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Final report

Marine Litter study to support the establishment of an initial quantitative headline reduction target - SFRA0025

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Imagine the result

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Marine Litter study to support the establishment of an initial quantitative headline reduction target - SFRA0025

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Marine Litter study to support the establishment of an initial quantitative headline reduction target

1 Executive summary

This report summarises the results of support given to the European Commission on several topics related to marine litter. The main scope is to support the development of an EU headline marine litter reduction target that can be used for benchmarking progress towards good environmental status for marine litter. Throughout, the report it makes reference to the scenarios analysed in the European Commission's Impact Assessment accompanying the proposal for reviewing the European waste management targets. These documents are all available at:

http://ec.europa.eu/environment/circular-economy/

1.1 Definition and height of a headline reduction target

1.1.1 Definition

A proposal of a headline reduction target for marine litter was developed, based on the targets already in use at the level of Member States or regional seas, the expectations of the general public and the stakeholders concerning an effective marine litter policy, the analysed occurrence of key marine litter types, loopholes and pathways retrieved from 343 recent beach screenings in the four regional seas, the modelled impact on marine litter of the different policy options included in the impact assessment study on the European Commission's proposal for reviewing the European waste management targets, and the assessed impact on marine litter that dedicated policy measures for specific litter items could have.

It is formulated as follows:

"A -30% reduction of the number of items of the top ten litter categories found as coast litter in each regional sea, by 2020, compared with 2015,

applying the screening method from the technical guidance documents on monitoring of marine litter and

excluding fragmented or undefinable litter items with guidance document codes G75, G76, G134, G145, G158, G210;

1.1.2 Level of ambition

The level of ambition of the proposed target is slightly above what was derived as the impact of the waste management options and recycling targets as described in the Commission's impact assessment.

Assessed impacts for the different options are:

	ML inflow evolution 2015-2020	**ML inflow evolution 2015-2025**	**ML inflow evolution 2015-2030**
	evolution (%)	evolution (%)	evolution (%)
Business as usual	4,40	8,53	12,29
option 1 full implementation	-4,63	-0,70	2,92
option 2 single calculation method	-3,77	0,17	3,81
option 3.1 higher mun. waste recycling targets	-4,63	-5,31	-7,40
option 3.2 higher packaging waste recycling targets	-16,26	-20,93	-18,41
option 3.3 landfill ban	-3,78	-0,62	2,50
option 3.4 combination	-16,91	-24,30	-25,42
scenario maximum feasible	-36,11	-35,72	-35,45

A reduction target of -35% reflects a situation whereby by 2030, all Member States reach the performance level for waste recycling and decoupling of waste generation from consumption, as was achieved in 2012 by the top three performing Member States. It also reflects a performance 10% above what can be expected only through implementation of the combination (most effective) policy option assessed in the Commission's impact assessment. Thus, if the target is to be met, not only general waste management actions, but also specific measures targeting individual litter types will be needed.[1]

These specific measures can be very effective, which means that the -35% target may be rather moderate. Measures targeting cigarette butts have resulted in reductions of total number of beach litter items of up to 18%, reductions in plastic carrier bags of up to 13%, bottle caps up to 7%, cotton buds up to 2% and deposit refund systems for beverage packaging up to 12%, depending on the specificities of the regional sea concerned.

The proposed target and its indicator:

- Use a benchmark year 2015;
- Focus on the top ten litter items;
- Are flexible with regard to the individual characteristics of each sea, whose list of top ten items may vary;
- Are based on common beach litter screening practices, and respect the nomenclature (Master List) and methodology of the Marine Litter Coordination Group Technical Guidance Documents on monitoring of marine litter.

[1] Note that the figures in the table above compare projected actual levels of litter in 2015 as the baseline, while the Commission's Impact Assessment takes full implementation of existing legislation as the baseline. See Chapter 4.4.1 for a direct comparison of the impact these alternative baselines have.

1.2 Public consultation

The outcome of the public consultation is reported in a separate document, which can be downloaded from the European Commission's website.[2] Though wide public support was observed across all sectors and all proposed reduction measures, the consultation found the highest levels of support for the establishment of marine litter targets, and high scores for driving the transition towards circular economy, improvements to general waste management and stronger waste management enforcement measures.

1.3 The relation between key behavioural measures and key marine litter items

There is potential for prevention of certain types of marine litter based solely on awareness-raising campaigns (e.g. disposal of cigarette butts by beach-users based on targeted campaigns and sanitary waste based on strong proper-disposal campaigns, with the support from producers). However, they seem to require a massive outreach to become effective, either through large-scale campaigns involving industry and the media or through multiple small-scale, local initiatives.

Economic incentives such as the Deposit-Refund scheme for drink containers seem to be very effective in increasing collection rates of high-quality material to recycle and based on the results of short-term pilot projects have a greater impact than those based solely on awareness-raising and subsequent voluntary initiative of the individual. Incentives do not necessarily need to be economic; a campaign in Turkey to collect bottle caps in order to raise money for charity demonstrated that an 'altruistic' incentive was also a possible driver.

A key measure to prevent littering of smaller items is providing dedicated infrastructure. The reduction in the number of littered cigarette butts as a result of providing dedicated butt bins and personal ashtrays is remarkable. Unfortunately, few results are available on the effect on marine litter of optimizing waste disposal infrastructure on littering of metal cans, food packaging, plastic bottles, etc. This could be an area for further research.

1.4 Benefits of reducing marine litter

1.4.1 Costs of degradation and benefits of reducing marine litter

The total quantified cost of degradation is estimated to be 259 m€ to 694,7 m€. These however represent a small portion of actual costs as it has not been possible to quantify impacts to all economic sectors. The monetised costs are attributed to tourism and recreation (up to 630 m€) and fisheries (up to 62 m€) as the ‘main affected sectors’. It has not been possible to monetise the costs of all the affected groups and sectors, such as shipping and voluntary beach cleaning, or cleaning of harbours and marinas.

[2] http://ec.europa.eu/environment/consultations/marine_litter_en.htm

The benefits of reducing marine litter are also assessed for these two sectors, taking into account reduced beach cleaning costs, fewer fouled propellers and avoided damage to fishing nets and catch.

The projected increases/decreases in costs associated with the various policy options analysed in the Commission's impact assessment are summarised as follows:

	Marine litter inflow evolution 2015-2030	Marine litter reduction benefits (m€/year)
	evolution	
Business as usual	+12,29 %	-58,40
option 1 full implementation	+2,92 %	-13,87
option 2 single calculation method	+3,81 %	-18,10
option 3.1 higher mun. waste recycling targets	-7,40 %	35,16
option 3.2 higher packaging waste recycling targets	-18,41 %	87,48
option 3.3 landfill ban	+2,50 %	11,88
option 3.4 combination	-25,42 %	120,79
scenario maximum feasible	-35,45 %	168,45

1.4.2 Health and environmental effect of marine litter

Marine litter can affect marine organisms in a multitude of ways, either through physical damage such as entanglement or lacerations or through indirect health effects such as intoxication after ingestion. Direct damage and entanglement pose serious threads to wildlife such as sea turtles, marine mammals, fish and invertebrates, as well as all kinds of birds and even sea snakes, which can be cut, trapped, strangled or drowned in the debris. “Ghost fishing”, whereby lost or abandoned fishing gear continues to catch fish, is a significant source of damage to marine biodiversity. Marine litter can also cause direct environmental impacts in the form of alterations in or physical damage to important habitats such as shorelines, coral reefs, deep sea habitats and sea grass fields. Marine debris can also function as a way of transportation for a variety of different species, assisting in the distribution of non-native and even invasive species, which can in itself impact the local environment.

Another problem concerning marine litter and wildlife is the threat of ingestion. Many different species of marine life have been known to ingest pieces of debris, with far-reaching consequences including starvation and death. Plastics in the marine environment can pose a threat in the form of its physical components, chemical ingredients and adsorbed chemicals. Microplastics have been found to not only pass through the digestive system, but can also travel to the circulatory system of marine species. Chemicals adsorbed from the environment, such as PBTs (Persistent Bio accumulative and Toxic substances) and metals, are a real concern when entering the food chain as a part of ingested plastic particles. Human health can be directly influenced by marine litter in the form of physical damage; anyone visiting a beach could get hurt from washed up debris on beaches such as broken glass, medical waste or other sharp objects. People entering the water can become entangled by floating or submerged debris such as fishing nets, ropes or fishing line. Indirect health effects can be caused by chemicals, toxins or other harmful particles in the water such as viruses or bacteria, all of which have entered the water column through anthropogenic sources. The risk of chemicals adhered to plastics in the marine environment transferring through the food web from marine organisms to humans has not yet been conclusively established and represents an important knowledge gap.

1.5 Potential of specific EU legislation and instruments towards marine litter

A broad range of EU policies and legislation deals either directly or indirectly with marine litter. In an exploratory analysis we identified which of these instruments are most relevant and which have the greatest potential for adaptation in order to develop a more effective and integrated EU marine litter policy.

Directive	Reference	Relevance score	Feasibility score	Priority score
Packaging and Packaging Waste Directive	Directive 94/62/EC	5	5	5
Waste Framework Directive	Directive 2008/98/EC	4	5	4,5
Micro- and nano-plastics in cosmetics	Cosmetic Products Regulation (EC) No 1223/2009; REACH Regulation (EC) No 1907/2006	4	5	4,5
Port Reception Facilities Directive	Directive 2000/59/EC	4	4	4
Water Framework Directive	Directive 2000/60/EC	4	4	4
Green Public Procurement and Eco-labelling	Communication “Public procurement for a better environment” (COM (2008) 400 Ecolabel Regulation (EC) No 66/2010	4	4	4
Marine Strategy Framework Directive	Directive 2008/56/EC	4	3	3,5

Landfill Directive	Directive 1999/31/EC and Decision 2003/33/EC	3	4	3,5
Ship-source Pollution Directive	Directive 2005/35/EC	4	3	3,5
Eco-design	Directive 2009/125/EC	3	3	3
Urban Waste Water Treatment Directive	Directive 1991/271/EEC	4	3	3,5
Integrated Coastal Zone Management (ICZM) Recommendation and Maritime Spatial Planning Directive	Recommendation 2002/413/EC Publication of MSP Directive pending	4	2	3
Bathing Water Directive.	Directive 2006/7/EC	2	1	1,5

2 Introduction

This report summarises the results of support given to the European Commission on several topics related to marine litter. The main scope is to support the development of an EU headline marine litter reduction target that can be used for benchmarking progress towards good marine environmental status for marine litter.

Throughout, the report it makes reference to the scenarios analysed in the European Commission's Impact Assessment accompanying the proposal for reviewing the European waste management targets. These documents are all available at:

http://ec.europa.eu/environment/circular-economy/

Several related topics are touched upon as well.

We can translate the content of this study into the following questions:

- What can we learn from already established reduction targets in the different Member States or at the level of regional sea conventions? Which kind of targets and target values are proposed? What is the opinion of stakeholders? See chapter 3.1.
- Where can we retrieve data on beach litter, and why would we focus on beach litter to describe marine litter inflow? See chapter 3.2
- What is the impact of the waste management scenarios proposed as part of the Commission's recent review of the waste acquis on marine litter, in particular in relation to recycling targets? First we analyse the parameters describing the impact of these targets or waste management policy options on future waste quantities, chapter 4.1. Then we analyse the data on key marine litter types and pathways, chapter 4.2. Finally we assess the impact of these waste management options on the future occurrence of marine litter, chapter 4.3.
- What is opinion of key stakeholders on marine litter issues, and which aspects should be taken into account when considering a target? A separate document is based upon statistical analysis of the European Commission's public consultation on marine litter. It can be downloaded from the Commissions website[3].
- What is the potential for behavioural change on marine litter? How strong are policy measures focusing on behavioural change, and what could be its impact, on top of the general waste policy options that are analysed above? The analysis in chapter 6 takes into account stakeholders' perceptions, thus complementing the analysis on the public consultation, but also analyses the effectiveness of several behaviour-related pilot studies and best practices.
- What is the quantitative effect of specific measures? A selection of behavioural measures, as well as policy measures is analysed to determine the quantitative impact on marine litter. A range of measures is assessed for cigarette butts,

[3] http://ec.europa.eu/environment/consultations/marine_litter_en.htm

plastic bags, bottle caps, cotton buds and refund systems for single use beverage packaging. See chapter 7.

- What quantitative headline reduction target could be proposed? Based on all aspects above, a proposal for the definition of a target and a target value is developed, motivated and benchmarked against some possible alternatives. See chapter 8.
- What are the benefits of marine litter reduction? Why should we propose a reduction? Both economic aspects (chapters 9.1 and 9.3) and health and environmental aspects (chapter 9.2) are covered.
- How are policy instruments related to the issue of marine litter selected, and which of these should be looked at to strengthen an integrated marine litter policy. An exploratory analysis is included in chapter 10.

This report is complemented with annexes in Excel which clarify all data and all modelling used in the different chapters.

3 Analysis of the baseline used by MS in the MSFD reports and proposed targets

The Marine Strategy Framework Directive (MSFD) sets the overarching goal of achieving of maintaining 'Good Environmental Status' (GES) for all EU Member States' marine waters by 2020. GES is determined for a series of 11 so-called 'descriptors' of the marine environment, number 10 of which relates to marine litter. See section 9 for a detailed discussion of the MSFD.

As part of their reporting obligations under the MSFD, Member States, by 2012, had to provide an initial assessment of the status of their marine waters (Article 8), specify GES in respect of their marine waters (Article 9) and establish a series of targets in order to reach GES by the 2020 deadline.[4]

3.1 Reduction targets set by Member States and Regional Seas' Conventions

Out of the 20[5] coastal Member States assessed, Latvia, Lithuania, Malta, Cyprus, Bulgaria and Romania did not put forward any targets to 2020 or beyond.

The lack of consistent and harmonised data was mentioned by several Member States as a barrier to be able to define an adequate baseline and appropriate targets. Nevertheless, 15 Member States proposed some sort of target, although these varied in nature, ability to quantify and the marine compartments to which they are associated.

3.1.1 Types of targets proposed by Member States

All 15 Member States that presented targets have defined them as reflecting somehow a reduction of marine litter present in the marine environment (or a particular compartment). A small part of them have indicated complementary targets related to reduction in the INPUT of marine litter, either through specific sources (e.g. fisheries) or pathways (e.g. riverine input).

The only explicit quantitative target presented has been defined by Belgium and is associated with litter ingestion by Fulmars: less than 10% of the northern fulmars should have more than 0.1g plastic in their stomachs, which corresponds to the OSPAR EcoQO. Netherlands makes reference to the same Quality Objective but as an indicator of "quantity of plastics in fulmar stomachs".

Based on the reporting and proposals of Member States, we make a distinction between 3 types of targets:

[4] Summaries of this reporting exercise, along with the Commission's assessment are available at: http://ec.europa.eu/environment/marine/eu-coast-and-marine-policy/implementation/reports_en.htm
[5] Reporting for Poland, Malta and Croatia was not available at the time of the analysis.

3.1.1.1 Reduction of litter PRESENT in the marine environment

Countries that define the target as a reduction in the overall amount of litter present in the marine environment or in any of its compartments (coast, seafloor, water column) or biota;

Examples:

BELGIUM – “Negative trend in the annual evolution of the quantities of stranded litter”;

FRANCE – “Significantly reduce the amount of waste in the marine environment”;
GERMANY – “Adverse ecological effects are reduced to a minimum”;

PORTUGAL – “Decrease, by 2020, the level of marine litter at selected beaches, compared to the level in 2014”.

Sweden and Estonia put forward ambitious state targets: “the marine environment shall be free from human litter, as far as possible” and “the amount of marine litter is minimal” respectively. Though these targets are subjective and do not specify a timeframe, we assume that such a state requires a reduction of the current levels, despite not being fully quantified.

Spain is the only Member State that establishes targets regarding a particular category of marine litter – the one originating from fisheries – in 2 compartments of the marine environment (beach, seafloor).

3.1.1.2 Reduction in the INPUT of litter from land or sea-based activities

Some Member States target a reduction in the INPUT of litter from land or sea-based activities and specific sectors;

Examples:

GERMANY – “Continuously reduced inputs”

SPAIN – “Reduction in the amount of marine litter generated by both terrestrial and marine sources”

FRANCE – “Reduce the amount of waste transported by rivers”; and “Reduce the production of waste by uses and activities carried out on the coast”

DENMARK – “The proportion of litter on Danish beaches which originates from beach visitors is falling”

Though they are closely related and in some cases the description from the Member State can be somehow dubious, there are fundamental differences between “presence” and “input” targets: the first may be reached by strong prevention and remediation measures, while the second is inherently preventative in nature. There are quite a large set of factors affecting the quantities and distribution of marine litter in a certain area and variables that affect its transport, accumulation and fragmentation processes are yet to be fully understood. It can be therefore very challenging to detect clear reduction trends in the amount of litter present in the sea that can be associated to the implementation of measures in a particular area.

It may be more feasible to monitor the progress towards the latter type of target and it may reflect more clearly the impact of measures being implemented to reach the target, as they can be more directly linked to operational targets (e.g. if one had established as target a reduction of the waste released by coastal tourism, an operational target could be the increase in the collection rate of cigarette butts among beach-users).

France and Germany have clearly presented both types of targets.

3.1.1.3 Other, operational types of targets

Certain Member States propose other targets that contribute to increased knowledge or capacity to deal with the issue, including operational targets. They are defined a.o. as targets the development or implementation of actions that can contribute to better understand, monitor or address marine litter.

Examples:

FINLAND – “Implementation of the 'No-Special-Fee' system”[6] ;

ITALY – “Increasing effort in collecting waste on the sea-bed”;

SPAIN – “Improvement of knowledge on the characteristics and impacts of marine litter, including their origin and dispersion”;

UNITED KINGDOM – “Surveillance indicator to monitor the quantities of litter in the seafloor”

DENMARK – “The occurrence of litter in the water column and on the sea-floor is being mapped”

Table 1: Type of targets proposed by member States

	SE	FI	EE	DE	DK	IE	UK	NL	BE	FR	ES	PT	IT	SI	GR
Reduction of litter PRESENT in the marine environment	X	X	X	X		X	X	X	X	X	X	X	X	X	X
Reduction in the INPUT of litter from land or sea-based activities				X	X					X	X				
Other targets (E.g. operational, monitoring, etc.)		X			X		X				X	X	X	X	

3.1.1.4 Conclusion

All 15 Member States that presented targets have defined them as a reduction of marine litter present in the marine environment (or a particular compartment);

[6] "No-special-fee” refers to Port Reception Systems for ship-generated wastes, in which disposal fees are included are as part of overall port charges, whether the ship disposes of its waste or not. It thereby encourages ships to deliver waste ashore and to avoids the incentive to (illegally) dump waste between ports.

however these targets are mostly qualitative rather than quantitative. A small number have indicated complementary targets related to reduction in the INPUT of marine litter.

3.1.2 Targets at the Regional level and Regional Action Plans

All of the North-East Atlantic EU Member States put forward some sort of target for marine litter. They tended to focus their targets in terms of reduction of the litter PRESENT in the marine environment and most of the EU contracting parties of OSPAR have defined targets associated with beach litter and to the ingestion of litter by Fulmars, in line with the OSPAR beach litter Pilot Programme and the OSPAR-EcoQO, respectively.

EU Baltic States show a great diversity of targets, with ambitious but subjective “state” targets (e.g. “Amount of marine litter is minimal”) and measure-related targets such as “implementation of the “no special fee”-system”.

Mediterranean States tend to complement or have higher focus on targets related to reduction of input or specifying reduction at source.

There are no targets proposed by EU Member State from the Black Sea, although Bulgaria mentions some strategies to prevent and reduce marine litter.

3.1.2.1 North-East Atlantic - OSPAR

The OSPAR general objective with regard to marine litter, as laid down in the Strategy for the protection of the Marine Environment of the North-East Atlantic for the years 2010-2020 is “to substantially reduce marine litter in the OSPAR maritime area to levels where properties and quantities no not cause harm to the marine environment”, which is in line with the definition of Descriptor 10 of the Marine Strategy Framework Directive. OSPAR Ministers declared in 2010: “We note that quantities of litter in many areas of the North-East Atlantic are unacceptable, and therefore we will continue to develop reduction measures and targets, taking into consideration an ambitious target resulting in a reduction in 2020” (Bergen Statement).

The Regional Action Plan (RAP) for Prevention and Management of Marine Litter in the North-East Atlantic was adopted by the OSPAR Commission on 27th June 2014 (OSPAR Agreement 2014-1). The RAP was developed through a series of workshops, coordinated by Germany, involving relevant expertise from the public and private sectors, academics and non-governmental organisations and under a dedicated OSPAR inter-sessional correspondence group on marine litter (ICG-ML). The RAP and its implementation aim at delivering the following elements:

a) a focus on specific sources or items of marine litter that are of most concern in each OSPAR region or the OSPAR maritime area as a whole;
b) the development of regional measures, taking into account the socioeconomic aspects including cost effectiveness, for reducing the input of marine litter from sea based and land based sources, and for removing

litter from the marine environment. These measures should be based on an assessment of the OSPAR Marine Litter Checklist, the measures identified at the Berlin Conference and any existing and new initiatives within Contracting Parties;

c) Regionally coordinated SMART[7] reduction/operational targets, including those linked to sources, taking into account the MSFD targets submitted by EU Members State Contracting Parties to the European Commission;
d) monitoring and necessary arrangements required to assess progress towards reaching the targets, taking into account any outputs from the EU Technical Group on Marine Litter, and including the work in progress for the MSFD monitoring programmes;
e) Cooperation with other relevant regional and international organisations, including Regional Seas

The RAP does not set but foresees the development of agreed regionally coordinated SMART reduction/operational targets which are to be linked to the relevant actions listed in its implementation plan, starting from 2015, including those linked to sources. The development of these targets is to consider the MSFD targets defined by EU Member States and the EU headline reduction target required by the 7th Environment Action Programme. Any operational or reduction targets developed in relation to specific actions or measures produced under the framework of the RAP will be assessed through the Joint Assessment and Monitoring Programme and based upon the monitoring for the common indicators, where applicable.

3.1.2.2 Baltic Sea – HELCOM

In the HELCOM 2013 Ministerial Declaration addresses marine litter, the Ministries have agreed to develop a regional Action Plan by 2015 in order to achieve a significant quantitative reduction of marine litter by 2025, compared to 2015. This Action Plan “should allow to (…) develop common indicators and associated targets related to quantities, composition, sources and pathway of marine litter, including riverine inputs, in order to gain information on long-term trends, and carry out the monitoring of the progress towards achieving the agreed goals and to gain an inventory of marine litter in the Baltic Sea as well as scientific sound evaluation of its sources.” A zero draft has been prepared which is modelled closely on the OSPAR action plan. The current indications are that a draft will be further elaborated at a stakeholder workshop in autumn 2014, before CPs negotiate a final text with a view to agreement in 2015.

3.1.2.3 Mediterranean Sea – Barcelona convention

In December 2013, the Contracting Parties of the Barcelona Convention adopted the Regional Plan on Marine Litter Management in the Mediterranean. No specific

[7] SMART stands for Specific, Measurable, Achievable, Relevant and Time-bound

quantitative targets are defined in the document, except the general objectives of the Action Plan, which are:

a) Prevent and reduce to the minimum marine litter pollution in the Mediterranean and its impact on ecosystem services, habitats, species in particular the endangered species, public health and safety;
b) Remove to the extent possible already existent marine litter by using environmentally respectful methods;
c) Enhance knowledge on marine litter; and
d) Achieve that the management of marine litter in the Mediterranean is performed in accordance with accepted international standards and approaches as well as those of relevant regional organizations and as appropriate in harmony with programmes and measures applied in other seas.

Nevertheless, the Action Plan describes also some strategic, operational objectives and lists a series of prevention measures (following the Waste Hierarchy) and remediation measures that should be considered and implemented by the CPs to the extent possible and within a specific time-frame.

3.1.2.4 Black sea – Bucharest convention

In its Black Sea Strategic Action Plan (BS SAP 2009), the Bucharest Convention addresses the main areas of concern, and their causes, through the aims of four Ecosystem Quality Objectives. Marine litter is only mentioned as one of the descriptors as well as the parameter of discharges under the 4th objective: Ensure Good Water Quality for Human Health, Recreational Use and Aquatic Biota.

The Black Sea Strategic Action Plan presents short-term and mid-term “management targets” with a medium priority: the Contracting Parties are urged to “amend national waste strategies and/or national coastal zone management plans with the aim of coastal and marine litter minimization” and “develop regional and national marine litter monitoring and assessment methodologies”.

3.1.3 Baseline, timeframe, significance and compartments of the reduction targets

Regarding those reduction targets which have been set, what are the reference values against which they are measured? How do Member States propose to measure the reduction trends and how significant these must be?

3.1.3.1 Timeframe and reference values

Denmark - significant reduction by 2025 and in relation to the baseline values to be established in 2015 through the collection of scientific available data.

Netherlands - reduction in the quantity of visible beach litter in relation to the reference of period 2002-2009.

Belgium - overall reduction in the total number of visible items on coastlines by 2020 (e.g. based on a 5-year moving average).

Portugal – by 2020, decrease in the level of marine litter at selected beaches, compared to 2014; decrease the quantity of marine litter deposited on the seafloor, during the period of 2014-2020.

Spain – Achievement by 2020 of an overall sub-regional reduction of the number of marine litter items on the coastline (as measured against an average 5-year intervals); Reduction or no increase in marine litter originating from fisheries in relation to the reference levels established in 2012.

Slovenia – Reduction of waste in coast, water column and seafloor between 2012 and 2020; Microplastics in the marine environment should not increase beyond the levels of 2011/2012.

3.1.3.2 Significant reductions

Only three Member State clearly stated that the reduction targets need to be significant (Denmark, France and Germany) and of these, only Denmark indicates a reference against which to measure that change.

3.1.4 Target associated to specific compartments

The Commission Decision on criteria and methodological standards on GES (Commission Decision 2010/477/EU) provides the criteria and associated indicators for Descriptor 10 – Marine Litter:

10.1. Characteristics of litter in the marine and coastal environment

— Trends in the amount of litter washed ashore and/or deposited on coastlines, including analysis of its composition, spatial distribution and, where possible, source (10.1.1)

— Trends in the amount of litter in the water column (including floating at the surface) and deposited on the sea-floor, including analysis of its composition, spatial distribution and, where possible, source (10.1.2)

— Trends in the amount, distribution and, where possible, composition of micro-particles (in particular micro-plastics) (10.1.3)

10.2. Impacts of litter on marine life — Trends in the amount and composition of litter ingested by marine animals (e.g. stomach analysis) (10.2.1).

This indicator needs to be developed further, based on the experience in some sub-regions (e.g. North Sea), to be adapted in other regions.

Most Member States have defined at least an overarching target (e.g. “reduce the present quantity of marine litter”) and the associated indicators, which are usually in line with the COM DEC indicators and reflect monitoring of a specific compartment within the marine environment (e.g. beach litter in the case of “quantity and composition of litter deposited on the shore”). Table 3 provides an overview of the compartments covered by the different indicators selected by Member States (shaded cells). In some cases, Member States have defined their targets directly associated to a specific compartment (e.g. *Decrease, by 2020, the level of marine litter at selected beaches, compared to 2014; Reduced levels of plastic particles in Fulmars stomachs*), which is signalled by “T” in Table 3. This provides an overview and comparison of the different compartments that Member States are expected to monitor in order to measure progress towards the targets they have defined.

Table 2: Marine compartment in relation to which Member State reported monitoring indicators and specific targets

Compartments (COM DEC Indicators)	SE	FI	EE	DE	DK	IE	UK	NL	BE	FR	ES	PT	IT	SI	GR
BEACH Litter (10.1.1)						T	T	T	T		T	T			
SEAFLOOR Litter (10.1.2)									T			T			
Litter in BIOTA (10.2.1)						T			T				T		
MICROPLASTICS (10.1.3)													T	T	

T = Member States have indicated a target associated with a specific compartment

Litter deposited on the coastline/beach is the preferred indicator/compartment to use for monitoring or in relation to which the target applies. This is not surprising, as 10 out of these 15 Member States have taken part in the OSPAR beach litter Pilot Programme and beach litter surveys have been recognised by the TG-ML as one most mature and cost-effective methodologies to monitor marine litter.

3.1.5 Quantitative and qualitative targets

It is not always clear how the trends and variations that indicate a reduction are to be established and how to consider the data in terms of geographic scale, i.e. whether assessment should take place on a site-by-site basis, or on aggregated scale, and if the latter, how to take account of the fact that some sites would reflect higher levels of direct/localised inputs whereas others are remote and thus more affected by wider trends.

Some examples from the Member States:

- Negative trend on annual evolution (beach, sea): Belgium
- Overall reduction/average amounts (beach): Belgium, UK, Ireland, Netherlands, Slovenia
- Threshold (biota)– Less than 10% of the Northern Fulmars contain more than 0.1g of plastic in their stomach: Belgium
- Decreasing trends (Fulmars): Netherlands
- Reduction of the increase rate of the concentration of microplastics in the sea-surface: Italy

3.1.6 Conclusions and recommendations

There is quite a wide diversity of targets defined by Member States, in terms of nature, ambition and measurability, even between neighbouring countries. Nevertheless there are good elements that should be preserved and strengthened.

3.1.6.1 Beach monitoring as a common indicator

All Member States (except Italy) have indicated beach litter as an indicator to assess the reduction of marine litter or directly relate beach litter to a target formulated. This is quite positive, as it reflects the intention to implement beach litter monitoring programmes widely in Europe. If done in line with the TG-ML Guidance, it constitutes a cost-effective methodology and a critical step towards a harmonised and comparable monitoring approach across all EU coastal MS. For this reason, the remaining countries should be encouraged to consider beach litter as a common indicator to be adopted.

3.1.6.2 Monitoring strategy and methodologies are determinant

Member States should look for further specification and harmonisation in terms of how trends and reductions are to be determined (e.g. across what geographical or time scales) and have comparable reference periods. This may require additional technical guidance in order to encourage harmonisation and enable comparability.

3.1.6.3 "State" and "Pressure" Targets

It may be adequate to encourage the establishment of both "state" and "pressure" targets and indicators, as complementary in defining and monitoring the presence of marine litter and the impact of policy responses. Well-formulated "pressure" targets and indicators can better reflect the effectiveness of specific operational "responses" but naturally should not substitute "state" or "impact" indicators.

Although the overall definition of targets and indicators is inconsistent across different countries and often not fully adequate, the overall commitment of Member States in achieving a reduction of marine litter is positive, particularly in light of the lack of consistent data that would allow for the establishment of comprehensive quantitative targets.

Nevertheless, for some Member States, in particular within the OSPAR area where beach monitoring is on-going for a considerable amount of time, it would be expected that the existing data would allow the establishment of a baseline, even if very general. Where Member States are hesitant about establishing quantitative state targets, pressure/operational-oriented targets can complement their efforts, as they refer to human processes and activities which are easier to monitor and influence. As some MSs have done, formulating a sub-set of targets for specific sources of marine litter (e.g. litter generated by fisheries) or even particular types of items (e.g. reduce the average occurrence of the top identifiable items found on reference beaches) should facilitate breaking down such a complex issue into more quantifiable and complementary elements.

3.1.6.4 Strengthening coherence at regional level

The targets and associated indicators reported by MSs indicate some level of coherence at the regional level, in particular in the OSPAR region (e.g. Fulmars as a regional indicator of ingestion of litter, considered as a “common indicator” by OSPAR) which should be further strengthened and adopted by other countries in the region. The particular case of “impact” indicators on biota, in which specific marine animals need to be selected but depend on the geographic coverage across different countries in a region or sub-region, highlights the need for such regional coordination.

Progress in developing dedicated Action Plans for marine litter in the four European marine regions is uneven. Although plans have now been adopted for the Mediterranean and the North East Atlantic (with the one for the Baltic under development) there are varying levels of specificity and ability to quantify the actions they contain. Targets have not always been set, and where they exist, they are not always SMART. It is important that the plans still to be developed and future updates to the existing ones are oriented towards specific actions with a measureable impact in preventing or reducing marine litter in general and by targeting the most problematic waste streams.

3.2 Baseline data on (marine) beach litter

3.2.1 Marine beach litter as the most detailed indicator for marine litter inflow

Marine litter originates from land-based sources, like coastal and beach tourism, recreational activities, households (e.g. sanitary waste), input from rivers, sewage, storm water overflows, agriculture, illegal dumping, dumps and landfills, etc. as well as from sea-based sources like off-shore industry, commercial shipping and fishing, port activities, recreational fishing and boating, etc.

The marine environment works as a sink in which marine litter accumulates. It is very difficult to remediate accumulated marine litter, especially when fragmented into e.g. micro-plastics. The policy focus should therefore be on preventive efforts and measures, minimizing the input of new litter entering the marine environment.

The MSFD Technical Group on Marine Litter has produced a guidance document on the monitoring of marine litter in European Seas, focussing on beach litter, sea floor litter, floating litter, litter in biota and micro-litter. Of these, we selected beach litter, since as outlined above, this is the most mature indicator, and the one for which the most data are available. Our working assumption is that beach litter is a sufficiently representative fraction of new litter entering the marine environment, while recognising that accumulation of beach litter may occur, and that beach litter will be more representative of land-based sources than that which is deposited far offshore.

By monitoring beach litter, some indications on litter inflow can be established, in particular for urban beaches and those geographically under the influence of specific activities and discharges (e.g. down-current from river mouths).

Beach litter surveys carried out using the OSPAR methodology are a primary tool for monitoring the amount of litter entering the marine environment. They contribute to the description and quantification of marine litter in a very detailed way in terms of material and nature of item. They can therefore provide information to enable the identification of major sources and loopholes and potentially the effectiveness of management or mitigation measures. They can be a basis to develop tailor-made measures for marine litter reduction for each regional sea.

Because of the lack of consistently collected data in all regional European seas and because of its great variability even when collected regularly, there is currently no accepted European or regional baseline against which to measure progress towards good environmental status. The monitoring programmes required by Article 11 of the MSFD to be implemented by 2014 should provide a comprehensive baseline including for marine litter. In the meantime, this project made an attempt to analyse available data-sets for OSPAR and some countries in the other regions, according to the methodology and parameters developed and used in the Pilot Project on Plastic Cycle and Loopholes (European Commission, 2012).

3.2.2 Data collection on marine beach litter

In many regional seas monitoring activities and studies have been carried out on marine beach litter. We used in total 343 data sets, predominantly dating from 2012-2013, that have been collected according to OSPAR item-categories or similar (e.g. UNEP). Data were analysed in order to gain an insight into the nature of the main sources and loopholes for beach litter. An overview of the number of screenings included for the different countries and the different regional seas is given in Table 3. In total, 151 data sets were included from the North Sea (45%), 152 from the Baltic Sea (43%); 33 from the Mediterranean Sea (9%) and 7 from the Black Sea (2%).

Table 3: Overview of OSPAR screenings included in the beach litter analysis.

Country	Number	Regional sea included
Estonia	67	BAL
Finland	5	BAL
Latvia	13	BAL
Romania	7	BLA
Sweden	106	BAL
Greece	2	MED
Spain	36	NOR/MED
Belgium	19	NOR
Denmark	1	NOR
France	36	NOR
Germany	16	NOR
Ireland	2	NOR
Netherlands	16	NOR

UK	17	NOR
Total	**343**	

An overview of all the cases included in the analysis can be found in Annex 2. OSPAR screenings include the ones performed by the OSPAR Beach Litter Programme, some conducted during the ARCADIS pilot study “4 seas” (European Commission, 2013c), some conducted by the Belgian MUMM (Management Unit of the North Sea Mathematical Models and the Scheldt estuary), some produced in the MARNOBA project and some realized by MIO-ECSDE. All were conducted using the OSPAR methodology, as described in the Guideline for Monitoring Marine Litter on the Beaches in the OSPAR Maritime Area (Wenneker & Oosterbaan, 2010). MARLIN screenings were conducted following the Marlin Beach Litter Measurement Method Description, an adaptation of the UNEP/IOC’s guidelines for the Baltic Sea conditions by the MARLIN project in cooperation with Statistics Sweden (MARLIN & SCB, 2011).

Due to the number of datasets, spread over the regional seas although not completely at random, we assume that individual outliers or extreme values will be levelled out, based on the “law of large numbers”: the average of the results obtained from a larger number of observations should be close to the population value, and will tend to become closer as more observations are performed. The more obvious outliers have been remediated in the analysis in chapter 4.2.

4 Contribution of waste scenarios to changes in marine litter

4.1 Waste generation and treatment scenarios

DG Environment, working with the European Environment Agency, has commissioned the development of a model of municipal waste generation and management for all EU Member States. It will be used, firstly, to develop scenarios which facilitate the understanding of the gap between likely waste management performance in specific Member States and the targets for recycling, recovery and landfill diversion under existing legislation. It will then be used to quantify the impact of different scenarios in respect of impacts on the environment, including (but not limited to) greenhouse gas emissions, job creation, and costs[8].

In this exercise we analyse the impact of these scenarios on the primary sources of beach litter, as is identified in chapter 4.2. See paragraph 3.2.1 on why beach litter is chosen as a proxy for marine litter inflow.

The following scenarios are under consideration, in line with the Commission's draft Impact Assessment study accompanying the proposal for reviewing the European waste management targets (European Commission, 2014):

a) **Business as usual:** No additional actions at EU level. Waste management will evolve in line with historical trends and existing national planning for waste infrastructure.

   This assumes the levels of recycling and the share of waste treatment systems remain constant after the last reported year. This provides a base case against which to compare the more dynamic future scenarios in the further analysis. BAU differs from the actual situation only in its demographic and economic evolution towards 2020.

b) **Option 1: Full implementation**: We assume that all existing EU targets will be met by all Member States, through a.o. early warning procedures, better enforcement and better performing EPR schemes.

c) **Option 2: Simplification, improved monitoring, dissemination of best practices**: The improved monitoring consists of the establishment of a single measurement method for the target for recycling of household and other similar waste. Currently, in order to achieve the existing 50% target for recycling of such waste, Member States can choose between the four methods included in article 3 of Decision 2011/753/EU:

   (a) the preparation for reuse and the recycling of paper, metal, plastic and glass household waste;

[8] http://www.wastemodel.eu/

(b) the preparation for reuse and the recycling of paper, metal, plastic, glass household waste and other single types of household waste or of similar waste from other origins;

(c) the preparation for reuse and the recycling of household waste;

(d) the preparation for reuse and the recycling of municipal waste.

However, the single measurement method would see a harmonised approach, with all Member States using method d, which has the widest scope of application.

d) **Option 3.1: Measures to upgrade the EU targets - increasing the recycling/preparation for reuse target for overall municipal waste**

	2020 (4 measurement methods)	2025 (only method d)	2030 (only method d)
Option 3.1 - Low	50%	50%	60%
Option 3.1 - High	50%	60%	70%

Option 3.1 sees an increase in the recycling/preparation for reuse for municipal waste. Both "high" and "low" scenarios are addressed. The impact of the single measurement method outlined in Option 2 is also taken into account from 2025 onwards.

e) **Option 3.2: Measures to upgrade the EU targets - increase the targets of the packaging waste Directive**

	2020	2025	2030
Overall recycling/preparation for reuse	60%	70%	80%
Plastics	45%	60%	To be reviewed
Non-ferrous metal	85%	90%	90%
Ferrous metal	70%	80%	90%
Glass	70%	80%	90%
Paper/Cardboard	85%	90%	90%
Wood	50%	65%	80%

f) **Option 3.3: Measures to upgrade the EU targets - limit landfilling to 'non-recoverable waste'**

Landfilling	
Ban on plastic, paper, glass and metals (*25% max landfilling)*	2025
Global ban *(5% max landfilling)*	2030

g) **Option 3.4: Measures to upgrade the EU targets - combination**: The interacting options 3.1, 3.2 and 3.3 are combined.

Next to these formally considered scenarios, we add the following scenarios for information purpose:

h) **Maximum feasible scenario**. We assume that the EU will perform as a whole at the level of the actual performance of its top 3 Member States, also including an increased decoupling of waste generation growth from consumption or economic expansion.
i) **"Plastics only" scenarios.** What would be the impact of recycling targets from option 3.4 applied on the plastic fraction of marine litter?

The following parameters are assessed for each of these scenarios:

Table 4: Parameters on different waste management performances for each of the described options and scenarios

	Year	Today 2012	Business as usual	OPTION 1 Full implemen-tation	OPTION 2 Single calculation method	OPTION 3.1h Higher municipal waste recycling targets	OPTION 3.2 Higher packaging waste recycling targets	OPTION 3.3 Specific landfill diversion targets	OPTION 3.4 combination	Maximum feasible	Plastics only
MSW generation (tonnes)	*2012*	*253.249.000*									*>35.455.000*
	2020		270.147.000	270.147.000	270.147.000	270.147.000	270.147.000	270.147.000	270.147.000	260.257.440	>37.820.580
	2025		276.147.000	276.147.000	276.147.000	276.147.000	276.147.000	276.147.000	276.147.000	262.657.501	>38.660.580
	2030		280.147.000	280.147.000	280.147.000	280.147.000	280.147.000	280.147.000	280.147.000	264.293.483	>39.220.580
Level of decoupling (D)		*D=0,59 decoupling*	*D=2,55 Absolute decoupling*	*D=2,55 Absolute decoupling*	*D=2,55 Absolute decoupling*	*D=2,55 Absolute decoupling*	*D=2,55 Absolute decoupling*	*D=2,55 Absolute decoupling*	*D=2,55 Absolute decoupling*	*D=5,11 Absolute decoupling*	*D=2,55 Absolute decoupling*
Recycling performance of MSW (%)	*2012*	24,43%									
	2020		24,43%	35%	50%	35%	50%	50%	50%	38,18%	31%
	2025		24,43%	35%	50%	60%	50%	50%	60%	38,18%	41%
	2030		24,43%	35%	50%	70%	50%	50%	70%	38,18%	41%
Recycling performance of MSW plastics (%)	*2012*	7%						57% landfill			
	2020		7%	11%	10%	11%	31%	-0% landfill	31%	24%	31%
	2025		7%	11%	10%	12%	41%	-32% landfill	41%	24%	41%
	2030		7%	11%	10%	15%	41%	-52% landfill	41%	24%	41%
Recycling performance of MSW glass (%)	*2012*	53%						57% landfill			n.a.
	2020		53%	78%	76%	78%	69%	-0% landfill	78%	82%	
	2025		53%	78%	76%	91%	78%	-32% landfill	91%	82%	
	2030		53%	78%	76%	91%	87%	-52% landfill	91%	82%	

	Year	Today 2012	Business as usual	OPTION 1 Full implemen-tation	OPTION 2 Single calculation method	OPTION 3.1h Higher municipal waste recycling targets	OPTION 3.2 Higher packaging waste recycling targets	OPTION 3.3 Specific landfill diversion targets	OPTION 3.4 combination	Maximum feasible	Plastics only
Recycling performance of MSW metals (%)	*2012*	25%						57% landfill			n.a.
	2020		25%	36%	35%	36%	60%	-0% landfill	60%	76%	
	2025		25%	36%	35%	42%	67%	-32% landfill	67%	76%	
	2030		25%	36%	35%	51%	73%	-52% landfill	73%	76%	
Recycling performance of MSW paper (%)	*2012*	41%						57% landfill			n.a.
	2020		41%	60%	58%	60%	60%	-0% landfill	60%	86%	
	2025		41%	60%	58%	70%	62%	-32% landfill	70%	86%	
	2030		41%	60%	58%	84%	62%	-52% landfill	84%	86%	
Recycling performance of MSW wood (%)	*2012*	62%									n.a.
	2020		62%	62%	62%	62%	62%	62%	62%	62%	
	2025		62%	62%	62%	62%	62%	62%	62%	62%	
	2030		62%	62%	62%	62%	62%	62%	62%	62%	
Recycling performance of packaging (%)	*2012*	64%						23% landfill			
	2020		64%	64%	64%	64%	64%	-0% landfill	64%	75%	45%
	2025		64%	64%	64%	64%	70%	-0% landfill	70%	75%	60%
	2030		64%	64%	64%	64%	80%	-18% landfill	80%	75%	60%
Recycling performance of packaging, plastics (%)	*2012*	34%						37% landfill			
	2020		34%	34%	34%	34%	45%	-0% landfill	45%	96%	45%
	2025		34%	34%	34%	34%	60%	-12% landfill	60%	96%	60%

	Year	Today 2012	Business as usual	OPTION 1 Full implemen-tation	OPTION 2 Single calculation method	OPTION 3.1h Higher municipal waste recycling targets	OPTION 3.2 Higher packaging waste recycling targets	OPTION 3.3 Specific landfill diversion targets	OPTION 3.4 combination	Maximum feasible	Plastics only
	2030		34%	34%	34%	34%	60%	-32% landfill	60%	96%	60%
Recycling performance of packaging, glass (%)	*2012*	71%						29% landfill			n.a.
	2020		71%	71%	71%	71%	71%	-0% landfill	71%	96%	
	2025		71%	71%	71%	71%	80%	-4% landfill	80%	96%	
	2030		71%	71%	71%	71%	90%	-24% landfill	90%	96%	
Recycling performance of packaging, steel (%)	*2012*	75%						27% landfill			n.a.
	2020		75%	75%	75%	75%	75%	-0% landfill	75%	91%	
	2025		75%	75%	75%	75%	80%	-2% landfill	80%	91%	
	2030		75%	75%	75%	75%	90%	-22% landfill	90%	91%	
Recycling performance of packaging, aluminium (%)	*2012*	57%						27% landfill			n.a.
	2020		57%	57%	57%	57%	85%	-0% landfill	85%	79%	
	2025		57%	57%	57%	57%	90%	-2% landfill	90%	79%	
	2030		57%	57%	57%	57%	90%	-22% landfill	90%	79%	
Recycling performance of packaging, paper (%)	*2012*	83%						8% landfill			n.a.
	2020		83%	83%	83%	83%	85%	-0% landfill	85%	96%	
	2025		83%	83%	83%	83%	90%	-0% landfill	90%	96%	
	2030		83%	83%	83%	83%	90%	-3% landfill	90%	96%	
Recycling performance of packaging, wood	*2012*	38%						32% landfill			n.a.
	2020		38%	38%	38%	38%	50%	-7% landfill	50%	79%	

	Year	Today 2012	Business as usual	OPTION 1 Full implemen-tation	OPTION 2 Single calculation method	OPTION 3.1h Higher municipal waste recycling targets	OPTION 3.2 Higher packaging waste recycling targets	OPTION 3.3 Specific landfill diversion targets	OPTION 3.4 combination	Maximum feasible	Plastics only
(%)	2025		38%	38%	38%	38%	65%	-27% landfill	65%	79%	
	2030		38%	38%	38%	38%	80%	-22% landfill	80%	79%	

4.1.1 Municipal Solid Waste generation in 2012

Data are retrieved from EUROSTAT database [env_wasmun], disseminating the yearly reports by Member States in accordance with a subset of the Eurostat/OECD Joint Questionnaire. Data are provided by Member States and other OECD countries to OECD and Eurostat under a so-called gentlemen's agreement, without binding legal obligation but all Member States do report.

