93 Mt.

Countries that have introduced policies to reduce the use of plastic carrier bags have all reported declining use (Ireland, France, Belgium, Luxembourg, Spain, UK, etc.). Part of this will have been offset by increased use of bin liners, other plastic bags and carrier bags made of other materials. In Spain, for example, the shares of biodegradable bags and (especially) reusable bags are increasing very rapidly, at the expense of conventional plastic carrier bags.

As mentioned earlier, average weights are estimated for single-use non-biodegradable (8.5 g), single-use biodegradable (8.9 g) and multiple-use plastic (78.9 g) carrier bags. Although average weights have declined in the past, they are assumed to remain constant over the projection period. The plastic carrier bag market is dominated by single-use non-biodegradable bags in terms of units (Figure 9).

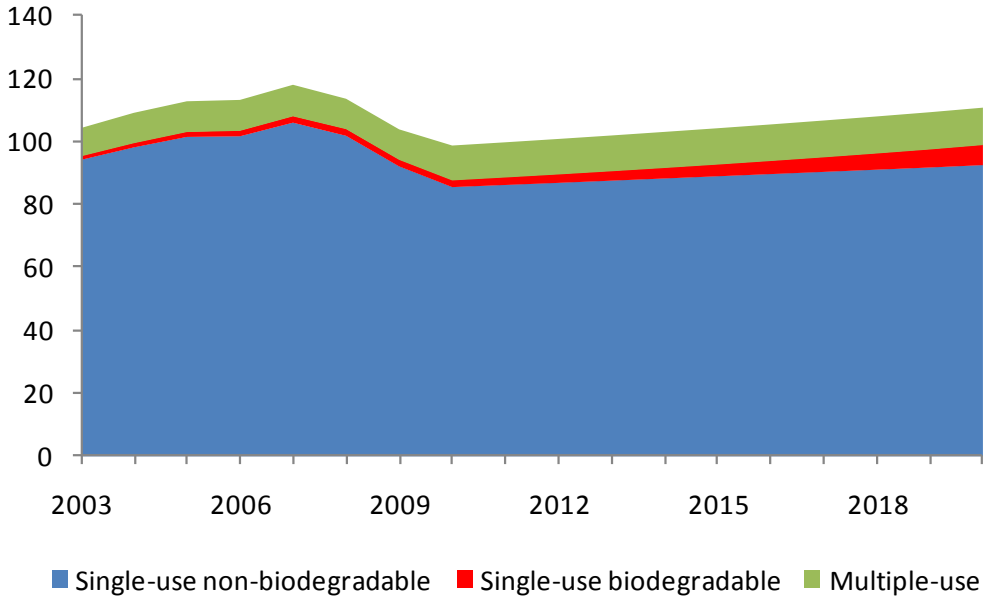

Figure 9: Number of plastic carrier bags produced in EU-27, 2003-2020 (billions)

At EU-27 level, the number of plastic carrier bags used is projected to rise from 99 billion in 2010 to 111 billion in 2020. Over the same period, EU-27 population is also projected to rise, from 499m to 510m. The number of bags used per person thus increases by a smaller proportion, from 198 bags in 2010 to 217 bags in 2020.

2.8.2.2 *Plastic carrier bag end-of-life options*

Effective recycling of mixed plastics waste including plastic carrier bags can be a challenge because the low weight-to-volume ratio of films and plastic bags makes it less economically viable to invest in the necessary collection and sorting facilities. However, there have been several innovations in recycling technology over the last decade that have increased the accuracy and productivity of automatic sorting systems. Detectors are more reliable and decision and recognition software more sophisticated. Another area of innovation has been in finding higher value applications for recycled polymers in closed-loop processes, which can directly replace virgin polymer. A number of European countries are already collecting limited amounts of post-consumer flexible packaging such as plastic carrier bags. Recycling of these materials has become possible because of improvements in sorting and washing technologies and emerging markets for recyclate. The most noticeable shift is in newer Member States, who have greater room for improvement.

The JRC report on *Assessment of the Environmental Advantages and Drawbacks of Existing and Emerging Polymers Recovery Processes* (see Table 13) assumes that the collection rate increases from 5% in 2005 to 7.5% in 2015. Applying that rate of increase to our 2010 recycling estimate, the share of plastic carrier bags going to recycling increases from 6.6% in 2010 to 9.3% in 2020.

No similar projections were found for other end-of-life options. However, on the basis of existing policy and market trends (restrictions on new landfill etc.), and investment lock-in (in countries with energy recovery facilities that are generally profitable), we assume that at EU level the increase in the share of recycling goes along with a reduction in the share of landfill, and that the

share of energy recovery remains constant to 2020. The share of landfilling/incineration thus declines from 49.7% to 46.9% over the period, while that of energy recovery remains constant at 39.1%.

2.8.2.3 Plastic carrier bag litter

It is difficult to identify clear trends in plastic carrier bag litter. There is evidence in some areas of constant or increasing levels over a particular time period, however it is difficult to extrapolate to a general European trend. On the other hand, there is little or no evidence of a long-term decline. The picture is complicated by inadvertent littering (e.g. escape from landfill), clean-up activity, sinking, ingestion and break-up into microplastics.

The share of plastic carrier bags that end up as litter is projected to remain stable at 4.6% in the Baseline Scenario. However, the number of bags littered will grow from 4.5 billion in 2010 to 5.1 billion in 2020. Due to the persistence of plastic, this means that the stock of plastic carrier bag litter in the marine and land environments will grow rapidly.

Table 21: Summary of plastic carrier bag flows in EU, 2010 and 2020 (Mt)[170]

	Production		Exports		Imports		Consumption		End-of-life						Litter	
									Recycling		Energy recovery		Landfill			
	2010	2020	2010	2020	2010	2020	2010	2020	2010	2020	2010	2020	2010	2020	2010	2020
Single-use non-biodegradable	0.38	0.39	0.02	0.03	0.36	0.42	0.73	0.78	0.05	0.07	0.28	0.31	0.36	0.39	0.03	0.04
Single-use biodegradable	0.01	0.03	0.00	0.00	0.01	0.03	0.02	0.06	0.00	0.01	0.01	0.02	0.01	0.03	0.00	0.00
Multiple-use	0.73	0.72	0.03	0.03	0.17	0.25	0.87	0.93	0.06	0.09	0.34	0.36	0.43	0.46	0.04	0.04
Total	**1.12**	**1.13**	**0.05**	**0.06**	**0.54**	**0.70**	**1.61**	**1.77**	**0.11**	**0.17**	**0.63**	**0.69**	**0.80**	**0.83**	**0.07**	**0.08**

[170] BIO analysis based on available data and stakeholder estimates.

Table 22: Numbers of plastic carrier bags used and littered in EU-27, 2010 and 2020[171]

	Total use (billions)		Use per person		Litter (billions)	
	2010	2020	2010	2020	2010	2020
Single-use non-biodegradable	85.3	92.2	171	181	3.9	4.3
Single-use biodegradable	2.3	6.5	5	13	0.1	0.3
Multiple-use	11.0	11.8	22	23	0.5	0.5
Total	**98.6**	**110.5**	**198**	**217**	**4.5**	**5.1**

[171] BIO analysis based on available data and stakeholder estimates.

Chapter 3: Identification of policy options

Having described the nature, scale and outlook of the problem in the previous chapter, this chapter identifies policy options to address it. Key underlying assumptions regarding exemptions and consumer behaviour are described. Five options are then identified: do nothing, voluntary approach, waste prevention target, pricing measures and a ban.

3.1 Underlying assumptions

3.1.1 Exemptions

A policy to reduce the use of plastic carrier bags should only be introduced where it will have a positive environmental impact and where practical alternatives are available. Policy options can thus be applied in a blanket manner to all plastic carrier bags or with exemptions for certain type of bags. The two main types of exemption to be considered from an environmental impact perspective are for biodegradable plastic carrier bags and multiple-use plastic carrier bags.

In some countries where bans or other policies to reduce plastic carrier bag use are in place, **biodegradable** (according to the existing baseline requirements in the Packaging Directive) bags are exempted. Some administrations more strict than others about the nature of the biodegradability (for example requiring full compliance with national compostability standards).

However, the LCA evidence for a blanket exemption of biodegradable plastic carrier bags at EU level is unconvincing. The merits of such an exemption in a particular case depend on a range of factors including the source of the biomass and the existence of appropriate waste management. Furthermore, a shift to biodegradable bags would not reduce the amount of bags discarded as litter and associated impacts such as the visual nuisance to tourism.

In several countries, such as Denmark and Ireland, the policies in place do not distinguish between biodegradable and other plastic carrier bags. The options considered in the rest of this chapter take the same approach and do not exempt biodegradable plastic carrier bags. Member States may or may not decide to promote these kinds of bags depending on their national circumstances.

In order to change consumer behaviour and reduce the overall impact of waste plastic carrier bags on the environment, it would appear appropriate to exempt **multiple-use** plastic carrier bags. LCA results are more positive for multiple-use plastic carrier bags than for single-use ones in typical use cases. However, pricing measures (Option 4 below) would apply to all plastic carrier bags in order to encourage reduced use and greater levels of reuse and because in practice retailers already charge their customers for multiple-use bags.

One way to distinguish multiple-use from single-use plastic carrier bags is by wall thickness. For example, a threshold of 49 microns could be an appropriate level in order to discourage use of single-use plastic carrier bags without adversely affecting multiple-use plastic carrier bags. More

detailed analysis would be required to determine the optimal level from environmental and economic points of view.

From a perspective of the availability of practical alternatives, note that the very thin plastic sacks and bags used to wrap loose, unpackaged foods such as raw meat, fish, fruits and vegetables in butcher shops, supermarkets or at outdoor markets would be exempted where justified on food safety grounds.[172] Airport security sacks for liquids, gels and aerosols could also be exempted.[173] Neither of these types of bags are carrier bags since they generally do not have handles; they are more accurately described as sacks. In most if not all Member States that have introduced policies to reduce the use of plastic carrier bags they are already exempt.

Other retail channels might be able to obtain similar exemptions where an unacceptably high economic impact and a lack of practical alternatives can be shown. For example, airport duty-free outlets or pharmacies might argue that plastic carrier bags are required by security legislation and thus consumers would have no choice but to use them.

3.1.2 Reduced use of single-use plastic carrier bags and switching

Each policy option to be analysed in this report will result in a different level of reduction in the use of single-use plastic carrier bags. However, we need to make some common assumptions about how consumers respond to using fewer single-use bags.

Single-use plastic carrier bags perform a service that can be either foregone or replaced by a range of alternatives, some more environmentally friendly, others less. With single-use plastic carrier bags no longer available for free (or at all), consumers resort to alternative solutions to carry their groceries home. They either come up with their own alternatives or use those proposed by retailers, if any.

The most common response is to use some type of multiple-use plastic carrier bag for shopping (primary use). In Ireland, a national survey found that after the introduction of a levy, 90% of supermarket shoppers used reusable/long life bags, 6% used cardboard boxes, 4% single-use plastic bags (i.e. they chose to pay the levy) and 1% other means.[174] Paper bags tend not to be distributed by supermarkets or other large retailers in Europe though they are more often used by high-street boutiques such as clothing retailers.

As well as primary use for shopping, many single-use plastic carrier bags are used for a secondary use such as to replace bin liners. Policies to reduce the use of single-use plastic carrier bags can thus potentially result in increased bin liner sales. The plastic bag levy in Ireland probably resulted in an initial increase in sales of some kinds of bin liners for example.[175] However, any increase in

[172] For example, under the Regulation on plastic materials and articles intended to come into contact with food (EU 10/2011).
[173] Note however that many airports already charge for these security bags. For example see www.rte.ie/news/2009/0506/terror.html.
[174] Department of the Environment and Local Government (2003) *Attitudes and Actions 2003: A National Survey on the Environment*.
[175] Tesco reported a 77% increase in pedal bin liner sales immediately after the introduction of the ban, SuperQuinn reported an 84% increase in nappy disposal bags, and SuperValu/Centra reported a 75% increase in swing bin liner sales. Larger bin liners and garden bags do not seem to have shown any increase. Such increases as there may have been are not confirmed by official sources.

bin liner sales would be small in comparison to the reduction in single-use plastic carrier bags (see Annex B for evidence from Australia of this effect).[176]

Apart from switching, consumers are inventive in finding other solutions: filling bags to their capacity, shopping more locally, buying products with less packaging, using trolleys, backpacks or handbags to carry small numbers of items, etc.

It has not been attempted to model such complex consumer behaviour in this report or to assess the environmental impacts of all type of bags. However, it is assumed for each policy option below that 50% of the reduction in use of single-use plastic carrier bags (translated into tonnes) results in a corresponding increase in *tonnes* of multiple-use plastic carrier bags used (i.e. a much smaller increase in the *number* of multiple-use plastic carrier bags used). The other 50% of the reduction in use of single-use plastic carrier bags is considered to be the result of shoppers either reducing their consumption of carrier bags altogether or finding alternative solutions. Therefore, reductions in the number of single-use plastic carrier bags are accompanied by a (smaller) increase in the use of multiple-use plastic carrier bags. As multiple-use bags are reused several times there will still be a significant net reduction in environmental impacts.

3.2 Option 1 – Baseline scenario

In this "do nothing" or "business as usual" option, there would be no additional policies and measures aiming to limit the use of plastic carrier bags, either at Member State or EU level, beyond those already in place or decided by mid-2011. For example, the effects of a tax at Member State level decided in 2010 are taken into account but no new taxes, bans or voluntary agreements are assumed. This option is identical to the problem definition and baseline scenario described earlier in the report.

3.3 Option 2 – Voluntary approach at EU level

Voluntary approaches have been developed by policy makers and industry in a range of sectors to provide pragmatic responses to new policy problems, namely the need for more flexible ways to achieve sustainability, and the need to take into account rising concerns about industrial competitiveness and administrative burden.[177] However, political will is needed for them to come about and there is a significant risk that such agreements are later abandoned. Clear targets and good reporting are key to their effectiveness, with consequences if targets are not met.

Voluntary approaches can focus on reducing environmental impacts indirectly, for example by increasing the recycled or bio-based content of bags. However, the more direct approach and the one taken throughout this report is to reduce the number of plastic carrier bags used

[176] Environment Australia (2002) *Plastic Shopping Bags – Analysis of Levies and Environmental Impacts*, www.tud.ttu.ee/material/piirimae/eco…/Plastic%20bag/analysis-final.pdf.

[177] Growing use of voluntary approaches has been observed in OECD countries: over 300 negotiated agreements in EU Member States, about 30 000 local pollution control agreements in Japan and over 40 voluntary programmes in the United States have been surveyed in recent years. Source: Börkey P., Glachant M. and F. Lévêque *Voluntary Approaches for Environmental Policy in OECD countries*, Centre d'économie industrielle, Ecole Supérieure des Mines de Paris.