No data for 2012 are already disseminated; data on total municipal waste generation waste for 2011 are used as a proxy:

Municipal waste [env_wasmun]		
Last update	03.02.14	
Extracted on	12.02.14	
Source of data	Eurostat	
WST_OPER	Waste generated	
UNIT	Thousands of tonnes	
GEO/TIME	2010	2011
European Union (28 countries)	255.147	253.249

For the “plastics only” scenario we take into account the composition of municipal waste, as assessed by Eunomia in Table 6. Plastics represent at least 14% of municipal waste, and would be at least 35 million tonnes.

4.1.2 Municipal solid waste generation in 2020, 2025, 2030

The model of municipal waste generation and management forecasts the following evolution in municipal waste generation and treatment, compared to 2010:

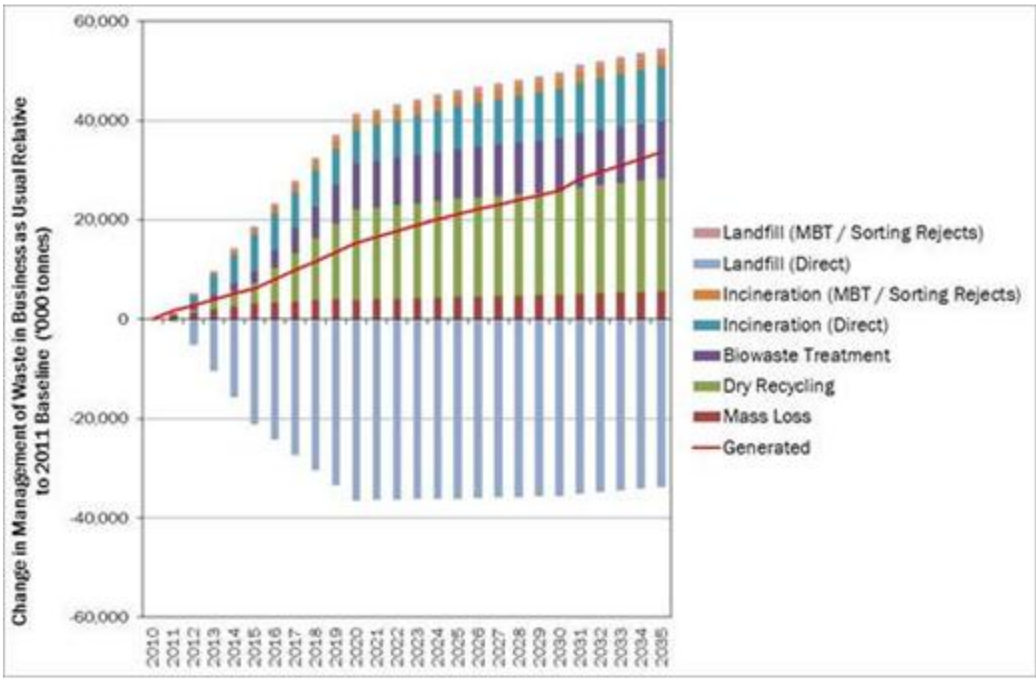


Table 5: Assessed increase of MSW generation (EUNOMIA)

year	assessment	Total (tonnes)	Yearly growth rate (%)
2020	+ 15.000.000 tonnes	270.147.000	0,57
2025	+ 21.000.000 tonnes	276.147.000	0,53
2030	+ 25.000.000 tonnes	280.147.000	0,47

For the “plastics only” scenario we take into account the composition of municipal waste, as assessed by Eunomia in Table 6. Plastics represent at least 14% of the municipal waste in weight: 2020 = 37.820.580 tonnes, 2025 = 38.660.580 tonnes, 2030 = 39.220.580 tonnes.

The draft Commission proposal for reviewing the European waste management targets does not take into consideration targets for decoupling or prevention of waste generation. Quantities of waste generated as per the business as usual situation are used as the basis for options 1, 2 and 3.

For the maximum feasible scenario we do take into account shifted levels of decoupling. See analysis in chapter 4.1.3.

An excel file ‘calculation waste scenario indicators.xlsx’ with the detailed calculation is added in annex to this report. See tab ‘total generation’.

4.1.3 Levels of decoupling

The scenarios evaluated do not take into account shifts in decoupling or in the level of waste prevention. Specific EU waste prevention targets are not included in the options assessed. Although waste prevention will occur, and through dissemination of best practices and the effect of implemented waste prevention plans the level of prevention or decoupling may be on average higher than today, we maintain a conservative approach by not taking this into account. Due to a lack of binding targets, it is not clear the level to which prevention may increase.

In the options assessed, we present the level of decoupling as deduced from the Eunomia results for MSW rates, as projected in the Commission's draft Impact Assessment. For most scenarios, we compare this result with the level of decoupling observed today. For the analysis of the maximum feasible scenario, we use a higher projected level of decoupling for MSW, derived from the actual decoupling levels of the best performing Member States. For the fraction non-municipal waste (e.g. part of packaging waste) we also use decoupling levels we assess based on actual 2012 data, thus not based on the Eunomia modelling that only considers municipal waste. The method developed hereunder is thus only relevant to describe those scenarios in which the Eunomia data are not to be used, i.e. the maximum feasible scenario and the data on industrial waste.

4.1.3.1 Level of decoupling in 2012 for MSW

Municipal solid waste (MSW) generation and level of decoupling go hand-in-hand. We assume that future MSW generation depends upon:

- the generation per capita which is defined by the level of consumption and the level of decoupling of waste generation from consumption
- the demographic evolution.

Data for MSW generation in 2011 are retrieved from EUROSTAT database [env_wasmun]. It reports data on municipal waste as collected via a subset of the Eurostat / OECD Joint Questionnaire: waste collected by or on behalf of municipal authorities. For areas not covered by a municipal waste collection scheme, the reporting countries estimate the amount of waste generated.

Decoupling is defined as the ratio between the growth rate of waste generation and the growth rate of the annual private final consumption expenditure, for values of a set of preceding years.

- Decoupling is calculated at the level of the EU-28 and at the level of individual Member States.
- The indicator uses the growth rate of municipal waste generation as a proxy for waste generation generally and takes data from the five preceding years.
- Formula:

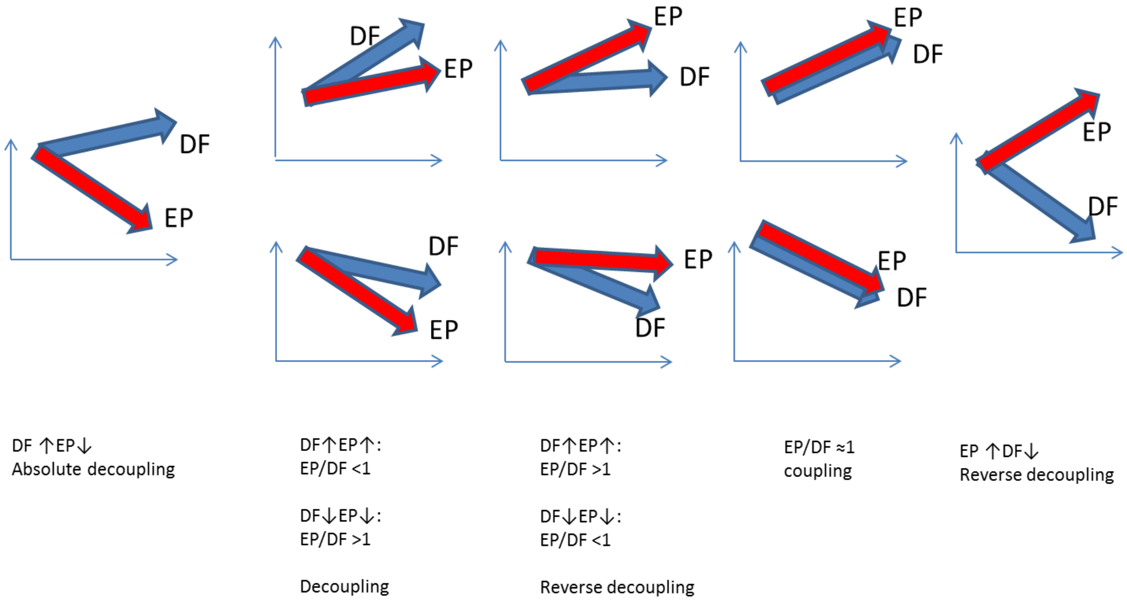
$$D_{(y-5)\to y} = \left(b(DF)_{(y-5)\to y} - b(EP)_{(y-5)\to y}\right)$$

  With

  $D_{(y-5)\to y}$: the decoupling indicator for a time interval of five years from y-5 to y b(EP) $_{(y-5)\text{->}y}$: the slope of the linear regression of waste generation (environmental pressure) over the last five years | EP expressed as an index with y-5 = 100

b(DF) $_{(y-5)\text{->}y}$: the slope of the linear regression of the private consumption expenditure (driving force) over the last five years | DF expressed as an index with y-5 = 100

- EP: generation of municipal or household waste, database EUROSTAT [env_wasmun].
- DF: Private consumption expenditure, database EUROSTAT [nama_co3_k]. Both EP and DF are expressed as total values for the Member State



Depending on the value of the decoupling indicator, the status can be described as:

- Absolute decoupling: the environmental pressure drops, even if the driving force increases. D>2
- Decoupling, the environmental pressure follows then driving force, but not completely. 0<D<2
- Coupling, environmental pressure and driving force are strictly linked, and evolve in the same way. D≈0
- Reverse decoupling; environmental pressure evolves in a more prominent way than the driving force. D<0

The average generation of municipal or household waste per capita evolves in line with the level of decoupling. If coupling occurs, the growth rate for average waste generation is identical to the growth rate of the driving force (in case the foreseen final consumption expenditure). If not, the decoupling level corrects and nuances this growth rate. The growth rate of the average waste generation per capita:

- In case of absolute decoupling: 0 – steady state
- In case of decoupling the average waste generation follows its driving force in a way that its growth rate equals the DF growth rate multiplied by $-\frac{1}{2} * D + 1$

- In case of coupling the growth rate equals the growth rate of the DF
- In case of reverse decoupling the average waste generation follows its driving force in a way that its growth rate equals the DF growth rate multiplied by $-\frac{1}{2} * D + 1$, topped of at 2.

The total generation is obtained by multiplying the average generation by the expected population.

If the decoupling level of 2012 is continued into the future, the following quantities of municipal solid waste could be expected.

municipal waste		
generation per capita in EU-27 (2010)	505,98	kg/inh.y
decoupling level	decoupling	D=0,59
growth rate DF (final cons.exp.)	0,76	%
growth rate	0,54	%
generation per capita in 2020	533,72	kg/inh.y in 2020
population in 2020	514.365.687	inh
generation in 2020	**274.529.492**	**tonnes**
generation per capita in 2025	548,16	kg/inh.y in 2020
population in 2025	519.109.103	inh
generation in 2025	**284.556.551**	**tonnes**
generation per capita in 2030	551,10	kg/inh.y in 2020
population in 2030	522.342.413	inh
generation in 2030	**287.861.656**	**tonnes**

We use EU-27 data because no final consumption expenditure data for Croatia are available.

An excel file 'calculation waste scenario indicatrors.xlsx' with the detailed calculation is added in annex to this report. See tab 'decoupling'.

4.1.3.2 Level of decoupling in 2012 for industrial waste

For industrial waste, we use the decoupling level calculated using GDP as the driving force instead of final consumption expenditure. For EP waste generation we use the same growth rate as for MSW per capita. We do not apply demographic data as we assume that industrial waste generation depends solely from GDP growth and decoupling, and less not from demographic evolutions.

Decoupling and growth rate for **industrial waste**

GDP growth rate	2,69	%	
decoupling level	0,59		decoupling
industrial waste yearly growth rate	1,89	%	

An excel file 'calculation waste scenario indicatrors.xlsx' with the detailed calculation is added in annex to this report. See tab 'decoupling'.

4.1.3.3 Decoupling in options 1, 2 and 3 and the plastics only scenario

We calculate the level of decoupling taking into account the MSW growth as assessed by Eunomia, see Table 5, and as per the Commission's draft Impact Assessment.

From the data in Table 5, we can derive a projected level of decoupling of D=2,55 which is notably higher that the level measured for 2012. Absolute decoupling means that waste generation per capita will not increase with increasing consumption expenditure, but that total waste generation will increase with growing demography.

EP (environmental pressure) - kg/inh.y		EP indexed
2010	509	100,00
2015	*517*	101,57
2020	525	103,14
2025	532	104,46
2030	536	105,32

b(EP)	b(DF)	D
1,35	3,91	2,55

absolute decoupling

DF (driving force) - M.euro		DF indexed
2010	6.484.351	100,00
2015	6.742.282	103,98
2020	6.994.557	107,87
2025	7.246.831	111,76
2030	7.499.106	115,65

generation per capita in EU-27 (2010)	505,98	kg/inh.y
decoupling level	absolute decoupling	D=2,55
growth rate DF (final cons.exp.)	0,76 %	
growth rate	0,00 %	

For industrial waste we use the level of decoupling as analysed for 2012, see paragraph 4.1.3.2.

An excel file ‘calculation waste scenario indicatrors.xlsx’ with the detailed calculation is added in annex to this report. See tab ‘decoupling’.

4.1.3.4 Level of decoupling in the maximum feasible scenario

Actual decoupling rates for Member States are calculated as follows:

	b(EP)	b(DF)	D	
European Union (27 countries)	-0,79	-0,20	0,59	decoupling
European Union (28 countries)	-0,80	n.a.		
Belgium	-0,83	1,41	2,24	absolute decoupling
Bulgaria	-1,88	0,26	2,14	absolute decoupling
Czech Republic	2,72	0,72	-2,00	reverse decoupling
Denmark	5,11	2,70	-2,40	reverse decoupling
Germany	0,57	1,07	0,50	decoupling

	b(EP)	b(DF)	D	
Estonia	-8,70	-5,01	3,69	absolute decoupling
Ireland	-4,34	-1,75	2,59	absolute decoupling
Greece	4,05	-3,26	-7,30	reverse decoupling
Spain	-3,00	-1,40	1,60	decoupling
France	-0,22	0,51	0,73	decoupling
Croatia	-1,78	n.a.		
Italy	-0,02	-0,31	-0,28	reverse decoupling
Cyprus	0,72	-0,68	-1,40	reverse decoupling
Latvia	-4,09	-5,83	-1,74	reverse decoupling
Lithuania	-1,08	-4,21	-3,13	reverse decoupling
Luxembourg	1,47	1,40	-0,07	coupling
Hungary	-4,55	-2,56	1,99	decoupling
Malta	-2,74	2,51	5,25	absolute decoupling
Netherlands	-1,16	-0,40	0,75	decoupling
Austria	-1,86	1,14	3,00	absolute decoupling
Poland	-0,35	3,41	3,77	absolute decoupling
Portugal	0,66	-0,25	-0,91	reverse decoupling
Romania	-1,81	1,49	3,30	absolute decoupling
Slovenia	-4,93	1,19	6,12	absolute decoupling
Slovakia	1,40	0,81	-0,59	reverse decoupling
Finland	-0,60	0,95	1,55	decoupling
Sweden	-2,34	1,62	3,95	absolute decoupling
United Kingdom	-1,59	-0,65	0,94	decoupling

Absolute decoupling occurs in Belgium, Bulgaria, Estonia, Ireland, Malta, Austria, Poland, Romania, Slovenia, and Sweden. This contains broadly two categories of Member States: those where waste prevention is starting to show significant effects and Member States where economic growth and increasing consumption do not (yet) go hand in hand with increased municipal waste, e.g. because living standards require a higher level of reuse and a lower level of single use or disposable items. If however collection coverage evolves during the observed 5 year timeframe (if e.g. collection coverage increases towards 100% of all households), and if the waste generation statistics depends on the amount of waste collected (which is often the case because it is more easily measurable), we may have a false indication of less decoupling.

In the maximum feasible scenario we assume high levels of absolute decoupling throughout the European Union, based on the average of the decoupling levels of Slovenia, Malta and Sweden:

municipal waste		
generation per capita in EU-27 (2010)	505,98	kg/inh.y
decoupling level	absolute decoupling	D=5,11
growth rate	0,00	%
generation per capita in 2020	505,98	kg/inh.y
population in 2020	514.365.687,00	inh
generation in 2020	**260.257.440**	**tonnes**
generation per capita in 2025	505,98	kg/inh.y
population in 2025	519.109.103,00	inh
generation in 2025	**262.657.501**	**tonnes**
generation per capita in 2030	505,98	kg/inh.y
population in 2030	522.342.413,00	inh
generation in 2030	**264.293.483**	**tonnes**

4.1.4 Recycling performance of MSW

4.1.4.1 Actual situation

The EUROSTAT database [env_wasmun] reports for 2011:

Municipal waste [env_wasmun]			
Last update	04.07.13		
Extracted on	28.11.13		
Source of data	Eurostat		
UNIT	Thousands of tonnes		
WST_OPER	Waste generated	Material recycling	% material recycling
GEO/TIME	2011	2011	
European Union (EU28)	253 249	61 879	24,43%
European Union (EU27)	251 604	61 756	24,54%
Belgium	5 125	1 839	35,88%
Bulgaria	2 753	76	2,76%
Czech Republic	3 358	496	14,77%
Denmark	4 001	1 224	30,59%
Germany	48 805	22 113	45,31%
Estonia	399	70	17,54%
Ireland	2 850	950	33,33%
Greece	5 607	840	14,98%
Spain	22 997	3 856	16,77%
France	34 336	6 615	19,27%
Croatia	1 645	123	7,48%
Italy	32 500	6 400	19,69%
Cyprus	560	63	11,25%
Latvia	721	62	8,60%
Lithuania	1 339	244	18,22%

Luxembourg	356	95	26,69%
Hungary	3 809	654	17,17%
Malta	243	15	6,17%
Netherlands	9 947	2 724	27,39%
Austria	4 650	1 250	26,88%
Poland	12 129	1 118	9,22%
Portugal	5 139	593	11,54%
Romania	7 800	80	1,03%
Slovenia	844	243	28,79%
Slovakia	1 767	78	4,41%
Finland	2 719	592	21,77%
Sweden	4 350	1 426	32,78%
United Kingdom	32 500	8 040	24,74%

The average EU-28 recycling percentage for municipal solid waste in 2011 was 24,43% in weight.

4.1.4.2 Business as usual

An average recycling percentage of 24,43% of MSW is and will in future be recycled. It should be noted that the BAU is merely a benchmark scenario, as defined above. In reality it can be expected that recycling performances may keep improving even if all Member States did not reach full compliance.

4.1.4.3 Option 1: Full implementation

Targets for the recycling level for MSW are formulated in article 11 of the Waste Framework Directive:

By 2020, the preparing for re-use and the recycling of waste materials such as at least paper, metal, plastic and glass from households and possibly from other origins as far as these waste streams are similar to waste from households, shall be increased to a minimum of overall 50 % by weight;

Decision 2011/753/EU clarifies how this should be interpreted and measured. The recycling target of 50% refers to: either

(a) the sum of paper, metal, plastic and glass household waste,

(b) the sum of paper, metal, plastic, glass and other single types of household or similar waste,

(c) household waste as a whole,

(d) municipal waste as a whole.

Member States can opt for one of these calculation methods to demonstrate compliance with the target.

- If all Member States selected option c or d, the overall recycling level for household waste (as per option c) or municipal waste (as per option d) would be 50%.

- If all Member States selected option a or b, the overall recycling level would be lower, since (a) and (b) are narrower definitions. We calculate this level using the household waste composition as assessed by Eunomia. See column 2 in Table 6:

Table 6: Composition of household waste (source EUNOMIA) and calculation of recycling performance for MSW in case of full compliance.

composition:			
	%	recycling target	%
Paper	20	50% recycling (European Commission 2008)	24
Glass packaging	8		
Plastic packaging	14		
Metal packaging	6		
Furniture	3,5		
Textile	2,5		
WEEE	3	65% separate collection (European Commission 2012)	2
Other dry	7		
Biowaste[9]	30	*14% max* [10] (European Commission 2001)	*4*
Other wet	6		
Total	100		26
Total including composting of biowaste			30

In case all Member States use method a to comply with the recycling target we assume that 50% of the sum of paper, glass, plastic and metal household waste will be recycled. These four fractions represent 48% of all household waste according to the composition of household waste as assessed by Eunomia. 50% of 48% represented 24% of overall household waste being recycled.

Other waste fractions, such as WEEE, fall under other recycling targets while biodegradable waste falls under landfill diversion targets set in the Landfill Directive 1999/31/EC. The 65% separate collection target for WEEE as set in the WEEE Directive 2012/19/EU is taken into account. For biodegradable waste we assess a maximum recycling of 14% based on actual performance. Eurostat [env_wasmun] reports 35.115.000 tonnes MSW composted out of 253.249.000 tonnes MSW generated for EU-28 in 2011, or 13,9%. We consider this input to the aerobic or anaerobic treatment as recycled, although it is not always clear if the treatment “generates compost or digestate which, following any further necessary reprocessing, is used as a recycled product, material or substance for land

[9] Biodegradable waste or waste for composting is not relevant in the context of marine litter, but we need to take it into account when assessing overall recycling performance figures.

[10] Eurostat [env_wasmun] reports 35.115.000 tonnes MSW composted on 253.249.000 tonnes MSW generated for EU-28 in 2011, or 13,9%. The statistics do not clarify if this input to the aerobic or anaerobic treatment can be counted as recycled, while it is not clear if the treatment “generates compost or digestate which, following any further necessary reprocessing, is used as a recycled product, material or substance for land treatment resulting in benefit to agriculture or ecological improvement”.

treatment resulting in benefit to agriculture or ecological improvement" (European Commission, 2001).

If all Member states opted for method a (thus focussing on four fractions) and were compliant with the targets from both the Waste Framework Directive and the WEEE Directive, we would observe 26% recycling of the sum of household waste. We use this as a proxy for MSW.

If all Member States applied method b and count composting for recycling and recycling of other fractions above the four selected wastes, they could meet the overall 50% target with lower recycling rates for plastics, metals, glass or paper. Just adding average composting performance to the targets may therefore risk actually lowering ambition level of action on the four specific waste streams, although neglecting recycling or composting efforts on other waste streams may lead to an underestimation of overall activity. If we nevertheless add composting of biowaste to the recycling performances of the four other waste streams we obtain recycling performance of 30% in case of full compliance with targets.

When Member States are free to choose the method they prefer, complying with the targets would lead to recycling of overall MSW of between 26% and 50%. 35% is thus taken as a sensible but conservative guestimate.

Targets must be met by 2020. In this scenario, they remain at this level beyond 2020.

4.1.4.4 Option 2: single calculation method

50% of municipal waste is recycled from 2020 onwards.

4.1.4.5 Option 3.1: increased MSW recycling targets

A high and low variant of this option exist. The high variant of this option is analysed, which proposes the following MSW recycling targets:

- 2020: 50%, but because the 4 measurement methods can still be used, a more realistic proxy of 35% is used, as explained in paragraph 4.1.4.3.
- 2025: 60% (single measurement method)
- 2030: 70% (single measurement method)

4.1.4.6 Option 3.2: higher packaging waste targets

No targets for MSW are defined. We assume that the targets from option 2 (with single measurement method) remain valid: 50% by 2020.

4.1.4.7 Option 3.3: specific landfill diversion targets

No targets for MSW are defined. We assume that the targets from option 2 (with single measurement method) remain valid: 50% by 2020.

4.1.4.8 Option 3.4: combination

The highest targets from the options 3.1, 3.2 and 3.3 have been taken into account

- 2020: 50%
- 2025: 60%
- 2030: 70%

Single calculation method

4.1.4.9 Maximum feasible scenario

The top three performers in the actual situation are:

- Germany: 45,31 %
- Belgium: 35,88 %
- Ireland: 33,33 %

The average of this top three is 38,18 %, using the four measuring methods.

Data retrieved from EUROSTAT database [env_wasmun] reports for 2011, see paragraph 4.1.4.1., based on the OECD/Eurostat Joint Questionnaire.[11]

4.1.4.10 Plastics only scenario

The recycling performances of the plastics fraction, as calculated in the next chapter 4.1.5 for option 3.4, are used.

4.1.5 Recycling performance of MSW plastics, glass, metals and paper

4.1.5.1 Actual situation

We use the data reported by Member States under annex I (waste generation) of the Waste Statistics Regulation, as disclosed by EUROSTAT in database [env_wasgen]. We assume that data reported as metal (W06), glass (W071), paper (W072) or plastic (W074) waste, with origin 'households' represent separately collected fractions to be recycled. Metal, paper, plastics and glass waste fractions included in mixed waste will either be reported in the figure for mixed wastes (W101) or as waste with another origin (e.g. E36_E37_E39 Water collection, treatment and supply; sewerage; remediation activities and other waste management services). We also take into account animal and vegetal waste as an important separate fraction to be considered for option 1 (full implementation while still allowing four measurement methods).

By dividing the quantities of these waste fractions by the total waste generated by households (we use EUROSTAT database env_wasnmin, waste excluding major mineral wastes), we can compare the recycling performance, or the source separate collection efforts, between EU-27 Member States for these waste fractions. Outliers, probably due to diverging definitions, are marked in red and are not taken into consideration.

[11] Note that the recycling rates reported in table 3 of the Commission's draft Impact Assessment are higher as they reflect the amount of waste recycled versus the amount of waste treated, while paragraph 4.1.4.1 reflects the amount of waste recycled versus the amount of waste generated.

It is more difficult to assess the actual recycling rate for the total sum of generated plastic, paper, metal, glass or biowaste municipal waste because the EUROSTAT data are not detailed enough. We use the Eunomia assessment of the composition of municipal waste and calculate, based on total generation of municipal waste per Member State, a possible generated quantity per fraction. We compare these calculated quantities with the amounts of the separately collected municipal waste fraction. In this way we assess rough figures on actual recycling percentages for paper, plastics, glass and metal waste from municipal origin. Because it is based on average composition of MSW at EU-28 level, the outcome at this level will be more accurate than for individual Member States that can have a differing waste composition.

WASTE	Metallic wastes	Glass wastes	Paper and cardboard wastes	Plastic wastes	Household and similar wastes	animal and vegetal waste	Waste excluding major mineral wastes
GEO/TIME	2010	2010	2010	2010	2010	2010	2010
European Union (28 countries	3.120.000	8.960.000	17.180.000	2.120.000	138.260.000	26.130.000	212.050.000
European Union (27 countries	3.120.000	8.960.000	17.180.000	2.120.000	138.260.000		212.050.000
Belgium	87.728	283.903	678.361	101.598	330.845	964.447	4.084.689
Bulgaria	0	0	0	0	2.396.337	0	2.396.337
Czech Republic	82.672	78.289	158.626	63.500	2.704.704	172.197	3.297.532
Denmark	113.570	128.654	84.684	5.270	1.254.841	313.265	2.161.272
Germany	272.139	1.910.846	5.645.743	45.895	16.111.914	8.494.631	36.311.611
Estonia	167.702	20.313	10.158	2.543	162.122	8.116	407.353
Ireland	10.762	86.832	20.968	6.044	1.380.802	123.626	1.722.523
Greece	0	0	0	0	4.593.233	0	5.197.519
Spain	56.415	609.835	1.224.038	185.499	19.258.474	558.430	22.824.799
France	636.131	1.706.185	1.392.789	190.900	18.042.903	3.771.278	26.617.828
Croatia	0	0	0	0	0	0	0
Italy	317.822	1.778.507	3.062.718	648.642	21.378.070	4.154.330	32.473.736
Cyprus	17.088	15.596	111.079	76.203	94.419	40.741	414.830
Latvia	0	8.848	39.986	3.760	393.243	5.745	577.311
Lithuania	351.481	22.945	49.539	13.815	755.321	4.459	1.246.190
Luxembourg	8.421	12.553	24.661	346	112.712	67.700	244.098
Hungary	177.536	22.007	120.293	23.481	2.363.465	103.086	2.860.947
Malta	1.016	1.777	1.489	816	108.782	3.454	138.099
Netherlands	64.349	357.748	1.127.573	89.551	4.408.606	1.707.527	8.552.061
Austria	117.400	222.851	677.000	151.456	1.501.827	464.120	3.477.266
Poland	12.474	175.976	94.765	93.765	8.381.246	84.761	8.889.685
Portugal	1	186.375	188.673	48	5.002.570	15	5.463.649
Romania	33.803	98.013	169.423	188.885	3.193.716	27.618	5.894.950
Slovenia	7.615	21.756	38.865	15.032	506.510	52.384	695.619
Slovakia	10.007	42.643	48.163	22.789	1.458.095	95.567	1.690.498
Finland	9.778	43.187	247.067	9.463	857.327	168.474	1.680.763
Sweden	172.897	252.135	454.986	67.165	2.157.280	446.940	4.038.272
United Kingdom	388.539	867.974	1.512.558	115.350	19.354.616	4.298.545	28.685.781

	Metallic wastes	Glass wastes	Paper and cardboard wastes	Plastic wastes	animal vegetal waste
	waste source separately collected as % of total waste generated by households				
European Union (28 countries)	1,47	4,23	8,10	1,00	12,32
European Union (27 countries)	1,47	4,23	8,10	1,00	0,00
Belgium	2,15	6,95	16,61	2,49	23,61
Bulgaria	0,00	0,00	0,00	0,00	0,00
Czech Republic	2,51	2,37	4,81	1,93	5,22
Denmark	5,25	5,95	3,92	0,24	14,49
Germany	0,75	5,26	15,55	0,13	23,39
Estonia	41,17	4,99	2,49	0,62	1,99
Ireland	0,62	5,04	1,22	0,35	7,18
Greece	0,00	0,00	0,00	0,00	0,00
Spain	0,25	2,67	5,36	0,81	2,45
France	2,39	6,41	5,23	0,72	14,17
Croatia					
Italy	0,98	5,48	9,43	2,00	12,79
Cyprus	4,12	3,76	26,78	18,37	9,82
Latvia	0,00	1,53	6,93	0,65	1,00
Lithuania	28,20	1,84	3,98	1,11	0,36
Luxembourg	3,45	5,14	10,10	0,14	27,73
Hungary	6,21	0,77	4,20	0,82	3,60
Malta	0,74	1,29	1,08	0,59	2,50
Netherlands	0,75	4,18	13,18	1,05	19,97
Austria	3,38	6,41	19,47	4,36	13,35
Poland	0,14	1,98	1,07	1,05	0,95
Portugal	0,00	3,41	3,45	0,00	0,00
Romania	0,57	1,66	2,87	3,20	0,47
Slovenia	1,09	3,13	5,59	2,16	7,53
Slovakia	0,59	2,52	2,85	1,35	5,65
Finland	0,58	2,57	14,70	0,56	10,02
Sweden	4,28	6,24	11,27	1,66	11,07
United Kingdom	1,35	3,03	5,27	0,40	14,98

The recycling percentage in this table expresses the relation of recycled metal, plastic, glass, paper and biodegradable waste compared to the total amount of generated waste (of all kinds) from households. In the next table the quantity of recycled metal, glass, paper, plastic or biodegradable waste from households is compared to an assessed quantity of metal, glass, paper, plastic or biodegradable waste as generated by households. The top three values, for the maximum feasible scenario, are indicated in green.

	total generation	paper	metals	plastics	glass	biodegrad	paper	metals	plastics	glass	biodegrad	paper	metals	plastics	glass	biodegrad
	Waste excluding major mineral wastes	20%	6%	14%	8%	30%	tonnes					%				
		generation					source separate collection					assessed recycling performance % (proxy)				
European Union (27 countries)	212.050.000	42.410.000	12.723.000	29.687.000	16.964.000	63.615.000	17.180.000	3.120.000	2.120.000	8.960.000	26.130.000	41	25	7	53	41
Belgium	4.084.689	816.938	245.081	571.856	326.775	1.225.407	678.361	87.728	101.598	283.903	964.447	83	36	18	87	79
Bulgaria	2.396.337	479.267	143.780	335.487	191.707	718.901	0	0	0	0	0	0	0	0	0	0
Czech Republic	3.297.532	659.506	197.852	461.654	263.803	989.260	158.626	82.672	63.500	78.289	172.197	24	42	14	30	17
Denmark	2.161.272	432.254	129.676	302.578	172.902	648.382	84.684	113.570	5.270	128.654	313.265	20	88	2	74	48
Germany	36.311.611	7.262.322	2.178.697	5.083.626	2.904.929	10.893.483	5.645.743	272.139	45.895	1.910.846	8.494.631	78	12	1	66	78
Estonia	407.353	81.471	24.441	57.029	32.588	122.206	10.158		2.543	20.313	8.116	12		4	62	7
Ireland	1.722.523	344.505	103.351	241.153	137.802	516.757	20.968	10.762	6.044	86.832	123.626	6	10	3	63	24
Greece	5.197.519	1.039.504	311.851	727.653	415.802	1.559.256	0	0	0	0	0	0	0	0	0	0
Spain	22.824.799	4.564.960	1.369.488	3.195.472	1.825.984	6.847.440	1.224.038	56.415	185.499	609.835	558.430	27	4	6	33	8
France	26.617.828	5.323.566	1.597.070	3.726.496	2.129.426	7.985.348	1.392.789	636.131	190.900	1.706.185	3.771.278	26	40	5	80	47
Italy	32.473.736	6.494.747	1.948.424	4.546.323	2.597.899	9.742.121		317.822		1.778.507	4.154.330		16		68	43
Cyprus	414.830	82.966	24.890	58.076	33.186	124.449	111.079	17.088	76.203	15.596	40.741		69		47	33
Latvia	577.311	115.462	34.639	80.824	46.185	173.193	39.986	0	3.760	8.848	5.745	35	0	5	19	3
Lithuania	1.246.190	249.238	74.771	174.467	99.695	373.857	49.539		13.815	22.945	4.459	20		8	23	1
Luxembourg	244.098	48.820	14.646	34.174	19.528	73.229	24.661	8.421	346	12.553	67.700	51	57	1	64	92
Hungary	2.860.947	572.189	171.657	400.533	228.876	858.284	120.293	177.536	23.481	22.007	103.086	21		6	10	12
Malta	138.099	27.620	8.286	19.334	11.048	41.430	1.489	1.016	816	1.777	3.454	5	12	4	16	8
Netherlands	8.552.061	1.710.412	513.124	1.197.289	684.165	2.565.618	1.127.573	64.349	89.551	357.748	1.707.527	66	13	7	52	67
Austria	3.477.266	695.453	208.636	486.817	278.181	1.043.180	677.000	117.400	151.456	222.851	464.120	97	56	31	80	44
Poland	8.889.685	1.777.937	533.381	1.244.556	711.175	2.666.906	94.765	12.474	93.765	175.976	84.761	5	2	8	25	3
Portugal	5.463.649	1.092.730	327.819	764.911	437.092	1.639.095	188.673	1	48	186.375	15	17	0	0	43	0
Romania	5.894.950	1.178.990	353.697	825.293	471.596	1.768.485	169.423	33.803	188.885	98.013	27.618	14	10	23	21	2
Slovenia	695.619	139.124	41.737	97.387	55.650	208.686	38.865	7.615	15.032	21.756	52.384	28	18	15	39	25
Slovakia	1.690.498	338.100	101.430	236.670	135.240	507.149	48.163	10.007	22.789	42.643	95.567	14	10	10	32	19
Finland	1.680.763	336.153	100.846	235.307	134.461	504.229	247.067	9.778	9.463	43.187	168.474	73	10	4	32	33
Sweden	4.038.272	807.654	242.296	565.358	323.062	1.211.482	454.986	172.897	67.165	252.135	446.940	56	71	12	78	37
United Kingdom	28.685.781	5.737.156	1.721.147	4.016.009	2.294.862	8.605.734	1.512.558	388.539	115.350	867.974	4.298.545	26	23	3	38	50

4.1.5.2 Business as usual

The assessed actual (2010) recycling percentages for specific MSW fractions have been calculated on the assessed quantity of each waste fraction generated, and the reported quantity recycled. See excel file under Annex 5: Calculations waste scenario indicators final:

Paper	41%
Metals	25%
Plastics	7%
Glass	53%
Biodegradable waste	41%

4.1.5.3 Option 1: Full implementation

- Approach 1: We observe calculation method a in which the sum of paper+metals+plastics+glass is to be 50% recycling.
- Approach 2: We also observe calculation method b in which the sum of paper+metals+plastics+glass and biodegradable waste (as the major 'other' recyclable waste fraction in municipal waste) is to be 50% recycling.
- Approach 3: We observe that under calculation methods c or d the total level of recycling is to be 50%.[12]

In order to "scale-up" from existing recycling rates, we respect the current proportions, meaning that the ease or difficulty to recycle specific fractions will remain as present, with paper and glass being the easiest to recycle and plastic the more challenging waste stream, even when the actual recycling ratios increase for all:

Paper	41
Metals	25
Plastics	7
Glass	53
Biodegradable	*41*

Under approach 1 we calculate, using this ratio, the level of recycling of the four fractions needed to obtain 50%, this is achieved by increasing recycling for each fraction by a factor of 1,62:

[12] The non-household municipal waste fraction is usually relatively small. We use household results as a proxy for MSW results assuming that household recycling levels are also to be achieved by municipal non-household waste as well, which is similar to household waste in its nature and composition.

	actual recycling	actual generation	ratio	1,62	assessed recycling	
Paper	17.180.000	42.410.000	41	66%	27.862.478	
Metals	3.120.000	12.723.000	25	40%	5.060.008	
Plastics	2.120.000	29.687.000	7	12%	3.438.210	
Glass	8.960.000	16.964.000	53	86%	14.531.304	
sum	31.380.000				50.892.000	
total generation	101.784.000				101.784.000	
recycling percentage	30,83	%			50,00	%

Under approach 2 we calculate, using this ratio, the level of recycling of the four fractions plus biodegradable waste needed to obtain 50%, this is achieved by increasing recycling for each fraction by a factor of 1,44:

	actual recycling	actual generation	ratio	1,44	assessed recycling	
Paper	17.180.000	42.410.000	41	58%	24.704.876	
Metals	3.120.000	12.723.000	25	35%	4.486.567	
Plastics	2.120.000	29.687.000	7	10%	3.048.564	
Glass	8.960.000	16.964.000	53	76%	12.884.499	
Biodegradable	26.130.000	63.615.000	41	59%	37.574.995	
Sum	57.510.000				82.699.500	
total generation	165.399.000				165.399.000	
recycling percentage	34,77	%			50,00	%

Approach 3 and 4 are assessed to be comparable with approach 2, as the recycling of fractions other than the five included in approach 2 is not expected to be of a nature to change the results considerably. For assessing the average we assume that all methods are equally used:

Results:

	Approach 2, 3 and 4	Approach 1	Assessed average
Paper	58%	66%	60%
Metals	35%	40%	36%
Plastics	10%	12%	11%
Glass	76%	86%	78%

In this analysis we did not take into account the targets of the Packaging Directive, because these later targets are on all packaging, and not only packaging from municipal origin. For packaging targets see paragraph 4.1.6. Of course both targets are overlapping. In the analysis on its impact on marine litter we will systematically take into account the highest impact expected from compliance with these targets, see paragraph 4.2.

4.1.5.4 Option 2: single calculation method

The total amount of municipal waste recycled must be 50%. We assume that the major recycled fractions are paper, metals, plastics, glass and biodegradable wastes. Other fractions of municipal waste (like textiles, WEEE, wood…) may be recycled as well but we assess that the impact on the total level of recycling is rather limited because of the small occurrence of these waste streams in MSW compared to other wastes. For this reason we take over the figures from above, for approach 2 (3 and 4) including the four waste streams plus biodegradable waste:

	Recycling
Paper	58%
Metals	35%
Plastics	10%
Glass	76%
Biodegradable	59%
Total MSW	50%

4.1.5.5 Option 3.1: increased MSW recycling targets

2020 is as in option 1 using 50% recycling and the 4 measurement methods.

2025 is as in option 2 for the low variant and with 60% recycling in the high variant.

60%				**increase factor**		
	actual recycling	actual generation	ratio	**1,73**	assessed recycling	
Paper	17.180.000	42.410.000	41	70%	29.645.851	
Metals	3.120.000	12.723.000	25	42%	5.383.880	
Plastics	2.120.000	29.687.000	7	12%	3.658.277	
Glass	8.960.000	16.964.000	53	91%	15.461.398	
Biodegradable	26.130.000	63.615.000	41	71%	45.089.993	
Sum	57.510.000				99.239.400	
total generation	165.399.000				165.399.000	
recycling percentage	34,77	%			60,00	%

2030 is with 60% recycling in the low variant and 70% recycling in the high variant. In this option we can no longer use the assumption of an unchanged ratio between recycled fractions, because recycling percentages cannot increase above 100%. We assume for glass a stable, capped recycling performance of 91%, as in 2025 high variant. Further increasing it with a factor 2,07 would lead to recycling performances above 100% which is of course not possible.

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70%				increase factor		
	actual recycling	actual generation	Actual recycling performance	**2,07**	assessed recycling	
paper	17.180.000	42.410.000	41%	84%	35.498.693	
metals	3.120.000	12.723.000	25%	51%	6.446.794	
plastics	2.120.000	29.687.000	7%	15%	4.380.514	
glass	8.960.000	16.964.000	53%	*91%*	15.461.398	
biodegradable	26.130.000	63.615.000	41%	85%	53.991.900	
sum	57.510.000				115.779.300	
total generation	165.399.000				165.399.000	
recycling percentage	34,77	%			70,00	%

Summary:

		Paper	Metal	Plastics	Glass
2020	Low	60,1%	36,4%	10,6%	78,4%
	High				
2025	Low	60,1%	36,4%	10,6%	78,4%
	High	69,9%	42,3%	12,3%	91,1%
2030	Low	69,9%	42,3%	12,3%	91,1%
	High	83,7%	50,7%	14,8%	91,1%

4.1.5.6 Option 3.2: higher packaging waste targets

Packaging recycling targets focus both on municipal and industrial packaging waste without making a distinction between both categories. It is likely that a large fraction of municipal plastics, paper, metal and glass waste will consist of packaging. However, no data sources are available from Eurostat or from the Eunomia modelling exercise to discern what fraction of municipal plastics, paper, metal and glass waste is actually packaging waste. This is rather problematic and motivated the use of the described assessment below:

A recent sorting exercise on the mixed fraction of municipal solid waste has been performed in The Netherlands (Rijkswaterstaat, 2013). We make the broad assumption that the Dutch waste composition may be a proxy for waste composition across Europe. This is not taking into account cultural differences that lead to different consumption habits and thus different waste compositions. Lacking data inhibits however more detailed research on this topic.

The analysis leads to following results:

	Packaging	all	% packaging
paper cardboard	7,5	17	44,12
plastics	8,3	13	63,85
glass	4,7	5,1	92,16
metals	3,27	4,4	74,32

We make the assumption that this ratio is also applicable for the source selected fraction, which means that it is as simple or difficult to source separate the packaging as the non-packaging waste of each material. This assumption may be significant because for packaging and non-packaging streams (other than paper) often there exists different collection chains.

For the packaging fraction of each material we assume compliance with the increased recycling targets. For the non-packaging fraction we assume business as usual recycling:

	Packaging recycling target			Non packaging recycling performance (BAU)			Weighed recycling performance		
	2020	2025	2030	2020	2025	2030	2020	2025	2030
paper	85,00	90,00	90,00	40,51	40,51	40,51	60,14	62,34	62,34
metals	72,20	81,47	90,00	24,52	24,52	24,52	59,96	66,84	73,18
plastics	45,00	60,00	60,00	7,14	7,14	7,14	31,31	40,89	40,89
glass	70,00	80,00	90,00	52,82	52,82	52,82	68,65	77,87	87,08

4.1.5.7 Option 3.3: specific landfill diversion targets

Landfill diversion imposes bans on the landfilling of municipal solid waste. The draft Impact Assessment examines the possibilities of a ban in 2025 on the four specified fractions, of which only 25% of the generated waste fractions can still be landfilled, and in 2030 on all MSW, of which only 5% of the waste generated as a whole still can be landfilled. This will have an effect on both waste recycling and waste incineration with energy recovery, and also on mechanical biological (pre)treatment or MBT which converts municipal waste into an industrial residual waste with, for example, lower methane generating potential, that still can be landfilled. The effect on recycling cannot be assessed because it is unknown what the ratio between recycling/incineration with energy recovery and MBT or other techniques will be. Within the scope of this exercise we can however assess the amount that is no longer landfilled and which therefore will not be subject to landfill escapes or other landfill-based pathways for marine litter.

The Waste Statistics Regulation requests Member States to report on quantities of specific waste fractions that have been landfilled, incinerated, recycled or otherwise recovered. This is disclosed for 2010 in Eurostat database [env_wastrt]. When analysing the landfill diversion for the four waste streams we use waste codes metal (W06), glass (W071), paper (W072) and plastic (W074). Metals, glass, paper and plastic fractions included in other waste streams (e.g. equipment, or mixed waste) are not included in the analysis because the exact average composition of these waste streams is not known. The table below shows that levels of landfill for the four mentioned fractions (which are mainly source separated fractions of MSW) are already below the threshold values. The database env_wastrt does not distinguish between waste of municipal and other origin. Only plastics are landfilled at a rate of 11,26% which is below the threshold of 2025 but may even not be problematic for the threshold of 5% over all for 2030. Based on this analysis we do not consider source separated fractions and focus on the mixed municipal waste, code W101 household and similar wastes.

The percentage in the third column of each waste stream is the part of each stream, treated in the reporting Member State, which ends up in a landfill.

WASTE	Metallic wastes			Glass wastes			Paper and cardboard wastes			Plastic wastes			Waste excluding major mineral wastes		
GEO/WST_OPER	Total waste	Disposal		Total waste	Disposal		Total waste	Disposal		Total waste	Disposal		Total waste trea	Disposal	
European Union (28 countrie	79.050.000	420.000	0,53	14.410.000	770.000	5,34	38.700.000	1.870.000	4,83	9.950.000	1.120.000	11,26	759.010.000	220.590.000	29,06
European Union (27 countrie	78.880.000	410.000	0,52	14.400.000	770.000	5,35	38.680.000	1.870.000	4,83	9.940.000	1.120.000	11,27	756.660.000	218.760.000	28,91
Belgium	1.623.074	48.071	2,96	245.560	86.472	35,21	819.359	19.544	2,39	169.210	10.515	6,21	28.004.579	2.424.971	8,66
Bulgaria	1.008.714	17.034	1,69	72.575	6.455	8,89	141.740	9.265	6,54	39.690	3.682	9,28	7.445.360	5.868.321	78,82
Czech Republic	1.830.631	2.498	0,14	213.426	9.605	4,50	219.914	5.158	2,35	217.867	50.349	23,11	9.827.304	3.621.923	36,86
Denmark	1.047.906	293	0,03	177.750	172	0,10	660.190	25	0,00	73.790	2.453	3,32	6.368.020	293.471	4,61
Germany	9.663.285	18.851	0,20	3.066.441	31.237	1,02	5.067.081	0	0,00	1.828.623	9.641	0,53	128.027.881	11.067.624	8,64
Estonia	3.234	0	0,00	16.515	161	0,97	3.945	22	0,56	3.349	519	15,50	10.436.336	8.268.874	79,23
Ireland	8.324	20	0,24	14.997	1.019	6,79	11.498	219	1,90	81.073	163	0,20	3.303.974	1.930.767	58,44
Greece	2.226.627	11.188	0,50	66.928	36.790	54,97	317.103	1.631	0,51	156.920	129.581	82,58	22.456.246	17.790.559	79,22
Spain	5.724.367	203.473	3,55	1.185.268	38.263	3,23	4.309.471	327.951	7,61	1.465.233	298.908	20,40	56.796.951	25.655.215	45,17
France	8.849.000	0	0,00	2.483.314	424.314	17,09	7.005.000	1.384.000	19,76	1.248.697	212.697	17,03	81.501.071	23.915.530	29,34
Croatia	162.803	6.249	3,84	9.627	1.198	12,44	20.220	1.072	5,30	12.393	1.598	12,89	2.351.104	1.825.293	77,64
Italy	12.267.329	7.401	0,06	2.496.069	62.249	2,49	3.969.579	1.597	0,04	1.778.916	73.782	4,15	76.399.718	20.747.937	27,16
Cyprus	37.818	15.055	39,81	24.455	14.099	57,65	145.521	94.069	64,64	83.997	74.352	88,52	862.265	539.743	62,60
Latvia	24.400	0	0,00	2.800	0	0,00	16.828	31	0,18	29.810	281	0,94	837.777	608.598	72,64
Lithuania	13.686	3	0,02	53.515	319	0,60	68.087	6	0,01	21.509	3.007	13,98	4.121.848	3.246.093	78,75
Luxembourg	3.139.028	0	0,00	12.131	0	0,00	5.079	0	0,00	160.844	0	0,00	4.572.829	51.051	1,12
Hungary	891.975	8.857	0,99	58.300	3.848	6,60	695.955	1.069	0,15	75.316	8.618	11,44	9.306.174	5.456.254	58,63
Malta	0	0		0	0		84	0	0,00	67	67	100,00	237.670	215.111	
Netherlands	1.225.726	1.001	0,08	788.953	0	0,00	2.684.263	3.052	0,11	378.878	9.279	2,45	37.520.392	1.184.756	3,16
Austria	1.683.681	6.679	0,40	271.922	1.408	0,52	1.518.070	0	0,00	193.790	13	0,01	10.976.875	1.200.534	10,94
Poland	6.129.630	3.432	0,06	815.425	1.219	0,15	1.638.756	147	0,01	339.698	10.336	3,04	63.361.809	17.992.164	28,40
Portugal	946.031	10.350	1,09	406.190	19.257	4,74	708.381	10.412	1,47	209.087	138.007	66,00	17.247.160	8.066.961	46,77
Romania	1.608.850	10.639	0,66	123.811	362	0,29	466.912	6.847	1,47	299.783	4.824	1,61	35.347.740	19.041.152	53,87
Slovenia	812.947	200	0,02	17.560	1.675	9,54	396.930	5	0,00	43.250	5.086	11,76	3.088.101	861.159	27,89
Slovakia	529.662	14.245	2,69	55.629	11.548	20,76	88.401	3.681	4,16	78.890	23.728	30,08	5.287.639	2.938.351	55,57
Finland	877.162	7.845	0,89	145.687	1.191	0,82	660.650	532	0,08	58.715	247	0,42	20.597.619	3.419.937	16,60
Sweden	1.800.705	187	0,01	145.339	385	0,26	1.911.509	557	0,03	130.460	406	0,31	14.561.913	1.311.103	9,00
United Kingdom	14.910.217	25.902	0,17	1.435.834	13.642	0,95	5.150.525	2.693	0,05	772.026	52.635	6,82	98.163.304	31.042.579	31,62

Treatment of mixed municipal waste W101 as reported for 2010 in Eurostat database env_wastrt, in tonnes, and landfill percentage

tonnes	treated (total)	disposed	% disposal
European Union (EU28)	153010000	87530000	57,21
European Union (EU27)	151790000	86320000	56,87
Belgium	1856149	38722	2,09
Bulgaria	3042883	3042883	100,00
Czech Republic	3519313	3027035	86,01
Denmark	1935654	56207	2,90
Germany	20895402	75256	0,36
Estonia	277433	265397	95,66
Ireland	1102677	1101610	99,90
Greece	4770638	4770638	100,00
Spain	13359452	11545238	86,42
France	21280659	8704573	40,90
Croatia	1218238	1210983	99,40
Italy	22091789	15030034	68,03
Cyprus	172669	146926	85,09
Latvia	585569	584092	99,75
Lithuania	1064067	1064067	100,00
Luxembourg	154168	30149	19,56
Hungary	3103759	2672505	86,11
Malta	20964	201555	961,43
Netherlands	5885126	276996	4,71
Austria	1224854	15516	1,27
Poland	8079690	7368687	91,20
Portugal	8136978	5904662	72,57
Romania	4308852	4306754	99,95
Slovenia	559734	555342	99,22
Slovakia	1445831	1275949	88,25
Finland	1668444	1104706	66,21
Sweden	2367466	17013	0,72
United Kingdom	18695556	13139034	70,28

Compared with the landfill diversion targets (25% in 2025 and 5% in 2030), the decrease of landfill is assessed for all waste fractions at:

2020	0	%
2025	-32,21	%
2025	-52,21	%

4.1.5.8 Option 3.4: combination

The high scores of options 3.1, 3.2 and 3.3 are assessed, taking into account that recycling percentages for option 3.3 correspond to the single measurement method.

	2020	2025	2030[13]
Paper	60,14	69,90	83,70
Metals	59,96	66,84	73,18
Plastics	31,31	40,89	40,89
Glass	75,95	91,14	91,14

4.1.5.9 Maximum feasible scenario

The top three highest recycling performances for the different MSW fractions are observed, and an average is taken as the maximum feasible scenario:

	average % top 3	
Belgium, Germany, Austria	86	Paper
Denmark, Cyprus, Sweden	76	Metals
Belgium, Romania, Austria	24	Plastics
Belgium, France, Austria	82	Glass

4.1.5.10 Plastics only scenario

We use the performance for MSW plastics from option 3.4

4.1.5.11 Wood MSW

Wood MSW, although a small fraction, is added as a supplementary fraction for which recycling performance could be assessed. These data are to be used when focusing on wood packaging waste.

Eunomia assesses that MSW is made up of 3,5% furniture (see Table 6), and does not refer to other wood fractions in MSW. Furniture is however a composite product which, apart from wood tends to contain large fractions of metals and textiles. The Dutch analysis on mixed MSW composition (Rijkswaterstaat, 2013) finds a percentage of 2,7% of wood MSW, but this may be an underestimate as wood waste like furniture and other streams may be separately collected at source. If we assume an average percentage of 3% (an educated guess in between both figures), the following recycling percentages can be calculated. Values above 100% are not taken into consideration, but indicate the large uncertainty levels of this specific analysis.

[13] The Impact Assessment notes that a 2030 plastics target could still be developed at a later date which would alter these figures.

Wood MSW	Generation reported env_wasgen ≈ source separated	total MSW env_wasgen	% wood waste	generation assessed	recycling assessed
European Union (EU28)	3.940.000	212.050.000	3,00%	6.361.500	61,94
European Union (EU27)	3.940.000	212.050.000	3,00%	6.361.500	61,94
Belgium	205.794	4.084.689	3,00%	122.541	
Bulgaria	0	2.396.337	3,00%	71.890	0,00
Czech Republic	27.923	3.297.532	3,00%	98.926	28,23
Denmark	51.883	2.161.272	3,00%	64.838	80,02
Germany	670.517	36.311.611	3,00%	1.089.348	61,55
Estonia	1.955	407.353	3,00%	12.221	16,00
Ireland	10.156	1.722.523	3,00%	51.676	19,65
Greece	0	5.197.519	3,00%	155.926	0,00
Spain	192.053	22.824.799	3,00%	684.744	28,05
France	624.775	26.617.828	3,00%	798.535	78,24
Croatia	0	0	3,00%	0	
Italy	691.888	32.473.736	3,00%	974.212	71,02
Cyprus	7.769	414.830	3,00%	12.445	62,43
Latvia	0	577.311	3,00%	17.319	0,00
Lithuania	9.610	1.246.190	3,00%	37.386	25,71
Luxembourg	5.386	244.098	3,00%	7.323	73,55
Hungary	2.940	2.860.947	3,00%	85.828	3,43
Malta	3.829	138.099	3,00%	4.143	92,42
Netherlands	299.174	8.552.061	3,00%	256.562	
Austria	197.204	3.477.266	3,00%	104.318	
Poland	0	8.889.685	3,00%	266.691	0,00
Portugal	1.373	5.463.649	3,00%	163.909	0,84
Romania	127.466	5.894.950	3,00%	176.849	72,08
Slovenia	14.189	695.619	3,00%	20.869	67,99
Slovakia	1.559	1.690.498	3,00%	50.715	3,07
Finland	22.696	1.680.763	3,00%	50.423	45,01
Sweden	25.030	4.038.272	3,00%	121.148	20,66
United Kingdom	742.885	28.685.781	3,00%	860.573	86,32

High levels of recycling are already achieved, but wood waste is a relative small fraction of MSW. The general MSW recycling targets as proposed will have only a minor impact on wood waste. Increasing wood waste recycling will be of minor importance to reach the targets. We assume a stable BAU recycling percentage of 62% throughout options 1, 2, 3.1, 3.3. and the year 2020 under option 3.2. The recycling target for wood packaging waste in 2025 is 65% and in 2030 it is 80% which is above the actual level. But the Dutch analysis on MSW composition concluded that MSW wood waste very seldom consist of packaging.

The maximum feasible scenario indicates that higher percentages of MSW wood waste recycling are feasible, but difficult to assess based on the actual reported data.

4.1.6 Recycling performance of packaging waste and of plastic, glass, metal and paper packaging waste

Packaging concerned is both municipal and industrial packaging.

The data source used for this analysis is the EUROSTAT database [env_waspac]. Recycling percentages may be exaggerated in case no good proxy is used for the amounts of packaging being put on the market. Article 2.2 of Decision 2005/270/EC establishing the formats relating to the database system pursuant to the Packaging Directive states that: *"For the purposes of this Decision, packaging waste generated in a Member State may be deemed to be equal to the amount of packaging placed on the market in the same year within that Member State."* Member States are thus free to use the amount of packaging put on the market (in case they have reliable figures on this) as a proxy for packaging waste generation.

EUROSTAT metadata do not contain information on how individual Member States have assessed the amount of "packaging placed on the market". Member States are allowed to use surveys, national statistical institute data, administrative sources such as municipalities, data from waste management facilities, collective management schemes, reprocessing plants, responsible producers, exporter/importer businesses (EUROSDTAT, 2011).

It is however likely that most Member States, if not all, use the proxy in which "Packaging waste generated in a Member State may be deemed to be equal to the amount of packaging placed on the market in the same year within that Member State.". As packaging has a short lifespan and is discarded at the moment of consumption of the packaged product, this is a reasonable assumption.

4.1.6.1 Actual situation

WASTE	Packaging	Packaging	%
GEO/WST_OPER	Waste generated	Recycling	
European Union (27 countries)	80.172.092	51.013.192	64
Belgium	1.702.505	1.364.890	80
Bulgaria	314.639	204.939	65
Czech Republic	945.316	659.175	70
Denmark	883.096	479.371	54
Germany	16.486.200	11.829.600	72
Estonia	193.029	121.336	63
Ireland	863.596	612.308	71
Greece	866.090	540.630	62
Spain	7.146.841	4.602.415	64
France	12.810.715	7.849.891	61
Italy	11.637.700	7.509.304	65
Cyprus	75.554	39.255	52
Latvia	216.089	110.042	51
Lithuania	292.348	181.886	62
Luxembourg	112.047	76.440	68
Hungary	838.449	497.216	59
Malta	53.253	22.503	42
Netherlands	2.748.000	1.977.000	72
Austria	1.232.059	810.980	66
Poland	4.611.056	1.901.650	41
Portugal	1.565.838	914.585	58
Romania	992.510	496.040	50
Slovenia	207.396	131.949	64
Slovakia	443.673	276.805	62
Finland	709.643	416.372	59
Sweden	1.294.793	737.545	57
United Kingdom	10.929.657	6.649.065	61

Metal waste is reported by all Member States, both generation and recycling. Steel packaging and aluminium packaging is however only reported by Czech Republic, Germany, Ireland, Greece, France, Italy, Cyprus, Sweden and the UK. Together these nine Member States produce the following quantities, based on which we can assess an EU average on the ratio of steel/aluminium for metal packaging and for metal packaging recycling. Steel and aluminium are by far the most frequently occurring metal packaging materials, with other metals like tin occurring as a protective layer against corrosion on steel plate. Tin cans are therefore mainly steel packaging:

reported steel	2.016.898
reported aluminium	254.684
% steel	88,79
% aluminium	11,21

reported steel recycling	2.016.898
reported alu recycling	254.684
% steel recycling	88,79
% alu recycling	11,21

These ratios are used to interpolate steel and aluminium production and recycling for non-reporting Member States:

Packaging waste [env_waspac]				
Last update	8/10/2013			
Extracted on	7/01/2014			
Source of data	Eurostat			
FLOW	Domestic			
UNIT	Tonnes			
TIME	2011			
GEO	WASTE/WST_OPER	Waste generated	Recycling	%
European Union (EU27)	Metallic packaging	4.612.009	3.333.448	72,28
European Union (EU27)	Aluminium packaging	*661.071*	*373.738*	*56,54*
European Union (EU27)	Steel packaging	*3.950.938*	*2.959.710*	*74,91*
Belgium	Metallic packaging	127.584	124.285	97,41
Belgium	Aluminium packaging	*18.288*	*13.935*	*76,20*
Belgium	Steel packaging	*109.296*	*110.350*	
Bulgaria	Metallic packaging	13.414	9.381	69,93
Bulgaria	Aluminium packaging	*1.923*	*1.052*	*54,70*
Bulgaria	Steel packaging	*11.491*	*8.329*	*72,48*
Czech Republic	**Metallic packaging**	**51.282**	**34.850**	**67,96**
Czech Republic	**Aluminium packaging**	**9.086**	**2.628**	**28,92**
Czech Republic	**Steel packaging**	**42.196**	**32.223**	**76,37**
Denmark	Metallic packaging	43.371	25.167	58,03
Denmark	Aluminium packaging	*6.217*	*2.822*	*45,39*
Denmark	Steel packaging	*37.154*	*22.345*	*60,14*
Germany	**Metallic packaging**	**881.100**	**818.100**	**92,85**
Germany	**Aluminium packaging**	**93.000**	**82.900**	**89,14**
Germany	**Steel packaging**	**788.100**	**735.200**	**93,29**
Estonia	Metallic packaging	29.687	18.664	62,87
Estonia	Aluminium packaging	*4.255*	*2.093*	*49,18*
Estonia	Steel packaging	*25.432*	*16.571*	*65,16*
Ireland	**Metallic packaging**	**57.261**	**38.145**	**66,62**
Ireland	**Aluminium packaging**	**12.002**	**4.661**	**38,84**
Ireland	**Steel packaging**	**45.259**	**33.484**	**73,98**
Greece	**Metallic packaging**	**119.480**	**52.700**	**44,11**
Greece	**Aluminium packaging**	**20.240**	**6.500**	**32,11**
Greece	**Steel packaging**	**99.240**	**46.200**	**46,55**
Spain	Metallic packaging	426.307	320.726	75,23

Packaging waste [env_waspac]				
Spain	Aluminium packaging	*61.106*	*35.959*	*58,85*
Spain	Steel packaging	*365.201*	*284.767*	*77,98*
France	**Metallic packaging**	**592.563**	**436.083**	**73,59**
France	**Aluminium packaging**	**56.063**	**25.923**	**46,24**
France	**Steel packaging**	**536.500**	**410.160**	**76,45**
Italy	**Metallic packaging**	**554.533**	**393.448**	**70,95**
Italy	**Aluminium packaging**	**68.600**	**40.800**	**59,48**
Italy	**Steel packaging**	**485.933**	**352.648**	**72,57**
Cyprus	**Metallic packaging**	**5.288**	**4.697**	**88,82**
Cyprus	**Aluminium packaging**	**2.816**	**246**	**8,74**
Cyprus	**Steel packaging**	**2.472**	**4.451**	
Latvia	Metallic packaging	10.664	7.922	74,29
Latvia	Aluminium packaging	*1.529*	*888*	*58,11*
Latvia	Steel packaging	*9.135*	*7.034*	*76,99*
Lithuania	Metallic packaging	13.093	8.958	68,42
Lithuania	Aluminium packaging	*1.877*	*1.004*	*53,52*
Lithuania	Steel packaging	*11.216*	*7.954*	*70,91*
Luxembourg	Metallic packaging	4.644	3.826	82,39
Luxembourg	Aluminium packaging	*666*	*429*	*64,44*
Luxembourg	Steel packaging	*3.978*	*3.397*	*85,39*
Hungary	Metallic packaging	60.165	50.254	83,53
Hungary	Aluminium packaging	*8.624*	*5.634*	*65,33*
Hungary	Steel packaging	*51.541*	*44.620*	*86,57*
Malta	Metallic packaging	4.000	1.208	30,20
Malta	Aluminium packaging	*573*	*135*	*23,62*
Malta	Steel packaging	*3.427*	*1.073*	*31,30*
Netherlands	Metallic packaging	193.000	176.000	91,19
Netherlands	Aluminium packaging	*27.664*	*19.733*	*71,33*
Netherlands	Steel packaging	*165.336*	*156.267*	*94,52*
Austria	Metallic packaging	62.515	38.846	62,14
Austria	Aluminium packaging	*8.961*	*4.355*	*48,60*
Austria	Steel packaging	*53.554*	*34.491*	*64,40*
Poland	Metallic packaging	247.118	111.347	45,06
Poland	Aluminium packaging	*35.421*	*12.484*	*35,24*
Poland	Steel packaging	*211.697*	*98.863*	*46,70*
Portugal	Metallic packaging	93.000	66.000	70,97
Portugal	Aluminium packaging	*13.330*	*7.400*	*55,51*
Portugal	Steel packaging	*79.670*	*58.600*	*73,55*
Romania	Metallic packaging	55.230	34.410	62,30
Romania	Aluminium packaging	*7.917*	*3.858*	*48,73*
Romania	Steel packaging	*47.313*	*30.552*	*64,57*
Slovenia	Metallic packaging	15.043	6.075	40,38
Slovenia	Aluminium packaging	*2.156*	*681*	*31,59*
Slovenia	Steel packaging	*12.887*	*5.394*	*41,86*
Slovakia	Metallic packaging	26.857	15.673	58,36
Slovakia	Aluminium packaging	*3.850*	*1.757*	*45,65*
Slovakia	Steel packaging	*23.007*	*13.916*	*60,48*
Finland	Metallic packaging	53.999	43.125	79,86

Packaging waste [env_waspac]				
Finland	Aluminium packaging	*7.740*	*4.835*	*62,47*
Finland	Steel packaging	*46.259*	*38.290*	*82,77*
Sweden	**Metallic packaging**	**61.194**	**46.161**	**75,43**
Sweden	**Aluminium packaging**	**26.293**	**17.343**	**65,96**
Sweden	**Steel packaging**	**34.901**	**28.818**	**82,57**
United Kingdom	**Metallic packaging**	**809.617**	**447.397**	**55,26**
United Kingdom	**Aluminium packaging**	**160.877**	**73.683**	**45,80**
United Kingdom	**Steel packaging**	**648.740**	**373.714**	**57,61**

Packaging waste [env_waspac]

Last update 08.10.13
Extracted on 04.12.13
Source of data Eurostat

FLOW Domestic
UNIT Tonnes
TIME 2011

WASTE	Paper and cardboard packaging	Paper and cardboard packaging	%	Plastic packaging	Plastic packaging	%	Metallic packaging	Metallic packaging	%	steel packaging	steel packaging	%	alu packaging	alu packaging	%
GEO/WST_OPER	Waste generated	Recycling		Waste generated	Recycling		Waste generated	Recycling		Waste generated	Recycling		Waste generated	Recycling	
European Union (27 co	31.779.682	26.363.324	83	14.944.821	5.127.796	34	4.612.009	3.333.448	72	3.950.938	2.959.710	75	661.071	373.738	57
Belgium	656.019	592.963	90	315.961	130.730	41	127.584	124.285	97	109.296	110.350		18.288	13.935	76
Bulgaria	110.270	108.211	98	94.963	37.198	39	13.414	9.381	70	11.491	8.329	72	1.923	1.052	55
Czech Republic	374.591	339.056	91	209.414	119.433	57	51.282	34.850	68	42.196	32.223	76	9.086	2.628	29
Denmark	397.273	253.375	64	188.261	41.956	22	43.371	25.167	58	37.154	22.345	60	6.217	2.822	45
Germany	7.346.900	6.464.300	88	2.775.800	1.346.700	49	881.100	818.100	93	788.100	735.200	93	93.000	82.900	89
Estonia	60.283	47.713	79	52.006	20.606	40	29.687	18.664	63	25.432	16.571	65	4.255	2.093	49
Ireland	334.354	305.871	91	158.707	75.366	47	57.261	38.145	67	45.259	33.484	74	12.002	4.661	39
Greece	378.750	347.900	92	207.770	68.530	33	119.480	52.700	44	99.240	46.200	47	20.240	6.500	32
Spain	3.411.000	2.613.999	77	1.355.155	438.981	32	426.307	320.726	75	365.201	284.767	78	61.106	35.959	59
France	4.881.558	4.294.990	88	2.031.859	473.818	23	592.563	436.083	74	536.500	410.160	76	56.063	25.923	46
Italy	4.436.203	3.525.642	79	2.075.000	749.332	36	554.533	393.448	71	485.933	352.648	73	68.600	40.800	59
Cyprus	24.865	21.968	88	15.184	5.773	38	5.288	4.697	89	2.472	4.451		2.816	246	9
Latvia	64.009	48.116	75	36.186	8.310	23	10.664	7.922	74	9.135	7.034	77	1.529	888	58
Lithuania	88.589	74.178	84	60.356	23.477	39	13.093	8.958	68	11.216	7.954	71	1.877	1.004	54
Luxembourg	32.700	25.450	78	23.800	7.911	33	4.644	3.826	82	3.978	3.397	85	666	429	64
Hungary	276.533	259.998	94	208.662	77.797	37	60.165	50.254	84	51.541	44.620	87	8.624	5.634	65
Malta	22.209	16.153	73	11.403	3.293	29	4.000	1.208	30	3.427	1.073	31	573	135	24
Netherlands	1.144.000	1.014.000	89	444.000	225.000	51	193.000	176.000	91	165.336	156.267	95	27.664	19.733	71
Austria	501.978	424.266	85	264.152	91.889	35	62.515	38.846	62	53.554	34.491	64	8.961	4.355	49
Poland	1.419.869	833.299	59	784.474	177.163	23	247.118	111.347	45	211.697	98.863	47	35.421	12.484	35
Portugal	687.267	489.679	71	356.709	93.045	26	93.000	66.000	71	79.670	58.600	74	13.330	7.400	56
Romania	293.100	191.990	66	278.810	112.460	40	55.230	34.410	62	47.313	30.552	65	7.917	3.858	49
Slovenia	82.226	60.458	74	44.729	33.791	76	15.043	6.075	40	12.887	5.394	42	2.156	681	32
Slovakia	177.742	142.556	80	106.624	53.236	50	26.857	15.673	58	23.007	13.916	60	3.850	1.757	46
Finland	255.051	246.876	97	117.126	29.768	25	53.999	43.125	80	46.259	38.290	83	7.740	4.835	62
Sweden	504.483	381.129	76	211.901	72.323	34	61.194	46.161	75	34.901	28.818	83	26.293	17.343	66
United Kingdom	3.817.860	3.239.188	85	2.515.809	609.910	24	809.617	447.397	55	648.740	373.714	58	160.877	73.683	46

Glass packaging Waste generated	Glass packaging Recycling	%	wood packaging Waste generated	wood packaging Recycling	%
16.170.148	11.507.096	71	12.380.655	4.665.951	38
387.988	387.988	100	201.589	127.725	63
69.374	41.245	59	21.444	8.904	42
186.966	139.193	74	94.548	26.099	28
151.786	130.386	86	96.459	28.487	30
2.669.700	2.360.500	88	2.791.300	840.000	30
37.308	24.400	65	13.745	9.953	72
149.931	121.805	81	76.388	70.886	93
117.090	43.150	37	43.000	28.350	66
1.459.581	972.690	67	481.647	256.019	53
2.881.265	2.036.000	71	2.418.348	609.000	25
2.266.034	1.568.405	69	2.305.930	1.272.477	55
17.622	5.954	34	7.419	730	10
51.967	26.814	52	53.262	18.880	35
63.233	46.850	74	59.527	28.190	47
37.325	35.660	96	10.443	3.593	34
109.641	45.172	41	181.896	63.207	35
10.603	1.821	17	4.712	0	0
516.000	427.000	83	442.000	135.000	31
271.999	225.164	83	91.170	19.274	21
1.078.763	485.451	45	1.080.832	294.390	27
374.360	223.327	60	54.502	42.534	78
139.730	83.790	60	225.540	73.390	33
31.146	25.632	82	32.843	5.117	16
81.299	51.954	64	50.843	13.386	26
66.448	58.393	88	215.934	38.210	18
203.000	186.500	92	301.395	51.432	17
2.739.989	1.751.852	64	1.023.939	600.718	59

4.1.6.2 Business as usual

The assessed actual (2011) recycling percentages for packaging waste and for specific packaging waste fractions are considered to remain stable under BAU:

Packaging waste	64%
Paper packaging waste	83%
Metal packaging waste	72%
Steel packaging waste	75%
Aluminium packaging waste	57%
Plastic packaging waste	34%
Glass packaging waste	71%
Wood packaging waste	38%

4.1.6.3 Option 1: Full implementation

Targets as included in the Packaging and Packaging waste Directive, art 6, are:

Packaging waste	55% to 80%
Paper packaging waste	60%
Metal packaging waste	50%
Plastic packaging waste	22,5%
Glass packaging waste	60%

The analysis on business as usual scenario shows that the targets have been met.

For steel, aluminium and wood packaging waste we assume BAU recycling performances.

As we assume that recycling performance will not decrease in option 1 compared to the business as usual situation, we take over the BAU percentages in this option for all packaging waste types.

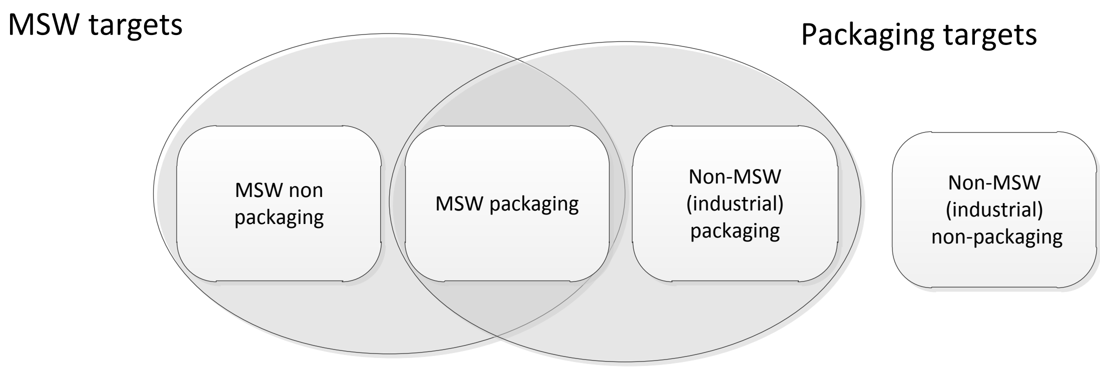
4.1.6.4 Option 2: single calculation method

Full compliance with the actual packaging recycling targets, even if expanded over all non-packaging paper MSW, does not lead to 50% recycling of MSW. Even the higher level of packaging recycling already ongoing under BAU does not lead to 50% recycling of overall MSW either. Recycling of non-packaging MSW fractions, or recycling at a higher level will remain necessary to obtain 50% MSW recycling under the single measurement method. The main reason for this is the low level of ambition in the Packaging and Packaging Waste Directive for plastic packaging recycling (22,5%).

	municipal waste composition	Targets (%)	BAU packaging recycling (%)	% recycled targets	% recycled BAU
Paper	20	60	83	12	17
Glass packaging	8	60	71	5	6
Plastic packaging	14	22,5	34	3	5
Metal packaging	6	50	72	3	4
Furniture	3,5			0	0
Textile	2,5			0	0
WEEE	3			0	0
Other dry	7			0	0
Biowaste	30			0	0
Other wet	6			0	0
sum	**100**			**23**	**31**

In this option we take over the BAU results, because the single calculation method is fully covered by the parameters for MSW fractions and it is not directly applicable to packaging waste, especially not to non-household packaging waste. Both targets are partially overlapping.

Figure 1: Overlap between MSW and packaging targets



To analyse the effect on marine litter of overlapping targets for MSW packaging (see chapter 4.2) the effect of both targets is evaluated and the target with the largest impact is taken into account. For non-packaging MSW, only the MSW targets are considered, while for the packaging fraction of industrial waste only the packaging targets are taken into account.

4.1.6.5 Option 3.1: increased MSW recycling targets

The overall MSW recycling targets will have an impact on the MSW packaging waste fraction, but too many uncertainties exist to assess this impact. It is unclear how much recycling of non-packaging MSW will contribute to reaching the increased targets and it is unclear how to distribute the impact of MSW packaging waste recycling over the total packaging waste recycling.

For option 3.1 we take over the BAU recycling performance for packaging.

As illustrated in paragraph 4.1.6.4, this will be overcome when analysing the impact on marine litter, by considering the parameter with the highest impact in case of overlap.

4.1.6.6 Option 3.2: higher packaging waste targets

The targets assessed are as outlined below. For plastic packaging we assume a 60% recycling rate for 2030, as in 2025, even though the draft legislative proposal (COM/2014/0397 final) indicates that notes that this is to be reviewed at a later stage.

	2020	2025	2030
Overall recycling/preparation for reuse	*64%*	70%	80%
Plastic packaging	45%	60%	***60%***
Non-ferrous metal packaging	85%	90%	90%
Ferrous metal packaging	*75%*	80%	90%
Glass packaging	*71%*	80%	90%
Paper/Cardboard packaging	85%	90%	90%
Wood packaging	50%	65%	80%

For overall recycling in 2020 we take over the higher BAU value of 64% instead of 60% because the actual level of recycling is already above the proposed target value and we do not assume that recycling performance will decrease. For glass we take over BAU of 71% instead of 70%, and for steel we take over 75% instead of 70%

4.1.6.7 Option 3.3: specific landfill diversion targets

As in paragraph 4.1.5.7

Compared with the landfill diversion targets (25% in 2025 and 5% in 2030), the decrease of landfill is assessed for all waste fractions at:

2020	0	%
2025	-32,21	%
2025	-52,21	%

Actual levels of landfill of packaging waste are:

landfill of packaging waste						
Packaging waste [env_waspac]						
Last update	13.02.14					
Extracted on	05.03.14					
Source of data	Eurostat					
GEO	European Union (27 countries)					
STK_FLOW	Domestic					
UNIT	Tonnes					
WST_OPER	Waste generated	Recovery		disposal	disposal %	
WASTE/TIME	2011	2011				
Packaging	80.172.092	61.973.910		18.198.182	22,70	%
Paper and cardboard packaging	31.779.682	29.083.010		2.696.672	8,49	%
Plastic packaging	14.944.821	9.478.600		5.466.221	36,58	%
Wooden packaging	12.380.655	8.375.813		4.004.842	32,35	%
Metallic packaging	4.612.009	3.360.949		1.251.060	27,13	%
Aluminium packaging	:	:				
Steel packaging	:	:				
Glass packaging	16.170.148	11.527.122		4.643.026	28,71	%
Special value:						
:	not available					

Everything not recovered is considered disposed. This can include both landfilling and incineration without energy recovery. This latter form of disposal however has become rare.

Disposal is reduced as follows: to assess the decrease for 2025 we subtract the allowed quantity of 25% from the actual disposal percentage. For 2030 we subtract the allowed percentage of 5% from the actual disposal percentage:

	disposal rate	disposal reduction		
		2020	2025	2030
Packaging	23	0	0	-18
Paper and cardboard packaging	8	0	0	-3
Plastic packaging	37	0	-12	-32
Wooden packaging	32	0	-7	-27
Metallic packaging	27	0	-2	-22
Aluminium packaging	:	:	:	:
Steel packaging	:	:	:	:

Glass packaging	29	0	-4	-24

4.1.6.8 Option 3.4: combination

The high scores of options 3.1, 3.2 and 3.3 are assessed, taking into account that recycling percentages for option 3.3 correspond to the BAU recycling rates.

	2020	2025	2030
packaging	64 %	70 %	80 %
Plastic packaging	45 %	60 %	60 %
Non-ferrous metal packaging	85 %	90 %	90 %
Ferrous metal packaging	75 %	80 %	90 %
Glass packaging	71 %	80 %	90 %
Paper/Cardboard packaging	85 %	90 %	90 %
Wood packaging	50 %	65 %	80 %

4.1.6.9 Maximum feasible scenario

The recycling performance of the three best performing Member States for the different MSW fractions is observed, and an average is taken as maximum feasible scenario. These figures are included in Table 4, for 2020, 2025 and 2030, to evaluate what the effect on marine litter would be in case the maximum feasible scenario would be reached in these years.

packaging	75 %
paper packaging	96 %
plastic packaging	61 %
metal packaging	94 %
steel packaging	91 %
alu packaging	79 %
glass packaging	96 %
wood packaging	79 %

4.1.6.10 Plastics only scenario

Option 4 for plastic packaging is taken over: 45 % recycling in 2020 and 60% from 2025 onwards.

4.2 Key marine litter types and sources

4.2.1 Methodology for detailed analysis of collected data

The analysis of the data collected to identify the key marine litter types and sources, was based on the methodology used in the Pilot Project "Case studies on the plastic cycle and its loopholes in the four European regional seas areas" (2012).

A series of properties are linked with the OSPAR categories, going beyond the traditional classification on e.g. material types of the item. The parameters are designed to facilitate the pinpointing of sources, pathways, loopholes and certain characteristics of marine litter found in the area that can indicate specific needs in terms of strategies. For the categorization of items, the OSPAR categorization (after 2009 adjustments) was used.

Parameter	Choice options	Kind of attribution
Material *(the main material of which the litter is composed)*	Plastic; Rubber; Cloth/textile; Paper/cardboard; Processed wood; Metal; Glass; Sanitary (mixed composition); Other pollutants; Ceramic/pottery; Faeces (bagged); Other	one single selection
Life cycle phase	Pre-consumer phase – industrial process phase Pre-consumer phase – transport Post-Consumer phase – waste/litter disposal by industry or private consumers Post disposal phase – waste treatment chain escapes	Attribute likelihoods (4 levels)
Use category	Packaging Use item (consumption good) Raw material Recreational item (as a specific form of use item)	one single selection
Packaging type *According to Article 3.1 Packaging and Packaging Waste Directive 1994/62/EC*	Primary – product packaging e.g. candy wraps Secondary – group packaging e.g. six-packs Tertiary – shipment packaging e.g. pallets Quaternary – service packaging e.g. shopping bags Unknown/multiple Not relevant (in case of other use categories)	one single selection
Use durability	Short life, single use Long lasting item Multiple-dose/use	one single selection
Source activity	Individual/Consumer Professional/Industrial Unknown	one single selection
Sector of origin	Fishing; Shipping; Other Maritime Industries;	Attribute

Parameter	Choice options	Kind of attribution
	Aquaculture; Coastal/Beach tourism; Recreational boating; Agriculture; Port activities; Construction & demolition; Other industrial activities; General household waste littering or fly tipping; Toilet; Dump sites/ landfills; Waste collection/transport	likelihoods (6 levels)
Main origin	Sea-based Land-based	Attribute likelihoods (4 levels)
Release	Intentional, including negligence Accidental	Attribute likelihoods (4 levels)
Pathways	Direct (on site dumping) Diffuse (sewage) Diffuse (inland waterways and *rieras*) Diffuse (others)	Attribute likelihoods (4 levels)
Geography of origin	*In situ* generation Local (short distance) Long distance or transnational	Attribute likelihoods (4 levels)
Fragmenting	Early (will fragment in decades) Late (will fragment in centuries)	one single selection
Risk/impact	Ingestion; Entanglement; Maritime safety; Beach-use safety; Aesthetics; Invasive species; Toxic	Multiple selection

4.2.1.1 Likelihood approach

Several monitoring or beach clean-up programs have defined “item-indicators” to assess the contribution of different sources (e.g. OSPAR, clean-up campaigns from the Marine Conservation Society (MCS)). While some items are straight forwardly related to specific sectors (e.g. fishing gear) most marine litter items can originate from multiple-sources and usually some of the categories of source indicator items are very broad (e.g. “public litter” or “tourism/recreation”, used by MCS and OSPAR, respectively). For this study, we applied and adapted the Matrix Score Technique (Tudor & Williams, 2004), which allocates different levels of likelihoods of each litter category to potential sources. The likelihoods are then given a score and the relative contribution of the different sources calculated. This method allows for the possibility of specific item types originating from more than one source; this flexibility and transparency means that it is less prescriptive than some other methods.

The attribution of likelihoods was made based on the type of litter, distance from each source, dimension of the activity in the area and potential deficiencies that can lead to input of marine litter, waste management practices and any other local factor that is known to affect litter contribution. Unlike the pilot study, in which regional workshops with key stakeholders for each site discussed and defined likelihoods for the top marine litter items found in the area, the general approach in this case used predefined standard likelihoods for each regional sea, heavily based on extrapolations from the Pilot Study.

This general approach does have some drawbacks. The attribution of likelihoods depends very closely to the type, intensity and loopholes associated with the activities in the area. Even within one single country, the typologies of marine litter can be very distinct. With this in mind, the extrapolation of the likelihoods, attributed in the Pilot Project "Case studies on the plastic cycle and its loopholes in the four European regional seas areas" (2012), has been done very conservatively to avoid overestimating uncertain contributions and conclusions regarding these estimations should be done cautiously.

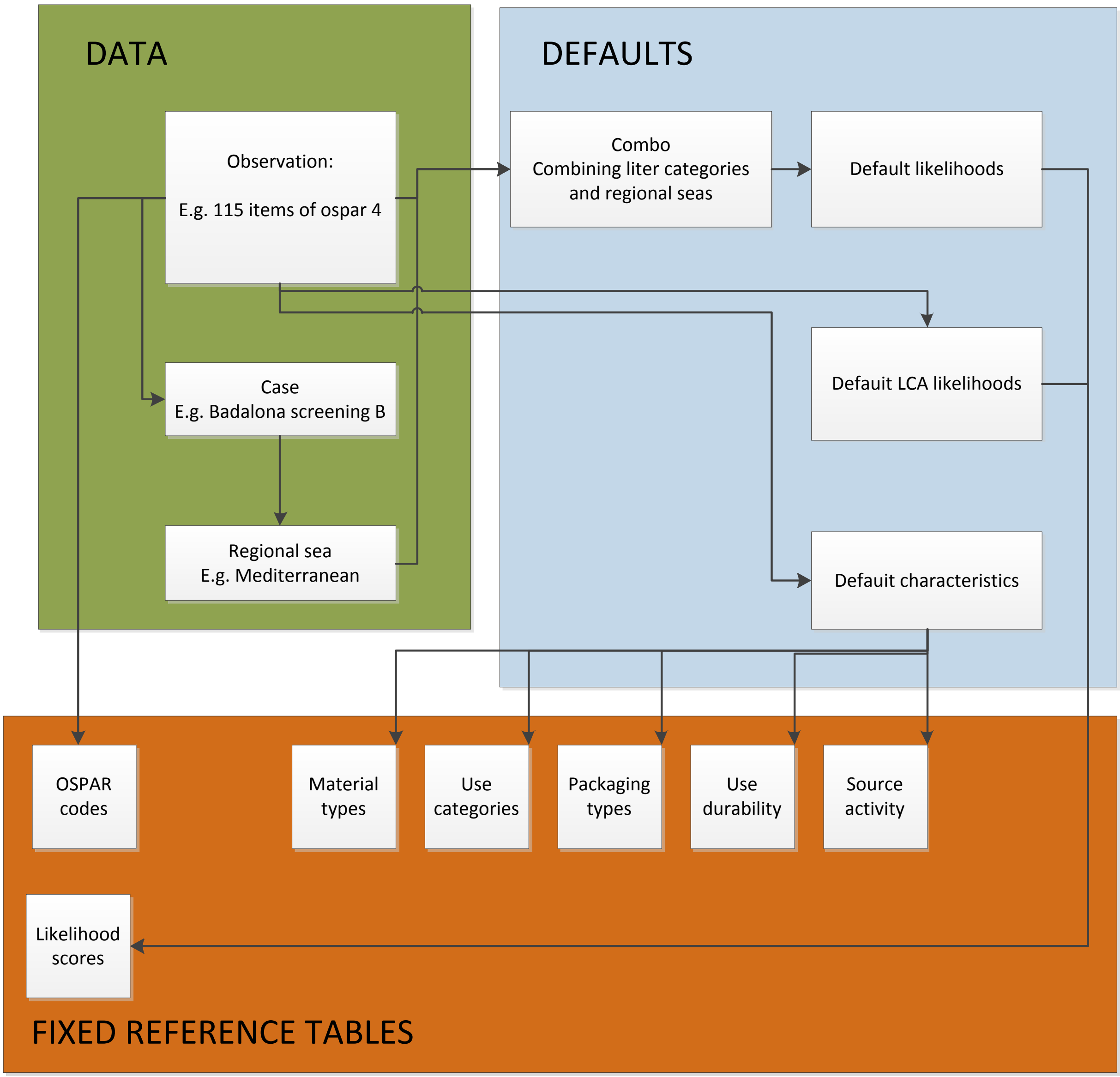
4.2.1.2 Detailed Access Analysis

After a consistency and quality revision, all data-sets of marine litter were converted to a specifically developed Microsoft Access application for detailed analysis. The application facilitates the analysis of possible outstanding relations, trends and similarities or differences between the four regional seas.