3.4 Option 3 – Waste prevention targets

This option assesses a waste prevention target for the use of single-use plastic carrier bags. The target is based on the number of single-use plastic carrier bags used per person, as the simplest and most direct way to reduce environmental impacts.[178] The target can be set at EU or at Member State level, but either way it would be up to Member States to select and implement appropriate measures (except bans, which would avoid conflict with EU law) to induce the necessary behaviour change by industry, retailers and consumers. The EC would provide support in the form of guidance, exchange of good practices, etc.

As there is little official data on use of plastic carrier bags, new data collection procedures would have to be put in place. The actor(s) responsible for reporting along the supply chain (plastic carrier bag producers or more likely retailers) and the organisation with responsibility for collating the data and monitoring progress towards the target would need to be carefully defined.

3.5 Option 4 – Pricing measures

Pricing measures encourage reuse and help reduce littering by applying an economic incentive and raising consumer awareness. The potential of using pricing measures to change behaviour and reduce plastic carrier bag use is large. Laws at Member State level that oblige shops not to give away plastic carrier bags for free have led to drastic reductions of use and consequently litter in the countries concerned.

Several Member States have already implemented various types of pricing measure (see Annex B). A price can either be imposed on suppliers at the manufacturing and import stage (usually by weight) or charged to retail customers directly (per bag). A weight-based tax such as that of Denmark is more appropriate when the policy aim is to reduce the total amount of plastic used, whether by making bags thinner or by reducing the quantity (a combination of these effects has been observed in Denmark). However, if the main policy aim is to reduce litter and the number of bags used, then measures that target consumer behaviour directly are more appropriate and may be more effective overall.

If retailers are able to pass on the tax to consumers and allowed to keep the revenues, they can make very high profit margins. However, pricing measures are normally implemented so that the national administration collects the revenue. This involves some administrative burden but, as in the case of Ireland, the burden should be small in comparison to the revenues raised. The impact of the measure can be enhanced by ringfencing revenues for waste prevention actions and litter clean-up.

The effectiveness of a pricing measure depends in large part on the level at which the price is set. In principle, the tax should be high enough to cover the environmental and social costs generated

[178] The WFD defines "prevention" as measures taken before a substance, material or product has become waste, which reduce: the quantity of waste, including through the reuse of products or the extension of the life span of products; the adverse impacts of the generated waste on the environment and human health; or the content of harmful substances in materials and products.

over the life cycle of a plastic carrier bag (including end-of-life management). In addition, in light of the principles of producer responsibility, the costs of collection and treatment of plastic carrier bags need to be reflected in the price of the product. The steep drop in plastic carrier bag consumption in Ireland was due to the levy being set sufficiently high.[179]

Even a low price can have a big impact if customers see payment as a hassle or if use of plastic carrier bags becomes socially undesirable. The success of the charge in Ireland is partly attributable to an advertising awareness campaign and public recognition of its success.

The price may need to be increased over time to avoid usage creeping back up, as happened in both Ireland and Denmark. The primary purpose should be to reduce the consumption of single-use plastic carrier bags by influencing consumer behaviour, rather than to raise revenue.

Studies indicate that in order for the levy to achieve maximum effectiveness, it should be passed on in full from suppliers to retailers to consumers.[180] Therefore, the type of measure that will be analysed in this study is a consumer-based levy, which is expected to yield bigger reductions in the number of plastic carrier bags used and littered than a supply-side weight-based tax. The policy could be implemented either at Member State or EU level.

Note that this option would apply to all plastic carrier bags not just single-use, in order to encourage reduced use and greater reuse of all bag types and because in practice multiple-use plastic carrier bags are rarely distributed for free anyway.

3.6 Option 5 – EU ban on single-use plastic carrier bags

Under this option, the provision of single-use plastic carrier bags would be prohibited at EU level and would affect all retailers. A transitional period, for instance 18-24 months, would be given to enable producers and distributors to adapt to the new rules. Bans usually specify a minimum thickness, ensuring that heavier, more durable (and therefore more likely to be reused) bags are still permitted.[181]

This option requires a change in the legal basis of the Packaging Directive in order to allow for preventive measures at source in cases of non-essential packaging products, with a high environmental impact and for which more sustainable alternatives are available. Exemptions could also be possible for specific sectors, for example where it could be shown that alternatives are not available or the economic burden would be too high.

[179] Dikgang, J. et al. (2010) *Analysis of the Plastic Bag Levy in South Africa*, www.econrsa.org/papers/p_papers/pp18.pdf.
[180] GHK (2007) *The Benefits and Effects of the Plastic Shopping Bag Charging Scheme*, available: www.epd.gov.hk/epd/tc_chi/environmentinhk/waste/prob_solutions/files/GHK_study.pdf.
[181] Strange, K. (2011) *Plastic Bags: National Policies & Practices*, PlasticsEurope.

3.7 Options identified that were not pursued further

- **Voluntary agreement of the whole retail sector not to provide single-use plastic carrier bags**

All retailers would agree to stop selling or giving away single-use plastic carrier bags by 2015. This option would therefore cover all kinds of retailers – small shops, non-food retailers including clothing and footwear, cosmetics, electronic goods, etc. The delay in implementation would allow time to raise awareness among consumers, source alternatives and run down existing stocks.

A voluntary agreement between all retailers appears difficult to implement in practice. This is due to the large number of small shops and the fact that retailers have already taken different approaches to the issue of plastic carrier bags, with varying levels of success. In addition, in many Member States the share of single-use plastic carrier bags distributed by large retailers such as supermarkets represents 70% or more of the total. A voluntary agreement that would encompass all retailers is deemed difficult to achieve, as it would not be possible to engage all retailers nor to monitor such an agreement. Indeed, no voluntary agreement of such scope was found to exist. Also, it would be equivalent to a ban, which is analysed separately later in this report.

- **Requiring Member States to set up national prevention targets for single-use plastic carrier bags**

Member States are not alike in terms of plastic carrier bag reduction already achieved, types of bag used etc. Under this option, countries would be required to adopt a national target in line with their national context: population, projected GDP growth to 2020, the degree to which the country has already reduced use of single-use plastic carrier bags and other national circumstances. The method of setting differentiated targets could be based, for example, on that of the Renewables Directive.[182,183]

The measure could then be integrated into the National Waste Prevention Programmes to be adopted by the end of 2013. According to Article 29 of the WFD, Member States should determine appropriate specific qualitative or quantitative benchmarks for waste prevention measures adopted in order to monitor and assess the progress of the measures and may determine specific qualitative or quantitative targets and indicators.

Considering the variety of situations and policies in the EU-27, putting in place waste prevention targets at the Member State level seems overly complicated. The achievement of such targets would be uncertain and highly dependent on the political commitment of Member States.

[182] Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.
[183] Each Member State has a target calculated according to the share of energy from renewable sources in its gross final consumption for 2020. Since the renewable energy potential and the energy mix of each Member State vary, the Community 20% target has been translated into individual targets for each Member State, with due regard to a fair and adequate allocation taking account of Member States' different starting points and potentials, including the existing level of energy from renewable sources and the energy mix. It is appropriate to do this by sharing the required total increase in the use of energy from renewable sources between Member States on the basis of an equal increase in each Member State's share weighted by their GDP, modulated to reflect their starting points, and by accounting in terms of gross final consumption of energy, with account being taken of Member States' past efforts with regard to the use of energy from renewable sources.

- **Introducing a pricing measure on plastic carrier bags at EU level**

In this option, the pricing measure would be set at EU level. It could be in the form of a minimum mandatory component of the price or a fixed price at which retailers must offer plastic carrier bags to customers.

In terms of environmental impacts, a pricing measure harmonised at EU level may offer more certainty about the level of reduction than pricing measures set by Member States. However, setting a pricing measure at EU level would not be flexible enough to achieve optimum benefit. It might be less effective overall as some Member States would find the level excessively high, while for others it might be too low to have a noticeable effect. Member States differ widely in terms of progress already achieved to reduce plastic carrier bag use and the socio-economic context.

It could prove overly complex to set an appropriate level or levels for the tax, and the EU would face a high administrative burden. Crucially, a fixed and harmonised tax that would apply to all Member States would be decided at EU level by unanimity and so is unlikely to be passed.

3.8 Options shortlisted for scenario analysis

- **Voluntary commitment of a significant share of the retail sector not to provide single-use plastic carrier bags**

This option entails a voluntary agreement by a significant share of the retail sector to stop providing single-use plastic carrier bags by 2015. Large retailers such as supermarkets are responsible for a large proportion of the consumption of plastic carrier bags and are more likely to be able to agree a voluntary approach than smaller shops, which are very diverse and harder to monitor.

The Retail Forum may be the appropriate framework for such a commitment.[184] It counts 20 major retailers and 7 retail associations among its members.[185] Retailers not affiliated with the Retail Forum could be invited to join the agreement or might independently decide not to provide single-use plastic carrier bags. The Retail Forum contains many of Europe's large retail chains but there a lot of smaller shops especially in newer Member States that may not be members. For the purpose of this commitment, it is assumed that 46.5 billion single-use plastic carrier bags are sold or given away by the members of the Retail Forum, representing a 55% share of the European retail market.

Progress towards the achievement of the objective would be reported yearly. A revision of the overall achievements would be performed at the end of 2015 and depending on the results, further voluntary or regulatory measures may be envisaged.

[184] See http://ec.europa.eu/environment/industry/retail/index_en.htm.

[185] APED (Association of Portuguese distributors), Asda Wal-Mart, Auchan, C&A, Carrefour, CEC (Spanish trade federation), Colruyt, Confcommercio (Italian trade federation), Delhaize, El Corte Inglés, EuroCommerce (retail, wholesale and international trade sectors in 31 countries), Euro Coop (European Community of Consumer Cooperatives), European Retail Round Table, FCD (Fédération des Entreprises du Commerce et de la Distribution), IKEA, Inditex, Kaufland, Kingfisher, Leroy Merlin Spain, Lidl and Marks & Spencer.

A targeted voluntary commitment encompassing the actors that place the largest share of single-use plastic carrier bags on the market will improve cost effectiveness. Although the reduction of the use of single-use plastic carrier bags might be less drastic than in the case of a cross-sectoral commitment, it will impose a lower administrative burden related to enforcement while still providing for a significant reduction in the use of single-use plastic carrier bags. Furthermore, the established structure of the Retail Forum will facilitate effective reporting and monitoring. It will also avoid the time and cost required to create a new monitoring structure. Finally, due to the significant share of the sector involved in the Retail Forum, the initiative could have a ripple effect and be taken up by retailers that are not members of the Retail Forum.

- **Setting an EU level prevention target for single-use plastic carrier bags**

Under this option, a waste prevention target for single-use plastic carrier bags would be set at EU level based on the average consumption of the best-performing Member States. The rationale for a target at EU level lies in the transnational aspect of plastic carrier bag litter and pollution and the need to raise awareness of the problem.

Based on progress already achieved in some EU Member States (see Annex B for information on percentage reductions and how they have been achieved), a reduction of 80% in the number of single-use plastic carrier bags used in the EU by 2020 compared to 2010 seems an appropriate level of ambition. That equates to 35 single-use plastic carrier bags used per person in 2020. This is equivalent to the current average of Finland, Denmark, Luxembourg, Ireland, Austria, the Netherlands and France (34). Each Member State would therefore be required to achieve and/or remain below that level (Finland, Denmark, Luxembourg and Ireland for example are likely already to have achieved it using a range of measures from voluntary agreements to taxes). In order to do so, Member States would use the means they deem most appropriate: a prevention target at Member State level, a pricing measure, etc. An EU target level expressed in number of bags per person per year provides greater flexibility than imposing a common percentage reduction, which would not take into account progress already made.

An EU target would provide a clear objective while leaving flexibility for Member States as to the means of achieving the target (as long as the means are in line with Treaty provisions on the internal market) and taking into consideration progress already achieved.

- **Introduction of a legal requirement for Member States to take measures to ensure that plastic carrier bags are not provided for free to end users**

Under this option, Member States would be obliged to implement pricing measures for plastic carrier bags. The free provision of plastic carrier bags to customers would no longer be allowed.

A study for the Australian government argues that to achieve a significant reduction a levy should be set between €0.10 and €0.30.[186] This is supported by the Irish experience, where a €0.22 levy has resulted in a reduction of over 90%. It could be specified at EU level that the levy should not be below a certain level, such as €0.20. That is within the range of prices currently in place in the EU (Table 23).

[186] Environment Australia (2002) *Environment Australia Plastic Shopping Bags – Analysis of Levies and Environmental Impacts*, www.tud.ttu.ee/material/piirimae/eco…/Plastic%20bag/analysis-final.pdf.

Table 23: Single-use plastic carrier bag prices and per-capita use for selected Member States

MS	CY	DK	EE	DE	IE	LV	LU	MT	PL	PT	RO	ES[187]	SE	UK[188]
Price (€)	0.00	0.40	0.10-0.30	0.05-0.1	0.22	0.07	0.03-0.65	0.16	0.00	0.00	0.03	0.05-0.10	0.24	0.00-0.05
Number	141	4	-	-	18	-	18	-	-	-	252	-	-	129

Member States would then be free to set a higher levy (some already do) and individual retailers would also be free to charge more if they wished. The policy would be reviewed periodically, for instance every three years, and the minimum rate increased if necessary.

Member States would have to design their pricing measure carefully to achieve the objective of reduced waste generation in an optimal way. For example, the levy should not be so high that fiscal revenues are insufficient to cover administration costs.

Member States would be free to choose whether to use the funds to reduce other taxes, e.g. on labour or profits (a so-called double dividend), or to enhance the environmental benefit by ringfencing funds for litter clean-up activities, recycling and other environmental projects.

- **EU ban on single-use plastic carrier bags**

Bans have already been adopted by several countries worldwide and by Italy in the EU. Bans are effective in terms of environmental impact but raise difficult legal issues. Of the options considered here, an EU ban might be expected to result in the biggest reduction in use but would also impose an administrative burden on the EU. An important consideration is that a ban on plastic carrier bags could shift demand towards other packaging and carrying materials that also have environmental impacts, instead of entailing a change in consumer habits. The option is assessed in more detail.

In summary, five policy options are analysed further in the next chapter:

Option 1: Baseline Scenario;

Option 2: Voluntary commitment of a significant share of the retail sector not to provide single-use plastic carrier bags;

Option 3: Setting an EU level prevention target for single-use plastic carrier bags;

Option 4: Introduction of a legal requirement for Member States to take measures to ensure that plastic carrier bags are not provided for free to end users; and

Option 5: EU ban on single-use plastic carrier bags.