The database structure starts from the individual observation of marine litter categories. It is identified by referring to its OSPAR identification code, to the case and to the data source in which it is found. Quantitative data on the number of observations for this category are added.

Two kinds of links are connected with this observation:

- Straight one-to-one links on specific characteristics and parameters linked to the observation; e.g. the nature of the material
- Likelihoods; the observed or analysed chance that the category is linked to a specific parameter such as a source, sector, etc.



The Access application uses SQL queries to find answers to following and comparable questions:

- What are the predominant categories of marine litter observed in a regional sea? What is the predominant material?
- Taking into account the identified likelihoods and the observed frequencies of occurrence, what are the major sectors contributing to the marine litter?
- Do the key sectors differ when comparing across regional seas?
- Taking into account the identified likelihoods and the observed frequencies of occurrence, what are the predominant pathways? For which litter categories?
- What is the balance between fly tipping/deliberate dumping, and accidental losses/escapes from waste collection cycles?
- What is the balance between pre-consumer and post-consumer marine litter?
- What is the balance between waste from offshore/shipping sources and land-based sources?

- What is the balance between industrial origin and private/consumer origin? What are the predominant life-cycle-phases in the material streams in which marine litter originates?

Likelihoods are scored using the methodology described in Tudor D.T., Williams A., (2004). The likelihood level used for each parameter can be found in Table 7. The effective likelihoods are given in Annex 3.

Table 7: Likelihood levels and score values.

likelihood levels		
likelihood level description	**likelihood level percentage range**	**score value**
6 level codes		
Very likely	parameter attribution is almost certain ~100%	16,00
Likely	parameter attribution high >70% chance	4,00
Possible	parameter attribution is more or less 30%-70% chance	2,00
Unlikely	parameter attribution low	1,00
Very unlikely	parameter attribution is very unlikely	0,25
Not to be considered	parameter attribution is extremely unlikely or impossible ; ~0% chance	0,00
4 level codes		
Likely	4 level code ; parameter attribution high chance 70% to 100% chance	4,00
Possible	4 level code ; parameter attribution is more of less chance 30%-70% chance	2,00
Unlikely	4 level code ; parameter attribution low chance	0,25
Not to be considered	4 level code ; parameter attribution is extremely unlikely or impossible; ~0% chance	0,00

We use a more detailed six level range of likelihood levels and a more generalist four level range. For some aspects of parameters applying the six level range would be not feasible while the four level range is still manageable without too broad and uncertain interpretation.

4.2.1.3 Extrapolation of regional figures to EU level

Because of the differences between regional seas, and because of the unequal spread of available data-sets in the four regional seas, we always made analyses at the level of a regional sea. When EU-wide data are needed, we used these data to extrapolate. This is possible by taking into account the lengths of the coast lines of the different regional seas as a weighing factor. It is important to note that the regional sea named ‘North Sea’ is considered to be the combination of the North Sea and the North-East Atlantic Ocean, for which the countries Portugal, Spain, France, Belgium, Netherlands, Germany, UK, Denmark and Sweden are included. The wording “North sea” throughout this report should be considered a pars pro toto for the North-East Atlantic.

Table 8: Coast line lengths per regional sea, based on Figure 2.

	Km	Share of

		coastline
Baltic Sea	13.456	27%
Mediterranean Sea	16.628	33%
North Sea	19.885	39%
Black Sea	631	1%
Total coast line	50.600	100%

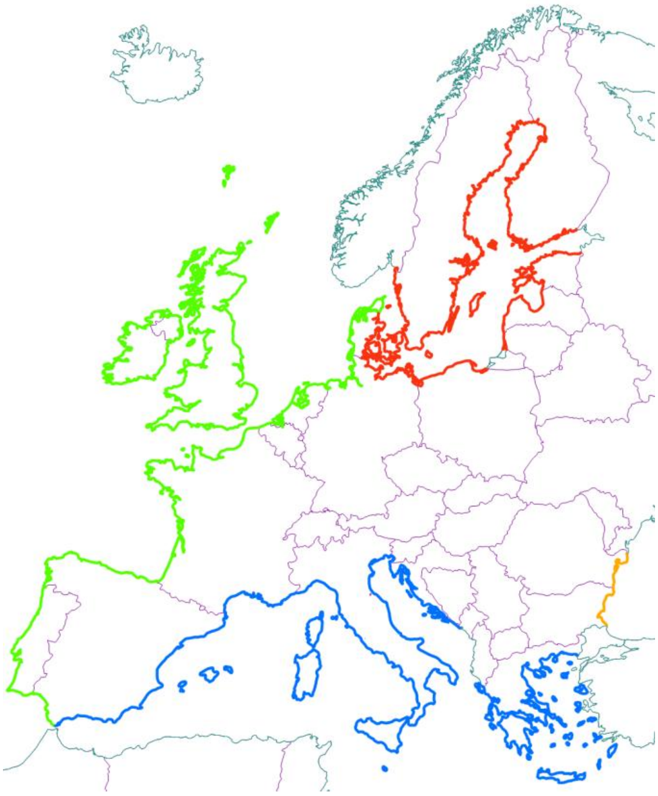


Figure 2: Coast lines of the different regional seas within the European territory.

Only coastlines of countries within the EU territory were chosen, since the reduction target only focuses on measures for reduction of marine litter in European countries and the detailed analysis of the surveys demonstrates that on-site generation/disposal and short distance transportation of the marine litter found on beaches is most prevalent. It is estimated that between 53% (North Sea) and 93% (Black Sea) of beach litter originates from land-based activities and only 2% (Black sea) to 27% (North Sea) of the beach litter items are likely to be transported over a long distance. Hence, as with marine litter more broadly, beach litter is primarily a regional matter.

To calculate the overall figures of the four seas for the material type, use category and source activity (no likelihoods used), the following methodology was applied:

- The number of items per 100 m found was registered in the data sets, with the items classified in only one category of the parameter, and reported per regional sea;

- The average number of items per 100 m in each category was calculated for each regional sea by dividing the total number of items found in a category per regional sea by the number of surveys per regional sea.
- The lengths of the coast lines of each regional sea were determined, based on Figure 2, and were used to extrapolate the number of items found on a stretch of 100 m to the total number of items that would be found all over the coast line stretch of each regional sea. In this case, it was assumed that the number of surveys per regional sea was high enough to be representative for the different coast line sections. For the Mediterranean Sea (33 samples) and the Black Sea (7 samples), the actual amount of surveys is rather low, so in the future, a higher number of surveys would increase the correctness of the data.
- Based on these total estimated amounts of items, overall proportions for parameters like material type, use category (packaging, raw material, use item, recreational item) and source activity (consumer, industrial, unknown) were calculated.

4.2.2 Top 15 beach litter items per regional sea

The top fifteen beach litter items for each regional sea were determined, based on the quantities (not the weights) of the items reported in the OSPAR screenings. The beach screening is based on counting items on a strip of 100 meter, and not on weighing these items. In this way the figures are not distorted by the presence of a few heavy items. However, this does risk over-representing smaller or fragmented items.

4.2.2.1 Baltic Sea

Top fifteen beach litter items

The top fifteen items for the Baltic Sea are reported in Table 9 and Figure 3 and account for 73% of the total number of beach litter items reported in the 152 OSPAR screenings. Plastic pieces with seizes between 2,5 cm and 50 are the dominant fraction (24%) having an average frequency of 34 items per 100 m coast line, followed by cigarette butts (10%) and other items such as plastic bottle caps/lids (5%), foam sponges (5%), ceramic/pottery items (5%) and plastic (shopping) bags (4%).

Table 9: Top fifteen beach litter items for the Baltic Sea and their share and average frequency per 100m coast line, based on 152 OSPAR screenings.

OSPAR code	Description	average # /100m	Share
46	Plastic/polystyrene pieces 2.5 cm > < 50cm (total)	34	24%
64	Cigarette butts	14	10%
15	Caps/lids (total)	7	5%
45	Foam sponge (total)	7	5%
96	Other ceramic/pottery items	7	5%
2	Bags (e.g. shopping)	5	4%
6	Food incl. fast food containers	4	3%
77	Bottle caps	4	3%
22	Cutlery/trays/straws (total)	3	2%
70	Wood Crates	3	2%
19	Crisp/sweet packets and lolly sticks (total)	3	2%
65	Cups	3	2%
31	Rope (diameter more than 1 cm)	3	2%
59	Other textiles	2	2%
67	Other paper items	2	2%
Total		102	**73%**

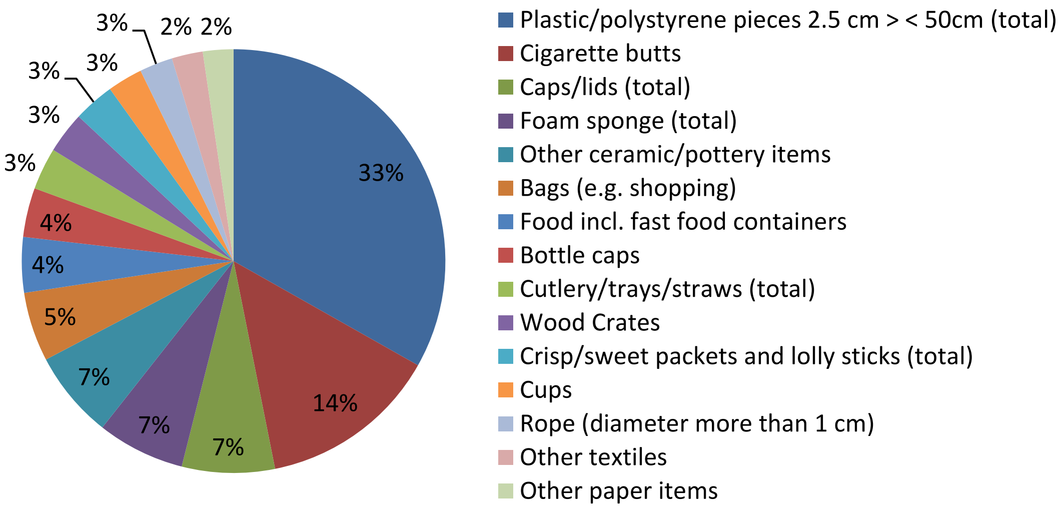


Figure 3: Top fifteen beach litter items for the Baltic Sea, based on 152 OSPAR screenings.

4.2.2.2 Black Sea

The top fifteen beach litter items for the Black Sea are reported in Table 10 and Figure 4 and account for 86 % of the total number of beach litter items reported in the 7 OSPAR screenings. Cigarette butts are the dominant fraction (36 %) having an average frequency of 326 items per 100m coast line, followed by crisp/sweet packets and lolly sticks (9 %) and drink bottles (9%) and other items as plastic pieces (6 %), plastic caps/lids (5%), drink cans (5 %), etc.

Table 10: Top fifteen beach litter items for the Black Sea and their share and average frequency per 100m coast line, based on 7 OSPAR screenings.

OSPAR code	Description	Average # /100m	Share
64	Cigarette butts	326	36%
19	Crisp/sweet packets and lolly sticks (total)	86	9%
4	Drink bottles (total)	85	9%
46	Plastic/polystyrene pieces 2.5 cm > < 50cm (total)	57	6%
15	Caps/lids (total)	49	5%
78	Drink cans	44	5%
3	Small plastic bags, e.g., freezer bags	31	3%
93	Other glass items	26	3%
53	Other rubber pieces	16	2%
6	Food incl. fast food containers	12	1%
21	Cups	12	1%
54	Clothing	11	1%
77	Bottle caps	10	1%
81	Foil wrappers	10	1%
22	Cutlery/trays/straws (total)	9	1%
Total		784	**86%**

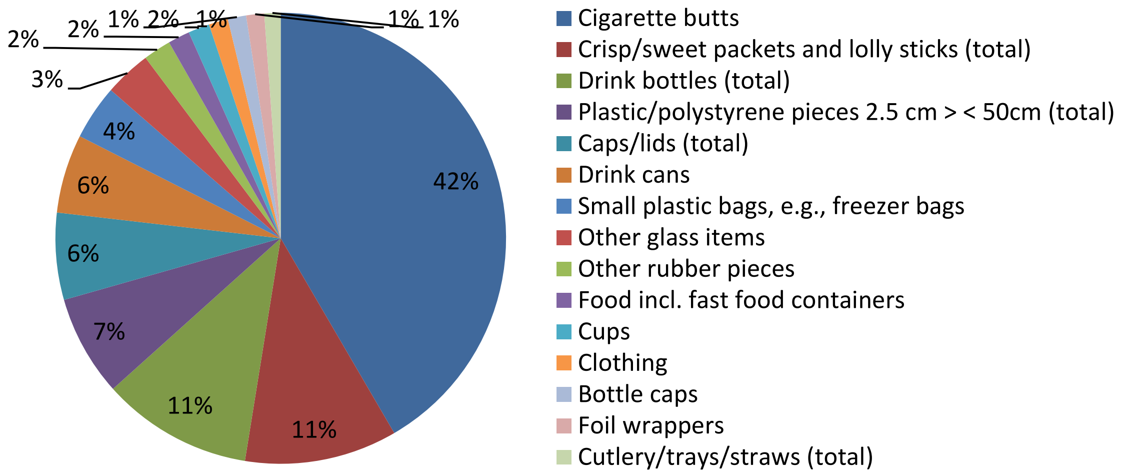


Figure 4: Top fifteen beach litter items for the Black Sea, based on 7 OSPAR screenings.

4.2.2.3 Mediterranean Sea

The top fifteen beach litter items for the Mediterranean Sea are reported in Table 11 and Figure 5 and account for 89% of the total number of beach litter items reported in the 33 OSPAR screenings. Plastic cutlery/trays/straws are the dominant fraction (17%) with an average frequency of 131 items per 100m, followed by cigarette butts (14%), plastic caps/lids (14%) and plastic drink bottles (12%).

Table 11: Top fifteen beach litter items for the Mediterranean Sea and their share and average frequency per 100m coast line, based on 33 OSPAR screenings.

OSPAR code	Description	Average # /100m	Share
22	Cutlery/trays/straws (total)	131	17%
64	Cigarette butts	112	14%
15	Caps/lids (total)	110	14%
4	Drink bottles (total)	91	12%
2	Bags (e.g. shopping)	43	5%
98	Cotton bud sticks	37	5%
60	Bags	35	4%
46	Plastic/polystyrene pieces 2.5 cm > < 50cm (total)	30	4%
91	Bottles	28	4%
19	Crisp/sweet packets and lolly sticks (total)	26	3%
6	Food incl. fast food containers	15	2%
63	Cigarette packets	12	2%
16	Cigarette lighters	11	1%
78	Drink cans	11	1%
102	Other sanitary items	9	1%
Total		701	**89%**

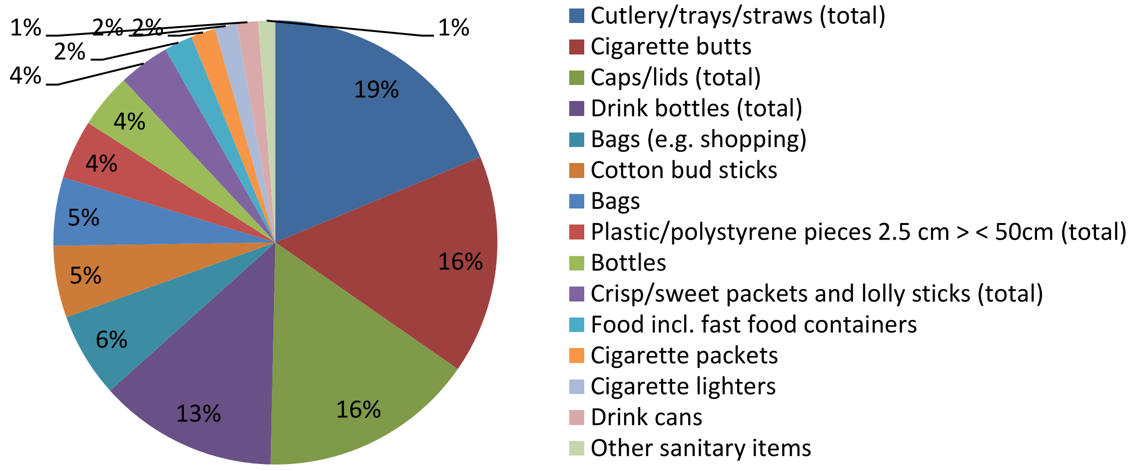


Figure 5: Top fifteen beach litter items for the Mediterranean Sea, based on 33 OSPAR screenings.

4.2.2.4 North Sea

The top fifteen beach litter items for the North Sea are reported in Table 12 and Figure 6 and account for 80% of the total number of beach litter items reported in the 151 OSPAR screenings. Plastic/polystyrene pieces, small (18%) and medium (14%) size are the dominant fraction, followed by string and cord items (12%) and plastic caps/lids (7%).

Table 12: Top fifteen beach litter items for the North Sea and their share and average frequency per 100m coast line based on 151 OSPAR screenings.

OSPAR code	Description	Average # /100m	Share
46	Plastic/polystyrene pieces 2.5 cm > < 50cm (total)	104	18%
117	plastic/polystyrene pieces 0-2,5 cm	81	14%
32	String and cord (diameter less than 1 cm)	68	12%
15	Caps/lids (total)	43	7%
59	Other textiles	26	4%
98	Cotton bud sticks	25	4%
19	Crisp/sweet packets and lolly sticks (total)	23	4%
31	Rope (diameter more than 1 cm)	20	3%
115	Nets and pieces of net < 50 cm	19	3%
6	Food incl. fast food containers	11	2%
4	Drink bottles (total)	10	2%
3	Small plastic bags, e.g., freezer bags	10	2%
64	Cigarette butts	9	2%
40	Industrial packaging, plastic sheeting	8	1%
45	Foam sponge (total)	8	1%
Total		466	**80%**

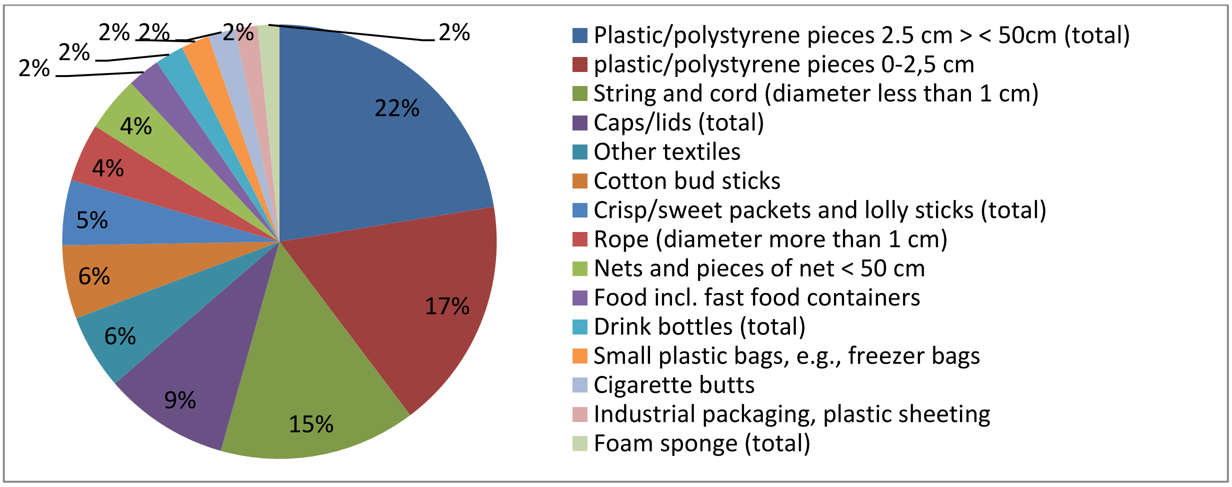


Figure 6: Top fifteen beach litter items for the North Sea, based on 151 OSPAR screenings.

4.2.3 Litter figures for the four regional seas

A detailed analysis on each regional sea is included in Annex 4

4.2.3.1 Litter composition – material type

Across the four regional seas, plastic is the most dominant fraction of the beach litter observed (69%)[14], followed by paper and cardboard (13%) and sanitary waste (6%).

[14] If sanitary waste (cotton bud sticks mainly made of plastic) is included this could rise to 75%. Other sources mention up to 80% plastics.

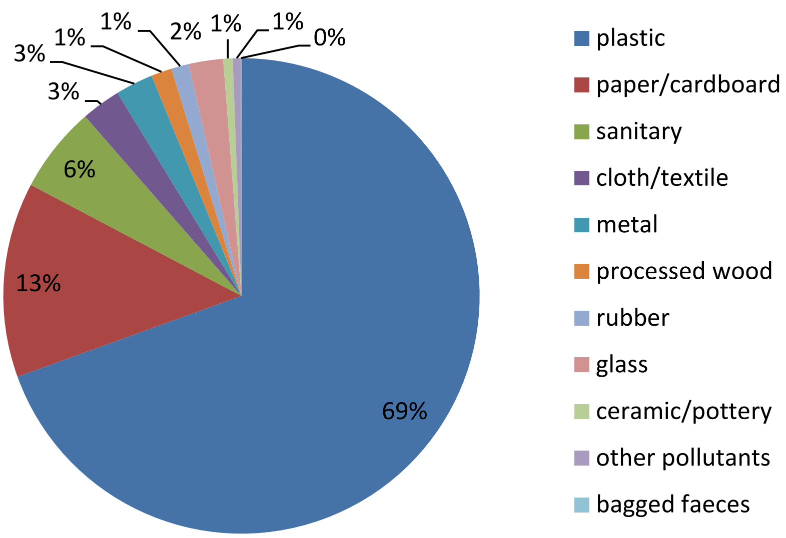


Figure 7: Overall beach litter composition of the four European regional seas.

The plastic fraction amounts for 42% (Black Sea) to 80% (North Sea) of the total beach litter items, while the paper and cardboard fraction accounts for between 2% (North Sea) and 38% (Black Sea).

The high fraction of plastic in the North Sea consists of large amounts of professional use items (plastic cords and strings, plastic pieces and pellets), while the plastic fraction in the Black Sea mainly consists of consumer packaging items like crisp/sweet packets, drink bottles, plastic pieces, caps/lids and bags.

The relatively high paper and cardboard fraction in the Black Sea (38%) and Mediterranean Sea (22%) is mainly due to the high amount of cigarette butts which are considered as paper in the categorization used by OSPAR. Cigarettes are however a complex composite product, containing a.o. a lot of plastics.

4.2.3.2 Litter sources

Industrial/Municipal solid waste

The overall proportion of municipal waste in beach marine litter of the European regional seas accounts for 63%, while industrial waste accounts for 20%. 17% could not be assigned to industrial or consumption activities and thus remains unknown.

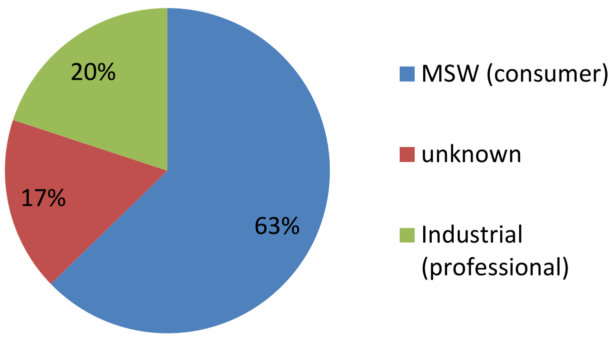


Figure 8: Overall proportions of municipal waste and industrial waste in beach litter items of the four European regional seas.

Packaging Material

Packaging items of beach litter are mainly made of plastic, whether they are municipal (consumer) waste (83%) or industrial waste (84%). Municipal packaging waste also consists of paper and cardboard (7%), glass (4%) and metal (4%) waste, while industrial waste also consists processed wood (10%) and paper and cardboard (4%) waste.

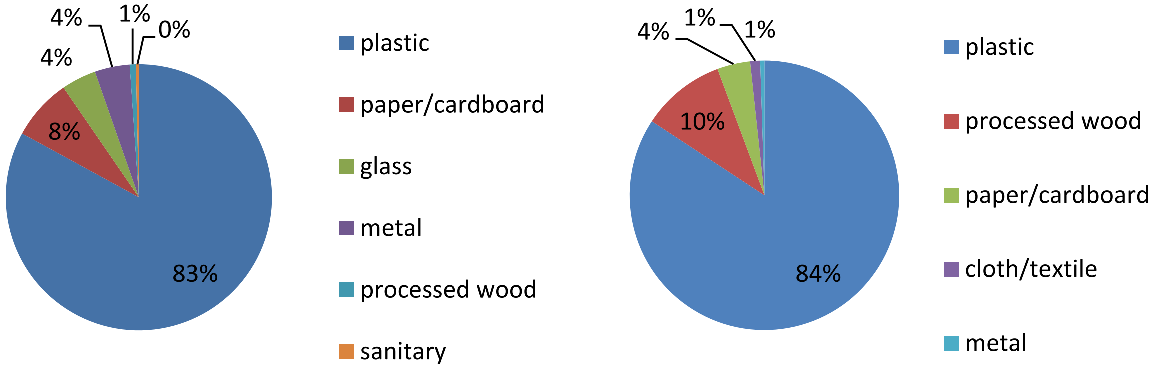


Figure 9: Packaging material in municipal beach litter items (left) and industrial beach litter items (right).

MSW material

Specifically for municipal beach litter items across the four regional seas, the main material type is plastic (61%), followed by paper and cardboard (21%), metal (3%), glass (3%) and other (12%).

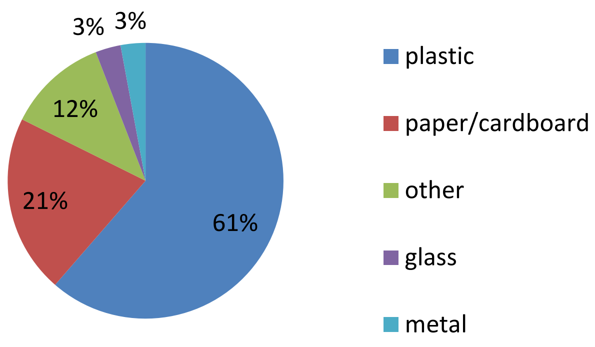


Figure 10: Material types of municipal beach litter items found on the beaches of the four regional seas.

4.3 Impact of waste scenarios on marine litter

In this chapter we link the outcome of the analysis of OSPAR beach litter screenings, and the identification of key characteristics and key sources, to the indicator values for each of the waste management scenarios outlined in the Commission's Impact Assessment. The goal is to obtain a single marine litter inflow decrease indicator, expressed as a percentage, for each scenario.

Please note: we always assess the amount of new litter inflow, discounting the impact of accumulation which may influence the figures of beach litter items found.

Calculations are made in excel files, in Annex 5 and Annex 6 to this report.

4.3.1 Business-as-usual scenario.

- We assume an increase of MSW generation:

year	Million tonnes MSW	Increase from 2015
2010	255	Not applicable
2015	263	0
2020	270	2,9%
2025	276	5,2%
2030	280	6,7%

This is based on Eunomia data, as explained in paragraph 4.1.2.

- We assess an increase of industrial waste generation, according to a decoupling factor of 0,59 and a yearly growth rate of 1,89%. There are no similar assumptions made by Eunomia, as the scope of their analysis is limited to municipal waste. See paragraph 4.1.3.2. For the timespan 2015-(2020, 2025, 2030) the increase of industrial waste generation is considered not to depend on demography but solely on economic (GDP) growth and decoupling. GDP data are EUROSTAT data at current market prices by NUTS 2 regions [nama_r_e2gdp] linearly extrapolated.

increase 2015-2020	9,83%
increase 2015-2025	20,63%

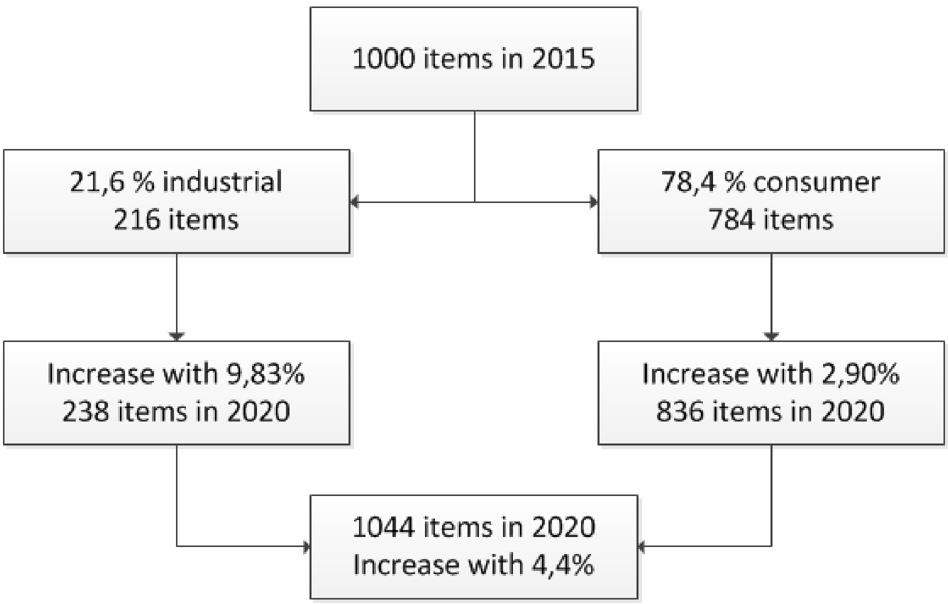
increase 2015-2030	32,50%

- In the business as usual scenario recycling performances and levels of landfilling remain unaltered.
- Marine litter inflow (excluding accumulation) is assumed to be correlated in a linear way to waste generation.
- Based on the analysis in chapter 4.2, we divide the litter items according to whether they are of consumer or industrial origin as per the table below. We know the balance between consumer and industrial for those items where the distinction could easily be observed. We recalculated the number of items where the origin is unclear or unknown using this same balance:

ratio	baltic	black	med	north		baltic	black	med	north
consumer (MSW)	48,24%	82,12%	91,43%	32,62%		58,19%	86,67%	94,24%	54,09%
industrial	34,66%	12,64%	5,58%	27,68%		41,81%	13,33%	5,76%	45,91%
unknown	17,11%	5,25%	2,99%	39,70%					
						100,00%	100,00%	100,00%	100,00%

- Taking into account the EU-beach length for each of the regional seas, we assess the distribution between industrial and consumer for the whole of the EU as: 78,37% consumer origin, 21,63% industrial origin.

For 1000 marine litter items found in 2015, we calculate that 1044 items may be found in 2020 under application of the business as usual scenario, and thus that marine litter inflow will increase by 4,4%. For 2025 this is an increase of 8,5% and for 2030 this is 12,3%



Conclusion: under the business as usual scenario marine litter inflow tends to increase by

4,4% in 2020 compared to 2015.

8,5% in 2025 compared to 2015

12,3% in 2030 compared to 2015

4.3.2 Option 1: Full compliance

- We assume the same increase of MSW and of industrial waste as in the business-as-usual scenario. We also assume the same decoupling and the same ratio between municipal and industrial marine litter.
- The overall recycling performance of MSW increases from 24,43% to 35%, which means that the non-recycled fraction, which is a potential source of marine litter, decreases by about 14%. We assume that all waste going to recycling will never be a source for marine litter.
- The increased recycling performance of MSW fractions is assessed in paragraph 4.1.5.3. This leads to a decreased marine litter source for these fractions

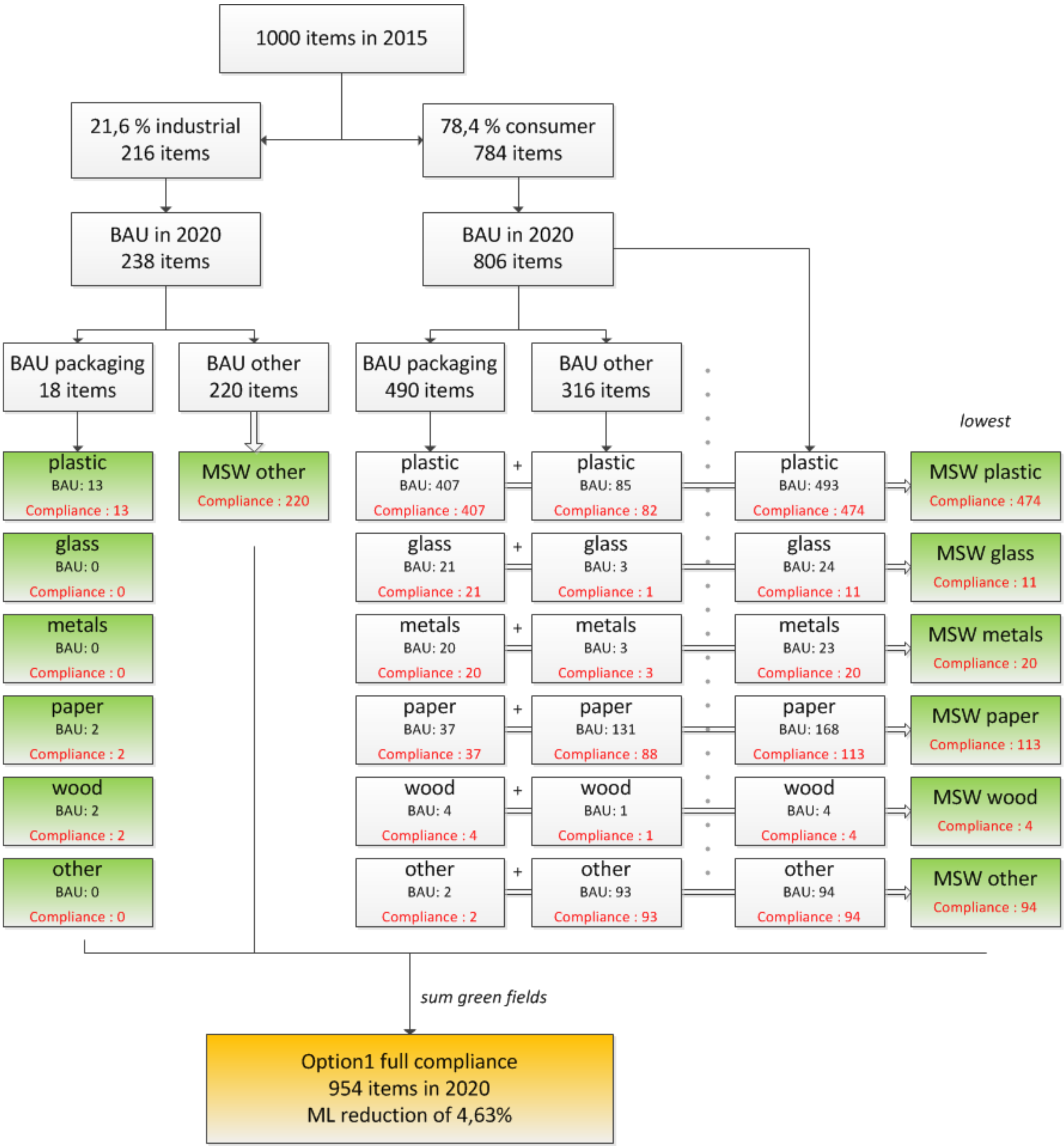
recycling rate MSW fractions

	2015	Compliant
plastic	7,1	10,6
glass	52,8	78,4
metals	24,5	36,4
paper	40,5	60,1

Rate of non-recycled material, ML source			decrease	decrease %	
Plastic	92,9	89,4	3,5	3,7	%
glass	47,2	21,6	25,6	54,2	%
metals	75,5	63,6	11,9	15,7	%
paper	59,5	39,9	19,6	33,0	%
			wood	0	%
			other	0	%

- We assess, based on the beach litter data-sets, that 60,8% of the total number of marine litter items from consumer sources is made up of packaging items, with 7,4% of the total number of items from industrial or non-consumer sources being made up of packaging items.
- For litter from consumers (MSW) we assess the degree to which complying with the actual standards leads to a reduction of the source of marine litter (i.e. the non-recycled fraction). We evaluate the MSW recycling targets on the basis of the total number of items generated as well as the packaging recycling targets on basis of the number of MSW packaging items generated. Both targets are partially overlapping, and both have to be complied with: we take into account the outcome with the highest reduction.
- We observe that full compliance with packaging recycling targets (but nothing more) leads to lower recycling performance than actually is the case today. We assume however that recycling percentages already attained will not decrease in this scenario.
- For litter from industry, litter other than MSW, we evaluate the effect of the targets on the industrial packaging fraction.
- We calculate the 'business as usual' number of marine litter items in 2020, 2025 and 2030, when assuming that in 2015 there are 1000 items. We subtract from this figure the effects of targets leading to a reduction of the litter source, as

calculated above, and we assess the possible marine litter reduction in the full compliance scenario.



Take care: Figures in this scheme are rounded. Sums are in line with the real, non-rounded values

Conclusion: under the full compliance scenario marine litter inflow tends to decrease by 4,6% in 2020 compared to 2015.

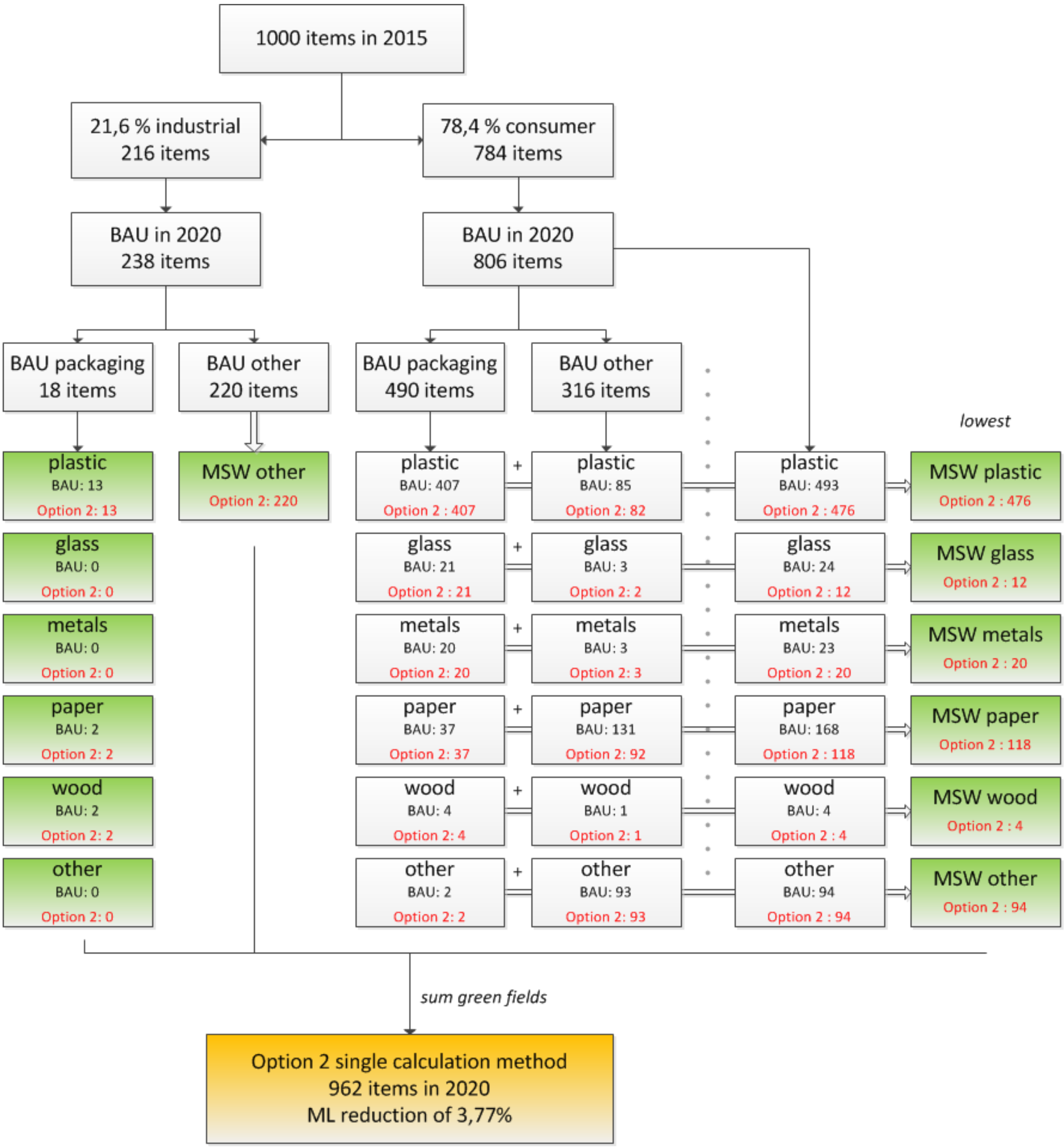
decrease by 0,7% in 2025 compared to 2015.

increase by 2,97% in 2030 compared to 2015.

4.3.3 Option 2: single calculation method

- We assume the same increase of MSW and of industrial waste as in the business-as-usual scenario, as well as the same decoupling rate and the same ratio between municipal and industrial marine litter.

- In this scenario we assume 50% overall recycling for municipal waste, with reassessed recycling performances for the different MSW fractions, as in paragraph 4.1.5.5.
- Concerning packaging waste recycling we assume full compliance with the existing targets, as in option 1. All other parameters are the same as in option 1.



Take care: Figures in this scheme are rounded. Sums are in line with the real, non-rounded values

Conclusion: under option 2 single calculation method marine litter inflow tends to

decrease by 3,8% in 2020 compared to 2015.

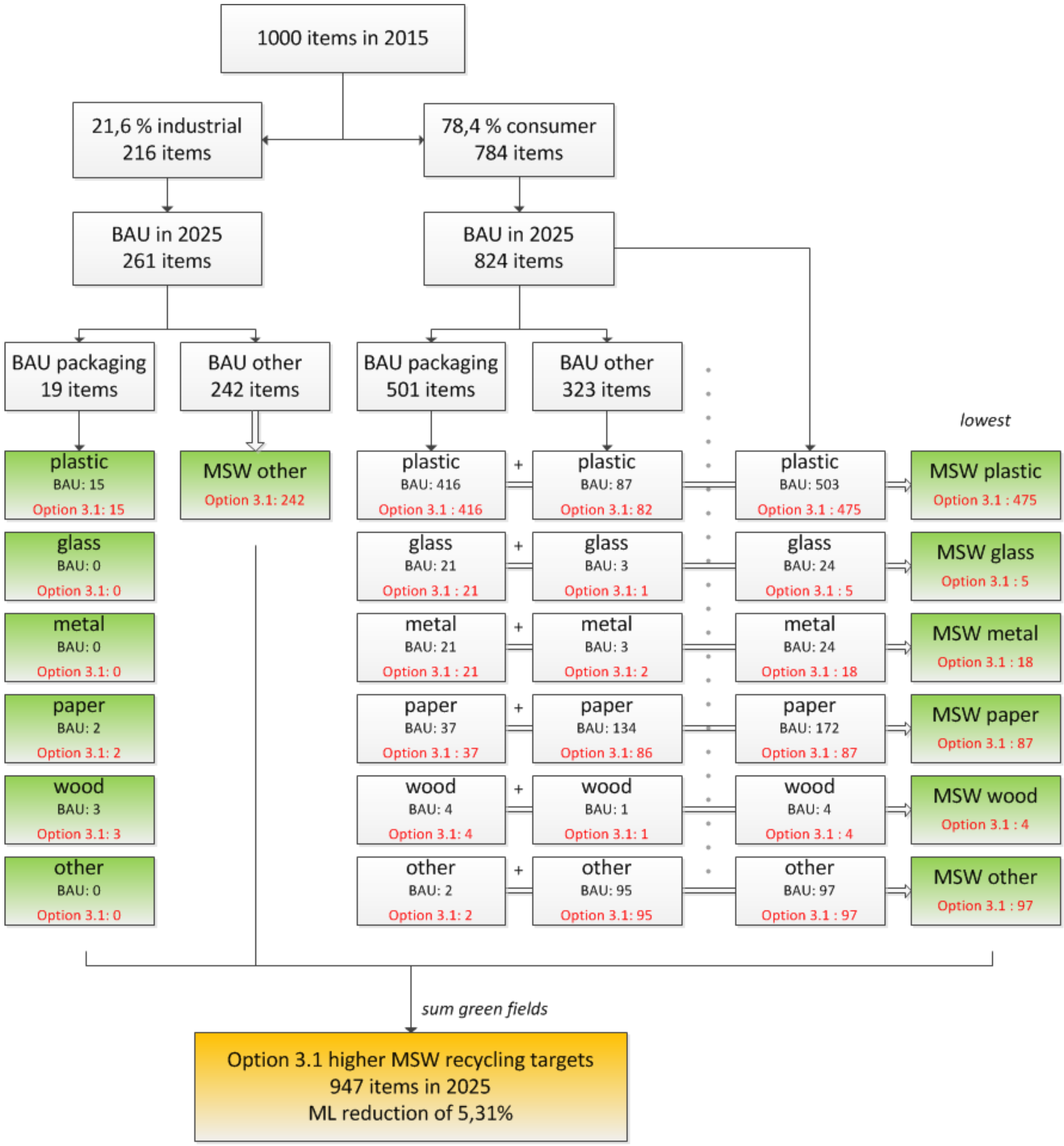
increase by 0,2% in 2025 compared to 2015.

increase by 3,8% in 2030 compared to 2015.