[187] Data refer to Andalusia.
[188] Data refer to Marks and Spencers only.

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Chapter 4: Impacts of policy options

This chapter assesses the impacts of the policy options identified in Chapter 3. An overall assessment is made, with quantification in the key impact categories of reduction of plastic carrier bags used and littered, oil used in production and life-cycle greenhouse-gas emissions. Other aspects are considered qualitatively, including trade and competiveness implications and administrative feasibility.

4.1 Selection of impact categories

One of the first steps required in analysing the impacts of different policy options is to select impact categories and associated indicators. Table 24 shows the full list of indicators that were considered. Only the most important were quantified, depending on availability of information and relevance.

Table 24: List of impacts by category

Category		Indicator
Environmental impacts	Emissions	Global warming potential (GWP)[189] GHG emissions
	Littering	Marine litter Visible land litter
	Resource efficiency/waste prevention	Raw material extraction Volumes of plastic bags recycled
	Biodiversity and land use	Number of animals entangled in plastic bags Impacts on fish stocks
	Waste generation	Plastic bag waste generation Energy used to produce and dispose of/recycle plastic carrier bags
	Water and soil quality (where applicable)	Eutrophication[190] Impacts on drinking water
	International impacts	Litter

[189] GWP is a measure of how much a given mass of a greenhouse gas (for example, CO_2, methane, nitrous oxide) is estimated to contribute to global warming. GWP is measured in terms of CO_2 equivalents.
[190] This is caused by the addition of nutrients to a soil or water system, which leads to an increase in biomass, damaging other organisms. Nitrogen and phosphorus are the two nutrients most implicated in eutrophication. Eutrophication is measured in terms of phosphate (PO_4 3-) equivalents.

Economic impacts	Functioning of the internal market and competition	Impact on the free movement of goods, services, capital and workers. Reduction in consumer choice, higher prices due to less competition, creation of barriers to new entrants, facilitation of anti-competitive behaviour, market segmentation.
	Competitiveness, trade and investment	Impact on the global competitive position of EU firms and their productivity Trade barriers Relocation of economic activity
	Operating costs and conduct of businesses / SMEs	Additional adjustment, compliance or transaction costs Cost and/or availability of essential inputs (raw materials, machinery, labour, energy, etc.) Stricter regulation of the conduct of a particular business Number of new businesses Number of closed down businesses
	Administrative burden on businesses	Implementation costs
	Administrative burden on Member States	Implementation costs Enforcement costs Control and monitoring costs
	Public authorities	Budgetary consequences for public authorities at all levels of government, both immediate and long run.
	Waste management costs	Costs of collection Costs of recycling technologies (investment and operational costs)
Social impacts	Employment and labour markets	Job loss/creation Particular effect on age groups Impact on the functioning of the labour market
	Standards and rights related to job quality	Effect on workers' health and safety Effect on employers' rights and obligations

In addition to the impact categories and indicators listed in the table, other criteria or impacts to consider include:

- degree of uncertainty/risk;
- technical feasibility;
- institutional feasibility;
- interaction with other interventions; and
- efficiency and effectiveness (value for money).

The following assumptions are made:

- The production 1 kg of PE plastic requires about 2 kg of oil to produce (including raw material and energy).[191]
- One single-use non-biodegradable plastic carrier bag weighing 7.5-12.6 g entails life-cycle emissions of 1.58 kg of CO_2, assuming a rate of 40% of reuse.[192]

4.2 Analysis of policy options

This section constitutes the main analysis of the identified policy options. Under each of the five main headings corresponding to the policy option, the three main impact categories (environmental, economic and social) are analysed.

4.2.1 Option 1: Baseline scenario

Option 1 is a business-as-usual scenario where no additional measures are introduced. This baseline scenario shows a slightly increasing trend over 2010-2020 All other Options are compared to this baseline and the reductions in environmental impact in each case are simply the difference between impacts with the Option and the impacts in the baseline scenario.

Table 25: Projected quantities of plastic carrier bags used in the EU in Option 1

Impact category	2010	2020
Plastic carrier bags (Mt)	1.613	1.772
Single-use plastic carrier bags (Mt)	*0.746*	*0.842*
Plastic carrier bags (billions)	98.6	110.5
Single-use plastic carrier bags (billions)	*87.6*	*98.8*

4.2.1.1 Environmental impacts

Based on current trends, EU production in terms of weight will remain quite stable until 2020. As most of the environmental impacts of plastic bags occur during the material extraction and production phases, those environmental impacts will also remain relatively stable or even improve slightly.

Nevertheless, in some Member States consumption of single-use plastic carrier bags is expected to increase as a result of stronger GDP growth – those countries may experience greater

[191] Source: www.designinsite.dk/htmsider/m0002.htm.
[192] UK Environment Agency (2011) *Life cycle assessment of supermarket carrier bags: a review of the bags available in 2006*.

environmental impacts as a result. Consumption of multiple-use plastic bags will also rise slightly at EU level.

The share of plastic carrier bags in the EU that ends up as litter is also expected to remain stable to 2020, as described earlier. However, due to their persistence in the environment, especially the marine environment, the environmental impacts of littered plastic carrier bags are expected to continue to increase. More fish, birds and other wildlife species will be entangled and undergo external and internal injuries, although the number is difficult to estimate. Leakage of chemical components will also continue without additional policy action. Particles will reduce in size as weathering and disintegration takes place, increasing the surface area and the possibility of chemical transport and the potential for ingestion by a wider range of biota.[193]

At the EU level, the rate of recycling is expected to increase. The overall impact of that will be positive, especially in terms of natural resources saved. The share of landfill will decrease, thus reducing leakage to soil.

In terms of plastic bag waste, exports could increase, with Asian demand for plastics expected to increase in the future. This will entail increased emissions of CO_2 from shipping. The overall balance might be determined by whether demand for plastics would otherwise be met by virgin plastics.

4.2.1.2 *Economic and social impacts*

- **Administrative burden and economic cost**

The increase in the stock of plastic carrier bag litter implies higher public spending on clean-up activities and higher cost to tourism.

Unilateral measures in different Member States might hinder trade, and impose a cost for industry to cope with the different rules and administrative burden for public authorities. Impacts may be more severe for SMEs who do not benefit from the same economies of scale as larger companies.

- **Employment, trade and competitiveness**

There will be no additional effects on employment. EU production of plastic carrier bags remains almost constant in the baseline scenario.

There might be negative economic consequences for smaller producers of single-use non-biodegradable bags. Some of them might be pushed to start producing single-use biodegradable plastic carrier bags or thick plastic carrier bags instead. The level of imports is also expected to increase. At the same time, increased recycling is expected to create some jobs in the recycling sector.

[193] Bowmer, T. and P.J. Kershaw (Eds.) (2010) Proceedings of the GESAMP International Workshop on plastic particles as a vector in transporting persistent, bio-accumulating and toxic substances in the oceans, GESAMP (IMO/FAO/UNESCO-IOC/UNIDO/WMO/IAEA/UN/UNEP Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection).

4.2.2 Option 2: Voluntary commitment of a significant share of the retail sector not to provide single-use plastic carrier bags

It is assumed that a voluntary agreement that involves the Retail Forum would result in a 55% reduction of the total amount of single-use plastic carrier bags used in the EU by 2015 compared to the base year 2010. From 2015 onwards, Retail Forum members no longer distribute single-use plastic carrier bags. A 55% reduction in the number of single-use plastic carrier bags used in the EU by 2015 translates to a 13% reduction (0.2 Mt) in plastic used in 2020. The overall number of plastic carrier bags used decreases by 46% because there is some switching to multiple-use bags.

Table 26: Effects of a 55% reduction in single-use plastic carrier bags used in the EU, 2020

Impact category	Baseline	Option 2	Reduction
Plastic carrier bags (Mt)	1.772	1.540	**0.232**
Single-use plastic carrier bags (Mt)	*0.842*	*0.379*	***0.463***
Plastic carrier bags (billions)	110.5	59.1	**51.4**
Single-use plastic carrier bags (billions)	*98.8*	*44.4*	***54.3***

4.2.2.1 *Environmental impacts*

A 55% reduction in the number of single-use plastic carrier bags used in the EU would also significantly reduce littering and other environmental impacts. Overall tonnes of plastic used to make all plastic carrier bags are reduced by 46% (taking into account the partial switch to multiple-use plastic carrier bags), leading to oil savings of 463 kt (assuming 2 kg of oil for 1 kg of plastic produced), avoidance of 81 $MtCO_2eq$ of life-cycle greenhouse-gas emissions (assuming 1.58 $kgCO_2eq$ per bag) and a reduction of 2.4 billion in the number of plastic carrier bags littered each year.

Table 27: Environmental impacts of a 55% reduction in single-use plastic carrier bags used in the EU, 2020

Impact category	Reduction
Oil (kt)	**463**
Emissions ($MtCO_2eq$)	**81.2**
Bags littered (billions)	**2.4**

4.2.2.2 *Economic and social impacts*

- **Administrative burden**

A voluntary agreement would be much less of a cost burden for government than a compulsory pricing measure (Option 4) or ban (Option 5) because as the initiative would be voluntary, enforcement and monitoring activities would not be necessary. This means that in this option, there would be overall less involvement of national administrations than in Options 3, 4 and 5.

- **Employment**

About 250-300 producers of plastic carrier bags in the EU employ 15 000-20 000 people.[194] These jobs could potentially be affected by the implementation of this option but only a small number of producers are thought to produce single-use plastic carrier bags only; producers of multiple-use plastic carrier bags might even stand to benefit.

Thin single-use plastic carrier bags are mostly imported from the Far East, mainly China, so EU manufacturing employment would not be affected by a reduction in their use. Much of the demand (we assume 50%) would shift to multiple-use plastic carrier bags such as LDPE, which most EU plastic carrier bag producers already specialise in and others could produce after investing in new or adapted machinery. Depending on the design of the policy and consumer preferences, there could even be a net gain in employment in the EU.

- **Trade and competitiveness**

As the agreement will not involve all retailers, EU plastic carrier bag producers as a group will not have to switch immediately to alternatives and will therefore have time to carry out research and development. It should also be noted that the sector is strongly affected by non-policy factors such as high and volatile oil (and therefore resin) prices, and increased competition from China, Thailand, India, etc.

Imports from outside the EU tend to be of lower quality single-use HDPE bags, while EU producers tend to specialise in higher-value, thicker LDPE bags. Such producers should be well placed to take advantage of a switch away from single-use plastic carrier bags. However, this may not be true of all types of plastic carrier bag, e.g. woven PP may be more competitively produced in Asia due to the labour involved.

Redesign and introduction of new types of plastic (bio-based, biodegradable or other) requires investment. Changes in manufacturing processes require new skills and technology. Some types, such as ethylene made from ethanol derived from renewable sources can be synthesised using existing factories and process lines. However, for new polymers such as PLA, equipment will have to be adapted and there could be an increase in the non-renewable energy required in the manufacturing chain. Biodegradable plastics can be in the range of twice to six times as expensive as conventional plastics. Redesign for reuse requires manufacturers to weigh the additional cost and lower unit sales against the potential for a higher unit sales price.

[194] Alber & Geiger estimate.

- **Awareness**

Public awareness would be raised by this common agreement, especially if accompanied by awareness-raising campaigns. However, the fact that not all retailers would be part of the agreement might result in maintaining uncertainty for consumers, limit their awareness and restrain a potential deeper change in consumption patterns.

4.2.3 Option 3: Setting an EU level waste prevention target for single-use plastic carrier bags

Member States would have to achieve a level of 35 (or fewer) single-use plastic carrier bags used per person, using a policy or policies of their choice. This is an 80% reduction in the number of single-use plastic carrier bags in 2020, and a 70% reduction in the total number of plastic carrier bags (the difference being due to switching from single-use to multiple-use). A 20% reduction in tonnes of plastic used is achieved.

Table 28: Effects at EU level of a waste prevention target of 35 single-use plastic carrier bags used per person, 2020

Impact category	Baseline	Option 3	Reduction
Plastic carrier bags (Mt)	1.772	1.425	**0.346**
Single-use plastic carrier bags (Mt)	*0.842*	*0.149*	***0.693***
Plastic carrier bags (billions)	110.5	33.7	**76.8**
Single-use plastic carrier bags (billions)	*98.8*	*17.5*	***81.2***

4.2.3.1 Environmental impacts

Option 3 reduces the number of single-use plastic carrier bags used by 80% and the total number of plastic carrier bags used by 70% (taking into account switching). That is a 20% reduction in tonnes of plastic, which saves oil, avoids greenhouse-gas emissions and reduces the number of bags littered, as summarised in the following table:

Table 29: Environmental impacts at EU level of a waste prevention target of 35 single-use plastic carrier bags used per person, 2020

Impact category	Reduction
Oil (kt)	**693**
Emissions ($MtCO_2eq$)	**121.4**
Bags littered (billions)	**3.5**

4.2.3.2 *Economic and social impacts*

- **Administrative burden**

This option will entail administrative costs for businesses since companies will have to report to national authorities about the volumes produced or sold. This burden might be significant in countries where for instance retailers provide plastic carrier bags for free and have not put in place any strategy to reduce the number of single-use plastic carrier bags distributed or sold or to progressively replace them with alternatives.

Member States and retailers will bear some administrative burden linked to the collection of data. It can be compared to the costs borne by Member States in the context of reuse, recovery and recycling targets put in place for other types of waste streams such as WEEE,[195] Packaging etc.

There will be an additional administrative burden at the EU level to ensure that targets are achieved and to deal with Member States that do not comply.

- **Employment**

The effects on employment would be the same as in Option 2. However, as the reduction will be progressive, EU companies will have more time to perform product development and invest in production of multiple-use plastic or other carrier bags.

- **Trade and competitiveness**

The effects would be the same as in Option 2, except that all retailers would be affected.

- **Awareness**

As the same target will have to be implemented all over the EU-27, awareness will be efficiently raised in countries where the reduction will be net and therefore visible for consumers.

4.2.4 Option 4: Introduction of a legal requirement for Member States to take measures to ensure that plastic carrier bags are not provided for free to end users

Member States that have introduced pricing measures have seen reductions in plastic carrier bag use across a very wide range (10-90%, see Annex B). In order to achieve the upper part of that range, the tax should be passed on to the consumer in full and be set at a sufficiently high level. We assume that pricing measures in Member States (beginning at an average rate of around €0.20 and rising over time) lead to a reduction of 50% in the number of single-use plastic carrier bags used in 2015 and a 90% reduction by 2020 as prices increase and consumer habits change.

[195] Total EU-27 burden for WEEE registering and reporting activities ranges from €36.7-42.8m assuming 8 hours needed per report, according to United Nations University, AEA, GAIKER, Regional Environmental Center and TU Delft (2007) *2008 Review of Directive 2002/96 on Waste Electrical and Electronic Equipment (WEEE)*, United Nations University, Bonn.

Option 4 results in a reduction of 379 kt of plastic or 84 billion plastic carrier bags in 2020. In other words, a 90% reduction in the number of single-use plastic carrier bags leads to a 21% reduction in tonnes of plastic used for carrier bags and a 76% reduction in the total number of plastic carrier bags.

Table 30: Effects of pricing measures on plastic carrier bags in the EU compared to baseline, 2020

Impact category	Baseline	Option 4	Reduction
Plastic carrier bags (Mt)	1.772	1.393	**0.379**
Single-use plastic carrier bags (Mt)	*0.842*	*0.084*	***0.758***
Plastic carrier bags (billions)	110.5	26.5	**84.1**
Single-use plastic carrier bags (billions)	*98.8*	*9.88*	***88.9***

4.2.4.1 *Environmental impacts*

The 76% reduction in the total number of plastic carrier bags results in a 21% reduction in tonnes of plastic carrier bags. This saves oil, avoids greenhouse-gas emissions and reduces the number of plastic carrier bags littered proportionately, as follows:

Table 31: Environmental impacts of pricing measures on plastic carrier bags in the EU compared to baseline, 2020

Impact category	Reduction
Oil (kt)	**758**
Emissions ($MtCO_2eq$)	**132.8**
Bags littered (billions)	**3.9**

The evidence from the Irish plastic carrier bag levy is that it had a positive effect on the environment, producing a noticeable reduction in litter. According to the Irish Litter Monitoring Body, plastic bag litter made up 5% of national litter prior to the levy. After implementation, the percentage of plastic bags in litter fell to 0.32% in 2002 and 0.25% by 2010.[196]

[196] Convery, Frank, et al. (2007) *The most popular tax in Europe? Lessons from the Irish plastic bags levy*.

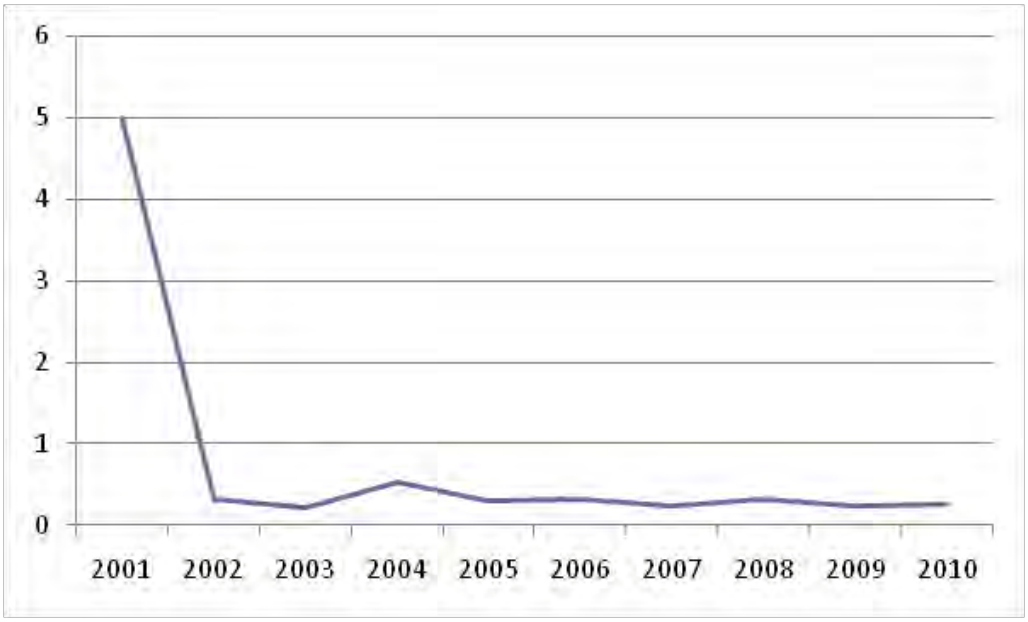

Figure 10: Share of plastic bags in national litter composition in Ireland, 2001-2010 (%)[197]

As well as reduced overall use, pricing measures would have a dramatic impact on levels of primary reuse (reuse of plastic carrier bags for a second or third shopping trip). A study of a voluntary pricing initiative by a retail chain in Portugal found that when bags were free, the reuse rate was 5%; when they were paid for, the reuse rate was 49%.[198] The study also found that customers filled bags to a much greater extent at checkout. The combination of these effects led to a 64% decrease in bag consumption.

4.2.4.2 *Economic and social impacts*

- **Administrative burden**

National authorities: The implementation of any sort of pricing measure would involve some costs for national authorities in order to set it up. For a mandatory levy, there will be legislative set-up costs to government in order to research and implement the levy. Set-up costs can be estimated at around €1m while annual administration costs would be around €0.4m.[199] The range depends in part on how well the levy is integrated with existing tax systems such as VAT.

Retailers: Suppliers and retailers will also face costs associated with time spent learning about the levy and may also have initial costs associated with the stocktake of single-use plastic carrier bags just prior to the introduction of a levy. If the use of plastic bags is reduced by a levy, some retailers may also require small structural adjustment at their counters to facilitate the use of alternative or reusable bags. This is likely to be done in cases where transaction time is costly to the retailer and would be increased by the introduction of multiple-use bags, for example in busy retailers such as supermarkets. This once-off cost may be, for example, to increase the bench

[197] National Litter Pollution monitoring System (2010) *Results Report*, www.litter.ie.
[198] University of Madeira and Quercus, cited by PRO Europe.
[199] In Ireland, €1.2m was spent on computer systems and other resources to administer the levy, along with around €350k on an awareness campaign and annual administration costs of €358k. Annual administration costs in Wales are expected to be around £0.5m. See Directorate for Environment and Sustainability, Wales (2010) *Explanatory Memorandum to the Single Use Carrier Bag Charge (Wales) Regulations 2010*.

space at the end of the counter to facilitate the customer packing his/her own multiple-use bag, or to change existing plastic carrier bag holders so that they also hold a chosen standard multiple-use bag.[200] However, the cost savings for retailers in purchase and storage of plastic carrier bags should more than offset the additional administrative and shoplifting costs.[201]

Consumers: There would also be a cost to consumers who purchase multiple-use bags rather than pay the levy. This could be estimated for example as two bags per person at €0.50.

- **Revenue**

Implementing a pricing measure on plastic carrier bags could generate significant revenues either for government or for retailers. The amount of revenue generated would depend on the size of the levy and the extent to which it reduces the amount of plastic bags purchased (the elasticity of demand).

In the example of Ireland's plastic bag levy, revenue generated from the plastic bag levy is earmarked to cover administration costs and for an Environmental Fund used to support waste management, litter clean-up and other environmental initiatives. Forecasts of the tax revenue before implementation were around €130m but the levy so was successful in reducing the use of plastic carrier bags that annual revenues from the tax were initially only around €12-14m. Administration costs are considered very low, at about 3% of revenues, because reporting and collection are integrated into the existing sales tax (VAT) reporting system.[202]

- **Employment**

The Scottish government recently carried out an impact assessment on a proposed plastic bag levy. According to the study, smaller enterprises are likely to suffer more from a levy as they have less capacity to adapt. The report estimates that 300-700 jobs could be lost directly in Scotland as a result of a levy on lightweight plastic carrier bags.[203]

However, as for other options, much of the demand would shift to multiple-use plastic carrier bags, which many EU producers already produce and others could produce after investing in new or adapted machinery.

In the retail sector, small shops might be more severely affected than larger ones because placing a price on plastic carrier bags might discourage impulse buying by "walk-up" customers. Such purchases may account for a smaller share of sales in larger retailers, who might also be better able to absorb any administrative burden. On the other hand, consumers may be expected to rapidly adapt and find alternative means of carrying their purchases.

- **Trade and competitiveness**

In theory, different taxes across Member States could affect the internal market and create competition distortions. However, in practice, the price of a plastic carrier bag would be a tiny

[200] Environment Australia (2002) *Plastic Shopping Bags – Analysis of Levies and Environmental Impacts*, www.tud.ttu.ee/material/piirimae/eco.../Plastic%20bag/analysis-final.pdf.
[201] Convery, Frank, et al. (2007) *The most popular tax in Europe? Lessons from the Irish plastic bags levy*.
[202] Ibid.
[203] Scottish Government (2005) *Proposed Plastic Bag Levy - Extended Impact Assessment: Volume 1: Main Report*, available at: www.scotland.gov.uk/Publications/2005/08/1993154/32013.

proportion of the average shopping transaction and so customers would be highly unlikely to cross borders to avoid it.[204]

- **Awareness**

One of the aims of the Irish levy was to raise awareness among consumers about litter and sustainability in general. Although difficult to measure, the levy itself proved popular among the public. However, awareness campaigns will be necessary in order to ensure that the objective of the measure is well understood by consumers. Otherwise, in countries where consumers are less aware of environmental issues in this sector, an abrupt levy without explanation might be perceived as a regular tax measure set up for fiscal purposes only.

4.2.5 Option 5: EU ban on single-use plastic carrier bags

Bans on single-use plastic carrier bags have been discussed in several countries. Italy is the only Member State to have imposed a national ban on (non-biodegradable) single-use plastic carrier bags. However, a number of non-EU countries have also put in place similar bans. It appears that developing countries in particular favour bans and minimum thickness standards rather than market-based instruments, most likely due to ease of enforcement, lack of waste collection and treatment systems, and the need to address significant problems caused by litter.[205]

We assume that it takes 18 months to implement Option 5; during 2013, the number of single-use bags goes to zero and remains zero from 2014 to 2020. A 100% reduction in the number of single-use plastic carrier bags corresponds to an 85% reduction in the total number of plastic carrier bags after taking into account switching to multiple-use. This is the most effective of the five Options in reducing the use of plastic carrier bags.

Table 32: Effects of a total ban on single-use plastic carrier bags, 2020

Impact category	Baseline	Option 5	Reduction
Plastic carrier bags (Mt)	1.772	1.351	**0.421**
Single-use plastic carrier bags (Mt)	*0.842*	*0*	***0.842***
Plastic carrier bags (billions)	110.5	17.1	**93.4**
Single-use plastic carrier bags (billions)	*98.8*	*0*	***88.9***

[204] Scottish Government (2005) *Proposed Plastic Bag Levy - Extended Impact Assessment: Volume 1: Main Report*, available at: www.scotland.gov.uk/Publications/2005/08/1993154/32013.
[205] Begum, Z *Plastics and Environment*, Dissemination Paper 12, Centre of Excellence in Environmental Economics, available at: coe.mse.ac.in/dp/Paper%2012.pdf.

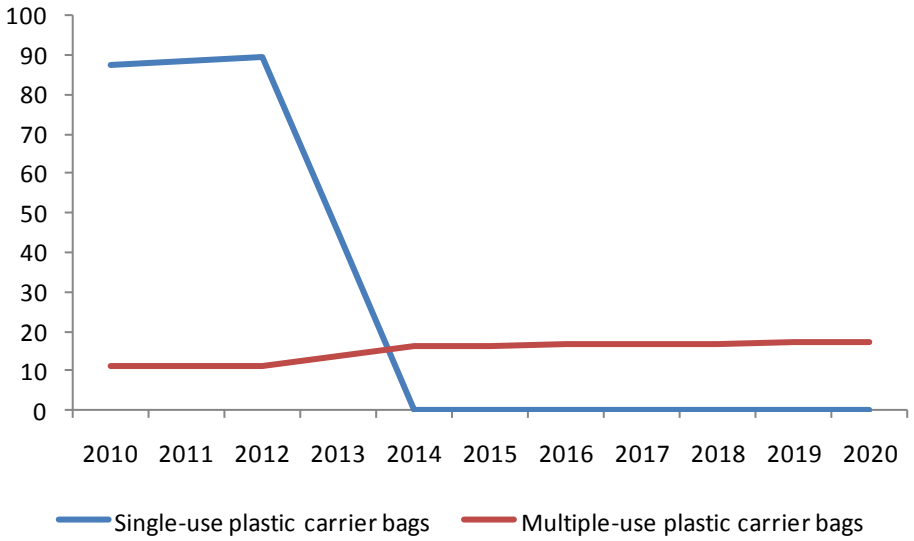

Figure11: Effects of a ban on single-use plastic carrier bags, 2010-2020 (billion bags)

4.2.5.1 *Environmental impacts*

A ban would reduce the number of plastic carrier bags littered by 4.3 billion, with significant benefits for biodiversity etc. Indirect benefits could also result from the strong message that would be sent about waste and recycling. The table below summarises the environmental impacts of a complete prohibition of the distribution of single-use plastic carrier bags in the EU in terms of oil, emissions and litter:

Table 33: Environmental impacts of a total ban on single-use plastic carrier bags, 2020

Impact category	Reduction
Oil (kt)	**842**
Emissions ($MtCO_2eq$)	**147.6**
Bags littered (billions)	**4.3**

In theory, a ban on all plastic bags could lead to the use of less sustainable alternatives and could be impractical for some retail transactions. For example, the increased use of alternative products such as paper bags could mean increased negative environmental impacts. However, it is not in the interests of retailers to provide this option since the storage costs of paper bags are substantially higher than those of plastic bags.[206] Paper bags are more expensive to retailers, and therefore to customers, on a per-bag basis than plastic bags.[207] There is no evidence of a switch

[206] Convery, F. et al. (2006) *The most popular tax in Europe? Lessons from the Irish plastic bags levy*, Science+Business Media, plasticbaglaws.org/.../study_the-most-popular-tax-in-Europe-2007.pdf.
[207] AECOM (2010) *Economic Impact Analysis: Proposed Ban on Plastic Carryout Bags in Los Angeles County*, prepared for Sapphos Environmental, available at: ladpw.org/epd/aboutthebag/PDF/SocioEconomicImpactStudy_final.pdf.

to paper taking place in supermarkets, though boutique shops such as clothes shops may choose them.

4.2.5.2 *Economic and social impacts*

- **Administrative burden**

A significant burden would be incurred for monitoring and compliance. On the other hand, there would be no reporting burden.

- **Effects on employment**

The measure will potentially affect about 250-300 producers of plastic carrier bags in the EU, and 15 000-20 000 employees.[208] However, half of the demand is expected to shift to multiple-use plastic carrier bags, which a majority of EU producers already produce and others could produce after investing in new or adapted machinery. This option could therefore have even have a positive effect on employment in the medium term. The specific producers affected and the extent of the impact will depend on the alternative(s) chosen by retailers and consumers. In France, the gradual switch to multiple-use bags initiated by major retailers has benefited PP bags, which are mainly produced in China.[209] In other countries, LDPE bags have seen greater take-up.