This option 2 scores slightly less than option 1, regarding marine litter inflow. This is because 50% recycling of MSW can be reached without 50% recycling of plastic waste, and plastic is by far the dominant material in marine litter.

4.3.4 Option 3.1: higher municipal waste recycling targets

- We assume the same increase of MSW and of industrial waste as in the business-as-usual scenario, as well as the same decoupling rate and the same ratio between municipal and industrial marine litter.
- MSW as a whole reaches 35% recycling in 2020, as in option 1, with four measurement methods. In 2025 (high option) and 2030 recycling levels are defined at 60% and 70%, using the single measurement method.
- The recycling performance of MSW fractions are assessed in paragraph 4.1.5.5. Based on these figures the decrease of non-recycled waste and the related decrease of marine litter sources are assessed.
- Other parameters are as in option 2.



Take care: Figures in this scheme are rounded. Sums are in line with the real, non-rounded values.

The graphic above represents the analysis on 2025, unlike previous graphics, because a distinction with option 1 needs to be illustrated.

Conclusion: under option 3.1 higher MSW recycling targets marine litter inflow tends to

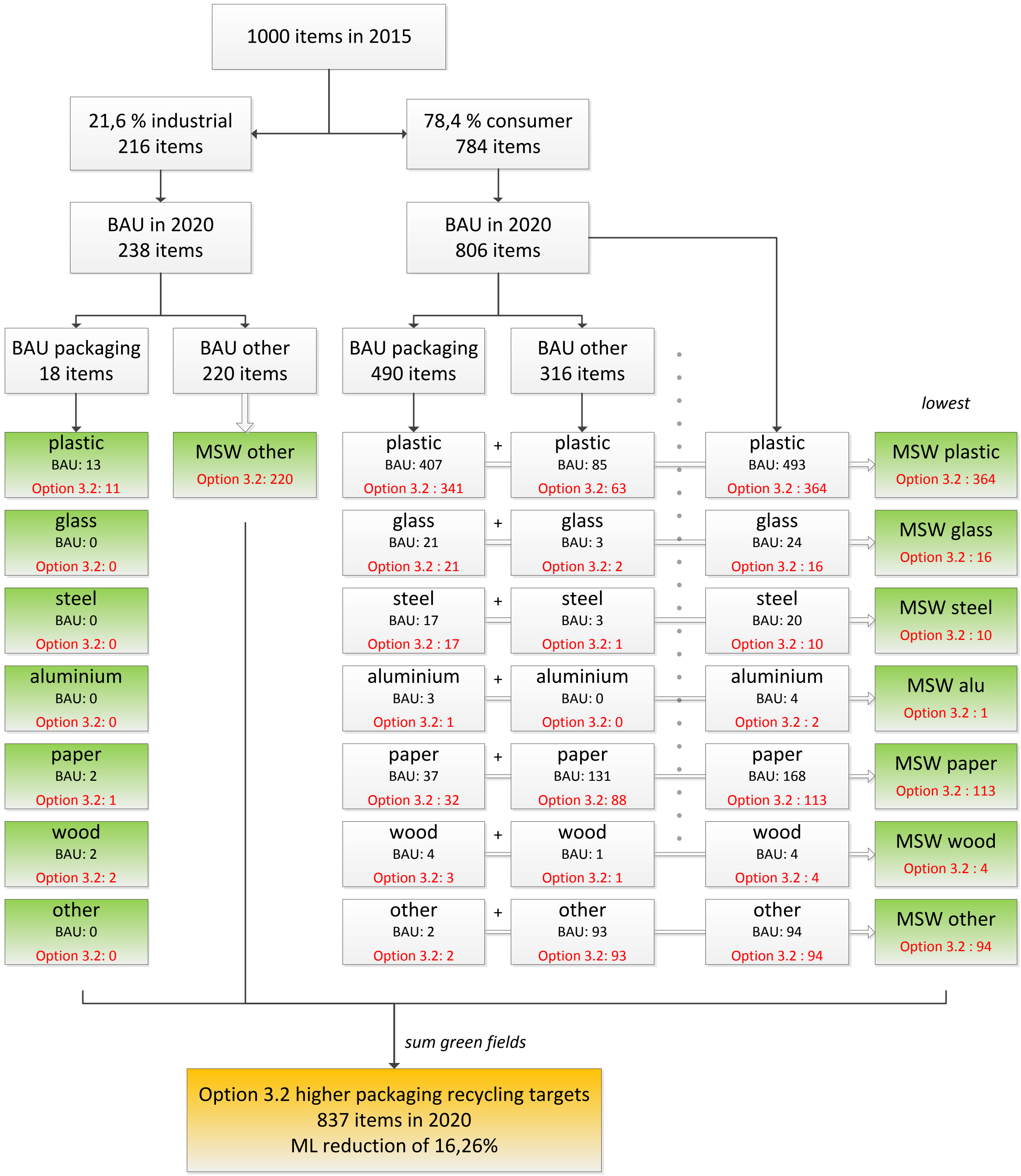
decrease by 4,6% in 2020 compared to 2015.

decrease by 5,3% in 2025 compared to 2015.

decrease by 7,4% in 2030 compared to 2015.

4.3.5 Option 3.2: higher packaging waste targets

- We assume the same increase of MSW and of industrial waste as in the business-as-usual scenario, as well as the same decoupling rate and the same ratio between municipal and industrial marine litter.
- MSW recycling targets are as in option 2.
- Packaging waste targets are as set out in the Commission's Impact Assessment.
- Data on metal are converted into data on steel and data on aluminium and other non-ferrous metals. We use the ratio between steel and non-ferrous metal as reported for packaging (both for generation and recycling) and assume that this ratio is also valid for non-packaging metal municipal waste.
- No detailed data on metal marine litter is available from the OSPAR screenings; we assume that in marine litter the same ratio between steel packaging and aluminium packaging occurs as in the general waste statistics.
- The illustration below on 2025 shows a.o. how the competing targets for MSW fractions and for packaging lead to different outcomes, the lowest of which is selected.



Take care: Figures in this scheme are rounded. Sums are in line with the real, non-rounded values

Conclusion: under option 3.2 higher packaging recycling targets marine litter inflow tends to

decrease by 16,3% in 2020 compared to 2015.

decrease by 20,9% in 2025 compared to 2015.

decrease by 18,4% in 2030 compared to 2015.

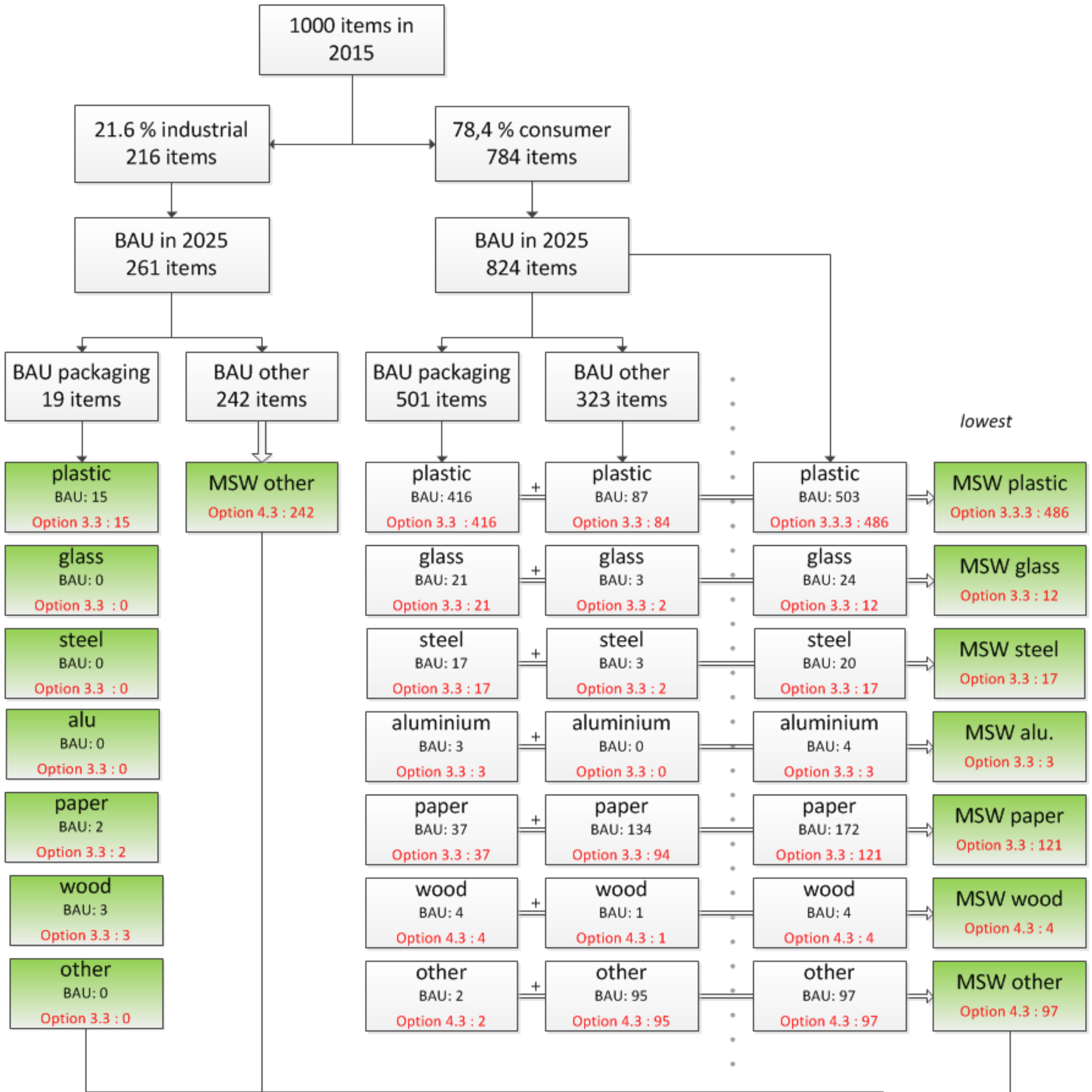
4.3.6 Option 3.3 limiting landfill

- We assume the same increase of MSW and of industrial waste as in the business-as-usual scenario, as well as the same decoupling rate and the same ratio between municipal and industrial marine litter.
- MSW recycling targets and packaging recycling targets are as in option 2
- Based on the OSPAR screenings we identified an average probability of 6,35% of marine litter sourcing from landfill and from waste collection and treatment. Landfill is a minor source for marine litter.

Baltic sea	Black sea	Mediterranean sea	North sea
8,11%	7,36%	8,58%	5,42%

- We compare actual landfill for the different fractions and assess what reduction occurs when the targets for 2025 and 2030 are applied. This reduction is applied on the 6,35% of landfill related marine litter, resulting in a reduction factor. We apply this reduction factor at the end of the calculation, on the assessed numbers of marine litter items for each of these fractions.

		landfill reduction due to landfill diversion		
	landfill BAU	2020	2025	2030
MSW plastics	57,21	0	-32,21	-52,21
MSW glass	57,21	0	-32,21	-52,21
MSW metals	57,21	0	-32,21	-52,21
MSW paper	57,21	0	-32,21	-52,21
MSW wood	57,21	0	0,00	-52,21
packaging plastics	22,70	0	-11,58	-31,58
packaging glass	28,71	0	-3,71	-23,71
packaging steel	27,13	0	-2,13	-22,13
packaging aluminium	27,13	0	-2,13	-22,13
packaging paper	8,49	0	0,00	-3,49
packaging wood	32,35	0	0,00	-27,35



	items	Reduction factor	Reduction
items MSW plastic non packaging	84	-0,0117	-1,0
items MSW glass non packaging	2	-0,0117	0,0
items MSW steel non packaging	2	-0,0117	0,0
items MSW aluminium non packaging	0	-0,0117	0,0
items MSW paper non packaging	94	-0,0117	-1,1
items MSW wood non packaging	1	0,0000	0,0
items MSW other non packaging	95	0,0000	0,0
items MSW plastic packaging	416	-0,0117	-4,9
items MSW glass packaging	21	-0,0117	-0,2
items MSW steel packaging	18	-0,0117	-0,2
items MSW aluminium packaging	3	-0,0117	0,0
items MSW paper packaging	38	-0,0117	-0,4
items MSW wood packaging	4	0,0000	0,0
items MSW other packaging	2	0,0000	0,0
			-7,9

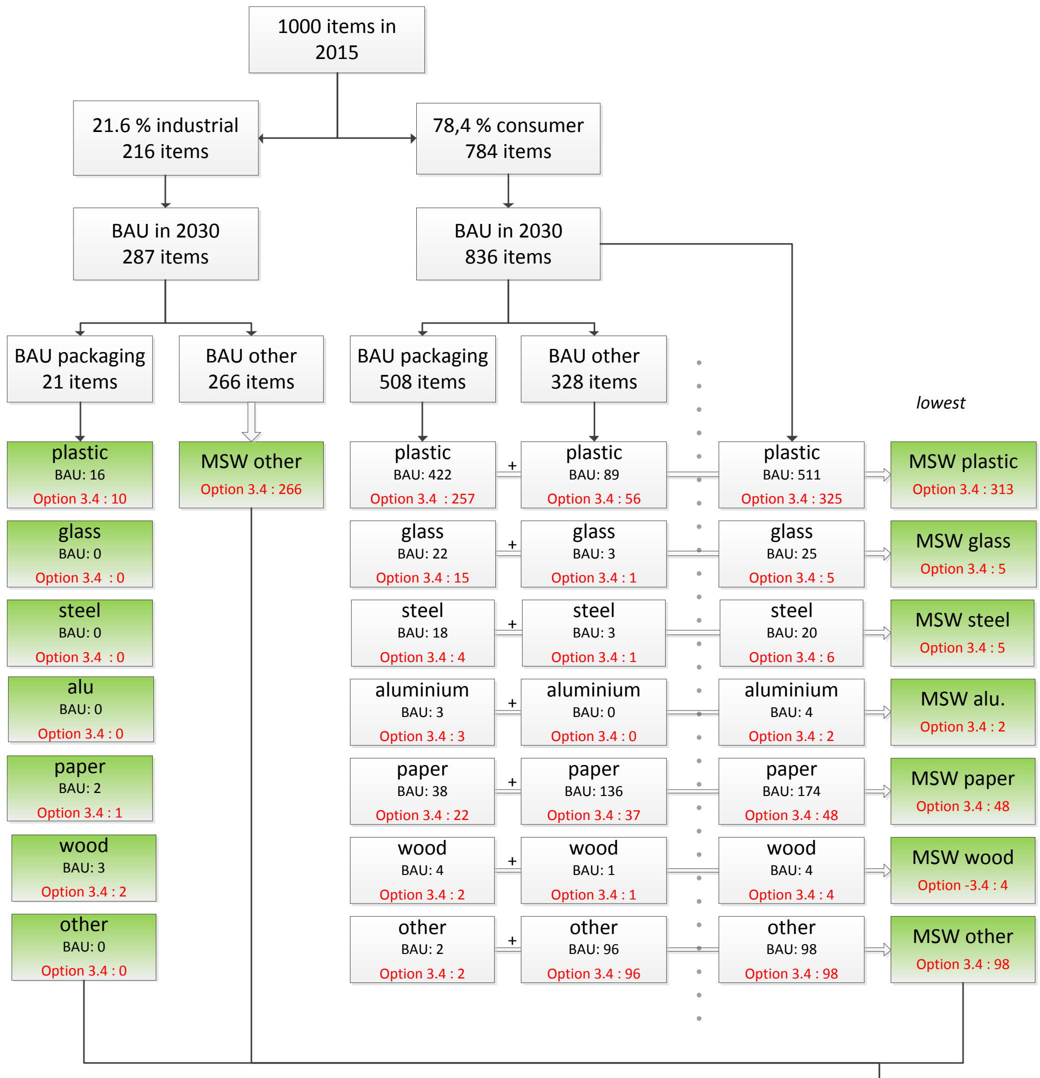
Take care: Figures in this scheme are rounded. Sums are in line with the real, non-rounded values

The reduction factors express how landfill reduction measures decrease the amount of litter items that are linked to la landfill source or pathway. If landfill goes down, fewer landfill related items will be found as marine litter. Landfill is however a rather modest source or pathway for marine litter, which means that landfill diversion targets will lead to a modest reduction of litter items. Without landfill reduction, we would find 1002 items, with landfill reduction items we find 8 items fewer, or 994 items.

Conclusion: under option 3.3 landfill diversion marine litter inflow tends to
decrease by 3,8% in 2020 compared to 2015.
decrease by 0,6% in 2025 compared to 2015.
increase by 2,5% in 2030 compared to 2015.

4.3.7 Option 3.4: combining options 3.1, 3.2 and 3.3

Since option 3.4 involves a mix of policies, the highest parameter values for the options 3.1, 3.2 and 3.3 are combined, meaning the best performances, either induced by MSW recycling targets, packaging recycling targets or landfill diversion targets are combined. For each waste source, the effect that has the largest impact is considered. As in option 3.3, landfill diversion impact is added once the impact of other measures has been assessed.



	items	Reduction factor	Reduction
items MSW plastic non packaging	56	-0,0190	-1,1
items MSW glass non packaging	1	-0,0190	0,0
items MSW steel non packaging	1	-0,0190	0,0
items MSW aluminium non packaging	0	-0,0190	0,0
items MSW paper non packaging	37	-0,0190	-0,7
items MSW wood non packaging	1	-0,0190	0,0
items MSW other non packaging	96	0,0000	0,0
items MSW plastic packaging	257	-0,0190	-4,9
items MSW glass packaging	15	-0,0190	-0,3
items MSW steel packaging	4	-0,0190	-0,1
items MSW aluminium packaging	3	-0,0190	0,0
items MSW paper packaging	22	-0,0190	-0,4
items MSW wood packaging	2	-0,0056	0,0
items MSW other packaging	2	0,0000	0,0
			-7,5

Option 3.4 combination
753 items in 2030
Landfill reduction -7,5
746 items in 2030

ML reduction of 25,42%

ML items full implementation in 2030 : 1029
ML reduction of 27,5% compared to full implementation option

Take care: Figures in this scheme are rounded. Sums are in line with the real, non-rounded values

This option is the one with the largest impact of those assessed, especially to the 2030 horizon. We therefore present the analysis for 2030 in the graphic above. The same figure is included in annex to the Impact Assessment.

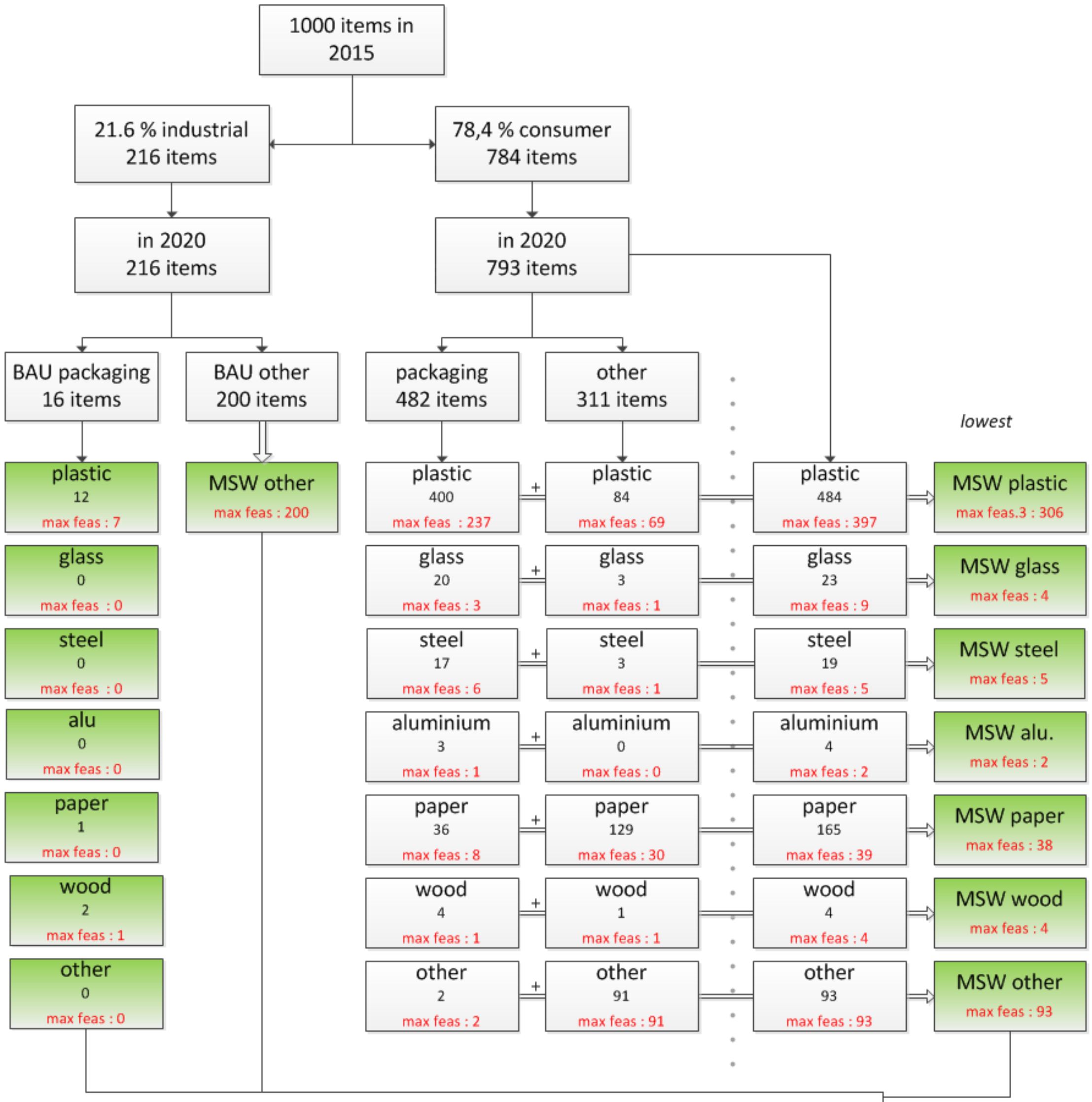
Throughout the assessment, data have been compared to a benchmark value of 1000 items in 2015. In the Commission's Impact Assessment the benchmark is defined as the full implementation scenario in 2030. This leads to different figures. See paragraph 4.4 for an overview.

Conclusion: under option 3.4 combination marine litter inflow tends to
decrease by 16,9% in 2020 compared to 2015.
decrease by 24,3% in 2025 compared to 2015.
decrease by 25,4% in 2030 compared to 2015.

4.3.8 Maximum feasible scenario

- We do not assume the same increase of MSW as in the business-as-usual scenario because we take into account absolute decoupling, which means that the average MSW generation remains stable and that total MSW generation increases only in line with demographic growth.
- For industrial waste, we assume the status quo for 2012 (2015) as we take into account absolute decoupling.
- We consider the same ratio between industrial and consumer marine litter as in the BAU scenario.
- The recycling rate for MSW is as assessed in paragraph 4.1.4.9 and the recycling rates for MSW fractions as in paragraph 4.1.5.9.
- The recycling rate for packaging is as assessed in paragraph 4.1.6.9
- Landfill reduction factors are calculated based on the actual landfill performance of the top three member States for the different materials

	landfill BAU	landfill maximum feasible
MSW plastics	57,21%	0,51%
MSW glass	57,21%	0,51%
MSW metals	57,21%	0,51%
MSW paper	57,21%	0,51%
MSW wood	57,21%	0,51%
packaging plastics	22,70%	0,62%
packaging glass	28,71%	2,89%
packaging steel	27,13%	6,40%
packaging aluminium	27,13%	6,40%
packaging paper	8,49%	0,25%
packaging wood	32,35%	0,20%



	items	Reduction factor	Reduction
items MSW plastic non packaging	69	6,3%	-4,3
items MSW glass non packaging	1	6,3%	-0,1
items MSW steel non packaging	1	6,3%	0,0
items MSW aluminium non packaging	0	6,3%	0,0
items MSW paper non packaging	30	6,3%	-1,9
items MSW wood non packaging	1	6,3%	0,0
items MSW other non packaging	91	0,0%	0,0
items MSW plastic packaging	237	6,2%	-14,7
items MSW glass packaging	3	5,7%	-0,2
items MSW steel packaging	6	4,9%	-0,3
items MSW aluminium packaging	1	4,9%	-0,1
items MSW paper packaging	8	6,2%	-0,5
items MSW wood packaging	1	6,3%	-0,1
items MSW other packaging	2	0,0%	0,0
			-22,1

Maximum feasible scenario
661 items in 2020
Landfill reduction -22,1
639 items in 2030
ML reduction of 36,1%

Take care: Figures in this scheme are rounded. Sums are in line with the real, non-rounded values

Conclusion: under the maximum feasible scenario marine litter inflow tends to

decrease by 36,1% in 2020 compared to 2015.

decrease by 35,7% in 2025 compared to 2015.

decrease by 35,5% in 2030 compared to 2015.

4.3.9 Plastics only scenario

This analysis assesses the impact on plastic marine litter in particular of the implementation of option 3.4.

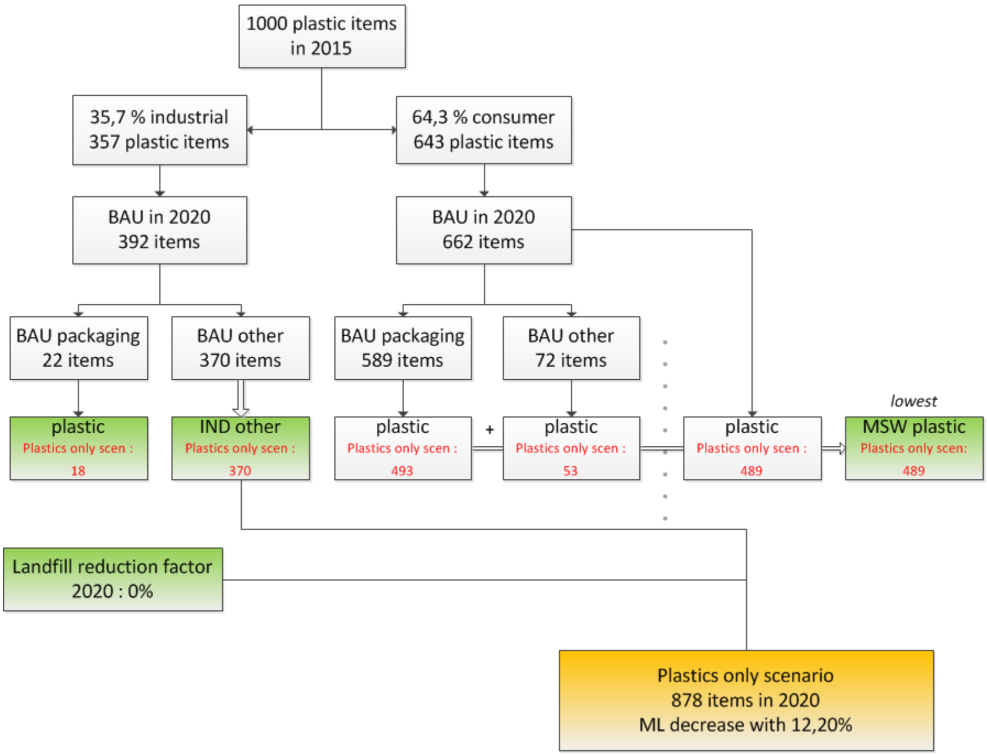
- We assume the same increase of MSW and of industrial waste as in the business-as-usual scenario, as well as the same decoupling.
- The ratio between municipal and industrial plastic marine litter is assessed based on the OSPAR screenings

	consumer	professional
Baltic	64,93%	35,07%
Black	96,15%	3,85%
Med.	96,07%	3,93%
North	36,03%	63,97%
EU	64,29%	35,71%

- The ratio packaging/non packaging for plastic marine litter, both from industrial or consumer sources, is assessed as follows using the OSPAR screenings

EU	industrial	5,5	%	packaging
		94,5	%	non packaging
	consumer	89,1	%	packaging
		10,9	%	non packaging

- All other parameters are as applicable to plastics in option 3.4.



Take care: Figures in this scheme are rounded. Sums are in line with the real, non-rounded values

Conclusion: when only considering plastic marine litter, under application of option 3.4, combined options, marine plastic litter inflow tends to

decrease by 12,2% in 2020 compared to 2015.

decrease by 17,3% in 2025 compared to 2015.

decrease by 13,0% in 2030 compared to 2015.

4.4 General conclusions

4.4.1 On the impact of general policy measures on marine litter

- All options have a relatively limited impact on marine litter inflow reduction.
- The major driving force for marine litter reduction is the recycling performance of plastics.
- The non-packaging industrial fraction of marine litter is not controlled through MSW recycling targets nor through packaging recycling targets. Because this fraction represents quite a significant proportion of marine litter, the litter tends to increase in line with the increase of industrial waste generation.
- The level of decoupling and the level of future waste generation (and thus waste prevention) have a major impact on marine litter but variation in these levels of decoupling between the options is not included in this analysis.

The assessed result is marine litter inflow reduction due to changing general waste policy measures (like general recycling targets). To have a larger impact in marine litter reduction, above the assessed results, we may consider:

- Targeted measures which specifically address frequently occurring marine litter items (like plastic bags, caps and lids, cigarette butts, outdoor consumption packaging, fishery nets etc…)
- Measures or targets to increase decoupling of waste generation from economic growth or from levels of consumption. These kinds of measures usually are identified as prevention measures.
- Measures or targets for industrial non-packaging waste are needed, as this is one of the main loopholes not covered by the proposed recycling targets.

Table 13: summary table of impact of policy option on marine litter, compared to a 2015 benchmark

		ML inflow evolution 2015-2020		**ML inflow evolution 2015-2025**		**ML inflow evolution 2015-2030**	
	items 2015	items 2020	evolution (%)	items 2025	evolution (%)	items 2030	evolution (%)
BAU	100	104,4	4,40	108,5	8,53	112,3	12,29
option 1 full implementation	100	95,4	-4,63	99,3	-0,70	102,9	2,92
option 2 single calculation method	100	96,2	-3,77	100,2	0,17	103,8	3,81
option 3.1 higher mun. waste recycling targets	100	95,4	-4,63	94,7	-5,31	92,6	-7,40
option 3.2 higher packaging waste recycling targets	100	83,7	-16,26	79,1	-20,93	81,6	-18,41
option 3.3 landfill ban	100	96,2	-3,78	99,4	-0,62	102,5	2,50
option 3.4 combination	100	83,1	-16,91	75,7	-24,30	74,6	-25,42
scenario maximum feasible	100	63,9	-36,11	64,3	-35,72	64,6	-35,45
scenario plastics only	100	87,8	-12,20	82,7	-17,27	87,0	-13,03

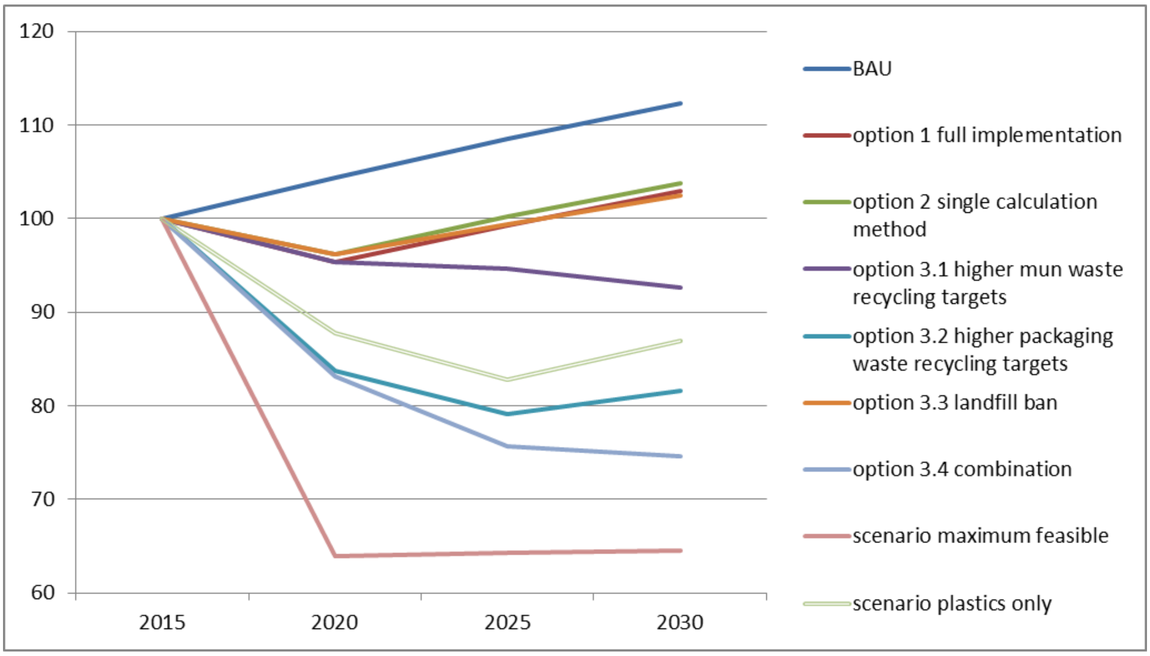


Figure 11: Summary graph on the impact of the different policy options on marine litter.

As noted in Section 4.3.7, this analysis has been carried out comparing the various options to the 'business-as-usual' scenario, using a benchmark value of 1000 items in 2015. As the Commission's Impact Assessment takes option 1 (full implementation) as the baseline, we recalculate the results, as follows:

Table 14: summary table of impact of policy option on marine litter, compared to the full compliance scenario

litter items 2015	1000	option 1	option 2	option 3.1	option 3.2	option 3.3	option 3.4
litter items 2020		954	962	954	837	962	831
litter items 2025		993	1002	947	791	994	757
litter items 2030		1029	1038	926	816	1025	746
% increase in 2020 compared to 2015		-4,6	-3,8	-4,6	-16,3	-3,8	-16,9
% increase in 2025 compared to 2015		-0,7	0,2	-5,3	-20,9	-0,6	-24,3
% increase in 2030 compared to 2015		2,9	3,8	-7,4	-18,4	2,5	-25,4
% increase in 2020 compared to option 1		0,00	0,84	0,00	-12,26	0,84	-12,89
% increase in 2025 compared to option 1		0,00	0,91	-4,63	-20,34	0,10	-23,77
% increase in 2030 compared to option 1		0,00	0,87	-10,01	-20,70	-0,39	-27,50

4.4.2 On the assessment of beach litter in the four seas

- Each regional sea has its own specific top ten of marine litter items, representing between 64 and 82% of the total number of items found. Most prevalent are caps and lids, cigarette butts, plastic foil and plastic pieces, packaging waste, plastic cords, etc. Each sea has also its own key sources and pathways with varying impact of direct littering, sewerage, inland waterways or other diffuse pathways. Intentional littering or littering out of neglect is in most regional seas higher than accidental littering.
- The ratio between sea-based and land-based sources may vary considerably between the regional seas. Although the proposed new waste legislation and recycling targets aim to tackle land-based sources, they will have little impact on sea-based sources. Sea-based measures, especially for industrial non-packaging sea-based litter, should thus be prioritised.
- Each sea would benefit from its own regional approach for its main litter types and sources, to be implemented in addition to the measures needed to realize the general waste management options calculated. This could be achieved through the on-going development and implementation of Regional Action Plans for marine litter, via the relevant Regional Sea Conventions[15].

4.4.3 On possible headline reduction targets

Based on the analysis of option 3.4 above, we believe that a reduction of marine litter inflow of 25% by 2025, compared to 2015 levels, with an intermediate target of 17% by 2020 is feasible, through the implementation of new waste legislation alone. However, we must keep in mind the regional specificities for litter sources and the need to adapt measures to each sea. The value of 25% is moderate, compared with the maximum feasible result of 35% that can be achieved if all Member States perform at the level of the actual top three best performers.

Looking to the requirement of the Marine Strategy Framework Directive to reach 'Good Environmental Status' by 2020, it is not clear that a 17% reduction of beach litter inflow would be sufficient to meet this goal. Specific marine litter measures on top of the planned general waste recycling targets may thus be needed, e.g. on non-packaging industrial litter or on sea-based sources.

The proposed targets could also be supplemented by measures aimed at changing behaviour and targeting specific marine litter items, in addition to general waste management strategies. See chapter 7 for an outline of such measures.

[15] In December 2013, the Mediterranean was the first regional sea in the world for which a Marine Litter Action Plan was adopted, via Barcelona Convention. OSPAR followed suit for the North-East Atlantic in June 2014, while HELCOM has agreed to adopt such a plan by 2015. There is no clear roadmap for a dedicated marine litter action plan for the Black Sea, although the issue features in the overall Strategic Action Plan.

5 Analysis of the results of the public consultation

The “Consultation on the establishment of a quantitative reduction headline target for marine litter” was open for citizens and stakeholders from 25.09.2013 to 18.12.2013

All citizens and organisations were invited to contribute to this consultation. Contributions were sought in particular from representatives of the waste management, plastic producer/recycling, fisheries and shipping sectors, as well as consumers, NGOs and international, national and sub-national authorities with responsibility for tackling marine litter.

The aim of this consultation was to understand stakeholders’ views on a range of actions and policies which could be undertaken in order to tackle the problem of marine litter. The results of the consultation are used as one of the bases for formulating a Union-wide quantitative headline reduction target for marine litter.

The results of the public consultation are analysed and published in a separate report that can be consulted at:

http://ec.europa.eu/environment/consultations/marine_litter_en.htm

6 The potential of behaviour change with regard to marine litter

6.1 Introduction

Marine litter is the consequence of inappropriate behaviour. Reasons for littering can be as diverse as lack of citizenship, lack of awareness or negligence towards the implications of littering, accidents, lack of (financial) incentives, failing collection systems, landfill escapes etc.. This chapter however focusses in a narrow approach on littering by consumers as well as fishermen. Individual human behaviour is framed as the major driving force of littering in this chapter.

6.2 Stakeholder's perceptions and behaviour in relation to marine litter and support for potential measures across different sectors

In order to effectively tackle marine litter, it is crucial to understand how people perceive the issue, including where responsibility within society lies and what measures should be considered across the different sectors. This section provides an overview and highlights of preliminary results from a European survey and European public consultation on the topic.

The MARLISCO project (2012-2015), funded through the EU's 7th Framework Project, has conducted an extensive survey to gather information on the level of awareness within European society of the characteristics, sources and impacts of marine litter as well as the attribution of responsibility for its prevention and management. The survey was launched in several European coastal countries, targeting key sectors, such as industry, retail, waste management, public authorities, the media, the education sector, and the general public. The results provide a baseline of awareness, attitudes and barriers in respect to understanding the issue and taking action, and how these vary between countries and across stakeholder groups.

A total of 3748 respondents completed the survey across Europe, from a range of stakeholder groups. Respondents (n>100) originated mainly from Cyprus, Denmark, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Romania, Turkey and United Kingdom.

Key questions were:

- How concerned is society with the issue of marine litter?
- What composes marine litter and where does it come from?
- Who is responsible for marine litter and which factors contribute to this problem?
- How likely and feasible is it for people to take particular actions?

A detailed analysis is included in Annex 8.

The results of the MARLISCO survey indicate that the majority of respondents notice litter when they visit the coast, and are concerned about the problem and its impacts. More specifically, respondents believed that the quantity of marine litter is increasing, and is a problem for all and not only to coastal communities. Nevertheless, there seems to be significant gaps in terms of knowledge, as respondents considerably underestimate both the proportion of marine litter which is made up of plastic and the contribution of land-based sources. This highlights the need for reinforced communication and awareness-raising activities, with a sound scientific basis.

In terms of responsibilities, respondents recognise the issue as being related to our current consumption patterns and that responsibilities are distributed across society, not being solely an issue of waste management or disposal behaviour.

The results of the stakeholder consultation show that measures such as awareness raising, legislation and enforcement, and provision of waste disposal bins are frequently chosen or suggested by participants.

When consumers are concerned, stakeholders indicated “avoid littering”, “reject single use plastic bags and bottles and use re-usable alternatives” and “separate waste at home and participate in systems for separate collection and deposit refund systems” as most preferred measures. Other measures that were frequently suggested by stakeholders were education and awareness raising, avoiding microbeads and reusing products. 12 stakeholders also suggested use of a deposit refund system.

Authorities (local, national and EU) are recommended to improve and better enforce existing legislation and to educate and raise awareness of consumers with regard to sources and impact of marine litter. Specifically for the EU level, stakeholders recommend to extend and improve producer responsibility over the entire product lifecycle (e.g. optimisation of packaging and production including design for re-use, recycling, prevention, low material demand, etc.)”. At local level, enforcement of public littering rules and taking action to ensure regulatory compliance of landfills and eradicate illegal dumpsites are recommended. The implementation of a deposit refund system is additionally suggested by stakeholders for the local and national level.

NGO’s are mostly seen in a role of educating and raising awareness of consumers, and in clean-up events.

When looking at the industry, producer responsibility is the most strongly recommended action for the plastic industry. The tourism and recreation sector is recommended to raise awareness with visitors and to provide litter bins. The fisheries sector and port authorities are recommended to educate employees and provide waste disposal facilities. Stakeholders plea, however, for an internationally harmonized waste disposal system.

When classifying the most recommended measures, MARLISCO gets the following results:

- Behavioural measures should be based on education (knowledge transfer) and raising awareness (responsibility and behaviour transfer)
- Preventive measures include the provision of waste disposal bins at litter sensitive areas. The presence of a frequently emptied bin, which is at close proximity and easily accessible at any times, diminishes the perceived burden of litter avoidance.
- Legal measures should focus both on improving legislation and on strengthening the enforcement of already existing legislation. Both are needed.
- Clean-up measures can be organised on an on-going/routine basis but the impact of dedicated, high-profile clean-up events is highlighted by the respondents.
- Economic measures should include deposit refund systems. Respondents demonstrated wide support for implementing extended producer responsibility (EPR) for plastic marine litter as an effective legal, economic and preventive measure. Only the plastic industry does not favour this kind of approach[16]

See also section 6.7 on financing litter prevention measures and EPR.

6.3 Effectiveness of prevention measures

6.3.1 Introduction

As summarized in the study “Feasibility of introducing instruments to prevent littering” (in short, littering prevention study), litter behaviour can be related to the following primary driving factors (Vernon et al., 2013; Curnow & Spehr, 2001)

- Context (such as overall cleanliness of the location, packaging design, etc.);
- Facilities (quality of waste disposal infrastructure);
- Attitudes and perceptions (awareness, opinions and attitudes).

The littering prevention study also found that a lot of research shows that the presence of receptacles reduces littering. The number, location and design of receptacles all can have their impact. In several countries (e.g. the Netherlands), guidelines have been developed to aid public authorities deciding on the optimal location, size and type of bins, depending on the type of area (e.g. urban, rural, residential area, roadside etc…) amongst others (Kort, Y.A.W et. al., 2005). A study of Keep America Beautiful (2009) showed that the lowest littering rate occurs when receptacles are available and close at hand. There were no data on the optimal number of receptacles in a location, but the results showed that the littering rate was only 12% within 10 feet (about 3 meters) of a receptacle, compared with a 30% littering rate for disposals more than 60 feet (about 18 meters).