A ban on single-use plastic carrier bags would most likely increase research and innovation efforts aimed at finding alternative materials to replace the banned plastic bags and in this way could generate new jobs to offset the jobs lost due to the ban. Indeed, Member States should find they have greater competitive advantage in higher unit value products than in the cheapest plastic carrier bags, for which economies of scale in production are key. However, this is not true of all bags, as the case of woven PP shows.

- **Trade and competitiveness**

A ban would reduce plastic carrier bag litter dramatically, thereby creating benefits for tourism and other sectors.

As mentioned above, imports from outside the EU tend to be thinner single-use HDPE bags, while EU producers tend to specialise in higher-value, thicker LDPE bags. Such producers should be well placed to take advantage of a switch away from single-use plastic carrier bags. However, this may not be true of all types of plastic carrier bag, e.g. PP may be more competitively produced in Asia.

The reduction or elimination of single-use plastic carrier bags could entail a significant decrease in activity for SMEs specialised in the production of plastic carrier bags. This implies that in the few EU-27 countries that still produce single-use plastic carrier bags, such as France, companies would have to either close production lines or switch to producing multiple-use plastic carrier bags.

[208] Alber & Geiger estimate.
[209] Source: Communication the French association of flexible packaging

One of the possible impacts of putting in place a ban on single-use plastic carrier bags could be to put significant demand pressure on companies selling alternative bags. For instance in Italy, which recently enacted a ban on these bags, there have been concerns about the production capacity of compostable plastics companies to fill the demand created by this law.[210] The transitional period of 18-24 months would help producers to adapt.

- **Awareness and acceptability**

Awareness will be effectively raised due to the drastic character of the measure. Nevertheless, even though consumer habits will be changed, insufficient communication might result in a lack of understanding, which combined with loss of convenience could lead to general dissatisfaction. People might perceive the measure as excessively drastic and lose sight of the environmental positive objective. Awareness of the alternatives to single-use plastic carrier bags must be raised and sustainable alternatives must be proposed. More flexible measures such as the tax imposed in Ireland were preceded by awareness campaigns and have proved to be popular.

[210] ICIS (2011) *Plastics converters complain to EU over Italy bag ban*, available at: www.icis.com/Articles/2011/01/25/9428931/Plastics-converters-complain-to-EU-over-Italy-bag-ban.html.

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Chapter 5: Comparison of the options

In this chapter, the policy options are compared to the baseline scenario and to each other, based on the assessment of the individual policy options in the previous chapter. A summary table of the main impacts is provided at the end of the chapter.

The comparison made in this chapter highlights the advantages and disadvantages of the various policy options, across the economic, social and environmental dimensions and identifies potential weaknesses and risks of the options. The options are compared from the point of view of effectiveness, efficiency and consistency, including potential trade-offs between competing objectives. The cost-effectiveness of different options is also considered since some of them will have budgetary implications. Table 34 below summarises the pros and cons of the various policy options analysed.

Table 34: Summary of pros and cons of policy options to reduce the use of single-use plastic carrier bags in the EU

Policy option	Pros	Cons
Option 1: **Baseline Scenario**	- No legal or administrative changes or costs associated with revising current legislation.	- Environmental, economic and social impacts associated with plastic carrier bag use in the EU would persist and/or worsen (e.g. accumulation of litter in the environment).
Option 2: **Voluntary commitment of a significant share of the retail sector not to provide single-use plastic carrier bags**	- Some reduction in plastic carrier bag use at participating shops. - Minimal disruption for consumers, manufacturers and retailers. - More 'buy-in' from retailers. - Less administrative burden for governments as they would be less involved than for mandatory measures.	- Not all shops would participate. - Under a voluntary agreement, it is unlikely that there would be a dedicated monitoring and enforcement body, nor sanctions to ensure participating retailers stick to the targets and commitments set out.

Policy option	Pros	Cons
Option 3: Setting an EU-level prevention target for single-use plastic carrier bags	- Flexibility for Member States as to the policy instruments to be used. - A waste prevention target would set clear guidelines on how much plastic bag reduction Member States should achieve.	- Risk that the target is not achieved, or that Member States implement costly or ineffective polices - Administrative burden would be on Member States.
Option 4: Introduction of a legal requirement for Member States to take measures to ensure that single-use plastic carrier bags are not provided for free to customers	- Raises awareness about resource efficiency and waste among the general public. - Funds from the levy can be ring-fenced for environmental projects such as litter clean-up, landfill remediation etc. - Provides incentive for consumers to reduce excessive bag use while preserving consumer choice.	- In terms of consumer behaviour, mandatory consumer charges are a more direct lever than a voluntary agreement. - Depending how Option 4 is implemented, there can be administrative burden for national administrations and/or retailers. - There is a cost for those consumers who pay the levy or purchase multiple-use bags.
Option 5: Introducing an EU-level ban on single-use plastic carrier bags	- Provides high level of certainty in the mitigation of environmental impacts, especially litter. - Possible increase in revenue and jobs for EU producers of alternative carrier bags.	- Loss of revenue and jobs connected with single-use plastic carrier bags. - Loss of consumer choice. - Damage to EU Internal Market.

Table 35 : Impacts of policy options to reduce use of plastic carrier bags compared to the Baseline Scenario (Option 1), 2020

Impact indicator	Option 1	Option 2	Option 3	Option 4	Option 5
Tonnes of plastic carrier bags (% reduction)	0	13	20	21	24
Tonnes of single-use plastic carrier bags (% reduction)	*0*	*55*	*80*	*90*	*100*
Number of plastic carrier bags (% reduction)	0	46	70	76	85
Number of single-use plastic carrier bags (% reduction)	*0*	*55*	*80*	*90*	*100*
Oil (kt saved)	0	463	693	758	842
Emissions ($MtCO_2eq$ avoided)	0	81.2	121.4	132.8	147.6
Reduction in number of bags littered (billions)	0	2.4	3.5	3.9	4.3

It is clear that the Baseline Scenario is not sustainable. Although good progress has been made in the several Member States that have policies in place to deal with plastic carrier bags, the use of single-use plastic carrier bags is still very high in Europe. As long as that is the case, litter will remain a worsening problem due to the lightweight, mobile nature of plastic carrier bags and their persistence in the environment.

Experience at Member State level shows that effective policy interventions exist. The seriousness and the transnational nature of the problem imply that action at EU level should be considered. A range of policy options has been considered in this report, and each of Options 2-5 is a great improvement over the baseline scenario (Option 1).

The first option, a voluntary approach, would have the significant advantage of being simple to implement, while still achieving a substantial reduction in use. However, it is not an optimal solution in terms of environmental impacts, as it would not ensure full market coverage, could be relatively slow to take effect, and might not achieve a high level of compliance.

A ban at EU level, by contrast, would be very effective in reducing the use of single-use plastic carrier bags. However, the decision would require unanimity and so is unlikely to be adopted. Also, it is a blunt instrument that gives no flexibility to producers, retailers or consumers. It could also conflict with Internal Market and international trade law.

Distribution of plastic carrier bags without charge leads to excess use. Pricing measures have an almost immediate effect on consumer behaviour, while also preserving consumer choice and giving retailers flexibility. Most of the available LCA literature suggests that single-use (HDPE) plastic carrier bags are more environmentally harmful than multiple-use plastic carrier bags. However, requiring that a price be placed on *all* plastic carrier bags would avoid the need to define single-use and multiple-use types. It would result in both a reduction in the use of plastic carrier bags overall and a shift from single-use to multiple-use plastic carrier bags.

One of the most attractive features of a demand-side pricing measure such as the one described in Option 4 is that it allows government revenues to be raised. However, Member States should not see this as a potentially significant source of revenue because the price should be set high enough that only a modest amount of revenue is raised – enough to cover the administrative costs and fund some environmental projects with the surplus. The main aim should be to reduce the use of plastic carrier bags. Although not yet widely applied, pricing measures at Member State level have been very effective, notably in Ireland.

The most effective approach may be to combine a waste prevention target at EU level (Option 3) with pricing measures at national level that would make it obligatory for shops to charge for plastic carrier bags (Option 4). This would provide the political commitment and monitoring that comes with an EU target, with the flexibility and efficiency of pricing measures. Pricing measures are most appropriately implemented at national level but an ambitious EU level target is important to help raise awareness and ensure implementation.

The reductions in environmental impact brought about by this combination (Option 3+4) in 2020 would be at least as high as those of Option 3 on its own. The combination of the two options is preferable for a number of reasons. Pricing measures are highly effective at reducing the use of plastic carrier bags. However, Option 4 does not specify the level of the price but leaves it up to

the Member State. This introduces a risk that the reduction achieved could be lower than expected. The combination of Option 4 with a waste prevention target at EU level, however, would ensure that the prices set by Member States would be at least high enough to achieve the target. The additional policy certainty provided by Option 3 also makes it easier for producers and retailers to adapt, by facilitating any investments or changes in business practices that would be required. The target would also help raise consumer awareness - a key success factor for Option 4. Finally, as pricing measures affect consumer behaviour almost immediately, the target set out in Option 3 might be achieved earlier in the project period than if the target were introduced on its own. This means that the cumulative benefits by 2020 would be even more positive. A small additional legislative burden would be necessary but it would be worth the improved and more cost-effective implementation that would result.

Based on experiences in Europe and around the world and the analysis in this report, the result of such an approach would be a steep reduction in the use of single-use plastic carrier bags in the EU and associated environmental impacts. There would be an increase in the use of LDPE and other multiple-use plastic carrier bags (with a potential beneficial or at least neutral impact on EU plastic bag producers), and only a small increase in the use of other carrier bags such as paper and cotton.

The overall environmental impacts would be positive on all indicators, including energy use and greenhouse-gas emissions but especially for litter, where the absolute number of bags is a key indicator of the impact.

Note that for all options other than Option 4, the precise definition of single-use plastic carrier bag might be subject to further assessment in an implementing measure. Based on stakeholder feedback, a definition of single-use that includes wall thickness of 49 microns or less would be appropriate.

Table 36 : Qualitative comparison of environmental, economic and social impacts of policy options to reduce use of plastic carrier bags

Impact indicator	Option 1	Option 2	Option 3	Option 4	Option 5	Option 3+4
Reduction in litter	--	+	++	+++	+++	+++
Resource efficiency	-	+	++	++	+++	+++
Emissions	-	+	++	++	+++	+++
Biodiversity and land use	--	+	++	++	+++	+++
Water and soil quality	-	+	++	++	+++	+++
Economic impacts of litter	--	+	++	+++	+++	+++
EU plastic carrier bag waste management sector	?	?	?	?	?	?
EU plastic carrier bag producers	=	=/+	=/+	=/+	=/+	=/+
Government revenues	=	=	?	++	=	+
Impact on retailers	=	+	?	=/+	=/-	=/+
Impact on consumers	=	?	?	-	--	-
Administrative burden	=	=	-	-/?	--	-

Legend:

+++	very beneficial effect
++	substantial beneficial effect
+	slight beneficial effect
=	No effect
-	negative effect
--	substantial negative effect
---	very negative effect
?	unknown effect

Annex A: SELECTED EXPERT CONTACTS

- **National authorities**

Belgium - Interregionale Verpakkingscommissie / Commission Interrégionale de l'Emballage, www.ivcie.be, Marc Adams, Caroline Auriel

Belgium - Federal Public Service, Health, Food Chain Safety and Environment, www.health.belgium.be, Johan Daniëls

Bulgaria - National administration, Grigor Stoyanov

Denmark - National administration, Anne-Mette Lysemose Bendsen

France - Service de la prévention des nuisances et de la qualité de l'environnement, Julien Koesten

France - ADEME, Sylvain Pasquier

Germany - Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, www.bmu.de, Thomas Schmid-Unterseh

Ireland - Department of Environment, Jean Clarke and Mary Meacle

Ireland - Environmental Protection Agency, Jonathan Derham

Luxembourg - Administration de l'environnement, Frank Thewes

Netherlands - Ministry of Infrastructure and the Environment, www.minienm.nl, Suzan Akop

Slovenia - Ministry of Environment and Spatial Planning, Katja Buda and Lucija Jukić Soršak

UK - Department for Business, Innovation and Skills, Peter Askew

UK - Department for the Environment, Food and Rural Affairs, Ian Atkinson

- **Industry associations**

EU - EPRO (European Association of Plastics Recycling and Recovery Organisations), www.epro-plasticsrecycling.org, Peter Sundt

EU - EuPC (European Association of Plastic Converters), www.eupc.org, Alexandre Dangis

EU - European Bioplastics, www.european-bioplastics.org, Marko Schnarr

EU - Oxo-biodegradable Plastics Association, www.biodeg.org, Secretariat

EU - PlasticsEurope, Géraldine Lissalde-Bonnet

France – ELIPSO (French Plastic and Flexible Packaging Association), www.elipso.org, Vincent Colard

Germany - IK Industrievereinigung Kunststoffverpackungen, www.kunststoffverpackungen.de, Heike Richter

- **Plastics recyclers**

Belgium - Rymoplast, www.rymoplast.be, Hubert Francx

Finland - Finnish Plastics Recycling, www.plastics.fi, Vesa Kärhä

France - Régéfilms, Bruno Gauthier

France - Eco-Emballages, Jean-Louis Davoust

France - CeDo, www.cedo.com, Ton Emans

- **Other**

EU - KIMO International, www.kimointernational.org, John Mouat

Finland - Finnish Environment Institute SYKE, Risto Saarinen

France - CEDRE (Centre de documentation, de recherche et d'expérimentations sur les pollutions accidentelles des eaux), Loïc Kerambrun

France - Ifremer, François Galgani

France - MerTerre, www.mer-terre.org, Isabelle Poitou

Germany - Alber & Geiger, Hubertus Droste, Fabian Pescher and Waltraud Heinrich

Ireland - Tobin Engineering, www.litter.ie, Claire Walsh

Spain - IRIS, Elodie Bugnicourt

UK - CEFAS, Thomas Maes

UK - University of Plymouth, Richard Thompson

Annex B: Initiatives to reduce the use of plastic carrier bags

Table 37: Initiatives to reduce plastic bag use in EU Member States[211]

MS	Existing or planned legislation to avoid the use of plastic carrier bags	Voluntary initiatives	Achieved or planned outcomes
AT	Austria has no legislation in place to address the issue of plastic bags, nor a national recycling scheme. However, the Greens intend to promote voluntary agreements with supermarket chains and in January 2011, the environment minister published a five-point plan to reduce the use of plastic bags.		
BE	Belgian authorities have had a voluntary agreement with retailers for 15 years where customers are charged a fee that goes to Fost Plus, a plastic collection and recycling firm. However there is no national scheme for recycling plastic bags separately. There is also a federal environmental tax on single-use plastic carrier bags. The packaging tax, introduced in May 2007, sets a charge of €3/kg for the distribution of plastic carrier bags used for carrying goods purchased from retailers. Article 6(3) of a Regulation of 27 June 1996 contains the legal provisions on avoiding the use of plastic carrier bags. The regulation is not yet in force in the Walloon region. Any reduction in the use of plastic carrier bags in the Walloon region is therefore on a voluntary basis or as a result of other legislation.	The retailers' association Comeos produced a plan to reduce the use of plastic carrier bags in retail, which has been in place since 2003. Members committed to reducing "single-use" plastic bags by 20-25% by 2006 and by 60% by 2009.	In Flanders, the voluntary agreement led to an 80% reduction in disposable plastic carrier bags between 2003 and 2009. In Wallonia, the plan has led to a 60% reduction in disposable plastic bags for the period 2007-2010 compared to 2003. The 2010-2013 plan targets a 90% reduction compared to 2003 in terms of tonnage/revenue. By 2011 an 86% reduction had been achieved.

[211] This table is based on a range of sources, notably a document prepared by the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management and Strange, K. (2011) *Plastic Bags: National Policies & Practices*, PlasticsEurope.

BU	In March 2011, Bulgaria's Ministry of Environment proposed the use of economic measures to limit the use of plastic bags. A tax on PE bags with a thickness of less than 15 microns will come into effect on 10 October 2011.[212] The tax will be paid per item by those who place plastic carrier bags on the Bulgarian market and retailers will pass the fee on to customers. The proceeds of the tax will be ringfenced for waste management projects. The tax is set to increase each year, from €0.077 initially to €0.28 in 2014. At the beginning of 2012 the Ministry of Environment and Water plans to extend the tax to bags thinner than 23 microns.[213]		The tax on thin plastic carrier bags is expected to result in a reduction of 30% of carrier plastic bags consumed.
CY	No measures in place. Proposals to make all bags biodegradable and to prohibit supermarkets from giving away free plastic carrier bags were rejected in 2008.		
CZ	Under Czech law: a) if no charge is applied at the supermarket till for plastic carrier bags (as is the case at Tesco for example), then they are treated as packaging. For the disposal of this packaging, a charge of around €230 per tonne of plastic carrier bags must be paid by the supermarket. This measure does not discourage use of plastic carrier bags directly but it does encourage supermarkets to impose a charge. b) if a charge is applied to plastic carrier bags (e.g. at BILLA supermarkets) it is not considered packaging and there is therefore no disposal fee. From 2011, free distribution of plastic carrier bags will be banned but it will be up to retailers how much they charge. The Czech Environment Ministry considers conventional plastic carrier bags containing additives to be problematic because a relatively large amount of plastic waste recycling is		

[212] Sustainable development academy (2011) *Bulgaria to introduce eco-tax on plastic bags*, available at: www.courseforsustainability.org/blacksea/news.php?id_news=470. ENDS Europe (2011) *Sorting out the plastic bag policy chaos*, 5 July 2011.
[213] National authority communication.

	carried out in the Czech Republic. Labelling is therefore now being considered.		
DE	No specific legislation.	Supermarkets voluntarily charge for plastic bags. Most German supermarkets charge between €0.05 and €0.10 per "single-use" bag, depending on the type of bag.	The problem is regarded as having been solved by packaging legislation.
DK	There has been a charge for plastic and paper carrier bags (with a volume of at least 5 litres) since 1993. The charge depends on the weight and material. On average it is 0.5 DKK per plastic bag (this charge is equal to 10 DKK/kg for paper bags and 22 DKK/kg (around €3) for plastic bags). It is up to individual businesses to decide whether or not they charge their customers for the bags (generally between 1.5 DKK and 3 DKK). As the cost can be absorbed in the cost of products, consumer behaviour change is not the direct target as in Ireland.		The environmental authorities do not have precise data on the number of carrier bags used. However, after the introduction of charges, the total use of plastic to make carrier bags fell from just under 18 750 tonnes in 1993 to around 7 750 tonnes in 1999. By 2009, use had crept back up to around 8 950 tonnes. According to environment authority data, carrier bags have become thinner since the introduction of charges,[214] and are made out of reusable (thick) material, so that their energy value can be used when burnt in incinerators. Many municipalities, organisations and businesses

[214] BIO calculations are that average weight may have reduced by up to one third since 2003.

			encourage the use of reusable bags. Use of paper and plastic bags is estimated to have fallen by two-thirds.[215]
EE	Under the current legislation, plastic carrier bags are considered to be part of packaging, so it is the duty of the producer (person who places the packaging on the market) to organise collection and arrange for recovery or recycling. If recovery or recycling targets are not met, the producer must pay a packaging tax for the amount it is below the target. The Estonian Green Party initiated draft legislation in 2010 to implement a new tax on plastic carrier bags. On 3 February 2011 it was still undergoing its first reading in Parliament. The draft being considered by the Estonian parliament suggested a tax of €0.20 per plastic bag over 20 cm x 30 cm in size (with handles) bought in retail. It is currently unclear what is happening with the plastic bag tax under the new government.	In retail, bags are sold for around €0.10, so are not free. In this way, the bulk use of these bags can be monitored to a certain extent. Reusable bags are promoted by media campaigns, as well as in other ways.	A tax of €0.20 on top of the average price of €0.10 would mean that the number of plastic bags sold would decrease quickly, like in Ireland. However, an evaluation of the policy has not yet been carried out.
EL	There is no legislation to reduce the use of plastic carrier bags.	Plastic bags are free everywhere in Greece, apart from Lidl. Since 2008, some supermarkets have made reusable shopping bags available but with limited success because thin plastic carrier bags are still distributed without charge. Some municipalities (e.g. Athens), districts (e.g. Samos) and large supermarkets have introduced	

[215] The Scottish Government (2005) *Proposed Plastic Bag Levy - Extended Impact Assessment: Volume 2: Appendices Appendix 1. International Context – Experience Elsewhere- Republic of Ireland*, available at: www.scotland.gov.uk/Publications/2005/08/1993259/33019.

		biodegradable shopping bags.	
ES	In transposing the Waste Framework Directive, Spain envisages the following reduction in plastic bag use compared to 2007: - 60% fewer plastic carrier bags by 2013; - 70% by 2015; - 80% fewer plastic carrier bags by 2016. From 2018, the use of plastic carrier bags should be stopped completely, except for plastic bags for meat, fish and freezer products (with a high water content), as no equivalent alternative to plastic bags has yet been found. In addition, from 1 January 2015, a message about the harmful environmental impacts of plastic carrier bags must be printed on all bags. The Andalusia region agreed a charge for the use of plastic carrier bags in June 2010, which came into force on 1 May 2011. It provides for a charge of €0.05 per plastic carrier bag in 2011, which should rise to €0.10 per plastic carrier bag in 2012. The Spanish body for standardisation and certification (AENOR) has made a standard on reusable PE carrier bags (UNE 53942 - 2009), guaranteeing their use at least 15 times.	There have also been voluntary agreements in Spain sinc at least 2008. The main retail associations signed up to voluntary agreements with the regional public authorities to promote the prevention and more sustainable use of carrier bags among consumers. Some large supermarket chains now either charge for plastic carrier bags (Día) or pay a small amount back (around €0.10) if the customer does not take any plastic carrier bags (Eroski Group).	One of the best examples is *Pacto por la Bolsa* in Catalonia, signed in 2009. Its target was a reduction of consumption of "single-use" bags by 50% by 2012. By 2010, a reduction of 40% had been achieved.

FI	No legislation specifically targeting plastic carrier bags.	Almost all supermarkets sell durable bags, paper bags and plastic bags. Some public institutions and private companies provide free multiple-use cloth bags.	
FR	In 2005, France adopted a law banning the sale of non-biodegradable plastic bags by 2010 but the text was never applied since it was deemed to be in breach of certain provisions of the Packaging Directive. The 2010 budget (*Loi de finances rectificative pour 2010, article 47*) instead set up a tax on non-biodegradable "single use" plastic carrier bags of €10/kg (around €0.06 per bag), which will be applied from 1 January 2014. This is set out in Article 266, as amended, of the general tax code book *'Code des Douanes'*. Biodegradable bags made from a minimum of 40% renewable resources would be exempt.	Until now, supermarket chains have had sole responsibility for reducing the number of plastic carrier bags. Since 1996, E.Leclerc has progressively replaced free thin plastic bags with biodegradable, reusable and cotton carrier bags. The supermarket chain has reduced the number of plastic carrier bags distributed to consumers from 1 billion in 1995 to 50 million in 2005. By 2005, 94% of its costumers owned one or more reusable bags. Other chains have followed its example and some have voluntarily started charging for plastic bags. The FCD retail federation made a commitment to reduce plastic carrier bag use in 2003 and aims to completely phase out thin plastic carrier bags by the end of 2011. Carrefour aims to completely end free provision by 2012.	The tax is intended to reduce the use of free thin plastic carrier bags to as close to zero as possible. In past years, increased provision of reusable carrier bags has succeeded in considerably reducing the excessive provision of free thin plastic bags in France's supermarkets. The number of thin plastic carrier bags used in France decreased from 10.5 billion to 1.5 billion from 2002 to 2009.

		The island of Corsica banned plastic carrier bags in 2003. A referendum was organised that proposed three options for the replacement of conventional plastic carrier bags: large reusable plastic bags costing €1, paper bags sold for €0.08, or bio-based bags sold between €0.05 and €0.14 depending on their size. Of the 30 448 persons who voted, the majority (61%) opted for the reusable plastic bag sold for €1.	
HU	It is reported that there is a tax and national recycling scheme in place.	Some supermarkets have started voluntarily charging for plastic bags.	
IE	A levy was introduced in March 2002 on the purchase of plastic carrier bags in supermarkets, petrol stations and shops. It began at a rate of €0.15 and was raised to €0.22 on 1 July 2007.[216] The regulations do not distinguish between biodegradable plastic bags and other plastic bags,[217] but exemptions are made for plastic bags for use with fresh fish, fresh meat and fresh poultry, if not exceeding 225 mm width, 345 mm depth, 450 mm length (including handle), as well as for fruits, nuts, sweets, icecream, cooked items, milk products on board an aeroplane or ship, or when marked as reusable. Charges are paid into an environment fund, which is used for financing recycling centres and other environmental activities such as cleaning up illegal landfill sites. Annual		The effects of the tax on the use of plastic bags in retail outlets and in the landscape were dramatic. Within five months of introduction, a 90% reduction was achieved. At the same time, €3.5m was collected. At that time, 328 bags per person per year were used. This number was reduced to 21. However there was subsequently a gradual increase in plastic bag usage, to 30 bags per

[216] For more information see www.citizensinformation.ie/en/environment/waste_management_and_recycling/plastic_bag_environmental_levy.html.
[217] Source: www.environ.ie/en/Environment/Waste/PlasticBags.

	revenues have risen from around €12-14m to €23.4m in 2009. Collection and associated administration costs are low, at about 3% of revenues.[218] In 2011, provision has been made in national legislation which sets a ceiling for the levy at €0.70 and enables the levy to be amended once in any financial year.		person/year in 2006. In response, the plastic bag levy was increased. This resulted in a decrease to 26 bags per person in 2008 and 18 bags per person in 2010. The aim of the increased rate was to keep the number of plastic bags per person to 21 or fewer. The share of plastic bags in litter pollution in Ireland has fallen from 5% in 2001 to 0.25% in 2010.
IT	Italy has taken the most drastic action of any EU Member State so far, in its Law of 27 December 2006, No 296, Article 1, paragraphs 1129, 1130 and 1131. Paragraph 1129: In order to reduce the amount of CO_2 emissions to the atmosphere, improve environmental protection and support the agri-industry on biomaterials, in 2007 a national pilot programme was launched for the gradual reduction of carrier bags placed on the market that are not biodegradable under the EU criteria defined in law, and the technical conditions adopted at EU level. Paragraph 1130: In accordance with paragraph 1129 (…) the programme is aimed at establishing measures to be gradually implemented at national level to achieve the ban on placing carrier bags on the market that are non-biodegradable and that do not fulfil the technical and legal biodegradability criteria adopted at EU level. The ban came into force on 1 January 2011 and does not provide for any specific penalties for infringements. It applies to all product sectors and all types of non-biodegradable carrier bags. Reusable plastic bags are exempt. Shops and supermarkets will only be able to provide customers with the plastic bags		The goals are to reduce CO2 emissions, protect the environment and support the agricultural sector with the commercialisation of bio-based materials. A drastic reduction in the number of non-biodegradable plastic bags in favour of the use of reusable bags and shopping bags is expected, along with a corresponding increase in number of bags made of biomaterials from biodegradable and compostable material.