[16] EUROPEN position paper see http://ec.europa.eu/environment/consultations/marine_litter_en.htm

Especially with regard to smokers, the availability of ashtrays is important to prevent butt littering. Smokers often cite a lack of ashtrays as a reason for littering cigarette butts (Victorian Litter Action Alliance, 2007). The Keep America Beautiful study (2009) showed that 65% of cigarette disposals were improper. Only 15% of variance in general littering results from contextual variables (e.g. existing litter, lack of convenient receptacles, etc.), but for cigarette litter about 38% was associated with the context. One of the strongest predictors of cigarette littering was the number of ash receptacles. A remarkable finding of the study was that the relation between littering and receptacles was limited to ashtrays. The presence of trashcans or recycling containers did not reduce the rate of cigarette butt littering. It was only the presence of ash receptacles, either as stand-alone, or integrated into a trashcan, that correlated with lower rates of cigarette butt littering. This effect may be due to smoker's fear of causing fire in regular bins.

Cigarette butts are amongst the most frequently found marine litter items. Effective measures targeting cigarette butts could have a large impact on the total amount of beach litter items observed. This is quantified in chapter 7.2.

6.3.2 Littering on-land

The *litter prevention study* did not analyse projects on public waste disposal infrastructure for **general litter**. It is hard to find any literature on this topic. The study does mention the "City of Leiden gives the City Population a Yellow Bag" project. Leiden is a Dutch coastal municipality with kerbside collection of household waste, which struggles with seagulls that tear the waste bags open causing street litter. The city now promotes yellow bags that are stronger and which are less attractive to seagulls. The new bags were introduced in 2012, and are still in use. This measured inspired the Belgian coastal municipality Blankenberge, who tested the same bags for two weeks. In Blankenberge, they were not convinced though and decided to invest in underground waste disposal infrastructure instead.

6.3.2.1 Cigarette butts

More information is available on measures targeting specific types of litter, mainly **cigarette butts** and chewing gum litter. As cigarette butts are the most frequently found litter item both on land in street litter as well as in beach litter (see paragraph 4.2), preventive measures targeting cigarette litter are very important. (Victorian Litter Action Alliance, 2007; Keep Britain Tidy, 2012; Keep Australia Beautiful National Association, 2013).

The *litter prevention study* analysed the following measures related to smoking related litter:

1. Ashtray cones
2. No butts on the beach
3. Butt FREE Australia

All three mentioned measures include personal ashtrays; Butt FREE City also included fixed litter bins. <u>Ashtray cones</u> were first launched in Mediterranean countries Spain, Italy and Portugal, but have spread in the meantime to other countries. Ashtray cones are cardboard or plastic cones provided to beachgoers, in which small litter items such as cigarette butts, gum, sweet wrappers, etc. The cones are to be emptied in the appropriate receptacle. The plastic cones are reusable: they are stored in a dispenser dock and can be picked up, used and returned. Main problems are that the cones are left at the beach, (thus potentially ending up as marine litter themselves) or that they are taken instead of returned to the dispenser.

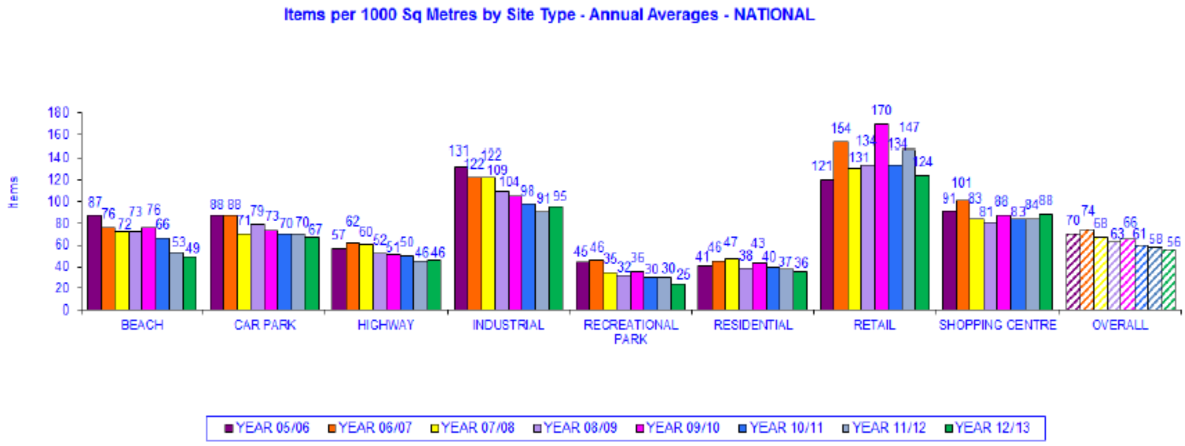
The No butts on the beach campaign was initialized in 2002 by the NGO *Surfers against sewage*, and is still running alongside other campaigns targeting littered packaging, plastic bags and flushed sanitary products. These campaigns are predominantly about awareness-raising, however the *No butts on the beach* campaign included the development of a personal 'butt bin' to let smokers stub out their cigarettes and store them safely until they can get to a bin. No results on the effects of this campaign are available[17].

Butt FREE Australia targets cigarette litter using an integrated set of measures, including awareness & education, infrastructure and enforcement. But very special is that they have different campaigns depending on the location and target audience: Butt FREE City, Butt FREE Beach, Butt FREE Highway, Butt FREE Pubs n Clubs, etc.

In 2005, the Butt FREE **Beaches** campaign *Please butt it then bin it* ran during the summer period. As part of this campaign, 3000 personal ashtrays were distributed along with 30 permanent butt bins for emptying the personal ashtrays. To assess the results of the campaign, quadrant butt litter counts were performed. An average reduction of 43,5% butt litter was recorded over the 6 participating beaches (and also including associated locations such as the area near the toilet block or the beach café). As well as butt counts, observations of people's behaviour were also carried out before and after the campaign, counting the number of people who litter or dispose of their butts properly. After the campaign, 15% fewer people disposed of their butts illegally (i.e. butt out on the sand or flick butt onto the ground). (Surf Coast Shire, 2007).

When comparing the yearly national litter index since the start of the campaigns in 2005, a slow downward trend can be observed. However butts are persistently the most commonly found litter item since the start of the monitoring campaign 15 years ago[18]. Furthermore, results vary significantly depending on the location, as shown in the figure below, with the decrease in the number of litter items per 1.000 m^2 is most evident at beaches, industrial sites and recreational parks (Keep Australia Beautiful National Association, 2013). Note: these figures are for litter as a whole, not specifically butt litter.

[17] The organisation has been contacted, but no response was forthcoming
[18] Website: http://www.buttfree.org.au/research/butt-litter-statistics.html, website visited on 12 February 2014



Source: Keep Australia Beautiful National Association (2013) Annual Report – The National Litter Index 2012/2013

Another **butts prevention** campaign on **beaches** was the Italian “Ma il mare non vale una cicca?” campaign (So the sea isn't worth it? – the idiom is a play on words, as cicca is also Italian for cigarette butt). The initiative was launched by Italian environmental organization Marevivo in 2009 and continued annually ever since the campaign was implemented by volunteers distributing washable and reusable pocket ashtrays to beach users during the summer, together with an information booklet, which included details of, for example, the time of degradation of key types of litter items in the sea. Since 2009, between 40.000 and 100.000 ashtrays have been distributed annually.

Marevivo estimates that each ashtray will avoid 6 cigarette butts being disposed on the shoreline or water, per day (based on an average consumption of 12.7 cigarettes/smoker, according to data from the Italian Institute of Health)

Campaign	Ashtrays distributed	Butts spared/day (*)
2009	40.000	240.000
2010	80.000	480.000
2011	100.000	600.000
2012	100.000	600.000
2013	100.000	600.000
TOTAL	**420.000**	**2.520.000 (*)**

(*) Estimating a daily average of 6 cigarette butts collected per ashtray distributed

Considering that a beach user spends an average of 5 days on the beach/year, throughout this period, the campaign may have avoided the improper disposal of up 12 million cigarette butts on the beach.

A similar washable ash-tray, with the inscription ‘Hou het strand leuk, zonder peuk’ (keep the beach fun, without butt) has been distributed in a Flemish-Dutch Interreg project.

Figure 12 : Washable portable ash-tray from a Dutch-Flemish Interreg project

6.3.2.2 Bottle caps

Another promising general prevention measure is a campaign that increases collection of plastic bottle caps, which combines prevention and clean-up. The Blue Lid Campaign was launched in 2010 by the Faculty of Dentistry, Ege University. The aim of the campaign was to extensively collect plastic lids, a valuable recyclable item, and exchange them for manual or motor wheel chairs for disabled people.

Without much publicity, this campaign has become very popular in Turkey, with both individual participants collecting lids across the country and institutional/corporate supporters. The Spinal Cord Paralytics Association of Turkey (TOFD) also started a similar campaign in 2011. The Faculty of Dentistry, Ege University ended their campaign in late 2012 and passed their lids on to TOFD. The campaign has been executed by TOFD since the beginning of 2013.

The project works on a voluntary basis. With this project, both the bottle lids are recycled and many disabled people have their own wheelchairs. 250kg of bottle lids can be exchanged for a manual wheelchair. An electric wheelchair requires 2.5 tonnes of lids.

As a result of this campaign, over 500 tonnes of bottle caps have been collected and recycled, and thousands of wheel chairs have been provided to disabled people. The campaign has been widespread, appealing to the general public all across Turkey: lids are easy to collect and the social responsibility and benefit appeal to the public. Furthermore, there have been opportunities to generate employment in logistic companies, in TOFD, and in the recycling facilities.

Bottle caps and lids are also among the marine litter items most frequently found on beaches. Effective general prevention measures on caps and lids could have a large impact on the total amount of beach litter items observed. This is quantified in chapter 7.4.

6.3.2.3 Chewing gum

The final project examined demonstrates the positive results of dedicated infrastructure for chewing gum. Gum is not widely reported in the marine environment, although this may be due to the lack of an OSPAR code or because gum is difficult to observe in the sandy environment of a beach. So-called "gum targets" are a form of hardware fixed to column, signpost, bus stop or railing with a picture / design that encourages the public to stick their used chewing gum (see picture below). In Bournemouth, gum targets are collecting in excess of 1.700 pieces of gum per week. In Luton, gum targets collected in excess of 750.000 pieces of used gum in the first year, and reducing the cost of specialist gum removal services by 50%[19]. Of course, not all of the collected pieces of gum would have ended up on the streets or on beaches, but it is clear that they are likely to have a significant impact on gum litter production.

[19] Website: www.gumtarget.co.uk, website visited on 12 February 2014

Figure 13 : *Gum target (Source: http://www.gumtarget.co.uk/)*

In conclusion, waste disposal infrastructure, especially personal bins or infrastructure dedicated to specific litter items, have proven to significantly reduce litter. In the case of beaches, a reduction of more than 43% in butt litter was achieved through a combination of personal ashtrays and permanent butt bins. Of course, waste infrastructure measures usually go hand in hand with awareness campaigns, so these results are not solely attributable to prevention measures.

Gum litter prevention campaigns are successful in an urban environment where there are large numbers of consumers occur and where a disposal solution is readily available, easy and fun for the consumer. The same conditions occur on tourist beaches, and it can be assumed that gum is also consumed on the beach. A gum target on the beach would be effective contribution to solving the gum litter on beaches. Due to lacking data, no assessment on the possible quantitative impact could be made in chapter 7.

6.3.3 Dumping of consumer waste offshore

Following *Directive 2000/59/EC on port reception facilities for ship-generated waste and cargo residues* each port situated in an EU Member State that is normally visited by ships (incl. fishing vessels and recreational craft, irrespective of their flag) need to provide reception facilities for receiving ship-generated waste and cargo residues, including sewage and other residues generated during the service of a ship.

No specific preventive measures with regard to consumer waste have been found in the literature.

With regard to fishing gear, several initiatives have been taken. In 2008, in the US, the Fishing for Energy program (FfE)[20] was launched by the National Oceanic Atmospheric Administration's (NOAA) Marine Debris Program, National Fish and Wildlife Foundation, and Schnitzer Steel. Its goals were to provide a cost-free solution to fishermen to dispose of old, derelict or unusable fishing gear and to reduce the amount of derelict fishing gear in and around our coastal waterways. Commercial fishermen can dispose of old gear for free at designated drop-off sites near fishing ports. The gear collected is stripped of metals for recycling with the help of Schnitzer Steel and processed into clean, renewable energy at a nearby Covanta Energy-from-Waste facility. Since launching in 2008, FfE has reeled in more than 450 tonnes of old fishing gear, a portion of which has been retrieved directly from the ocean by fishermen. The partnership has also expanded to include a grant program that directly supports efforts to remove derelict fishing gear from US coastal waters and continues to partner with new ports to promote retired or derelict fishing gear collection through community education and outreach.

There are no data on the reduction of old fishing gear in the marine environment as a result of this initiative, but the program is assumed to have a reduction effect. However, such an approach raises questions about the *polluter pays principle*; as the old fishing gear is commercial waste, the community should not have to pay for this waste.

A comparable program, also launched in the US, by the NOAA Marine Debris Program and the Boat U.S. Foundation, is the Reel in and Recycle program[21], which set out to build a nationwide network of monofilament recycling locations to make proper disposal of monofilament more accessible. Reel in and Recycle offers local marinas or other waterfront access areas support for building and installing recycling bins, made of PVC pipes and simple signage. To date, Reel in and Recycle has helped install about 2,000 bins around the country and recycle about 8.500 km of fishing line.

As for the Fishing for Energy program, the amounts of waste collected are considerable, but the commercial waste is disposed of for free, which is not in line with the *polluter pays principle*.

[20] Website: http://www.covantaenergy.com/what-we-do/community-engagement/fishing-for-energy.aspx , website visited on 17 February 2014
[21] Website: http://marinedebris.noaa.gov/partnerships/reel-and-recycle, website visited on 17 February 2014

Figure 14 : PVC bins, source: http://marinedebris.noaa.gov/partnerships/reel-and-recycle.

6.4 Effectiveness of behavioural measures

6.4.1 Introduction

As mentioned earlier, about 85% of the variance in littering behaviour results from individual variables, including lack of awareness, lack of concern or lack of motivation. A strong correlation with age has been found in several studies: older individuals are less likely to litter than younger people (Vernon et al., 2013). Both groups therefore represent a clear market segment for focused messaging and campaigns; younger people because they have the largest impact and the older people because they are predisposed to non-littering messaging. Campaigns adapted for each group could be envisaged. Some studies also report a gender difference with men being more likely to litter than women. However, in the case of the Keep America Beautiful (2009) study, the difference was not found to be statistically significant. The authors presume that men are more likely to *report* littering, but in reality men and women are equally likely to do it. They conclude that awareness-raising campaigns should address both genders equally.

Behavioural measures aim at changing the attitudes and perceptions that drive littering. Awareness-raising and education try to make people aware of the consequences and the general impact of littering, and try to mould social norms. A UK survey (Lewis et al., 2009) and the Keep America Beautiful study (2009) identified a number of attitude-related reasons why people litter, including:

- it is seen as someone else's responsibility (e.g. someone else will pick it up, no trash can nearby);
- it is not really littering (e.g. because the litter is biodegradable);
- personal aspects (e.g. bad mood, time constraints, laziness).

The Keep America Beautiful study provides suggestions for sound messages in awareness-raising campaigns. Too often, campaigns convey messages about high littering rates, or depict images of heavily littered environments. The problem with this message is that they convey a normative message that other people litter: messages that show littering as common (i.e. normative) make it acceptable, and will generally undermine the ultimate goal of reducing litter. Instead, the study suggests messages that highlight the dramatic decline in the littering rate, and the widespread belief that littering is wrong. An injunctive norm of social disapproval can provide a strong behavioural motivation.

6.4.2 Littering on-land

Awareness-raising campaigns usually don't stand on their own, but they support other measures such as infrastructural investments, penalties or economic incentives. The difficulty is therefore to measures the results of an awareness campaign. Some evaluation studies measure the success of a campaign through analysing e.g. traffic to the campaign website, advertising reach and message retention. It is difficult to draw concrete conclusions from such data on litter reductions achieved. However, studies that target a specific waste stream, like butts or chewing gum, can sometimes present clear results.

6.4.2.1 Chewing gum

Although chewing gum is usually not reported as a distinct category of marine litter (see paragraph 6.3.2.3), there is however no reason to assume that littering behaviour related to chewing gum is different on the beach than in the streets. The Chewing Gum Action Group (CGAG) (technically and financially) supports local authorities with awareness raising campaigns on chewing gum litter prevention. The first CGAG campaign in 2006 ran across 15 local authorities and was founded on the insight that individuals react negatively to criticism or "don't"-type instructions, and in such cases will frequently do precisely the opposite of what is being asked. Therefore, the advertising conveyed a sense of gratitude to the reader and 'thanked' them for binning their gum. The following year, a wider campaign was developed with a striking visual appearance and a revised message about appropriate behaviour and enforcement, as well as the introduction of a threat of a fine of up to £80. Results showed significant improvement on 2006. The 2008 and 2009 campaigns were also very effective, with even more focus on the fine, resulting in a gum litter reduction of 48%. The campaigns which followed in 2010 and 2011 resulted in an overall reduction of 50%. The 2012 campaign tapped into the excitement surrounding the Olympic and Paralympic Games, urging people to do their country proud. Gum litter levels fell by an average of 54% in participating areas, with decreases of 85% (Coventry), 88% (Nottingham) or 93% decrease (Cardiff)[22] achieved in some cases. In contrast to the results of the Keep America Beautiful campaign (above), the results seem to indicate that when used appropriately, "don't"-type instructions can be very effective.

[22] Website http://www.chewinggumactiongroup.org.uk/, website last visited on 17 February

6.4.2.2 Cigarette butts

The Australian Butt FREE City programs include awareness-raising campaigns, education, infrastructure investments and enforcement. But in the evaluation of the national campaign "*Butt Littering – It's not a good look*" from 2010, the results of the awareness raising and education efforts were analysed (Butt FREE Australia, 2010).

The 'Awareness' components of the campaign delivered the 'Not a Good Look' message to an estimated reach of 1,864,616 people. About 36% of people surveyed in hotspots recognise the campaign advertising and 54% of those people could spontaneously recall one or more of the messages. This equates to campaign message retention of 19% (average) of the sample size in city hotspots nationally.

In seven cities, (self-reported!) behavioural change was analysed. The average rate of potential behaviour change was 10% of the community in city hotspots, but there was a significant variation between cities. Townsville, for instance, had a high population advertising reach (74%) and message retention in hotspots (35%), and also had a particularly high conversion rates from awareness to self-reported behaviour change of 29%. Melbourne had a self-reported behaviour change of only 7%. But the most interesting results were found in the city of Paramatta where the actual butt litter reduction was measured, and amounted to 8%.

Although this campaign was not specifically targeted at cigarette butts littered on beaches, but on butt littering more generally, the impact achieved was very significant, and it is reasonable to assume that a similar approach for beaches specifically could be highly effective.

6.4.2.3 Cotton buds

The UK awareness campaign *Bag it, Bin It* aimed at reducing the incidence of sanitary items and other sewage related debris (SRD) on UK beaches and riverbanks through a programme of promotion, education and partnership. It sought to raise awareness of the problems of SRD and to encourage people to dispose of personal waste carefully, whether in their own household waste bins or in special disposal bins in public toilets.

The awareness campaign focuses particularly on women between the ages of 15-45, asking them not to flush products down the toilet, but to bag them and bin them instead. In 2002 a schools campaign was launched across 6.000 UK schools.

A variety of campaign materials were produced, including the Bag it and Bin it logo, leaflets, posters, and stickers. As part of the campaign, manufacturers and retailers were encouraged to apply the logo and/or message to their products. In 2007 and 2008, the Marine Conservation Society and Surfers Against Sewage focused the Bag it and Bin it campaign on cotton bud sticks, to encourage manufacturers and retailers to improve labelling of these products and to replace the plastic cotton bud stick with a paper one. Extensive media coverage accompanied this.

The campaign was launched following discussions between South West Water, the Marine Conservation Society, Surfers Against Sewage and other organisations concerned about SRD in the water environment. The campaign was “steered” by a national group, whose members included: Water UK, Women’s Environmental Network, Surfers Against Sewage, National Households Hazardous Waste Forum, Marine Conservation Society, Absorbent Hygiene Product Manufacturers Association, EPC Environmental Services, Department of the Environment, Transport and the Regions, Environment Agency.

The campaign received support from leading retailers (Tesco, Sainsbury’s, Safeway, Morrison’s, Somerfield, ASDA, Co-op, Superdrug, and Boots) and key manufacturers (e.g., Johnson & Johnson, and Smith & Nephew), who included the campaign logo and/or the correct disposal messages on products that consumers might flush. The logo was printed on over 100.000 toilet stickers, 700.000 disposal units, 45 million products, and packaging for 80 million disposal bags.

The campaign also received significant press coverage, with over 700 media features.

The 2007-2008 focus on cotton bud sticks led to agreements from The Body Shop, The Co-op, Marks and Spencer, Asda, and Tesco to endorse the logo on their cotton bud products, and commitments from some of these retailers to produce cotton bud sticks with paper stems. Results from the 2007 MCS Beachwatch event marked a decrease in the number of cotton bud sticks observed on UK beaches, from 172 items/km in 2006 to 97,5 items/km in 2007. Overall, the quantity of cotton bud sticks and SRD on UK beaches declined when the national campaign was running (and following times of extensive publicity), and started to rise when national funding ceased in 2002. This indicates that well organized campaigns with consistent messaging over time can have a positive effect (Defra, 2006).

Cotton bud sticks are frequently found as marine litter, but their presence varies from one regional sea to another. This is in large part due to the differences in behaviour between different regions between whether they are improperly disposed of through the sewage system or through solid waste collection. In those areas where they are currently being flushed down toilets, prevention measures for cotton bud sticks could have a considerable impact on the total amount of beach litter items observed. This is quantified in chapter 7.5.

6.5 Deposit refund system as instrument against littering

6.5.1 Dansk Retursystem and Norsk Resirk

The "Feasibility of introducing instruments to prevent littering” study (in short, littering prevention study) performed by RPA, ARCADIS and ABPmer (European Commission, 2013a) assessed two deposit refund systems for non-refillable packaging (e.g. metal cans, plastic bottles), namely Dansk Retursystem and Norsk Resirk.

The Norsk Resirk refund system was started in 1999. Single-use beverage packing for sale in Norway carries both a basic fee and an environmental fee. When consumers return the packaging, they will be refunded the environmental fee. According to the 2011 annual report, 98% of participating plastic bottles were returned and recycled. In addition, 96% of participating cans were returned and recycled. The Norsk Resirk is a relatively complex, nationwide measure which took about 10 years to set up, as a consequence of political issues in relation to taxes on such containers. Relative to other measures, this measure involves significant investment, including organization, transport, vending machines, collection, sorting, pick up agents, etc. (Martin Stewardship & Management Strategies Pty Ltd, 2011).

The foundations of the Dansk Retursystem were laid in the early 1980s, but the refund system only actually started in 2002. There are over 13.000 shops, restaurants, cafes, etc. that accept the return of used single-use beverage packaging, as well as almost 2.900 Reverse Vending Machines located around the country. The performance is a little less efficient than the Norsk Resirk, namely a return rate of 89% (Christiansen M. et al, 2006) in 2011 and 2012 for single-use beverage packaging (legislation requires a return rate of 95% by 2013). A problem for the Danish system is 'contamination' of the system with packaging from elsewhere. For example, with the average cost of cans of beer being almost double those in Germany, many Danish consumers buy their beverages and other products across the border. When cheap German beer is "imported" by consumers and their cans subsequently recycled, the Danish industry foots the bill for the extended producer responsibility of German producers. Both governments are trying to harmonise the deposit systems to avoid these problems.

Given the high rate of return of both systems, a low rate of littering of single-use beverage packaging can be expected when a deposit refund system is implemented. It primarily encourages people not to throw their used containers or bottles out, but it may also reduce litter as people pick up used containers and bottles on the streets in order to receive the deposit. As cited in the study Options and Feasibility of a European Refund System for Metal Beverage Cans (European Commission, 2011a) (in short, EU refund system study)) (Hogg D. et al, 2011), evidence from litter picking activities in Denmark strongly suggest that privately imported beverage cans are littered to a significantly higher extent than domestic cans included in the Dansk Retursystem.

6.5.2 The Deposit-Refund Scheme pilot in Cadaqués, Catalonia (SPAIN)

6.5.2.1 Concept

According to Retorna (2013)[23], in Catalonia, nine million beverage containers are sold every day. Of these, only 3.5 million are collected separately. The remaining 5.5 million end up in landfills, are incinerated or are littered in the environment. Between 15 April and 30 June 2013, a pilot project on a deposit refund system (DRS) was implemented in the city of Cadaqués, promoted by Retorna in

[23] RETORNA is a non-profit organisation that comprises the recycling industry, environmental NGOs, unions and consumers, working together towards “Zero Waste” objectives and the improvement of the current packaging collection system.

cooperation with the City Council. The project was based on a temporary implementation of a DRS for single-use beverage containers in most of the retailer shops of the municipality of Cadaqués and applied to beverage plastic and metallic containers smaller than 3L.

The general objectives of this pilot were:

- to assess the feasibility;
- to analyse the economic impact on municipal waste management;
- to serve as an example to different stakeholders;
- to assess the level of return of refundable containers, but also to determine the level of return with a deposit of €0.05;
- to assess the level of interest with both shops and shoppers;
- and to measure the impact on the waste collection system and street cleaning.

This pilot was promoted by Retorna and had the support of a series of recycling companies / organisations[24]. It was supervised by the Catalonia Waste Agency, which monitored the whole project, from its conception and design to its implementation and analysis of results. Retail outlets (supermarkets and small shops) are the key element in a DRS as they are responsible for managing both deposits and containers, and collect and refund the deposit paid by the consumers. For a viable and effective implementation of a DRS, it is essential to have the participation of a considerable number of retail outlets. In the case of Cadaqués, 8 small shops and 2 supermarkets participated, which accounted for over 95% of beverage sales for home consumption in this city. Consumers could return beverage containers in any of participating retail outlets either “over the counter" (in smaller shops) or through a purpose-built machine (in supermarkets).

6.5.2.2 Results

If such a scheme is implemented at a large-scale (i.e. at the regional or national level), all beverage containers (excluding those originating from foreign countries) would be covered by the system regardless where they are sold and where they are deposited. The assessment of the level of return to the participating outlets was carried out on the basis of two indicators:

- <u>total return of containers</u>: during the project period, the participating retail outlets sold 105.901 beverage containers labelled under the deposit scheme and in total 81.183 containers (labelled and non-labelled) were returned, resulting in a return rate 76.6%. By June, the return rate had increased to 82.03%, and peaked to 91.23% in the final week of the project. This means that packaging return increased continuously throughout the pilot period.
- <u>return of labelled containers (i.e. those that have been marked as having a refundable deposit)</u>: a return rate of 66.83% for labelled beverage containers was achieved by the final week of the pilot project. The return rate continuously increased during project, suggesting that the levels of return had not reached their peak and would have been higher if the project had lasted longer.

[24] Gremi de Recuperadors de Catalunya, Internaco SA, Rhenus Logistics and Tomra S.A.

The following economic and environmental effects were calculated:

- The DRS reduces the volume of bins occupied by such containers. Consequently, economic costs and environmental impact can be reduced by readjusting collection frequencies, and reducing the amount of material sent to landfills. A projection of the results obtained in Cadaqués estimated a reduction in volume of between 18 and 25% in dedicated packaging bins and between 4,7 and 6,6% of volume in undifferentiated bins.
- Visual surveys indicate that there was also a perception of greater cleanliness during the pilot test, particularly on the streets but also in other leisure areas of the municipality. Although no dedicated beach surveys were carried out to assess the impact on marine litter, it is assumed that the significant increase in collection and therefore reduction in improper disposal of beverage containers reduced the likelihood that this type of item ended up as marine litter. This could be an area for further study in any future pilot project.
- Finally, an assessment was made on the economic impact on the municipality, based on the variation in waste collection costs, variation in processing costs, and variation in the income from SIG[25]:
    - The reduction on collection costs from an implementation of a DRS in the municipality has been estimated between €24 242 and €35 372 per year, which represents between 6,5-9,5% of the annual cost of collection of light packaging and undifferentiated waste. On the other hand, there would be a loss of revenue of between €1 240 and €1 766.46 per year resulting from a reduction in containers collected through the existing selective collection arrangements. These are, however, more than offset by the reduction in collection expenses, and annual net savings were estimated at between €23 000 and €33 605. The analysis did not take into account the effects of 5% unclaimed deposit refunds.
- Maintenance costs would also be reduced to between €1 742 and €2 420 per year as 1,91% in weight of discarded municipal waste (6,62% in volume) would not go to landfill. This saving has been calculated on the basis of the current landfill fee.
- Finally, it would have been interesting to quantify in economic terms the proportional part of street cleaning attributable to the packaging under the study but such assessment is unfeasible as this flow in incorporated to general refuse. In any case, it would be fair to consider that the implementation of a DRS would have a positive impact.

6.5.2.2.1 Citizen Response

To assess the level of acceptance and public perception regarding the pilot, surveys have been conducted before and after the implementation of the pilot. During the last survey, 61% of the respondents perceived improved cleanliness in a number of public spaces and streets during the pilot and 85% of the respondents supported the implementation of a DRS.

[25] Integrated Waste Management System

6.5.2.2.2 Retailers Response

After the pilot period, concerns regarding the loss of space due to the storage of empty containers have almost entirely dissipated, as have concerns related to an increased workload. Fears of a decrease in sales have also been reduced, with the prevailing position that the system would not have a negative effect and that it would not affect the number of customers. More generally, retailers' image as responsible businesses has been enhanced. All shopkeepers and retail outlet managers interviewed support the implementation of the system in Catalonia.

As to the performance of the test, no problems have been detected in either manual or automatic return. Retail outlets have adapted well to the new system in their shops (charging and returning the deposit). The individual interviews conducted indicate a general overall positive assessment in 100% of retail outlets.

6.5.2.2.3 Increase in separate collections and better quality of the materials recovered

DRS resulted in a fivefold increase in separate collection of packaging and has improved the cleanliness of public areas in Cadaqués; separate collection in the municipality has gone from a level of 12% to a level of almost 67% as a consequence of the incorporation of the material collected through DRS. Charging a deposit on containers decreases the likelihood that these containers end up in a bin or elsewhere. Indeed, this pilot project has shown that only 1 in every 10 beverage containers found in a bin or selectively collected were subject to DRS.

Comparing the materials separated at a packaging selection plant and those obtained from the processing of the reject fraction, the bales of material recovered through the DRS in Cadaqués have the highest standards of quality in the recycling sector. This quality means that they reach selling prices between 20% and 40% higher - depending on the materials – than in the case of SIG[26].

6.5.3 Conclusion

The deposit refund systems show high return rates, which would imply a significant littering prevention effect in respect to this particular packaging item. It is hard to find a clear correlation, though, between the type of packaging collection system and the littering rate of a country. The EU study (European Commission, 2013a) described littering rates of beverage packaging for a number of countries. Countries with a deposit refund system like Denmark and Germany show low littering rates of beverage packaging, but also countries like Ireland without such system show comparable low littering rates.

Based on the observed quantities of marine litter items as examined in chapter 4.2 we assess whether we see a difference between single-use beverage packaging litter on German North Sea beaches compared to North Sea beaches of other Member states not applying a deposit refund system. Calculations are included in Annex 7.

[26] Integrate Waste Management System

North Sea		
Germany single use beverage litter	177	
Germany all litter items	2046	
Germany cases	16	
non-Germany single use beverage litter	8586	
non-Germany all litter items	86201	
non-Germany cases	135	
Germany % beverage litter	8,65	%
Non Germany % beverage litter	9,96	%
average beverage litter / 100 m		
Germany	11	items
Other North sea Member States	64	items
average litter /100 m		
Germany	128	items
Other North sea Member States	639	items

The number of beverage litter is only slightly less in relative terms to other items on German beaches. In quantitative terms however far more litter in general is found per 100 m on non-German North Sea beaches. No conclusive relation can be made between the deposit refund system and the occurrence of beverage litter on German beaches. However, this lack of a significant difference may be masked by the fact that other North Sea Member States also have similar systems, e.g. Denmark and Sweden. The dataset used in this study is however too small to do similar calculations for Denmark or Sweden.

The deposit refund study assessed the option to implement a harmonized deposit refund system across the EU for metal beverage cans. An estimated cost in the order of € 600 million was calculated for implementing the EU-wide system. But all Member States have already developed systems for responding to the requirements of the Packaging Directive, although some being more effective than other. For poor performing countries, the implementation of a deposit refund system could lead to increased collection and recycling rates. But other countries, like Belgium and the Netherlands, with high recycling rates of beverage packaging would gain little additional benefit from implementing such system, but incur significant additional costs. Furthermore, a stakeholder consultation learned that there is no support from any organization (either producer or NGO) for such EU-wide scheme. The top four reasons for rejecting this option were:

1. Too difficult/not currently feasible/unreasonable burden;
2. Producer responsibility / other waste collection schemers are sufficient / better;
3. A single scheme would infringe the principles of subsidiarity, proportionality and discrimination;
4. Too costly.

We can conclude that implementing a deposit refund scheme could be beneficial in some countries, mostly in countries where the actual collection and recycling rates of beverage packaging have significant room to improve (see Table 15), and the environmental and economic benefits can compensate for the costs for implementing this system.

Table 15: recycling rate for metal and glass packaging, per regional sea

Packaging waste [env_waspac]

Last update	13.02.14
Extracted on	07.08.14
Source of data	Eurostat
STK_FLOW	Domestic
UNIT	Tonnes
TIME	2011

WASTE	Metallic packaging	Metallic packaging	metal packaging recycling rate	Glass packaging	Glass packaging	glass packaging recycling rate
GEO/WST_OPER	Waste generated	Recycling		Waste generated	Recycling	
NORTH SEA / NORTH EAST ATLANTIC						
Belgium	127.584	124.285	97	387.988	387.988	100
Germany	881.100	818.100	93	2.669.700	2.360.500	88
Netherlands	193.000	176.000	91	516.000	427.000	83
Spain	426.307	320.726	75	1.459.581	972.690	67
France	592.563	436.083	74	2.881.265	2.036.000	71
Portugal	93.000	66.000	71	374.360	223.327	60
Ireland	57.261	38.145	67	149.931	121.805	81
Denmark	43.371	25.167	58	151.786	130.386	86
United Kingdom	809.617	447.397	55	2.739.989	1.751.852	64
MEDITERRANEAN SEA						
Cyprus	5.288	4.697	89	17.622	5.954	34
Spain	426.307	320.726	75	1.459.581	972.690	67
France	592.563	436.083	74	2.881.265	2.036.000	71
Greece	119.480	52.700	44	117.090	43.150	37
Slovenia	15.043	6.075	40	31.146	25.632	82
Malta	4.000	1.208	30	10.603	1.821	17
BALTIC/EAST SEA						
Finland	53.999	43.125	80	66.448	58.393	88
Sweden	61.194	46.161	75	203.000	186.500	92
Latvia	10.664	7.922	74	51.967	26.814	52
Italy	554.533	393.448	71	2.266.034	1.568.405	69
Lithuania	13.093	8.958	68	63.233	46.850	74
Estonia	29.687	18.664	63	37.308	24.400	65
Denmark	43.371	25.167	58	151.786	130.386	86
Poland	247.118	111.347	45	1.078.763	485.451	45
BLACK SEA						
Bulgaria	13.414	9.381	70	69.374	41.245	59
Romania	55.230	34.410	62	139.730	83.790	60

Source: Eurostat [env_waspac]

Considering that beverage containers tend to be among the most common marine litter items found, in particular in the Mediterranean and Black Sea, implementing a scheme that increases collection considerably could have a definitive impact in reducing input of such items in these regions. Furthermore, an economic incentive linked to collection of bottles also encourages the collection of "undeposited bottles" (e.g. from tourists which are not familiarised with the local system and dispose them in other ways) and also "stray" bottles.

Care should be taken to ensure coherence between different schemes between neighbouring countries to ensure that cross-border movement of beverage packaging is not accompanied by littering of the imported packaging as a result of its exclusion from the domestic deposit refund system.

If the deposit-refund scheme were extended to bottle caps/lids (e.g. the refund is valid only when the bottle includes its lid/cap, or if a higher premium were paid for bottles with lids/caps) it would be expected that it would also have a positive impact on the occurrence of this type of item (among the top items in every regional sea), even in those countries that have a deposit-refund scheme for drinks containers.

6.6 Effectiveness of prevention and behavioural measures compared to legal and economic instruments

The effectiveness of behavioural measures depends on two aspects:

- The message should be accepted and understood by the target group: they should be open to receive the message and understand the relationship between a problem and a behavioural pattern
- The target group should be ready to adapt its behaviour based on this information.

Measures based on awareness-raising must convince its target group of the size of the problem (sense of urgency); of the effectiveness of the proposed behavioural change and of the societal benefit resulting from behavioural change. This should be balanced against the benefits of unchanged behaviour: ease, lack of social pressure, cost avoidance.

Legal and economic instruments work along the same lines. Behavioural change should lead to a benefit that is sufficiently greater than the benefits of unchanged behaviour. However, due to the nature of the instrument, the benefits of behavioural change are much more direct (i.e. into one’s own wallet) than in case of awareness-raising that appeals on citizenship and other more general and vague benefits for society as a whole. Obtaining the financial benefit of avoiding a financial cost are individually measurable and highly visible for target groups. The same counts for avoiding the unwanted consequences (fines, prosecution etc.) of breaking legal rules.

Communication on legal and economic instruments should include the same elements of sense-of-urgency and effectiveness as the communication on behavioural measures, to create social acceptance of the instruments. But communication should also make the target group understand the individual financial and legal advantages of behavioural change, or the disadvantages of unchanged behaviour.

The effectiveness of legal and economic instruments is therefore much broader than that of merely sensitizing instruments that are based on understanding and good-will. Individual benefits or disadvantages have a much more sensitizing effect than general or societal benefits or disadvantages. This can be observed through e.g. the success of source separate waste collection and recycling of economic instruments like PAYT (pay as you throw) or EPR (extended producer responsibility). Although the visibility of the environmental problems is much larger in Member States with poorly-managed or illegal landfills, the most significant behaviour change can be noticed in Member States where economic or well-functioning legal instruments are implemented. A key condition is always that the individual benefits of behavioural shift are perceived to be higher than those of no shift.

At the same time, Chapter 6.4 however shows that well-executed awareness-raising campaigns can have an important impact on the reduction of specific marine litter items. Insufficient data are available to quantify any difference between legal and awareness-raising instruments.

Table 16: Reduction effects of litter measures of a different nature

Litter item	Reduction effect	Nature of the measure
Cigarette butts *(see Paragraph 6.3.2.1)*	43,5%	Awareness raising and infrastructure
Plastic bags *(see Paragraph 7.3)*	80%	Legal
Cotton buds *(see Paragraph 6.4.2.3)*	43,3%	Awareness raising
Refund bottles and cans *(see Chapter 6.5)*	28% North sea 34% Baltic sea 39% Mediterranean sea 35% Black sea	Legal/economic

6.7 Financing litter prevention measures: cost recovery through extended producer responsibility (EPR)

6.7.1 Belgian case for household packaging waste

In 2008, the Cooperation Agreement on the prevention and management of packaging waste was concluded between the Walloon Region, the Flemish Region and the Brussels Region. Partially implementing the Packaging and Packaging Waste Directive 94/62/EC, the agreement applies to all types of packaging that are placed on the Belgian market.

The Cooperation Agreement states that any operator responsible for putting at least 300kg of packaging waste on the market each year is subject to an EPR in the form of a take-back obligation. Most of the operators chose to join an accredited collective system or PRO (producer responsibility organisation), in case Fost-Plus for household packaging and VAL-I-PAC for industrial and commercial packaging. These accredited collective systems are established to ensure the achievement of the packaging recycling rates (80% recycling and 90% recovery for single use municipal packaging and 80% recycling and 85% recovery for industrial packaging)[27], by organising the collection and treatment of the packaging waste of their members. But within the cooperation agreement, it is also stated that an accredited body should contribute financially to the policy for the prevention and management of packaging waste.

The article in the Cooperation Agreement states that:

"The accredited body which fulfils the take-back obligation of packaging waste of domestic origin also fulfils a mission of public service and is therefore obligated to contribute financially to the policy for the prevention and management of packaging waste within the regions. This contribution is expressed as 0,50 € per capita per year /…/

The policy of the Regions on the prevention and management of packaging waste can, among other things, relates to:

- *The prevention of packaging waste;*
- *The fight against the presence of packaging in litter;*
- *Research & Development to improve the quality of packaging, and in particular their recyclability;*
- *The improvement of the results and/or the quality of the selective collection;*
- *The non-selective collection and treatment of packaging waste.*

  /…/

The region determines the actual destination of the contribution, after consultation with the authorized organization for household packaging."

The total amount of funding is allocated between the regions according to the most recent population statistics of the Ministry of Economy. The financial contribution of 0,50 €[28] per capita per year was distributed in 2012 to the Belgian regions as illustrated in Table 17.

Table 17: Total budget within the EPR scheme for the prevention and management of packaging waste items in the three regions of Belgium.

	Total budget 2012
Flemish Region	€ 3.313.551 (De Picker, E. 2013)
Walloon Region	€ 1.854.143,52 of which 517.144 was spent in 2012 (Département du Sol et des Déchets 2014)
Brussels Region	Not specified (Leefmilieu Brussel 2014)

[27] Cooperation agreement on the prevention and management of packaging waste concluded on 4 November 2008, between the Walloon Region, the Flemish Region and the Brussels Region of Belgium. This agreement has force of law throughout Belgium and applies to all types of packaging that are placed on the Belgian market.
[28] In 2013, the contribution was increased to 0,54€/capita; in 2014 to 0,55€/capita

The region determines the actual destination of the contribution, after consultation with the authorized organization for household packaging.

In Flanders, this budget was spent for different aspects of the prevention and management of municipal packaging waste, such as:

- Littering (€1.792.500 of which €30.000 for the monitoring of marine litter composition) – Flanders is the only Belgian region bordering the sea;
- Actions for specific target audiences/groups (€ 642.000)
    - Events;
    - Sport facilities;
    - School;
    - Youth;
    - Tourism (specifically coast tourism);
    - Recreational domains;
    - Airport Zaventem.
- Improvement of selective collection of packaging waste in terms of quality of waste to increase recycling rates, studies for optimising collection schemes, etc. (€335.000);
- Prevention actions, ecodesign actions, etc. (€90.000);
- R&D projects in terms of packaging types, costs of collection schemes, etc. (€130.000);
- Communication, awareness raising, international projects (€60.000).

In this way, packaging producers/importers partially contribute to marine litter aspects through the EPR scheme. It should also be noted that the Flemish anti-littering campaigns are also funded by the Belgian tobacco and gum industry.

In the Walloon Region, the budget was also spent for different aspects of the prevention and management of municipal packaging waste, such as:

- Actions for specific target audiences/groups (€ 475.086)
- Events (in the framework of the project “Emballagir”, www.emballagir.be);
- Prevention actions (Projects towards public cleanliness "Alapoubelle", distribution of cooking spatulas with an educational message, on civic amenity sites (€153.825)),
- Ecodesign actions (“Green Packaging award”) (€10.000);
- Communication (regional campaign on prevention (€106.550);
- Awareness raising (“ARENA game”) (€40.000).

In the Brussels Region, the budget is used for:

- Support for certain activities of Fost Plus: prevention actions (the "Greener packaging award), audits of packaging companies.
- Launching and monitoring of numerous studies to refine the strategy and /or communication tools for prevention of packaging waste:

- Study on innovative distribution systems to reduce packaging in the distribution;
- Study on reusable bags in small shops;
- Study on excess packaging and alternatives (results in 2013);
- Study on packaging produced within different scenarios of consumption (results in 2013);
- Starting a study on the environmental impact of disposable cups (results in 2013);

- The launch of a call for proposals to support prevention and sensitization actions from the field.
- Continuation of the program to support the transition to sustainable development of events.

6.7.2 Other cases

Belgium is certainly not a unique case. In the Netherlands, for instance, every year 20 Mio Euro from the producer EPR fees is reserved for anti-littering actions. Local authorities can apply for funding for their local littering campaigns, but the money is also used to finance the anti-littering organization Nederland Schoon that organizes national campaigns, carries out research and provides advice to companies.

In Australia, a differentiation is made between obligatory EPR and voluntary EPR schemes. Cigarette butt litter is subject to a voluntary EPR scheme. The three major producers in Australia are British American Tobacco Australia (BATA), Imperial Tobacco and Philip Morris. The latter two companies have funded campaigns of Keep South Australia Beautiful. BATA established the Butt Littering Trust (BLT) to focus on changing butt littering behaviour. More than 70 national projects were set up, including the Butt FREE Beach campaign. Some of these projects have been described in earlier sections of this chapter. However in 2011, BATA announced that they would discontinue financial support of the Trust and it ceased operation. The activities of Butt Free Australia have since been taken up by an NGO.