[218] Convery, F. et al. (2006) *The most popular tax in Europe? Lessons from the Irish plastic bags levy*, Science+Business Media, plasticbaglaws.org/…/study_the-most-popular-tax-in-Europe-2007.pdf.

	remaining in their stockrooms, giving them to customers free of charge; and only until 31 August 2011 in supermarkets and 31 December in smaller shops.[219] The Italian ban was announced without notifying the EC. On April 5, Italy gave notification of a draft law defining the scope of the ban on the marketing of non-biodegradable shopping bags. It also contains provisions related to penalties. The Commission has sent a detailed opinion to the Italian authorities. This kind of ban is a breach of the Packaging and Packaging Waste Directive, as well as internal market rules.		
LT	In Lithuania, there is no legislation or planned legislation to ban plastic carrier bags.	Most distributors voluntarily do not use plastic carrier bags.	
LU	No legislation specifically targeting plastic carrier bags.	A voluntary agreement is in place between the Environment Ministry and Valorlux (association of producers and importers of packaging material) regarding the sale of the multiple-use "Eco-sac" carrier bag. The voluntary agreement has a target of a market share for multi-use carrier bags of at least 51%. This agreement was first made with food and DIY shops. The first agreement was made in 2004, the second in 2006, and the third in 2008. It is applicable	The system is self supporting, and in addition, each year two studies are undertaken, financed by the sale of multiple-use carrier bags. 2002: 71m "single-use" plastic carrier bags 2004: 55m plastic carrier bags (Introduction of eco-bags) 2007: 11m plastic carrier bags (significant fall following introduction of a voluntary charge of €0.03 per bag) 2009: 6.5m plastic carrier bags Between 2003 and 2009, it was possible to reduce the amount of

[219] Legge finanziaria 20071.

		throughout the country. There is no provision for penalties. An annual inspection is carried out by a commission made up of the CLC trade association, Valorlux and the Environment Ministry). The initiative is expected to be continued; the next stage will include bakeries/patisseries and bookshops, followed by butchers, art and craft suppliers, pharmacies, shoe and leather shops. This will probably be with printed advertising, as some chains have begun to sell their own "eco" carrier bags.	plastic carrier bags from 599 tonnes to 134 tonnes, preventing 465 tonnes of plastic waste.
LV	The Latvian Environment Ministry states that each year around 20 tonnes of plastic bags must be disposed of. Taxes were therefore introduced on the use of plastic carrier bags which the retailer must pay. A tax rate of 0.80 LVL/kg is applied to plastic bags weighing more than 0.003 kg (the weight of 1 000 bags exceeds 3 kg). Since 2009, there are three categories of environmental levy: €0.02, €0.14 or €0.15 per plastic carrier bag, labelling (printed) on plastic carrier bags, and penalties for breaches of the conditions. In 2010 the law was amended again to prevent the use of carrier bags without handles to avoid the environmental levy.	Supermarkets now only offer plastic carrier bags for a charge.	No information on results has been found.
MT	Charges for plastic bags were introduced in 2005: Biodegradable: 0; Degradable: €0.14;		A decrease of 5m plastic bags was recorded in the first five months of 2005. Better traceability and monitoring of the production of plastic

	Plastic: €0.16.		carrier bags has resulted.
NL	In the Netherlands there is no specific legislation regarding plastic carrier bags. Since 1 January 2008, packaging importers, producers and purchasers pay a packaging tax, with different tariffs for each type of material. For plastic packaging such as plastic carrier bags, the tariff is currently €0.47/kg. To encourage the use of biodegradable carrier bags, these have a tariff of €0.08/kg. Finally, plastic waste has been collected separately in all around 430 Dutch municipalities and towns since 1 January 2010.	Voluntary agreements in retail mean that supermarket customers have not received most types of plastic carrier bag for free since the mid-1990s and today pay around €0.20 per bag. In many shops there are "bag bins" where used bags can be deposited and used again by other customers. The retail sector recently announced that the smaller, translucent bags will not be offered free either.	The Dutch Environment Ministry could not give details of the overall amount of plastic carrier bags placed on the market, or in relation to possible trends since the introduction of the legislation. They simply emphasise that currently 50-70% of plastic waste in Dutch households is recovered, and the measures put in place in the Netherlands in the last 20 years have led to a reduction in the use of plastic carrier bags approaching the situation of Ireland.
PL	Polish law does not have a specific regulation concerning plastic carrier bags. It is not planned to establish such regulations in future although a tax was considered during 2010.		
PT	Portuguese MPs have approved a legislative proposal to promote the following replacement measures: • Provision of biodegradable bags • Provision of reusable bags at affordable price • Environmental awareness of employees and consumers to promote the use of alternatives to plastic bags that are environmentally responsible; • Promotion of environmental awareness campaigns among consumers, aimed at the separation of waste at source and the appropriate referral within the existing		The proposal sets a 90% reduction target for the supply and consumption of thin-walled plastic bags at wholesalers and supermarkets by 2017 against a 2007 baseline. There are intermediate targets of a 30%and 60% reduction by 2013 and 2015.

	legal systems management; • Adoption of one of the following economic mechanisms to encourage a reduction in the use of plastic bags: Levying a charge for the supply of plastic bags; Applying a discount on the price of goods sold to consumers desisting entirely from taking free plastic bags		
RO	Government Regulation No 25/2008 (published in Gazette No 628 of 29 August 2008) entered into force on 1 January 2009. Introduction of a tax of €0.5 for each non-biodegradable plastic carrier bag placed on the market. In 2010, the tax was cut to €0.25 and applies to bags from non-renewable sources.		There is no data available to quantify the decline in use, though the Romanian association of Solid Waste Management reports that according to unofficial sources the decrease was 6-10%.
SE	No measures planned. Responsibility currently rests with producers, who are responsible for collection and disposal. The producer pays a disposal charge which is recovered through the price of the bag. Plastic bags could (theoretically) be collected at plastic bottle collection points.	Supermarkets pass the cost of disposal on to the consumer: a plastic bag costs €0.17-0.30. Swedes like to buy €0.50 plastic bags (almost twice as expensive) which are printed with the logo of an NGO or a local sports team. That organisation then receives 50% of the proceeds. The Swedish retailer Hemköp has introduced bags made of renewable materials (sugar cane). The material can be recycled like conventional PE.	Pricing under the current regulation is intended to reduce the use of plastic bags and to support the use of multi-use fabric bags. However, no data on the results achieved has been found.

SK	In Slovakia there is no legislation on the avoidance of plastic carrier bags and none is currently planned.	Some food stores (Billa, Hypernova and Kaufland) no longer give out plastic bags for free, but sell them.	
SI	In Slovenia there are proposals to introduce a tax on plastic bags that would be passed on to customers: €0.50 for bags made from at least 5% plastic; €0.40 for bags made from more than 95% biodegradable material; €0.20 for bags made from more than 95% textiles.		
UK	In the UK there are currently no legal requirements on avoiding the use of plastic carrier bags, only voluntary agreements between the ministry responsible (Defra) and leading supermarket and department store chains. However, the 2008 Climate Change Act provides conditions to allow the introduction of a general charge for plastic carrier bags. The Welsh Assembly Government plans to introduce a compulsory charge of 0.05 GBP (around €0.06) for "single-use" plastic bags in October 2011. Originally, the plan was to introduce a charge of 0.07 GBP from April 2011. However, these plans were changed after heavy lobbying from the British Retail Consortium (BRC) and others. The Scottish Government and Northern Ireland Assembly Government have been running an awareness-raising campaign for several years in order to reach the target of a significant reduction in plastic bag use, and is considering options to phase out free plastic bags in supermarkets. The Northern Ireland Assembly Government is currently consulting on proposals for a charge on carrier bags; the consultation closes on 12 October 2011.[220] Several towns and cities in the UK have also started to ban plastic shopping bags. The	A voluntary agreement between Defra and 21 large retailers had a target of a 25% reduction in the harmful environmental impact of carrier bags between May 2006 and December 2008. The amount of virgin polymer was used as an indicator and reusable bags were included. The agreement included support for reuse of carrier bags, increased recycling and a reduction in the weight of carrier bags. A second agreement followed with the target of a 50% reduction by May 2009 compared to 2006. Seven supermarket chains participated.	Defra statistics show that in May 2006, 870m thin bags were used in the participating supermarkets. In May 2009, this number was 452m and in May 2010 it was 475m. This is a reduction of around 45% compared to 2006, i.e. short of the target. Defra would like to achieve a 70% reduction in the long term. Further plans, such as the introduction of a charge for thin bags, are still an option according to Defra but are not currently being pursued. The devolved administrations in Scotland, Wales and Northern Ireland could however implement their own measures on this

[220] See www.doeni.gov.uk/consultation_document_on_proposals_for_a_charge_on_single_use_carrier_bags.pdf.

	town of Modbury banned plastic bags in 2007.[221] Chesham launched the Plastic Bags Free Chesham Campaign in 2007.[222]	The following agreement for 2010 (between the Scottish Government, Defra, the Welsh Assembly Government, and the Northern Ireland Department of the Environment with the British Retail Consortium (BRC) and its supermarket members) continued with the idea of further reductions, but did not set out concrete targets. The agreements were mainly aimed at simple plastic carrier bags that customers can get for free in supermarkets. There are no penalties involved. A variety of methods were used to cut use: some such as Marks and Spencer charge for bags, while others put signs in car parks reminding customers to reuse their bags. Others began giving out bags only when requested by customers.	issue, such as those planned by Wales for October 2011. According to the WRAP, the following progress was made (figures include the overall number of carrier bags, not just thin bags: 2008: -26% 2009: -48% 2010: decreasing trend stops; use of thin plastic bags increases 5% compared to May 2009.

Many other countries around the world have implemented policies to reduce the use of plastic carrier bags. Prohibitive legislation is more likely to be applied in poorer countries, where plastic bags and other waste items are more likely to clog drains and sewers, and where the risks for public health and the environment may be greater.

[221] Vidal, J. (2007) "Welcome to Modbury. Just don't ask for a plastic bag" in *The Guardian*, available at: www.guardian.co.uk/environment/2007/apr/28/plasticbags.frontpagenews.
[222] Plastic Bags Free Chesham Campaign, see: www.cheshamintransition.org.uk/waste-recycling/plastic-bag-free-chesham.html.

- In **Australia**, In Australia, it has been estimated that it costs governments, businesses and community groups over 4m AUD per annum to clean up littered plastic shopping bags.[223] An ex-ante impact assessment carried out by the Australian government indicated that a charge of 0.25 AUD (approximately €0.20, which is similar to the level of the plastic bag levy in Ireland) was likely to achieve the best environmental outcomes in terms of energy use and reduction litter. Rather than implement this charge as a mandatory levy, the Australian government responded to retail pressure and agreed to see what could be achieved through a voluntary retailer Code of Practice. The approach was implemented from 2003 to 2005. Supermarkets reduced HDPE plastic carrier bag provision by about 41-44% during this period and overall plastic bag use was reduced by about 34%.[224] According to the Australian Retail Association, the recycling rate increased to 14% as well. The initiative has also increased use of alternative forms of shopping bags: reusable shopping bags and to some extent kitchen tidy bags (Table 36).

Table 38: Change in plastic bag and kitchen tidy bag use in Australia, 2002-2006[225]

	2004	2005	2006
Decrease in HDPE bag use from previous year (million)	510	810	560
Decrease in HDPE bag use from previous year (tonnes)	2 777	4 498	3 455
Increase in kitchen tidy bags sold from previous year (million)	26	31	38
Increase in kitchen tidy bags sold from previous year (tonnes)	251	300	364
Net change in materials use (tonnes)	**-2 526**	**-4 198**	**-3 091**

[223] "Clean up Australia" campaign, *Say no to plastic bags*, www.cleanuptheworld.org/PDF/au/plastic-bags---revised-household-version.pdf.
[224] Australian Environment Protection and Heritage Council website, www.ephc.gov.au/taxonomy/term/54.
[225] Hyder Consulting cited in Strange, K. (2011) *Plastic Bags: National Policies & Practices*, PlasticsEurope.

The tables below show the results of calculations done by the Australian government of revenues from a plastic bag levy based on the size of levy.[226]

Table 39: Revenue from a levy on all retail bags (excluding reusable bags)

Reduction in plastic bags (%)	15 cent levy			25 cent levy		
	Direct levy revenue (million AUD)	GST[227] (million AUD)	Total revenue (million AUD)	Direct levy revenue (million AUD)	GST (million AUD)	Total revenue (million AUD)
50%	570.8	57.1	627.8	951.3	95.1	1 046.4
60%	463.5	46.4	509.9	772.5	77.3	849.8
70%	356.3	35.6	391.9	593.8	59.4	653.1
80%	249.0	24.9	273.9	415.0	41.5	456.5
90%	141.8	14.2	155.9	236.3	23.6	259.9
95%	88.1	8.8	96.9	146.9	14.7	161.6

[226] Environment Australia (2002) *Plastic Shopping Bags – Analysis of Levies and Environmental Impacts*, *www.tud.ttu.ee/material/piirimae/eco.../Plastic%20bag/analysis-final.pdf.*
[227] Australian goods and services tax.

Table 40: Revenue from a levy on supermarket plastic bags

Reduction in plastic bags (%)	15 cent levy			25 cent levy		
	Direct levy revenue (million AUD)	GST (million AUD)	Total revenue (million AUD)	Direct levy revenue (million AUD)	GST (million AUD)	Total revenue (million AUD)
50%	270	27.0	297.0	450	45	495
60%	216	21.6	237.6	360	36	396
70%	162	16.2	178.2	270	27	297
80%	108	10.8	118.8	180	18	198
90%	54	5.4	59.4	90	9	99
95%	27	2.7	29.7	45	4.5	49.5

- **Bangladesh** banned plastic bags in 2002, after being found to be responsible for the 1988 and 1998 floods that submerged most of the country. A ban was first placed in Dhaka city only, and due to its success, a nation-wide ban was proposed and implemented in 2002. The Bangladesh ban was the first nationwide ban on plastic bags in the world. It has successfully cleaned up the streets and drains of the country, while stimulating a re-birth of the jute bag industry.[228]
- **China** announced a nationwide ban on shops distributing free plastic bags from 1 June 2008. The amount that consumers should pay per bag is not defined; therefore retail outlets are free to set their own prices for plastic bags. Nonetheless, the selling price set by retailers should be higher than the operating costs. According to one study, people use at least 24 billion fewer plastic bags each year since the ban of free plastic bags.[229] Despite the reduction in plastic bag use, some implementation problems have been observed. There is a lack

[228] Plastic Free Times website: plasticfreetimes.com/bangladesh-plastic-bag-ban.
[229] Strange, K. (2011) *Plastic Bags: National Policies and practices*.

of effective substitutes for plastic bags and there are cases of double charging consumers.229 China also banned the production of ultra-thin bags less than 0.025 mm thick.

- Similar to China's policy regarding plastic bags, **Hong Kong** also has recently banned their free distribution. An environmental levy of 0.50 cents has been imposed on all plastic bags that fulfil the following criteria:
  - Wholly or partly made of plastic (e.g. PE, PP, PVC and nylon)
  - With a handle or any other carrying device attached to the bag
  - Non-woven bags made of polypropylene
- In **India,** there are local and regional bans on the use of plastic bags that are thinner than 0.030 to 0.070 mm, depending on the region. The Government of Delhi is currently pushing for a complete ban on the production and use of plastic bags nationwide, whereas the Environment Ministry supports only a partial ban. The justification for a partial ban is that there is no cheaper alternative to plastic bags.
- **Kenya** has introduced an extra tax on plastic bags. It also plans to ban ultra-thin bags early this year.
- **Macedonia** (candidate for EU membership) intends to introduce a total ban on non-biodegradable plastic shopping bags, prompting a switch to biodegradable bags by 2013. The distribution of free plastic bags by retailers has been banned since January 2009. Consumers are charged one Macedonian denar (€0.016) per plastic bag. In the past two years, the use of plastic bags in Macedonia has fallen by 40-50%.[230]
- In 2008, there was a proposal in **Norway** to ban all plastic carrier bags. Industry then proposed a voluntary target of 20% reduction by 2010. The idea was to eliminate about 15-20% of all the plastic bags used, i.e. those not reused for purposes like carrying residual waste, or carrying bottles to recycling stations or deposit machines. The short time period was chosen in the belief that high pressure on retailers over a short time period would be effective. However, a subsequent report by the Norwegian Environmental Protection Agency recommended that the bags should be neither taxed nor banned. No ban or tax was introduced and industry dropped its proposal.
- **Rwanda** has banned plastic bags less than 0.1 mm thick and introduced public awareness campaigns.