6.7.3 Conclusions on EPR as an instrument for marine litter reduction

Funding of anti-littering campaigns by producers of packaging, gum and tobacco products are already common practice in several countries, be it obligatory (e.g. Belgium, the Netherlands) or voluntary (e.g. Australia). In addition, producer responsibility was one of most strongly recommended actions for the plastic industry in the European Commission's stakeholder consultation.

As extended producer responsibility implies that a producer is responsible for its product during its entire life cycle, it would not be unreasonable to make producers (at least) financially responsible for street and marine litter. The industry claims that it cannot be made responsible for the behaviour of parties over which it has no control. This is partially true. Littering is a shared responsibility for producers, distributors and consumers along the life cycle phases of a product. The financial responsibility for producers in EPR systems could be a strong incentive for ecodesign or for adapted packaging and distribution strategies. There are ways to design packaging to make the packaging less prone to littering. In the Netherlands, for instance, a guide to anti-litter packaging has been developed[29]. It includes measures like making the packaging closable, avoiding loose parts, etc.

A part of the EPR fees can be used for litter prevention measures, such as investments in specific infrastructure like personal ashtrays or designated cigarette butt bins. Another part can be used for clean-up measures.

The concept of extended producer responsibility is clear: producers are responsible for the marine and street litter caused by their products. But putting this financial responsibility into practice will require research:

- For producers of tobacco products, the relationship between their product and the litter item is very straightforward. But with regard to packaging, only a part of packaging producers are responsible. The share of different types of packaging waste in street and marine litter should be determined and updated regularly to make individual producers responsible and not the whole of the packaging industry.
- The distribution of funding to local, regional and national authorities should be assessed. Questions such as the allocation to regions with a coastline (i.e. for marine litter) or those with larger urban areas (i.e. for street litter) should be addressed.

6.8 Conclusions and recommendations

6.8.1 The relation between key behavioural measures and key marine litter items

- There is potential for prevention of certain types of marine litter based solely on awareness-raising campaigns (e.g. disposal of cigarette butts by beach-users based on targeted campaigns and sanitary waste based on strong proper-disposal campaigns, with the support from producers). Such campaigns require significant outreach to be effective, either by big-scale campaigns involving industry and media or by a multiplication of small-scale, local initiatives;
- Economic incentives such as the Deposit-Refund scheme for beverage containers seem to be very effective in increasing collection rates of good quality material for recycling. Based on pilots that run for a short time, they tend to lead to a faster behaviour change than that observed as a result of awareness-raising and subsequent voluntary initiative of the individual. Economic incentives do not necessarily need to be directed at the individual concerned, as the Blue Lid Campaign in Turkey has shown, where a the benefit from an action was derived by a charity . Nevertheless, both approaches have the common characteristic of attributing a measurable value attributed to an item that otherwise would not be perceived.
- A key measure to prevent littering of smaller items is providing dedicated infrastructure. The reduction in amount of littered cigarette butts as a result of providing dedicated butt bins and personal ashtrays is remarkable.

[29] http://www.platformduurzaamverpakken.nl/media/boekje_verpakkingen.pdf

Unfortunately, few results are available on the effect of optimizing waste disposal infrastructure on littering of metal cans, food packaging, plastic bottles, etc. This could be an area for further research.

6.8.2 Matrix with the most effective measures per marine litter type / category

Below, the measures that have been discussed in previous sections of chapter 6 are presented with their effectiveness and feasibility. For more quantitative information on the effectiveness of these measures, we refer to chapter 7.

ML item	Measure	Where is impact situated	Effectiveness	Feasibility	Maximum observed reduction potential[30]
Cigarette butts	Dedicated butt bins	All locations	☺	☺	43.5%
	Ashtray cones	Beach	😐	☺	
	Awareness raising campaigns in combination with personal ashtrays	All locations	☺	☺	
Plastic bottle caps	Collection combined with a good cause	All locations, but most effect on beaches	☺	😐	No data
Plastic bottles & metal cans	Deposit refund system	All locations	☺	☹	38.95%
Cotton bud sticks	Awareness campaign with correct disposal logo	All locations	☺	☺	43.3%

Effectiveness: significant reduction in littering has been demonstrated

Feasibility: implementation has been proven to be easy with no disproportionate investments by authorities

[30] See chapter 7

7 Quantifying effects of anti-littering measures on marine litter

7.1 Method

From the literature described above we can retrieve or deduce more or less quantified information on the effect of specific anti-litter measures. We can derive which fraction of waste types or littered waste can be avoided by introducing specific measures focused not on general waste policy but on one specific frequently littered item.

To calculate the effect on marine litter we make following assumptions:

- We assume a direct linear relation between litter and marine litter, or sometimes between waste and marine litter. If the number of plastic bags consumed/littered generally drops by a certain percentage we assume that the number of plastic bags observed as beach litter will drop by the same percentage. If the number of littered cigarette butts reduces by another percentage we assume that the number of cigarette butts found in marine litter will drop accordingly.
- We analyse the effect on marine litter as if everything else remained unaltered. E.g. the effect of litter prevention measures for bottle caps will be assessed as if simultaneously no measures on packaging recycling are implemented. The figures calculated below are thus not to be counted together with the figures derived in chapter 4.3. General waste policy measures like targets on packaging will have an impact on bottle caps as well and will partially overlap with specific measures.

The effect of a measure on marine litter is expressed taking into account the diversity of each regional sea. We count together the number of items in the top ten and calculate the effect of specific measures on one of these items. Top ten items are as observed in chapter 4.2.2, but excluding “noise” as described further on in this report in chapter 8.1.2. It is good to exclude noise, because the level of defragmentation in noise largely contributes to the total number of items. Only in case the examined litter item (e.g. plastic bags) largely contributes to the noise, should we include specific types of noise.

We also compare with the total number of items found.

7.2 Cigarette butts

The presence of butt receptacles, either stand-alone, or integrated into a trashcan, correlate with lower rates of cigarette butt littering (Keep America Beautiful 2009). For cigarette litter, about 38% of littering was associated with the context of presence or absence of ashtrays. The Butt FREE Beaches campaign "Please butt it then bin it” of Butt Free Australia resulted in 2005 in a 43,5% butt litter reduction, based on quadrant butt litter counts on six participating beaches. (Surf Coast Shire, 2007).

The technique applied made use of the distribution of personal ashtrays and the installation of permanent butt bins for emptying the personal ashtrays. See paragraphs 6.3.2.1 and 6.4.2.2. If similar techniques were applied on European beaches, with a similar level of efficiency and success, this could lead to the following beach litter reduction performances:

sea north sea
measure cigarette butt littering prevention
effectiveness 43,50%

impact on marine litter			litter reduction
cigarette butt items observed	9	average #/100 m	
total items observed	585	average #/100 m	0,67 %
total top ten items observed	238	average #/100 m	1,64 %

OSPAR code		average #/100 m
32	String and cord (diamete	68
15	Caps/lids (total)	43
98	Cotton bud sticks	25
19	Crisp/sweet packets and	23
31	Rope (diameter more tha	20
115	Nets and pieces of net <	19
6	Food incl. fast food conta	11
4	Drink bottles (total)	10
3	Small plastic bags, e.g.,	10
64	Cigarette butts	9

sea baltic sea
measure cigarette butt littering prevention
effectiveness 43,50%

impact on marine litter			litter reduction
cigarette butt items observed	14	average #/100 m	
total items observed	139	average #/100 m	4,37 %
total top ten items observed	57	average #/100 m	10,68 %

OSPAR code		average #/100 m
64	Cigarette butts	14
15	Caps/lids (total)	7
45	Foam sponge (total)	7
96	Other ceramic/pottery ite	7
2	Bags (e.g. shopping)	5
6	Food incl. fast food conta	4
77	Bottle caps	4
22	Cutlery/trays/straws (tota	3
70	Wood Crates	3
19	Crisp/sweet packets and	3

sea	black sea
measure	cigarette butt littering prevention
effectiveness	43,50%

impact on marine litter			litter reduction
cigarette butt items observed	326	average #/100 m	
total items observed	912	average #/100 m	15,54 %
total top ten items observed	666	average #/100 m	21,29 %

OSPAR code		
64	Cigarette butts	326
19	Crisp/sweet packets and	86
4	Drink bottles (total)	85
15	Caps/lids (total)	49
78	Drink cans	44
3	Small plastic bags, e.g.,	31
6	Food incl. fast food conta	12
21	Cups	12
54	Clothing	11
77	Bottle caps	10

sea	mediterranean sea
measure	cigarette butt littering prevention
effectiveness	43,50%

impact on marine litter			litter reduction
cigarette butt items observed	326	average #/100 m	
total items observed	787	average #/100 m	18,01 %
total top ten items observed	628	average #/100 m	22,58 %

1	22	Cutlery/trays/s	131
2	64	Cigarette butts	112
3	15	Caps/lids (tota	110
4	4	Drink bottles (	91
5	2	Bags (e.g. sho	43
6	98	Cotton bud sti	37
7	60	Bags	35
8	91	Bottles	28
9	19	Crisp/sweet pa	26
10	6	Food incl. fast	15

The total number of beach litter items that would be found in case of implementation of cigarette butt prevention measures, which are as effective as on Australian beaches in 2005, decreases as follows:

	Reduction of top ten items	Reduction of total number of items
North sea	1,64%	0,67%
Baltic sea	10,68%	4,37%
Black sea	21,29%	15,54%
Mediterranean sea	22,58%	18,01%

Black sea and Mediterranean Sea data are based on smaller samples of beach litter screenings, and more sensitive to statistical outliers.

7.3 Plastic bags

In November 2013, the European Commission proposed an amendment to the Packaging and Packaging Waste Directive (94/62/EC) in order to reduce the consumption of lightweight plastic carrier bags. The proposal would require Member States to “take measures to achieve a reduction in the consumption of lightweight plastic carrier bags”. The impact assessment prepared by the Commission's services foresees added value from EU action in providing a common framework. It identifies overall savings and gains for producers, retailers and consumers from a policy combining a reduction target and charging for plastic bags. The European Parliaments initial appraisal of the impact assessment finds the EC proposal – which includes neither a reduction target nor pricing – largely coherent with the impact assessment, but lacking some of its ambition. On 10 March 2014, the Environment (ENVI) Committee (rapporteur Margrete Auken, Greens/EFA, Denmark) adopted a report with substantial amendments to the EC proposal. The amendments include mandatory charging for carrier bags in the food sector, and a recommendation to charge for bags in the non-food sector as well. Charges could be halved for bags that are both biodegradable and compostable. Within three years of its entry into force, MS would need to reduce their consumption by 50% of the EU average in 2010, and by 80% within five years. Very light bags (below 10 microns) used to wrap loose food would be exempt for five years, after which they would have to be replaced by bags of recycled paper or biodegradable and compostable bags. On 16 April 2014 the European Parliament adopted its position to reduce plastic bag consumption by 50% by 2017 and 80% by 2019. The proposal is awaiting further discussion in the aftermath of the EP elections.

Reduction of plastic carrier bags by 80% would have impact on the total of marine litter items. We consider OSPAR code 2 (bag e.g. shopping) but not OSPAR code 3 (small plastic bags e.g. freezer bags). OSPAR code 46 (plastic/polystyrene pieces 2.5 cm > < 50cm (total) and 117(plastic/polystyrene pieces 0-2,5 cm), which are considered ‘noise’, most probably contain a large fraction of fragmented plastic bags. In the calculation below it is difficult to exclude 46 and 117 as noise. Plastic bags easily defragment in a marine environment into less identifiable pieces, which are subsequently classified under codes 46 and 117.

We make the conservative assumption that 50% +- 25% of this waste also originates from plastic bags. This is merely an expert opinion based on own experience with beach litter screenings, but not supported by literature. While the precise proportion of marine litter attributed to plastic bags is uncertain, research and clean-up projects in different EU regions illustrate the scale of the problem. (European Commission 2013). The Impact Assessment on plastic carrier bags quoted bags accounting for 73% of the plastic waste collected by trawlers along the Tuscany coast (ARPA, ARPAT, DAPHNE II, 2011), or plastic bags representing more than 70% of total debris in most stations sampled in the Gulf of

Lions and around the cities of Nice and Marseille France (Galgani, 1996). Plastic bags were also found on UK beaches, reaching average densities of one bag every 23 meters (Marine Conservation Society, 2010), which gives an average of 4,3/100 m that is higher than the 0,8/100m average observed in the examined screenings for OSPAR code 2. Due to different observation techniques plastic bags may be overrepresented in floating litter and underestimated due to fragmenting and different classification in beach litter.

sea	north sea		
measure	plastic bag use reduction		
effectiveness	80,00%		
impact on marine litter			litter reduction
plastic bag observed	4	average #/100 m	
plastic bag fraction of plastic pieces	93	average #/100 m	
plastic bag fraction of plastic pieces upper limit	139	average #/100 m	
plastic bag fraction of plastic pieces lower limit	46	average #/100 m	
total items observed	585	average #/100 m	13,17 %
total items observed upper limit			19,49 %
total items observed lower limit			6,85 %
total top ten items observed	404	average #/100 m	19,08 %
total top ten items observed upper limit			28,24 %
total top ten items observed lower limit			9,92 %

46	*Plastic/polysty*	*104*
117	*plastic/polysty*	*81*
32	String and cor	68
15	Caps/lids (tota	43
98	Cotton bud sti	25
19	Crisp/sweet pa	23
31	Rope (diamete	20
115	Nets and piece	19
6	Food incl. fast	11
4	Drink bottles (t	10
2	*Bags (e.g. sho*	*4*

sea	baltic		
measure	plastic bag use reduction		
effectiveness	80,00%		
impact on marine litter			litter reduction
plastic bag observed	5	average #/100 m	
plastic bag fraction of plastic pieces	17	average #/100 m	
plastic bag fraction of plastic pieces upper limit	26	average #/100 m	
plastic bag fraction of plastic pieces lower limit	9	average #/100 m	
total items observed	139	average #/100 m	12,82 %
total items observed upper limit			17,80 %
total items observed lower limit			7,85 %
total top ten items observed	88	average #/100 m	20,31 %
total top ten items observed upper limit			28,20 %
total top ten items observed lower limit			12,43 %

46	*Plastic/polysty*	~~34~~
64	Cigarette butts	14
15	Caps/lids (tota	7
45	Foam sponge	7
96	Other ceramic	7
2	Bags (e.g. sho	5
6	Food incl. fast	4
77	Bottle caps	4
22	Cutlery/trays/s	3
70	Wood Crates	3

117	*plastic/polysty*	*1*

sea	black		
measure	plastic bag use reduction		
effectiveness	80,00%		
impact on marine litter			litter reduction
plastic bag observed	0,4	average #/100 m	
plastic bag fraction of plastic pieces	36		
plastic bag fraction of plastic pieces upper limit	54		
plastic bag fraction of plastic pieces lower limit	18		
total items observed	912	average #/100 m	3,19 %
total items observed upper limit			4,77 %
total items observed lower limit			1,62 %
total top ten items observed	713	average #/100 m	4,09 %
total top ten items observed upper limit			6,11 %
total top ten items observed lower limit			2,07 %

64	Cigarette butts	326
19	Crisp/sweet pa	86
4	Drink bottles (	85
46	*Plastic/polysty*	*57*
15	Caps/lids (tota	49
78	Drink cans	44
3	Small plastic b	31
6	Food incl. fast	12
21	Cups	12
54	Clothing	11

2	*Bags (e.g. sho*	*0,4*
117	*plastic/polysty*	*15*

sea	mediterranean		
measure	plastic bag use reduction		
effectiveness	80,00%		
impact on marine litter			litter reduction
plastic bag observed	43,0	average #/100 m	
plastic bag fraction of plastic pieces	15		
plastic bag fraction of plastic pieces upper limit	23		
plastic bag fraction of plastic pieces lower limit	8		
total items observed	787	average #/100 m	5,90 %
total items observed upper limit			6,66 %
total items observed lower limit			5,13 %
total top ten items observed	643	average #/100 m	7,22 %
total top ten items observed upper limit			8,16 %
total top ten items observed lower limit			6,29 %

22	Cutlery/trays/s	131
64	Cigarette butts	112
15	Caps/lids (tota	110
4	Drink bottles ((	91
2	Bags (e.g. sho	43
98	Cotton bud sti	37
60	Bags	35
46	*Plastic/polysty*	30
91	Bottles	28
19	Crisp/sweet pa	26
117	*plastic/polysty*	*0,1*

The total number of beach litter items that would be found in case of a reduction of the use of plastic carrier bags with 80% decreases as follows:

	Reduction of top ten items	Reduction of total number of items
North sea	19% (10%-28%)	13% (7%-19%)
Baltic sea	20% (12%-28%)	13% (8%-18%)
Black sea	4% (2%-6%)	3% (2%-5%)
Mediterranean sea	7% (6%-8%)	6% (5%-7%)

Black sea and Mediterranean Sea data are based on smaller sample of beach litter screenings, and more sensitive to statistical outliers.

7.4 Bottle caps

Two "Blue Lid" projects in Turkey resulted in the voluntary collection and recycling of bottle caps. See paragraph 6.3.2.2

- For the period 2010-2012, 280 tons of bottle caps were collected for the Faculty of Dentistry, Ege University.
- For the period 2011-2013, 250 tons of bottle caps were collected for the Spinal Cord Paralytics Association of Turkey.

Very roughly we could assess the success of the bottle cap collection at between 80 and 180 tons/year. Unfortunately there are no data available on the number of bottles being put on the market nor on the amount of bottles recycled. We thus cannot asses in how far the actions contributed in raising the recycling percentages for bottle lids. The bottle caps collected originate from:

- Bottles that were to be recycled
- Bottles that were to be disposed of through landfills or incineration
- Bottles or bottle caps that would have been littered.

We can only assume that a successful bottle cap campaign will contribute in the reduction of bottle cap in beach litter.

	total	top ten items
North sea	average #/100m	average #/100m
average number of items	585	238
average number of bottle caps	43	
marine litter reduction in case of 20% caps reduction	1,5%	3,6%
marine litter reduction in case of 50% caps reduction	3,7%	9,0%
marine litter reduction in case of 100% caps reduction	7,3%	18,1%

Baltic sea		
average number of items	139	57
average number of bottle caps	7	
marine litter reduction in case of 20% caps reduction	1,0%	2,5%
marine litter reduction in case of 50% caps reduction	2,5%	6,1%
marine litter reduction in case of 100% caps reduction	5,0%	12,3%

Black sea		
average number of items	912	666
average number of bottle caps	49	
marine litter reduction in case of 20% caps reduction	1,1%	1,5%
marine litter reduction in case of 50% caps reduction	2,7%	3,7%
marine litter reduction in case of 100% caps reduction	5,4%	7,4%

Mediterranean sea		
average number of items	787	628
average number of bottle caps	110	
marine litter reduction in case of 20% caps reduction	2,8%	3,5%
marine litter reduction in case of 50% caps reduction	7,0%	8,8%
marine litter reduction in case of 100% caps reduction	14,0%	17,5%

Depending on the success ration of a bottle lid campaign, and on the occurrence of bottle lids in the marine litter of a regional sea, between 1% and 7% of all marine litter could be avoided. When focusing on the top ten items the results are higher, with potential reductions of up to 18% in the North Sea if a 100% reduction were achieved.

7.5 Cotton buds

The UK awareness campaign *Bag it, Bin It* aimed at reducing the incidence of sanitary items and other sewage related debris on UK beaches and riverbanks. In 2007 and 2008, the Marine Conservation Society and Surfers Against Sewage focused the Bag it and Bin it campaign on cotton bud sticks. See paragraph 6.4.2.3. The campaign received support from leading retailers. Results from the 2007 MCS Beachwatch event marked a decrease in the number of cotton bud sticks observed on UK beaches, from 172 items/km in 2006 to 97,5 items/km in 2007.

A successful reduction campaign thus succeeded in reducing the number of cotton buds in marine litter by 43,3%

Sufficient data on the prevalence of cotton bud sticks are only available for the North Sea and the Mediterranean Sea in order to make an assessment:

sea	north sea		
measure	cotton buds littering prevention		
effectiveness	43,3%		
impact on marine litter			litter reduction
cotton bud items observed	25	average #/100 m	
total items observed	585	average #/100 m	1,85 %
total top ten items observed	238	average #/100 m	4,55 %

OSPAR code		average #/100 m
32	String and cord (diameter les	68
15	Caps/lids (total)	43
98	Cotton bud sticks	25
19	Crisp/sweet packets and lolly	23
31	Rope (diameter more than 1 (	20
115	Nets and pieces of net < 50 (	19
6	Food incl. fast food container	11
4	Drink bottles (total)	10
3	Small plastic bags, e.g., free	10
64	Cigarette butts	9

sea	mediterranean sea
measure	cotton buds littering prevention
effectiveness	43,3%

impact on marine litter			litter reduction
cotton bud items observed	37	average #/100 m	
total items observed	787	average #/100 m	2,04 %
total top ten items observed	628	average #/100 m	2,55 %

22	Cutlery/trays/straws (total)	131
64	Cigarette butts	112
15	Caps/lids (total)	110
4	Drink bottles (total)	91
2	Bags (e.g. shopping)	43
98	Cotton bud sticks	37
60	Bags	35
91	Bottles	28
19	Crisp/sweet packets and lolly	26
6	Food incl. fast food container	15

The total number of beach litter items that would be found, in case of a cotton but action as successful as in the UK in 2007, decreases as follows:

	Reduction of top ten items	Reduction of total number of items
North sea	4,5%	1,8%
Mediterranean sea	2,5%	2,0%

7.6 Refund plastic bottles and tin cans

The Norsk Resirk refund system reported in 2011 a return of 98% of participating plastic bottles and 96% of participating cans. The Dansk Retursystem reported an overall return rate of 89% for single-use beverage packaging. The Deposit-Refund Scheme pilot study in Cadaqués, Catalonia reported an average return rate of 76.6% which was however peeking towards the end of the pilot at 91.2%. See chapter 6.5.

Based in these three cases we assume that single use beverage packaging refund systems can lead towards 92% collection and recycling, independent of the regional sea where it is applied.

To assess the impact on such a refund system we will have to assess the amount by which the recycling of this kind of packaging is increased. Only the increase compared to a 'business as usual' assessment is important in order to calculate the impact of the refund system on marine litter, on top on existing collection and recycling efforts.

In the Spanish case a zero-assessment was made. Of 9 million beverage containers sold, 3,5 million were collected for recycling, and 5,5 million were not. The recycling rate without refund systems was thus 39%. The refund system has led to a supplementary recycling of 92-39 = 53%. A 53% reduction in the marine litter fraction of bottles and cans may be expected as a result.

For the Danish and German cases we cannot use a zero-assessment (i.e. a counterfactual where the system was not in place) as the system has been operational for a longer time.

For each EU member state bordering a regional sea we assess the possible benefit of a refund system by comparing 92% with the actual recycling rate of single use packaging as reported by Eurostat. The average is weighed based on the total length of the Member States coastline within each regional sea.

We assess the impact of refund systems on the OSPAR marine litter categories drink bottles – plastic (4), bottle caps - plastic (15), caps and lids - iron (77), drink cans (78), bottles - glass (91)

	recycling rate single use packaging (%) EUROSTAT [env_waspac] 2011	coastline length km) GIS analysis	impact of deposit refund system (%)	weighed impact (%)
North-east atlantic				28 %
Denmark	54	1635,7	**0**	
Germany	72	784,5	20	
Netherlands	72	1409,8	20	
Belgium	80	65,5	12	
France	61	2485,8	31	
Spain	64	1263,1	**53**	
Portugal	58	937,4	34	
UK	61	8880,6	31	
Ireland	71	2395,9	21	
Baltic sea				34 %
Denmark	54	2302,1	38	
Germany	72	1099,3	20	
Poland	41	625,3	51	
Lithuania	62	191,2	30	
Latvia	51	492	41	
Estonia	63	1199	29	
Finland	59	2426,1	33	
Sweden	57	4744,8	35	
Mediterranean sea				39 %
Spain	64	1903,6	**53**	
France	61	648,5	31	
Italy	65	4745,9	28	
Slovenia	64	22,2	28	
Croatia		1750,5	92	
Greece	62	6511,4	30	
Cyprus	52	564,9	40	
Malta	42	63,6	50	
Black sea				35 %
Romania	50	353,9	42	
Bulgaria	65	277	27	

For each regional sea the impact is assessed as follows. Top ten is expanded to all beverage packaging litter items[31]:

[31] Note that the average number of litter items per 100m is represented as an integer while the individual item totals are calculated to some decimal places (See Annex 7). This explains why the sum of "beverage packaging observed" may differ by one unit from the sum of the integers represented below.

sea north sea
measure deposit refund
effectiveness 27,56%

impact on marine litter		litter reduction
beverage packaging observed	58 average #/100 m	
total items observed	585 average #/100 m	2,71 %
total top items observed	243 average #/100 m	6,54 %

OSPAR code		average #/100 m
32	String and cord (diameter less than 1	68
15	Caps/lids (total)	43
98	Cotton bud sticks	25
19	Crisp/sweet packets and lolly sticks (	23
31	Rope (diameter more than 1 cm)	20
115	Nets and pieces of net < 50 cm	19
6	Food incl. fast food containers	11
4	Drink bottles (total)	10
3	Small plastic bags, e.g., freezer bags	10
64	Cigarette butts	9

77	Bottle caps	1
78	Drink cans	2
91	Bottles	1

sea baltic sea
measure deposit refund
effectiveness 34,28%

impact on marine litter		litter reduction
beverage packaging observed	15 average #/100 m	
total items observed	139 average #/100 m	3,59 %
total top items observed	61 average #/100 m	8,25 %

OSPAR code		average #/100 m
64	Cigarette butts	14
15	Caps/lids (total)	7
45	Foam sponge (total)	7
96	Other ceramic/pottery items	7
2	Bags (e.g. shopping)	5
6	Food incl. fast food containers	4
77	Bottle caps	4
22	Cutlery/trays/straws (total)	3
70	Wood Crates	3
19	Crisp/sweet packets and lolly sticks (	3

4	Drink bottles (total)	1
78	Drink cans	1
91	Bottles	1

sea	black sea
measure	deposit refund
effectiveness	35,37%

impact on marine litter		litter reduction
beverage packaging observed	219 average #/100 m	
total items observed	912 average #/100 m	8,50 %
total top items observed	697 average #/100 m	11,12 %

OSPAR code		
64	Cigarette butts	326
19	Crisp/sweet packets and lolly sticks (	86
4	Drink bottles (total)	85
15	Caps/lids (total)	49
78	Drink cans	44
3	Small plastic bags, e.g., freezer bags	31
6	Food incl. fast food containers	12
21	Cups	12
54	Clothing	11
77	Bottle caps	10

91	Bottles	31

sea	mediterranean sea
measure	deposit refund
effectiveness	38,95%

impact on marine litter		litter reduction
beverage packaging observed	241 average #/100 m	
total items observed	787 average #/100 m	11,92 %
total top items observed	640 average #/100 m	14,67 %

22	Cutlery/trays/straws (total)	131
64	Cigarette butts	112
15	Caps/lids (total)	110
4	Drink bottles (total)	91
2	Bags (e.g. shopping)	43
98	Cotton bud sticks	37
60	Bags	35
91	Bottles	28
19	Crisp/sweet packets and lolly sticks (	26
6	Food incl. fast food containers	15

77	Bottle caps	1
78	Drink cans	11

The total number of beach litter items that would be found in case of implementation of deposit refund systems for single use beverage packaging, decreases as follows:

	Reduction of top items	Reduction of total number of items
North sea	6,5%	2,7%
Baltic sea	8,3%	3,6%
Black sea	11,1%	8,5%
Mediterranean sea	14,7%	11,9%

Black sea and Mediterranean Sea data are based on smaller sample of beach litter screenings, and more sensitive to statistical outliers.

7.7 Conclusions

Wherever a single litter type is sufficiently present in the observed marine litter composition, anti-littering measures dedicated to this specific litter item will have some effect, ranging from a couple of percentage points to 10% or more on the total number of beach litter items found.

This shows that beyond taking general policy measures on waste recycling (e.g. general recycling targets for some materials) a significant effect can be expected from specific measures.

We calculated in previous chapters what level of marine litter reduction would correspond to implementing different options for general waste policy measures. See Table 13: summary table of impact of policy option on marine litter, compared to a 2015 benchmark. This target hardly ends up at a reduction of 35% of marine litter items compared to a benchmark value. However, when on top of these general policy options (usually general waste recycling targets) we add some of the specific measures as mentioned in this chapter 7, a target for marine litter inflow reduction of up to 50% could be seen as achievable. See also next chapter 8 on the definition of a marine litter headline deduction target proposal.

One should however take into consideration that the outcome of general waste policy measures and the outcome of specific marine litter item measures are difficult to add up. The figures calculated in this chapter 7 only represent the impact of a specific litter target in case no other measures are taken.

8 Quantitative headline reduction target for marine litter

8.1 Concept description of the proposed headline target

8.1.1 Wording

The proposed headline target can be described as:

"A -30% reduction of the number of items of the top ten litter categories found as coast litter in each regional sea, by 2020, compared with 2015, applying the beach litter protocol from the technical guidance documents and excluding fragmented or undefinable litter items with guidance document codes G75, G76, G134, G145, G158, G210"

-30% reduction reflects the maximum achievable impact due to the proposed waste recycling targets under Option 3.4 (-17% reduction) but necessitates a supplementary effort specifically oriented towards the major marine litter sources for each regional sea. The target remains well under the maximum feasible results (-36% reduction) in which all Member States equal the recycling levels of the actual top three for each waste type, and in which absolute decoupling is achieved for both municipal and industry waste.

See also chapters 7.7 and 8.2 for the possible introduction of a target of -50%, which includes much more the effects of separate marine litter measures on top of the general waste management policy.

8.1.2 Exclusion of "noise"

Marine litter items such as plastic, rubber or cloth pieces with OSPAR codes 46, 53, 59, 67, 93, 117 should be considered as 'noise'. Their numbers can increase due to further fragmentation instead of increased inflow, and due to their fragmented nature links with pathways and sources are much more difficult to establish.

OSPAR code	Master List Technical Guidance Document	OSPAR item description
46	G76	Plastic/polystyrene pieces 2.5 cm > < 50cm (total)
53	G134	Other rubber pieces
59	G145	Other textiles
67	G158	Other paper items
93	G210	Other glass items
117	G75	plastic/polystyrene pieces 0-2,5 cm

8.1.3 Top ten items

The top ten items, described with their OSPAR codes, to be considered for each regional sea is as follows. Of course this must be amended based on 2015 data:

Baltic Sea:

OSPAR code	Description
64	Cigarette butts
15	Caps/lids (total)
45	Foam sponge (total)
96	Other ceramic/pottery items
2	Bags (e.g. shopping)
6	Food incl. fast food containers
77	Bottle caps
22	Cutlery/trays/straws (total)
70	Wood Crates
19	Crisp/sweet packets and lolly sticks (total)

Black Sea:

OSPAR code	Description
64	Cigarette butts
19	Crisp/sweet packets and lolly sticks (total)
4	Drink bottles (total)
15	Caps/lids (total)
78	Drink cans
3	Small plastic bags, e.g., freezer bags
6	Food incl. fast food containers
21	Cups
54	Clothing
77	Bottle caps

Mediterranean Sea:

OSPAR code	Description
22	Cutlery/trays/straws (total)
64	Cigarette butts
15	Caps/lids (total)
4	Drink bottles (total)
2	Bags (e.g. shopping)
98	Cotton bud sticks
60	Bags
91	Bottles
19	Crisp/sweet packets and lolly sticks (total)
6	Food incl. fast food containers

North Sea:

OSPAR code	Description
32	String and cord (diameter less than 1 cm)
15	Caps/lids (total)
98	Cotton bud sticks
19	Crisp/sweet packets and lolly sticks (total)
31	Rope (diameter more than 1 cm)
115	Nets and pieces of net < 50 cm
6	Food incl. fast food containers
4	Drink bottles (total)
3	Small plastic bags, e.g., freezer bags
64	Cigarette butts

8.1.4 Advantages

Advantages of this approach are:

- It allows for regional/local specificity (e.g. top items in the Mediterranean Sea can be different from items in North-East Atlantic).
- Targeting specific items will facilitate consideration of a more robust statistical baseline (less variability than e.g. total number of items, quantities by weight, or specific material types) and therefore its monitoring will be more reliable.
- It is connected to sound and well-established indicators because beach litter monitoring can be used. Beach litter, monitored under OSPAR-like methods and nomenclature, is very visible, relatively easy to monitor, and consists largely of the final stages of a pathway of new litter towards the seas: a predominance of new litter above accumulated old litter.
- It enables operational targets to be formulated addressing the specific main sources and it can be linked directly to measures.
- Operational targets that reflect prevention, i.e. preventing items disposed from becoming marine litter, can be monitored more easily and are more reliable than a state-based target (which includes also marine litter accumulated over time, or transported from elsewhere without really reflecting additional input).

8.1.5 Alternatives

Alternative headline reduction target approaches could be:

- Top ten included in the headline reduction target;
- Top ten not mentioned, but only included in the measuring methodology;
- Target without referring to top ten litter items;
- Reduction percentage related to a reference year (2015);
- Reduction percentages related to an absolute value calculated under BAU for (2020);
- Reduction percentages related to an absolute value calculated under full compliance scenario for (2020);
- Reduction percentages reflecting the expected result for the selected waste management scenario (e.g. option 3.4);
- Reduction percentages higher than the expected result for the selected waste management scenario (e.g. option 3.4), taking into account the necessity to take specific litter- oriented measures beyond general waste policy measures.

8.2 Evaluation of the proposed indicator

8.2.1 Evaluation against criteria for good indicators/targets

8.2.1.1 Criteria for good indicators/targets

A good target, and its related indicator, needs to be:

- **Pertinent**: giving answers to the right questions. A reduction target needs to give answers on the question ”Is reduction taking place, in a sufficient way? Are the policy measures taken sufficiently adequate to obtain the reduction target?” The indicator has to serve multiple goals including state-of-the-environment measuring, support to policy development, policy evaluation, and communication.
- Based on **available data**: sufficient rough data or information as raw material needs to be accessible to construct the indicator. For marine litter in particular this can be an issue because data are scarce and often limited to either pressure data on litter quantities, or response data on nature and scale of policy measures taken. Data that can be put into a cause-effect relationship are scarce. It is advisable to use the amount of litter still entering the marine environment instead of the amount of litter already present in the seas.
- Respecting **data compatibility**: compatibility with Union waste data and commonly used litter indicators. Preferred data are those published on the EUROSTAT website, and the data collected using the standardised methods described in the (draft) “Monitoring Guidance for Marine Litter in European Seas” from WG-GES.
- Respecting **transferability**: transferability of the indicator to the different Member States and seas. Although the target and its indicators should be universally applicable, it could also take into account the regional context of each Member State or sea.
- **Popular**: The frequency of use of this type of indicator target is important. The use of existing and well established concepts could be an asset, because it will be more easily accepted than a brand new concept This might however be challenging for a relatively new policy domain like marine litter.
- **Mature**: The degree of maturity of the indicator, its proven quality and support. For the moment no widely-accepted, bottom-up factual standard for measuring marine litter and its progress towards a good environmental status has been developed. However, the “Monitoring Guidance for Marine Litter in European Seas” from WG-GES may be a

first step towards such a standard. The maturity of the proposed indicators will depend upon the maturity of its composite elements. Some problems occur with reliability, comparability and consistency of the statistics, but as experience is built up and quality control systems are introduced, the quality of marine litter statistics should increase.

- **Credible**: the target and its indicator need to be scientifically and statistically reliable, credible and robust. The methodology to calculate the indicator should be transparent, repeatable, unbiased and as simple as is practical. The indicator must be designed in a way that major players can agree on its relevance for a longer-term period.
- **Representative**: The indicator has to reflect developments in the topic area appropriately: indicators have to reflect the relation between the measures or policy mix applied and the effect on marine litter generation and composition/properties. This is sometimes difficult. If an indicator depends upon a direct measurement of the application of an instrument (output indicator), then there is detailed information on the instrument but the real impact of this instrument on the environment is not known. If the direct impact is measured (outcome indicator), then there is detailed information on the impact but uncertainty about its relationship to the instruments applied. With a single indicator you can measure one of these two aspects, but not both together.
- **Fit for Prioritization** of measures: the indicator must offer the political actors information about where the highest environmental benefits can be achieved given limited resources: This expands the scope of the indicator considerably. It should not only be usable for describing reality and defining policy needs, setting targets and measuring distance-to-targets, but also enable an ex-ante evaluation of the measures to be applied. This can only be achieved if indicators are comparable and allow cross-border benchmarking or learning from successes and failures in other Member States.

8.2.2 Evaluation against alternatives

8.2.2.1 Analysis

Five different levels represent the way in which a target approach corresponds with the criteria for good indicators; three grades for well performing approaches (☺ ☺ ☺ ; ☺ ☺ , ☺), one for neutral performing approaches 😐, and one for badly performing approaches ☹ .

	Reduction target on top ten items per regional sea	Reduction target on predefined EU top ten items	Reduction target on all litter, top ten only included in measuring method	Reduction target on all litter, no top ten approach	Reduction target referring to a reference year (2015)	Reduction target referring to a contemporary BAU estimate	Reduction target referring to a contemporary full compliance estimate	Reduction target reflecting the outcome of a general waste policy scenario	Reduction target above the outcome of a general waste policy scenario
Pertinent	☺ ☺ ☺ focus on real issues and identifiable items	☺ ☺ focus on real issues and identifiable, but predefined issues	😐 Misfit between generalist target and restricted calculation method [32]	☺ Focus on everything, including ‘noise’ or less relevant or non-identifiable items[33]	☺ Evaluation of policy measures generating progress over time	😐 Evaluation of progress in the absence of any further action (even though such action is required)	☹ Evaluation of progress above a (possibly outdated) legal minimum	😐 Target moderate, reflects the expected outcome on marine litter of other targets on recycling or landfill : spin-off	☺ ☺ Target ambitious, reflects the outcome of dedicated supplementary marine litter measures above general waste policy: larger challenge

[32] Less problematic as top ten covers the larger part of all litter.

[33] Including noise has disadvantages, as a problematic identification of sources and pathways on which policy can focus, but including noise has the advantage of not neglecting a quantitatively large fraction of marine litter

Data available	☺ Requires structured repeated data collection, once to identify top ten, and further only on top ten	☺ ☺ Requires structured repeated data collection only on top ten	☺ Requires structured repeated data collection, might be once to identify top ten, and further only on top ten	😐 Requires structured repeated data collection on all items, including fragmented items[34].	☺ ☺ Fixed and stable data used for benchmark	☹ The BAU has to be assessed with some uncertainty, and might be outdated at the moment of evaluation	☹ The compliance scenario has to be assessed with some uncertainty, and refers to legislation that may be updated.	☺ Based on modelling with known and predefined recycling targets (see chapter 4)	☹ Based on the assessed but uncertain outcome of specific measures (see chapter 6) on top of the modelling with recycling targets[35]
Data compatible	☺ ☺ ☺ In line with master list	☺ ☺ ☺ In line with master list	☺ ☺ ☺ In line with master list	☺ ☺ ☺ In line with master list	☺ ☺ ☺ In line with master list	😐 Depends on quality of modelling	😐 Depends on quality of modelling	😐 Data on decoupling and prevention are not included	☹ Modelling based on very limited available data from pilot cases
Transferable	☺ ☺ Adapted to local conditions in each regional sea	☹ Not adapted to local conditions in each regional sea	☺ Might be adapted to local conditions in each regional sea	😐 Not adapted to local conditions in each regional sea, but generally applicable	☺ ☺ Adaptable to local conditions	☺ ☺ Adaptable to local conditions	☺ ☺ Adaptable to local conditions	☺ ☺ Adaptable to local conditions	☺ ☺ Adaptable to local conditions

[34] Including fragmented items has the risk to count the degree of fragmentation instead of the degree of occurrence. This can cause 'noise' or distortion of the figures.
[35] Problems occur when the impact on marine litter from general waste policy has to be added to the impact of specific marine litter measures

Popular	☺ ☺ Based on known beach screening methods	☺ ☺ Based on known beach screening methods	☺ ☺ Based on known beach screening methods	☺ ☺ Based on known beach screening methods	☺ ☺ Based on known beach screening methods	☺ Based on known beach screening methods and on modelling	☺ Based on known beach screening methods and on modelling	☺ Easier to obtain political consensus (better for binding targets)	☹ More challenging and thus less easy to obtain political consensus (better for voluntary targets)
Mature	☹ ☹ Never done before	☹ ☹ Never done before	☹ ☹ Never done before	☹ ☹ Never done before	☹ ☹ Never done before	☹ ☹ ☹ Never done before and complex	☹ ☹ ☹ Never done before and complex	☹ ☹ Never done before	☹ ☹ Never done before
Credible	😐 Depends strongly on data quality	😐 Depends strongly on data quality	😐 Depends strongly on data quality	😐 Depends strongly on data quality	😐 Depends strongly on data quality	☹ Depends strongly on data quality and modelling quality	☹ Depends strongly on data quality and modelling quality	☹ Depends strongly on data quality and modelling quality	☹ Depends strongly on data quality and modelling quality including extrapolation of pilot studies
Representative	☺ Good to identify measures influencing the top ten	☺ Good to identify measures influencing the top ten	☹ Issues outside top ten may be unintentionally overlooked	☺ ☺ Good to identify measures influencing litter issues inside and outside the	☺ ☺ ☺ Good to identify overall progress, disregarding the reason of progress	☺ Only able to identify progress above progress that will occur	☺ Only able to identify progress above progress from efforts for compliance	😐 Only representing general waste policy ambitions	☺ Also representing policy ambitions for specific marine litter measures

				top ten, but risk of noise	(outcome indicator)[36]	anyway under stand- still conditions (output indicator)	(output indicator)		
Fit for prioritisation	☺ Limited to the top ten per regional sea	😐 Limited to the EU top ten	☺ Limited to the top ten per regional sea	😐 Less limited, but risk of noise	☹ Less link to specific policy measures	☺ ☺ ☺ Strong link to specific policy measures	☺ Link to certain specific policy measures, excluding measures on better implementation	☺ Prioritisation to be done at a general level	☺ Prioritisation to be done at the level of marine litter measures
analysis	☺ : 13 😐 : 1 ☹ : 2 preference	☺ : 10 😐 : 2 ☹ : 3	☺ : 8 😐 : 2 ☹ : 3	☺ : 8 😐 : 4 ☹ : 2	☺ : 13 😐 : 1 ☹ : 3 preference	☺ : 7 😐 : 2 ☹ : 5	☺ : 5 😐 : 2 ☹ : 6	☺ : 5 😐 : 3 ☹ : 3	☺ : 6 😐 : 0 ☹ : 6

[36] Although both approaches have their advantages, we prefer measuring the outcome, which is the progress in terms of good environmental status above a more output related indicator measuring the effectiveness of new policy instruments. The final goal is not to have efficient instruments but to reach at good environmental status. The goal is more important than the means, although good means will help achieving the goal. The focus on the goal is also motivated by the difficulty and the inherent uncertainty in linking means or instruments with outcome.

8.2.2.2 Conclusions

- The preferred target is based on the progress made on marine litter in the ten headline litter items for each individual regional sea. It is based on a zero-measure in a benchmark year which could be 2015. This year is chosen as it is the first full year for which monitoring data under the MSFD should be available
- The multi criteria analysis is less definitive
  - whether the height of the target should reflect the expected results of an ambitious general waste management policy with renewed targets for waste recycling, in case a -35% reduction by 2030 compared with 2015, or
  - whether it should also reflect the necessity to apply specific marine litter measures that can have a considerable impact on the litter reduction achievable, as calculated in chapter 7. A possible headline target could be -50% reduction by 2030 compared with 2015.
- This is a political choice that can be based on
  - Political levels of acceptance for this kind of targets
  - Political levels of ambition in the transition towards a good environmental status in the marine environment
  - The political choice to apply a target value of an obligatory or voluntary nature as a means to achieve this goal.

9 Benefits of reducing marine litter

9.1 Quantitative analysis of cost of degradation

Marine litter can cause serious economic losses to various sectors and authorities. Among the most seriously affected are coastal communities (increased expenditure on beach cleaning, public health and waste disposal), tourism (loss of income, bad publicity), fishing (reduced and lost catch, damaged nets and other fishing gear, fouled propellers, contamination) and shipping (costs associated with fouled propellers, damaged engines, litter removal and waste management in harbours). Economic costs are lost benefits to society (welfare effects).

The European Handbook on economic analyses for the MSFD states that ‘a socio-economic analysis aims to identify the impact on human welfare of a given policy. (European Commission, Working Group on Economic and Social Assessment, 2010).This includes economic as well as social aspects, and may include consideration of the distribution of these impacts across stakeholders. This section provides an assessment of the costs associated with the current degradation of the marine environment. The assessment uses a cost-based approach to understand impacts on human welfare arising from marine litter Unit costs from existing literature have been extrapolated to EU level, per sector. For the fishing sector, the costs of damage which have been found have been checked against the estimated % negative impact on fishery revenue.