[230] Strange, K. (2011) *Plastic Bags: National Policies and practices*, PlasticsEurope and ACR+.

- In 2003, **South Africa** banned the manufacture, trade and commercial distribution of plastic bags thinner than 30 microns and introduced a plastics levy of around 1.20 Euros/kg, which manufacturers are expected to pass on to consumers. The government wants to promote thicker and easier to recycle plastic bags, which would also stimulate the recycling industry.
- In 2007, **Uganda** banned the import and use of the thinnest plastic bags (0.03 mm) and has imposed a 120% tax on import and use of all other plastic bags. Any person caught using plastic bags in Uganda since early 2010 is liable to be jailed for three years or fined the equivalent of 1 500 USD.[231]
- **United Arab Emirates:** In 2010, the Ministry of prohibited the printing of commercial names, products names, and advertisements, on non-biodegradable plastic bags.
- In the **United States**, there is no regulation at federal level but local authorities can decide whether and how to intervene. San Francisco was the first city to ban (non-compostable) plastic bags from large supermarkets and pharmacies in 2007. Washington D.C. introduced a 0.05 USD fee for "single-use" paper and plastic shopping bags, resulting in a drop in monthly use from 22.5m bags in 2009 to 3m in 2010. The money collected goes to a dedicated river clean-up fund.[232] A 0.10 USD fee for plastic bags has been introduced in Los Angeles.
- **Other countries** with various forms of bans on plastic carrier bags include Morocco, Mauritius, Togo, Gabon and Congo-Brazzaville,[233] the Philippines and Tanzania.[234]

[231] Earth Times (2009) "Uganda to jail people found using plastic bags", 13 June 2009, www.earthtimes.org/articles/news/273039,uganda-to-jail-people-found-using-plastic-bags.html.
[232] ICC (2011) *Tracking Trash: 25 years of Action for the Ocean*, available at http://act.oceanconservancy.org/pdf/Marine_Debris_2011_Report_OC.pdf.
[233] OPA (2011) *Briefing Note*.
[234] Strange, K. (2011) *Plastic Bags: National Policies and practices*, PlasticsEurope and ACR+.

Table 41: Initiatives by retailers to reduce plastic carrier bag use[235]

Retailer	Target	Achieved or planned outcomes
El Corte Inglés	Implement biodegradable bags (compostable bags that can be transformed into fertilizer) in certain areas of El Corte Inglés' activities and various types of reusable bag for general use in every department.	Requirements included in the National Waste Plan (PNIR): 6% reduction in first year. More than 30% achieved by 2009. Report: Consumption of plastic bags was 7.6% lower in 2009 than in 2007.
ANCC/Coop Italia	Eliminate the use of disposable plastic bags.	Many other solutions proposed: reusable bags in different materials and biodegradable plastic bags that can also be used for waste separation in the home.
APED (Portugal)	Renewal of APED's "green bag".	The "green bag" is a reusable plastic bag that can be replaced at no additional cost. The customer pays for the bag only once. The damaged plastic bags are collected and recycled. Report: In 2009 the amount of reusable carrier bags sold was 2% (1 678 000) lower than in 2008.
Leroy Merlin (Spain)	Increase sales and availability of biodegradable and reusable bags in every shop.	In 2009, Leroy Merlin Spain sold 111 000 reusable bags and 6 500 biodegradable bags.
The Co-operative Group (UK)	Reduce the number of free single-use carrier bags by 50% by May 2009 with a 70% reduction planned for 2010.	Free distribution of single-use carrier bags shall be further reduced from 50% in 2009 to achieve a 70% reduction of consumption in 2010.

[235] Various sources.

C&A	Reduce the use of plastic bags.	The use of plastic bags from recycled material increased by approximately 25%, amounting to savings of 2 709 tonnes of plastic film.
Carrefour	Eliminate the use of free disposable checkout bags and promote the use of reusable carrier bags.	The number of free plastic disposable checkout bags was reduced from 6.1 billion in 2005 to 3.7 billion in 2009 (a reduction of 39%, or 59% per unit of sales).
Delhaize	Ban all plastic non-reusable carrier bags at supermarket checkouts in Belgium and strongly promote reusable alternatives.	The number of non-reusable carrier bags per store transaction decreased by 17% in Delhaize Belgium between 2006 and 2007. Alfa-Beta introduced biodegradable bags and launched reusable bags.
Marks & Spencer	In 2007, Marks & Spencer launched a goal of becoming a sustainable, carbon-neutral and zero waste-to-landfill business within five years ("Plan A").	In three years, M&S managed to reduce the use of plastic carrier bags by 64% in the non-food sector and by 81% in food halls, which is 417m fewer bags in 2009/2010 compared with 2006/2007. It achieved this by switching to exclusive use of fully recyclable plastic bags (LDPE instead of HDPE), charging 0.05 GBP per bag and encouraging reuse. Plastic bags sold in M&S shops are almost entirely made from its own operational plastic waste. By creating a closed recycling loop, M&S will soon be the first big EU retailer that does not send any operational waste to landfill. After two years, Plan A was cost positive, thus enabling M&S to finance projects such as sea and beach clean-up.
IKEA	In March 2007, IKEA set a goal of reducing its United States stores' plastic bag consumption by 50%. IKEA charged for thin plastic bags and reduced the price of the blue reusable PP bags (Table 1) in an effort to encourage shoppers to cut down on plastic bags.	Results indicate that 92% of IKEA customers went for the reusable bag over the pay-for-plastic option. Plastic bag usage dropped 95%. Since the programme began in March 2007, IKEA has donated more than 300 000 USD from their disposable plastic bag sales to American Forests.

	Shortly after, IKEA decided to phase out thin plastic carrier bags in certain locations. For example, all 15 UK IKEA stores are eliminating plastic bags.	
Wal-Mart	In October 2010, Wal-Mart launched a pilot project in three stores in California, which stopped selling thin plastic carrier bags. Instead, the Wal-Mart stores started offering small, lightweight reusable PP bags for 0.15 USD along with larger bags for 0.50 USD. Wal-Mart claims that each reusable bag offsets the use of 75 plastic bags. Wal-Mart's global strategy and target is to reduce plastic carrier bag waste at their stores around the world by an average of 33% per store by 2013 using a 2007 baseline.	If this goal is achieved, Wal-Mart estimates that there would be a reduction in plastic bag waste by the equivalent of 9 billion bags, which would avoid the production of 290 kt of greenhouse gases and prevent the consumption of the equivalent of 678 000 barrels of oil every year. To achieve this target, Wal-Mart is giving out fewer plastic bags, offering reusable ones and helping consumers recycle their existing bags.

Annex C: Initiatives in plastics recycling

Collection and sorting

Collection of plastic waste is either via "bring schemes" or kerbside collection, where all kinds of plastics are collected together and brought to a material recovery facility. In general, kerbside collection of plastic waste alongside municipal solid waste is more prevalent than bring schemes. This is because bring schemes require public behaviour or deposit refund schemes that provide direct economic incentives for the public to participate.[236]

In order to maximise cost efficiency, most kerbside collection schemes include mixed recyclable packaging (paper/board, glass, aluminium, steel and plastic). The plastic packaging fraction collected tends to consist mostly of plastic bottles and flasks but can also include plastic film (including sacks and bags), non-bottle rigid packaging and rigid non-packaging e.g. plastic toys. The national recycling collection systems in Austria, France, Germany, Ireland, Italy, Netherlands, Portugal, Spain and Sweden accept PE film, including plastic carrier bags:

- In France, an initiative between ADEME, Eco-Emballages and several members of the waste industry sector was launched in January 2011 that aims to extend collection of all types of plastic packaging, including plastic bags, to 5m French residents.[237] The pilot project will run until 2013 to determine the feasibility and effectiveness of collecting plastic films (including plastic carrier bags) as part of the plastic packaging collection scheme. The objective of the project is to increase the current plastic packaging collection rate of 20% to 40% (including plastic carrier bags). However, the report carried out before the launch underlines that uncertainty about the total amount of flexible packaging present in household waste is increased by a lack of clear data and trends regarding plastic carrier bags and plastic packaging from the retail sector.[238] Currently, plastic carrier bags are not included in the plastic waste collection scheme (i.e. plastic carrier bags are not collected with other plastics such as plastic bottles).
- In Germany and the Netherlands, plastic carrier bags are collected and recycled together with other plastic packaging. Modern sorting facilities for packaging waste then separate plastic carrier bags and other PE film.
- In Ireland, there is no separate collection scheme for plastic bags but plastic carrier bags can be collected as part of the household comingled collection scheme for dry recyclables (i.e. newspapers, magazines, cardboard packaging, drink and food cans etc.) PE film is sorted at sorting plants for household packaging, baled and sold in the market.

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[236] Hopewell, Jefferson et al. (2009) "Plastics recycling: challenges and opportunities" in Royal Society Journal, http://rstb.royalsocietypublishing.org/content/364/1526/2115.full.pdf.
[237] See www.parlons-entreprises.com/2011/02/le-credit-agricole-et-la-recuperation-des-films-plastiques.
[238] Eco-Emballages, ADEME (2009) *Etude sur l'opportunité du tri et du recyclage des emballages ménagers plastiques autres que bouteilles et flacons*.

- In the UK, many local authorities collect plastic bottles for recycling and a small number also offer kerbside collections targeting other waste plastics.[239]

In some countries, retailers take back plastic carrier bags in order to recycle them. For example, in Finland hundreds of shops are installing plastic bag collection points next to bottle collection points. More than 4 500 supermarkets collect plastic bags for recycling in the UK,[240] where the scheme is driven by the retailers themselves in co-operation with bag manufacturers.[241] More than 500 supermarkets, school and libraries in the Netherlands have put in place so called 'BagBubbles' where people can bring back their used bags or take one for use.

Collection and sorting of plastic carrier bags poses certain challenges. For example, some kerbside collection schemes do not accept plastic bags because their low density can make collection and recycling uneconomic.

With a view to extending collection to plastic films, the French recycling federation estimates the total cost for sorting centres at €105-148m.[242] Sorting plants collecting plastic film face issues caused by dirt and residues, blocking of sorting mechanisms and low added value of the sorted film.[243]

Recycling

Plastic (HDPE) carrier bags are recycled in the category 'PE film' along with other types of PE bag (fruit and vegetable, freezer, bread, food packaging, etc.) and other kinds of PE film (e.g. transport packaging for furniture, EEE products, etc.). The bags are normally clean and PE is well suited for recycling into new PE bags, waste sacks and other products, depending on the quality. HDPE and LDPE plastic carrier bags are recyclable in typical HD or LD film recycling plants.[244]

From a recycling point of view, the biggest disadvantage is the print or colour of the bag, which will discolour the recyclate and limit its use for white or transparent applications (white PE regranulate is the most valuable in the market).[245] A further challenge is when there is a mix of bag types: conventional HDPE, bio-based, oxo-biodegradable, biodegradable, compostable and others. Individual plastic carrier bags are often made up of more than one kind of polymer or there may be fibre added to the plastic (a composite) to give added strength. Overall however, stakeholders agree that plastic carrier bags can be feasibly recycled. Sorted PE film commands a high price as a secondary raw material, so high recycling rates can be achieved. Data from Green Dot Norway indicate that the leading recyclers in Europe process up to 80-100 kt per year – economies of scale are key to making a profit. Smaller plants recycle around 15-20 kt and thus face keen competition. Companies that both recycle and manufacture new bags or other products themselves are at an advantage and this is becoming more common, according to industry sources.

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[239] WRAP (year unknown) *The financial costs of collecting mixed plastics packaging*.
[240] National authority communication.
[241] Source: Stakeholder communication.
[242] FEDEREC (2010) *Le barème et l'extension des consignes de tri*, presentation by the President of the association FEDEREC.
[243] National authority communication.
[244] For example, see the GreenTec bag made by Norfolier: www.norfolier.com/index.php?page=73&.
[245] EPRO members are currently studying these potential impacts.

Some important advances in plastic bag recycling have been made in recent years. For example, Regefilms is a French recycling centre that specialises in the recycling of plastic bags and other plastic films. The recycling process at the plant takes collected plastic bag waste through numerous cleansing and purification processes to transform it into the final product: polyethylene granules or pellets that can then be used to make new plastic bags. The recycling centre can produce 10 kt of granules annually. Regefilms claims to be the only recycling company that has developed the type of technology that can efficiently recycle thin (low density) plastic carrier bags and transform the recycled material into new plastic bags.[246]

In France, plastic bags accounted for 2% of post-consumer plastic waste entering recycling facilities in 2005 and 1% in 2007, compared to plastics from WEEE and plastics from ELVs (4% each in 2007).[247]

The recycling of films including plastic carrier bags can be increased through separate collection, or investment in sorting and processing at recovery facilities for handling mixed plastic wastes. In order to have successful recycling of mixed plastics, high-performance sorting of the input materials needs to be performed to ensure that plastic types are separated to high levels of purity. However, companies will only invest if end markets for polymer recyclates develop sufficiently.[248]

Mechanical recycling of domestic non-bottle mixed plastics packaging is technically feasible, as well as environmentally and economically sustainable.[249,250] A study carried out by WRAP in the UK has identified that the key risks to the development of mixed plastics recycling in the UK are: availability of input material at the right market quality and price, demand and price for the output plastic streams and development of a process design which is attractive to investment.

There is little published research on the impact of non-conventional PE film in the recovered material stream. Tests in Spain by Cicloplast and Ecoembes on biodegradable plastics in the PE film recycling stream found that less than 8% biodegradable is acceptable; 8-20% is challenging but can be achieved by incorporating new applications; more than 20% is not possible due to the cost of sorting or dealing with potential contaminants and so energy recovery would be required (see below).[251] Research in this area is ongoing and should lead to an assessment of the contamination limits in recycled film without compromising quality.

[246] Capital M6, television broadcast 19 June 2011, *Vivre et consommer écolo: ruée sur les nouvelles solutions vertes*, www.m6.fr/emission-capital/19-06-2011.
[247] ADEME (2009) *Etude sur le recyclage des plastiques en 2007*, p29
[248] Hopewell, J. et al. (2010) *Plastics recycling: challenges and opportunities,* in T*he Royal Society Journal*.
[249] See WRAP (2008).
[250] Note that economic profitability depends on the national context. This study was carried out in the UK.
[251] Source: Stakeholder communication.

12 September 2011

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