Although marine litter has received increasing attention in recent years, few studies have explored its economic impact. Some literature does exist, however, and the following studies have been ranked based on their relevance:

- EU (mainly North Sea: UK, Scotland, Netherlands):
  - Mouat et al.; 2010 (mainly based on Hall; 2000)
  - Reinhard et al.; 2012
  - Wurpel et al. ; 2011
  - Fanshawe et al.; 2002
- Outside EU
  - STAP; 2011 (APEC countries).
  - McIlgorm et al.; 2008 (APEC countries).
  - Macfadyen, et al.; 2009 (UNEP; worldwide)

9.1.1 Tourism & recreation sector

Marine litter affects the aesthetic pleasure of tourists and local visitors to beaches. In the Mediterranean and Black Sea region, this impact is particularly acute as a result of the prevalence of sanitary and sewage-related waste, originating from mainland waters and coastal settlements.

For most municipalities and the private sector (e.g. holiday resorts in the Mediterranean Sea), the potential economic impact of marine litter on tourism is the principal motivation for removing beach litter. From this point of view, regular cleaning of beaches costs less than the potential reduction in revenue that could result from taking no action. Voluntary organisations also remove a significant amount of litter from beaches and the coastline, especially throughout the Northeast Atlantic and Baltic region. The following unit costs for beach cleaning activities have been found in the literature, subdivided by beach type:

Table 18: Beach cleaning costs, per beach type (source Mouat; 2010; Arcadis; 2013; Reinhard et al; 2012)

Beach type	Cost per km (€)	*year data*	Location	Sea[37]
Bathing	34.450	*2010*	Touristic beaches NL & B 10 municipalities	NS
	28.320	*2010*	Touristic beaches; NL 6 municipalities	NS
	38.190	*2010*	Spain: bathing beach	MED
	31.796	*2010*	Portugal: bathing beach	ATL
Non-bathing	214	*2010*	Sweden, non-bathing beaches	BAL
	372	*2010*	Denmark, non-bathing beaches	NS
Bathing & non-bathing	7.150	*2010*	UK, also cleaning of less touristic beaches	NS
	3.750	*2012*	Latvia (Riga) bathing & non-bathing beach	BAL
	11.000	*2007*	NL: average total coast length	NS
	8.278	*2010*	Portugal: bathing & non bathing beach	ATL

The table highlights large differences in cleaning costs between bathing and non-bathing beaches. One of the factors which influence cost is the intensity of beach use, which has an impact on the frequency of the need for cleaning. Designated bathing beaches (and their surrounding coastal areas) have to be cleaned regularly, generally by dedicated staff. Frequency is generally increased from Easter to September each year (Reinhard et al, 2012). Non-bathing beaches, if cleaned at all, have a cleaning frequency of 1 or 2 times per year (often in spring and on a (semi-) voluntary basis). More above, bathing beaches are littered with several small items, such as cigarette butts and lids. Such litter is more labour intensive to clean than larger items. Another factor influencing cost is the material type. Sandy beaches can be mechanically cleaned, which is less costly. This mechanical beach cleaning, however, is not feasible in coastal areas with rocky beaches (e.g. the Mediterranean Area). Costs for beach cleaning are generally borne by a mix of municipal authorities, the recreation industry and volunteers.

The perceived loss of amenity of fouled beaches can cause consumers to move to other beaches and coastal areas, leading to a loss of expenditure to the region. The economic loss to the whole EU economy is then represented by the relative

[37] NS: North Sea; MED: Mediterranean Sea; BAL: Baltic Sea; ATL: Atlantic Ocean;

change in values by consumers using a substitute beach. On an international scale, tourists may choose between holiday locations in different countries on the basis of the cleanliness of beaches. No overall welfare loss is observed where tourists choose one EU coastal area over another. However, losses occur if tourists choose a beach destination outside the EU, or choose to reduce their total beach visits. Quantification of this substitution effect is not straightforward. Cefas, the UK Centre for Environment, Fisheries and Aquaculture Science notes that "the levels of additionality and displacement within local, regional and national economies as a result of marine litter, are not known" (Cefas; 2012).

Based on the outcomes of Table 18, a minimum, maximum and average cleaning cost has been calculated, taking into account the beach type (i.e. "bathing & non bathing"). All cost data has been converted to 2013 prices using a GDP deflator.

Table 19: Cost of beach cleaning in the EU

	cost per km (€)	length of EU beaches (km)[38]	cost in the EU (m€)
Average	8.171	50.600	413,47
Minimum	3.828	50.600	193,70
Maximum	12.446	50.600	629,78

The estimates of these cost to the tourism and recreation sector (on average 413,47 €m per year) are extrapolated from individual figures of beach cleaning activities and therefore are subject to a high degree of uncertainty. It is vital to understand the assumptions made here. The most significant assumption is the extrapolation of beach cleaning costs of mainly Northern MS to the 4 EU regional seas, and the assumption that all bathing and non-bathing beaches are cleaned (which is not the case especially in the Med. & Black Sea).

9.1.2 Fishing sector

9.1.2.1 Cost analysis, per damage category

Fishing vessels experience a variety of issues due to marine litter. In the survey of Scottish fishing vessels[39] within the study "Economic Impacts of Marine Litter" (Mouat; 2010), 86% of fishermen experienced a reduced catch due to marine litter, 82% had their catch contaminated and 95% had snagged their nets on debris on the seabed. Just less than 1 incident per vessel per year due to fouled propellers and blocked intake pipes has been reported[40]. Research within the Fishing for Litter project in the UK South West region has shown that marine litter can cost the fishing industry up to £10.000 per boat, each year, through contamination of catches, broken gear and fouled propellers (KIMO; 2010).

[38] Source: own GIS analysis of EU coastline

[39] The majority of questionnaire responses received came from trawlers.

[40] As a comparison, Wallace (1990) reported that in the eastern US, over 45% of the commercial fishermen had their propellers caught, over 30% had their gear fouled, and over 35% had their engine's cooling system clogged by plastic debris.

The total costs of marine litter related incidents for EU fisheries are estimated using the average costs of marine litter per vessel in the Scottish fleet, analysed by Fanshawe (2002), Mouat et al (2010) and KIMO (2010)[41]. In the UK Cost Benefit Analysis for the MSFD (Cefas; 2012), average costs of litter to the fishery sector have been disaggregated into two categories.

a) Costs related to marine litter on the sea bottom
b) Costs related to marine litter in the water column

This is due to the different economic costs of marine litter impacts associated with specific fishing methods. Incidents due to dumped catch, repairs to fishing gears and reduced fishing time by clearing nets are mainly applicable to those fisheries that have contact with the seabed (trawlers). Incidents due to fouling are more likely to be due to litter in the water column and can therefore affect any type of vessel.

9.1.2.2 Costs related to marine litter on the sea bottom

Costs to the EU fishing fleet associated with litter incidents that involve dumping catch, repairing fishing gear and lost earnings as a result of reduced fishing time are estimated at €40,4 million per annum. The total cost has been estimated based on the average costs per vessel for this category of damage, multiplied by the number of active EU vessels that use seafloor fishing gear[42] (trawlers).

Table 20: Cost of reduced catch revenue in the EU

cost per vessel (€)	# trawlers in the EU	cost for the EU (m€)
2.340	12.238	28,64

Due to the degradation of catches, selection of fish in catches takes more time. Furthermore, contamination of catches forces the fishers to discard part of their catch. In Mouat et al (2010) losses are reported to amount €2.200/year/vessel (€2340 actualized to 2013 prices).

Table 21: Cost to fishing vessels: removing litter from fishing gear in the EU

cost per vessel (€)	# trawlers in the EU	cost for the EU (m€)
959	12.238	11,74

Vessels surveyed by KIMO (20110) spend an average of 41 hours a year removing marine litter from fishing gear. Given an average EU27 labour cost of €23,4 per

[41] GBP cost data have been converted using the exchange rate Euro 1 = 0,839 GBD (Dec 2013).

[42] According to the Community Fishing Fleet Register 12.238 trawlers (category “towed Gears”) are currently in use (European Commission, 2013d).

hour[43], vessels are estimated to spend €959 annually on removing litter from fishing gear.

9.1.2.3 Costs related to marine litter in the water column

Costs to the total EU fishing fleet associated with litter incidents that involve fouling (e.g. of propellers) are estimated at between €24,8 million per annum. The expenses of the EU fishing fleet on these kinds of incidents are calculated by multiplying the average vessel costs with the number of active EU fishing vessels[44].

Table 22: Cost to fishing vessels: broken gear, fouled propellers in the EU

cost per vessel (€)	# fishing vessels in the EU	cost for the EU (m€)
191	87 667	16,79

In Mouat et al. (2010), the damage due to litter is budgeted at €180/year/vessel, based on data of Scottish fishing vessels (€191 actualized to 2013 prices).

Table 23: Cost of rescue services in the EU

cost per vessel (€)	# fishing vessels in the EU	cost for the EU (m€)
52	87 667	4,54

In 1998 the Royal National Lifeboat Institution (RNLI) attended 200 incidents around the British Isles, costing between £2.200 and £5.800[45]. The UK total number of fishing boats at that moment was 7.800 (Fanshawe; 2002). Dividing the total costs of incidence by this total no. of fishing boats leads to a (yearly) cost per boat of minimum £56 and maximum £149. In Mouat et al (2010) it is indicated that 67,5% of rescues to vessels with fouled propellers were made to pleasure craft and 31,1% to fishing vessels (for the UK in 2008). Assuming this repartition of 31,1%, rescue costs are estimated to be £32[46] per fishing vessel (52€ actualized to 2013 and converted to €).

9.1.2.4 Aggregated costs to the fishing sector

Aggregating all costs per damage categories, losses to the fishing industry in general amounts to €61,7 million per year. These estimated costs generated by marine litter are equivalent to a reduction of (approximately) 0,9% of the total revenues that are generated by the EU fleet in 2010 (landed value of €6.600 million[47]).

[43] According to Eurostat (http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Hourly_labour_costs)
[44] 87.667 fishing vessels according to the EC - Fleet Register on the Net (European Commission, 2013d) http://ec.europa.eu/fisheries/fleet/index.cfm?method=Search.ListSearchSimple
[45] The rescues were divided between fishing vessels and pleasure craft. As noticed by the marina managers, the RNLI data confirmed that there are more incidences of recreational boats, becoming fouled in the summer months.
[46] 31,1 % x 102,5£ (average of 56£ and 149£ rescue costs per boat)
[47] According to Member States DCF data submissions, the total amount of income generated by the EU fishing fleet in 2010 (excluding Greece) was €7 billion. This amount consisted of €6,6 billion in fish sales, €34 million in fishing rights rental income, €193 million in non- fishing income, and €126 million in direct income subsidies (JRC, 2012).

Table 24: Marine litter costs to fishery sector as a % of fish sales in the EU

loss in revenue (%)	fish sales EU (m€)	cost for the EU (m€)
0,9%	6.600	61,7

The estimated % damage to fishery revenue has been compared with 2 literature sources. Takehama (1990) estimates that damage from marine debris in Japan is 0,3% of the annual gross value of the fishing industry catch (McIlgorm; 2008). In Mouat (2010), a much higher impact percentage has been found: marine litter costs the Scottish fishing fleet on average 5% of the total yearly revenue of affected fisheries[48] (based on 2009 data).

It can be concluded that our yearly calculated value of €61,7 million is closer to Takahama's estimation of 0,3% (€19,80 million cost for the EU) than the 5% loss in revenue, calculated for the Scottish vessel fleet (€330 million cost for the EU).

9.1.3 Shipping sector

Marine litter also pose a navigational hazard to vessels in general. Incidents involving vessel damage caused by marine litter are widespread with over 70% of UK harbours and marinas reporting that their users had experienced incidents involving marine litter. Costs of rescue operations for vessels with fouled propellers in UK waters involving the coastguard reached between €830.000 and €2.189.000 in 2008 (Mouat et al; 2010). The most frequently reported cause of fouled propellers was derelict fishing gear.

No unit costs per ship could be deducted from literature. Several sources only give anecdotal evidence of the dangers of blocked propellers and other gear. The economic study of Hall (2000) mentions "costly repairs, loss of time and danger to boaters and crews", but without exact calculations as most incidents are not reported. In Korea, marine debris was involved in 9% of all Korean shipping accidents in the 1996–98 period. In 1993, one ferry even capsized and sank with 292 deaths due to fouled propellers. Insurers, within a survey for the APEC countries, reported that large ships are less susceptible for marine litter than fishing vessels (McIlgorm et al ; 2008).

9.1.4 Total sectorial results

The total quantified cost of degradation is estimated to be 258,9 m€ to 694,7 m€. These however represent a small portion of actual costs as it has not been possible to quantify impacts to all economic sectors.

Summary table (price base 2013):

-	Low:	255,40 m€
-	High:	691,48 m€
-	Best estimate:	474,17 m€

[48] In 2009, marine litter is estimated to cost the Scottish fishing fleet between €11.7 million and €13 million.

The monetised costs are attributed to the following 'main affected sectors':

- Tourism & recreation:

The total quantified costs of EU wide beach cleaning range from 193,7 m€ to 629,8 m€

- Fishery sector:

The total quantified costs to industry have been estimated to be 61,7 m€ per year.

- Other key non-monetised costs by 'main sectors'

It has not been possible to monetise the costs of all the affected groups and sectors, such as shipping and voluntary beach cleaning, cleaning of harbours and marinas. These costs are described qualitatively.

9.1.5 Data gaps

The following data gaps have been encountered:

- **Lack of cost data in general.**

  The figures do not include all potential costs from marine litter, for example health costs from accidents and injuries caused by marine litter are not included. Also voluntary beach cleaning time is not included in the analysis. Costs have often not been reported, which explains this lack of data
- **Lack of cost data for Black Sea & Mediterranean Sea (to a minor extent Baltic Sea).**
  In the EU, research investigating the economic impact of marine litter has mainly been concentrated in the Northeast Atlantic region. Data is lacking for the Mediterranean, Baltic and Black Sea. For the Black Sea in particular, no data at all has been found via literature search.
- **Focus on economic value of human activities (no costs of environmental effects are taken into account).**

  The ecological values not directly related to money transfers, are not taken into account quantitatively. The analysis is based on money actually spent, the true economic impact of marine litter may be greater. For this reason, the calculation of the cost of avoiding degradation must be interpreted as a lower boundary for the actual cost of degradation.

9.2 Health and environmental effect of marine litter

9.2.1 Introduction

We recall that descriptor 10 of the Marine Strategy Framework Directive defines Good Environmental Status as that whereby "Properties and quantities of marine litter do not cause harm to the coastal and marine environment" .Given the prevalence of this concept of harm, it is clear that the environmental impact of marine litter is a major part of understanding the problem. Health is a logical step away from environment, as health is directly influenced by it. In the public consultation (Chapter 5) a clear preference of interest and priority was given to plastics in the environment and ingestion by wildlife. This will be taken as a general lead in this part of the report and the emphasis is placed on the ingestion of marine litter and on (micro) plastics. Next, a short overview will be given on how marine litter can influence the natural environment and its inhabitants, followed by a more focussed description of the current knowledge on plastic litter ingestion.

9.2.2 Impacts of marine litter

Marine litter can affect marine organisms in a multitude of ways, either through physical damage such as entanglement or lacerations or through indirect health effects such as intoxication after ingestion. Direct damage and entanglement pose serious threats to wildlife such as sea turtles, marine mammals, fish and invertebrates, as well as all kinds of birds and even sea snakes, which can be cut, trapped, strangled or drowned in the debris (Gregory, 2009; Sheavly and Register, 2007; STAP, 2011; Udyawer, *et al.*, 2013). In 1997 Laist already identified 247 species which could be impacted by entanglement or ingestion of marine litter. By 2012 the list had increased to 373 species, with a staggering total of 663 species having encounters with marine litter (CBD, 2012). Pictures such as seen in Figure 15 and (scientific) reports can be found abundantly, indicating the regularity with which such entanglement incidents happen.

Figure 15: Entangled seal at Gweek Seal Sanctuary in Cornwall (photo by Caroline Curtis; source: STAP, 2011.)

“Ghost fishing” ”, whereby lost or abandoned fishing gear continues to catch fish, is one of the main ways in which marine litter can cause direct physical harm and mortality to the marine environment and its inhabitants, and has been a recognised problem since 1985 (Brown and Macfadyen, 2007; Sheavly and Register, 2007; Wilcox *et al.*, 2013). Apart from the obvious effect of trapping wildlife and causing death through either drowning, strangling, cutting or starving of sharks, marine mammals and other species, the so-called “ghost-gear” can cause problems in active fisheries due to entanglement with gear, it can pose a risk to ships as propulsion systems could get entangled, it can damage benthic habitats and it can cause entanglement when washed ashore (Brown and Macfadyen, 2007). “Ghost-gear” can persist in the environment for a long time as modern equipment is usually made of synthetic fibres and is not bio-degradable (Brown and Macfadyen, 2007).

Marine litter can also cause direct environmental impacts in the form of alterations in or physical damage to important habitats such as shorelines, coral reefs, deep sea habitats and sea grass fields (Brown and Macfayden, 2007; Sheavly and Register, 2007; Watters *et al.*, 2010). Debris can become entangled in corals, seagrass or macroalgae, cutting or smothering them and blocking sunlight, eventually leading to a higher turbidity and siltation (Sheavly and Register, 2007). Debris can also cause damage to benthic habitats through scraping the surface, disconnecting organisms from it and removing sight-specific benthos and flora (Brown and Macfayden, 2007).

Marine debris can also function as a way of transporting a variety of different species, assisting in the distribution of non-native and even invasive species, which can in itself impact the local environment (Aliana and Molcard, 2003; Gregory, 2009; Sheavly and Register, 2007; STAP, 2011).

9.2.3 Ingestion

Another problem associated with marine litter and wildlife is the threat of ingestion. Many different species of marine life have been known to ingest pieces of debris, with far reaching consequences including starvation and death (Sheavly and Register, 2007). The uptake of marine litter of any size has been seen in many different species throughout the food web (e.g. Besseling *et al.*, 2013; Franeker *et al.*, 2013; Gross, 2013; Jacobsen *et al.*, 2010; Rochman *et al.*, 2013; Simmonds, 2012). Some organisms, mostly from the lower reaches of the food chain, are indiscriminate feeders which consume anything of the right size, including plastics (Cole *et al.*, 2011; Moore, 2008). Other organisms mistake the debris for food, for example a floating plastic bag may resemble a jellyfish which is a preferred food item of the endangered leatherback sea turtle (Moore, 2008). A third way marine life ingests marine litter is by eating prey which have in turn ingested such items, meaning the litter travels up through the food chain (Farrel and Nelson, 2013; Murray and Cowie, 2011; Satälä *et al.*, 2014). Once ingested, marine litter can pose multiple threats to the organism: it may block food from passing through the intestines (Van Franeker *et al*., 2013; Jacobsen *et al.*, 2010; Simmonds, 2012; Tourinho *et al.*, 2010), cause a decrease in food intake (Simmonds, 2012; Tourinho *et al.*, 2010) or may transport chemicals into the body (Andrady, 2011; Besseling *et al.*, 2012; Rochman *et al.*, 2013; Lithner *et al.*, 2011).

As up to 80% of litter found in the marine environment consists of plastic materials (Simmonds, 2012) and plastic is a product designed to last rather than degrade in the environment, concerns about plastic in the marine environment are well grounded. Plastics can pose a threat as a result of their physical make-up, chemical ingredients and adsorbed chemicals (Rochman *et al.*, 2013). Plastics tend to break down into smaller particles; the longer they are present in the marine environment, the more the smaller particles are prone to be ingested by marine life (Browne *et al*., 2008). The small particles are referred to as microplastics and can make up to 80% of the total amount of plastics in the marine environment (Browne *et al*., 2007). The exact size definition of a microplastic varies between studies (Andrady, 2011; Cole *et al*., 2011) from less than 10 mm (Graham and Thompson, 2009) to less than 1 mm (Browne *et al.*, 2007; Browne *et al*., 2008) and anything in between (Andrady, 2011; Barnes *et al*., 2009; Besseling *et al*., 2013; Ryan *et al*., 2009 and more). Microplastics can be split into two groups: primary and secondary microplastics, with the first being plastic manufactured to be of a microscopic size and the second being fragments derived from the breakdown of larger plastic debris (Cole *et al*., 2011). Particles may degrade even further than microplastic size, forming nanoplastics (Andrady *et al*., 2011; Cole *et al*., 2011). Because of the small size of microplastics (and nanoplastics) they have a high chance of being ingested by marine life.

Graham & Thompson (2008) showed the uptake of plastic particles in four different species of sea cucumbers, collected from different locations along the East coast of the US. They also showed that the uptake rate was far higher than predicted from the ratio of plastic to sand, indicating an actual preference for plastic particles over sediment particles.

The North Pacific Central Gyre (NPCG) is an area known for its high concentration of plastic particles in the water column. Boerger *et al.* (2010) studied the gut content of 670 common planktivorous fish caught in the NPCG during seven trawl samples. They found plastic pieces in 35% of the fish examined with a total of 1375 pieces of plastic. The number of ingested pieces ranged from one to 83 per fish, increasing with the size of the fish, with an average mass of 1.57 mg of total plastic per fish.

Planktivorous fish are not the only ones found with marine litter in their guts. Choy & Drazen (2013) describe a study on 595 individual pelagic predatory fish from the North Pacific Subtropical Gyre, of which 19% were found to have ingested marine litter.

And also outside of the ocean gyres, ingestion of plastic has been found in predatory fish. A study from Jackson *et al.* (2000) showed that in a sample of 69 fish from the Falkland Island region (the large pelagic southern opah (Lampris immaculatus)), 14% of the fish had ingested plastic.

Microplastics have been found to not only pass through the digestive system, but can also travel to the circulatory system, as seen in a study of blue mussels *Mytilus edulis* by Browne *et al.* (2008). In this study, blue mussels were exposed to fluorescent polystyrene particles which were found to travel from the gut to the circulatory system within 3 days and persisted for over 48 days, see Figure 16.

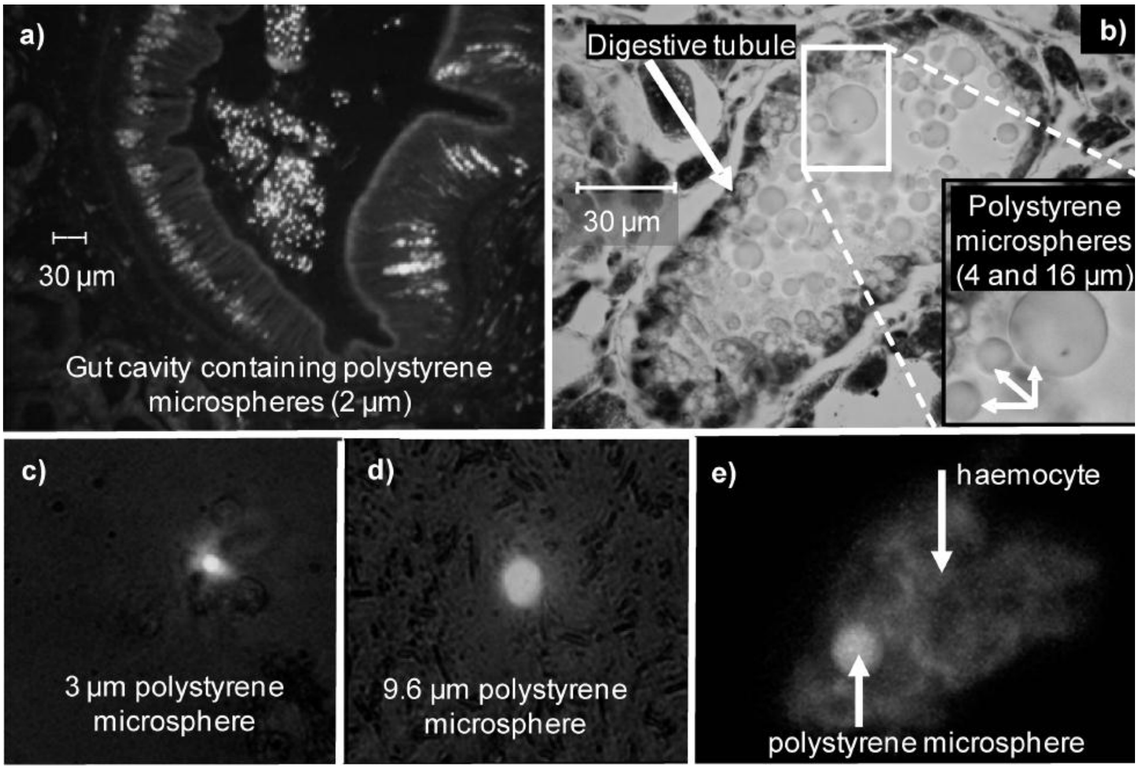


Figure 16: Uptake of plystyrene microspheres by blue mussel, from Browne *et al.* (2008). (a) Tissue section (4 µm thick) containing 2 µm and (b) 4-16 µm polystyrene microspheres in the gut cavity and digestive tubules. 3.0 (c) and 9.6 µm (d) polystyrene microspheres in the hemeolymph and (e) hemocytes (Browne *et al*., 2008).

Von Moos *et al.* (2012) did a similar experiment using blue mussels and high density polyethylene particles. The particles were transported to the gut and taken up in the cells and the mussels showed a strong inflammatory response to the particles.

Murray & Cowie (2011) studied plastic contamination in lobster species in the Clyde Sea. Plastic was found in the stomachs of 83% of the 120 animals studied. The plastics found were mainly in the form of monofilament strands, some of which had tangled together to form a ball (Figure 17). They also showed that the plastic particles were able to accumulate in the gut of the lobsters; specimens fed fish seeded with strands of polypropylene rope ingested the strands but did not excrete them.

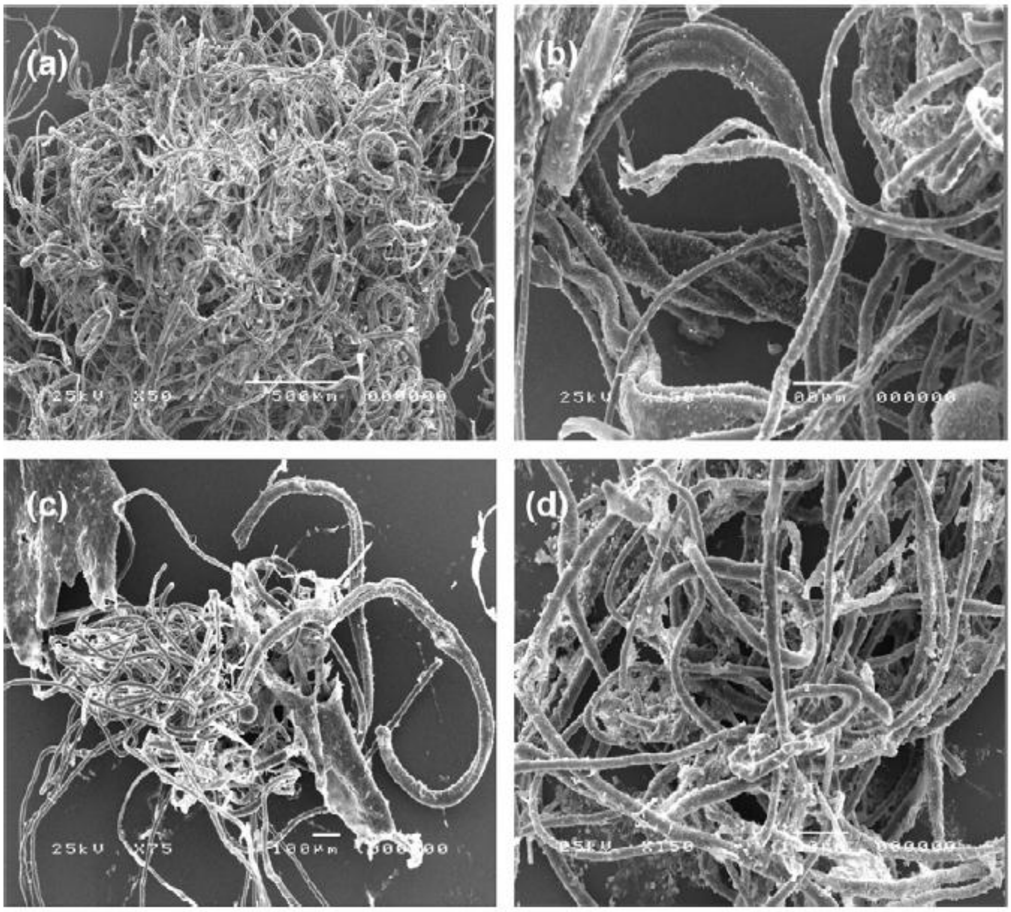


Figure 17: Plastic found in the stomachs of four lobsters. From: Murray & Cowie, 2011.

Chemicals adsorbed from the environment, such as PBTs (Persistent Bioaccumulative and Toxic substances) and metals, are a real concern when entering the food chain as a part of ingested plastic particles, as they can harm the organism through their toxic properties (Rochman, 2012). But plastic particles themselves also carry chemicals without adsorbing them from the environment. These so called 'additives' are monomers and oligomers of the component molecules of the plastics (Teuten *et al.*, 2009). Both the chemicals sorbed from the environment and the additives are of such a small size, that they can penetrate cells, chemically interact with biologically important molecules and possibly disrupt bodily functions, as well as bioaccumulate in foodwebs (Teuten *et al.*, 2009). PBTs such as Polychlorinated Biphenyls (PCBs), Polycyclic Aromatic Hydrocarbons (PAHs), Dichloro-Diphenyl-Trichloroethane and its metabolites (DDTs), Polybrominated Diphenyl Ethers (PBDEs), alkylphenols and Bisphenol A (PBA), have been found on plastic debris all around the world (Hirai et al., 2011).

An example is the chemical Bisphenol A (BPA), a plastic monomer and plasticizer used in the production of polycarbonate plastics, epoxy resins and consumer products (VandenBerg *et al.*, 2007). The monomeric form of BPA can leach from its source into its surroundings, such as water or the organism which has ingested the source (Meeker *et al.*, 2009). It has long been known that BPA has oestrogenic properties but can also affect other biological functions such as the thyroid (Meeker *et al.*, 2009). Furthermore, BPA has been connected to varying testosterone levels, miscarriages and has been shown to be involved in prostate carcinogenesis (Derouiche *et al.*, 2013; Meeker *et al.*, 2009). Another example is phthalates, a group of man-made chemicals primarily used as plasticizers. It can cause the “phthalate syndrome” as well as various endocrine disruptions (Meeker *et al.*, 2009).

Rochman *et al.* (2013) describe an experimental study in which marine fish were exposed to low-density polyethylene (LDPE), the largest component of global plastic production. The LDPE was presented to the fish mixed into the diet and sprinkled on the water surface, creating an environment similar to the one fish are exposed to in the wild. The fish were exposed to either virgin-LDPE, LDPE which had undergone a “marine-treatment” (deployed in an urban bay) or to no LDPE at all, for two months. The results showed that the mean concentrations of total PAHs, PCBs and PBDEs in fish which were exposed to the marine treated LDPE were 2.4, 1.2 and 1.8 times greater respectively than in fish which had not been exposed to LDPE at all. Glycogen depletion, fatty vacuolation and single cell necrosis, all signs of liver-stress, were found in the fish exposed to LDPE, while in the control group only a small percentage showed fatty vacuolation (21% versus 29% and 47%) and no other signs.

Besseling *et al.* (2013) did a study on the effects of microplastics ingestion and PCB bioaccumulation in lugworms (*Arenicola marina*). A positive relation was found between the uptake of plastic particles and the concentration in the sediment, as well as between the uptake of plastic particles and weight loss. The plastic particles were found to have negative effects on the fitness of the lugworm and a low dose of plastic increased bioaccumulation of PCBs.

9.2.4 Human health impacts

Human health can be directly influenced by marine litter in the form of physical damage; anyone visiting a beach could be injured by washed up debris on beaches such as broken glass, medical waste or other sharp objects (Sheavly and Register, 2007). People entering the water can get entangled in floating or submerged debris such as fishing nets, ropes or fishing line (Sheavly and Register, 2007). Indirect health effects can be caused by chemicals, toxins or other harmful particles in the water such as viruses or bacteria, all of which have entered the water column through anthropogenic sources (Sheavly and Register, 2007). Endocrine Disrupting Compounds (EDCs) such as Bisphenol A (BPA), Polybrominated Diphenyl Ethers (PBDE), Tetrabromobisphenol A (TBBPA) and Phthalates, are used as a component in the production of plastics and have been known to leach from plastic products and have been detected in humans (Talsness *et al.*, 2009). However, as humans come in direct contact with plastic products in daily life, the risk of contamination through marine litter is quite small in comparison. For example, Wagner & Oehlmann (2009) found a widespread contamination of xenoestrogens in mineral water from plastic bottles. They also found an increased reproductive output of *Potamopyrgus antipodarum* (a mollusc species) cultured in PET bottles, as compared to glass bottles. The knowledge on the direct and long-term effects of EDCs from plastics in humans is still limited and further research is needed (Thompson *et al.*, 2009). Plastic particles have been found in a wide variety of species (as described in Paragraph 2.3), including species used as a human food source such as bivalves, crustaceans and fish. The risk of chemicals adhered to plastics in the marine environment transferring through the food web from marine organisms to humans has not yet been conclusively established and represents an important knowledge gap.

9.2.5 Case studies

In the next section, a case study will be presented for four European sea regions (the Black sea, North sea, Baltic sea and the Mediterranean sea) and four different groups of animals (cetaceans, birds, zooplankton and reptiles) indicating how in each of these examples marine littering poses a problem to the environment and its inhabitants. Note that many more examples of many other species have been found; this is simply the tip of the iceberg when it comes to the impact of marine litter on wildlife.

9.2.5.1 Black sea, cetaceans

In the Black Sea three species of cetacean are present: the harbour porpoise (*P. phocoena*), short-beaked common dolphin (*D. delphis*) and common bottlenose dolphin (*T.truncatus*) (Birkun, 2002; Tonay *et al.*, 2007). A study carried out by Tonay *et al.* (2007), looked at the stomach contents of 42 harbour porpoises to determine their dietary habits. Of the 42 specimens, five had plastic debris in their stomachs. One of the individuals had over 40 grams of debris in its stomach, including plastic bags and sheeting. The effects of litter ingestion on cetacean species can differ widely and do not always have to be negative. However, there have been several recorded cases in which ingested litter did indeed have a negative or even fatal effect on the animal in question. Jacobsen *et al.* (2010) describe two cases of deceased sperm whales with debris in their stomachs, both having died of gastric impaction: one specimen was emaciated while the other specimen had a ruptured stomach. Tarpley and Marwitz (1993) describe two similar cases in which a pygmy sperm whale and a mink whale both had ingested plastic debris which occluded their stomachs, ultimately leading to their deaths. Another case is described by de Stephanis *et al.* (2013), in which a sperm whale is found dead, with ingested plastic, starvation and a ruptured stomach as its cause. The plastic debris found in the whale differed in size from several mm to over one meter with weights ranging from 20 g to over 2 kg. Table 25 shows the entire content of the whale's stomach, displaying a staggering amount of almost 18 kg of plastic debris.

Table 25: Content of the sperm whale stomach. From Stephanis *et al.* (2013).

Origin	Item type	Amount	Total (g)	Range (g)	Surface (m^2)	Range (m^2)	Length (m)
Greenhouse	Cover material of greenhouse	26	8136	20–1490	29.94	0.04–5.55	-
	Flower pot	2	57	22–35	0.02	0.02–0.02	3.1, 1.4

Origin	Item type	Amount	Total (g)	Range (g)	Surface (m^2)	Range (m^2)	Length (m)
General debris	Hosepipe	2	195	75–120	0.58	0.27–0.30	-
	Plastic burlap	7	1908	58–495	3.50	0.21–0.66	9.06
	Rope	5	3460	50–2000	-	-	-
	Plastic mulch of greenhouse	4	442	50–240	1.69	0.16–0.98	-
	Dishwater plastic pot	1	50	-	0.01	-	-
	Hanger	1	25	-	0.36	-	-
	Mattress	1	20	-	0.002	-	-
	Plastic carafe	2	80	30-50	-	-	-
	Small plastics	-	2500	-	-	-	-
	Spray plastic pot	1	48	-	-	-	-
	Tub of ice-cream	1	20	-	-	-	-
	Bag	5	986	35-500	1.3791	0.10-0.60	-
Cephalopods beaks	Cephalopods beaks	722	1098	-	-	-	-
Total plastic items	Total	59	17,927	20-1500	37.4804	0.002-5.55	9.06

Gorzelany (1998) describes to cases of bottlenose dolphins, one of which was found deceased due to the ingestion of fishing material which effectively suffocated the animal, while the other specimen died due to secondary causes of ingesting the same type of material, causing pneumonia, infection and anorexia. Gomercic *et al.* (2009) describe twelve cases of bottlenose dolphins being affected by larynx strangulation by ingested gill-net parts. In most of the cases the larynx strangulation was chronic, meaning the animal did not die quickly after ingesting the material but rather developed edema, mucosal injury and hypergranulation. Figure 18 shows a bottlenose dolphin with larynx strangulation, indicated by a piece of gill-net protruding from its mouth (from Gomercic *et al.*, 2009).

Figure 18: A bottlenose dolphin with larynx strangulation, the gill-net causing the strangulation also protruding from its mouth (from Gomercic *et al.*, 2009).

The ingestion of marine litter material might not kill the animal instantly but in most recorded cases the animal will eventually die, either from direct or secondary causes. In the Black Sea and also in the other marine areas of Europe, cetaceans are consumers of production at many trophic levels. Harbour porpoises and bottlenose dolphins are predators high up in the food chain and affecting their populations might also affect the structure and functioning of the whole ecosystem through top-down effects (Bowen, 1997).

9.2.5.2 North Sea, birds

OSPAR has set a preliminary target for acceptable ecological conditions in the North sea, with the Northern Fulmar (*Fulmaris glacialis*) as an indicator species, since they are known to ingest marine litter and do not regurgitate the undigested parts (Van Franeker *et al.*, 2012). Of the 204 fulmars studied between 2007 and 2011 in the Netherlands, 95% had plastic in their stomachs; of the 796 fulmars studied between 2007 and 2011 in the whole North Sea area also 95% of the fulmars had plastic in their stomachs. Birds ingesting plastic do not necessarily experience negative effect from the uptake. Several cases show however that ingestion of plastic debris cannot only cause negative effects but even mortality. Pierce *et al.* (2004) describe two cases: a Northern gannet and a greater shearwater, both dying from starvation after the uptake of a plastic object. In the case of the Northern gannet, a bottle cap was obstructing the pylorus (Figure 19), while in the case of the greater shearwater, only a small fragment of user plastic was blocking the same pathway.

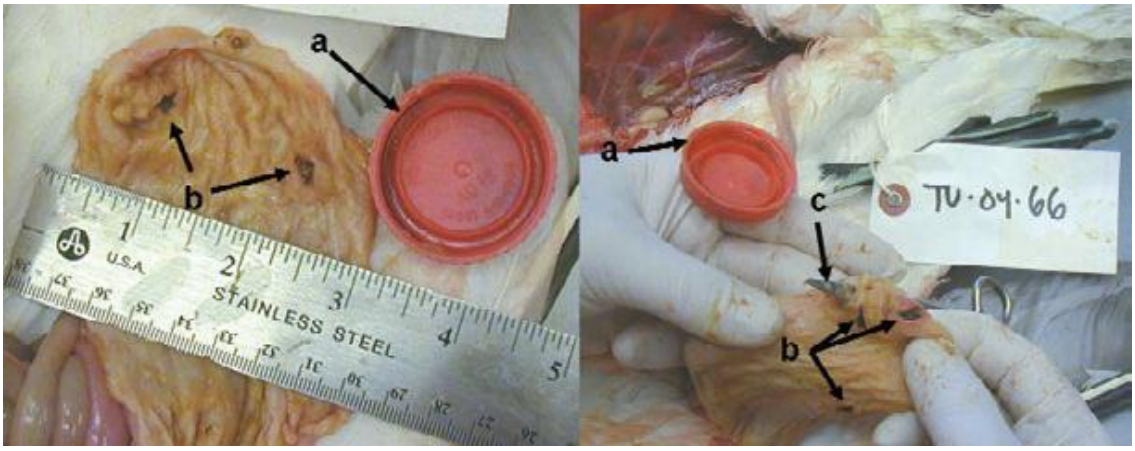


Figure 19: The gizzard of the Northern gannet with a bottle cap (a) which obstructed the pylorus. B indicates ulcerations caused by the bottle cap; c indicated the location of the pylorus. From: Pierce *et al.* (2004).

Ingestion of marine debris is not the only threat which plastic poses to birds, entanglement can also cause mortality. Votier *et al.* (2011) investigated the use of marine litter as nesting material by a colonial seabird, the Northern gannet. On average, each nest contained 470 g of plastic material and each year an average of 63 birds got entangled, which consisted mainly of juveniles (Figure 20). Votier *et al.* (2011) state that mortality is high because of entanglement but the exact impacts on population and ecosystem level require further investigation.

Figure 20: Plastic as a nesting material for northern gannets and entanglement in both adult and juvenile specimens. From: Votier *et al.* (2011).

Rodríguez *et al.* (2013) also looked at entanglement of northern gannets with marine debris, but in the non-breeding grounds. Here the entanglement rate was lower but still present, with immature birds being the most affected. Again, there is an urgent need for further research in order to evaluate the impacts of entanglement at population level.

In addition to direct or indirect physical harm, ingestion of plastic can also result in the transfer of harmful chemicals into seabirds' metabolism. Tanaka *et al.* (2013) demonstrated the presence of polybrominated diphenyl ethers (PBDEs) in abdominal adipose tissue of short-tailed shearwaters. These chemicals were not present in their natural prey but were indicated to be present in plastic particles found in the birds’ stomachs. Yamashita *et al.* (2011) also investigated plastics ingested by short-tailed shearwaters and found PCB concentrations in the abdominal adipose tissue. The effect of the ability of chemicals to transfer to the tissue of marine birds is not fully understood yet and more research is needed to evaluate the effects on the population and on the ecosystem.

9.2.5.3 Baltic Sea, plankton

Setälä *et al.* (2014) did a study on different Baltic Sea zooplankton taxa to scan their potential to ingest plastics. 10 mm fluorescent polystyrene microspheres were fed to the organisms so they would later be visible when ingested. The study showed a variety ranging from zero to 100% of the individuals with ingested materials, clearly indicating the capability of zooplankters to ingest microplastic particles. All the taxa studied (Mysid shrimps, copepods, cladocerans, rotifers, polychaete larvae and ciliates) showed uptake of plastic particles. Figure 21 shows a zooplankter with ingested plastic particles.

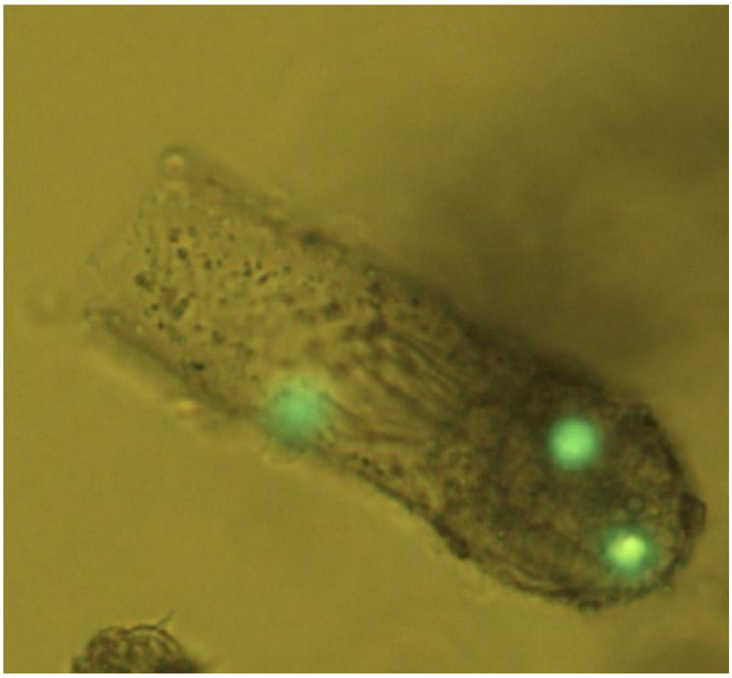


Figure 21: *Tintinnopsis lobiancoi* with ingested plastic particles. From: Setälä *et al.* (2014).

The study also showed the transfer of microplastics from one trophic zone to the next, as mesozooplankton which had ingested plastic was fed to macrozooplankton, which also ended up with ingested plastic particles. This is a clear indication of how plastic particles can travel through the foodweb. Moore (2008) states that indiscriminate feeders in particular, such as zooplankters, are prone to take up plastic particles, as they do not discriminate between natural or unnatural particles but ingest everything of approximately the right size. Larger organisms ingest the zooplankters also automatically ingest the plastic particles. The zooplankters themselves are not the only indiscriminate feeders; larger organisms also, such as baleen whales can take up both the zooplankton and the free floating plastic particles (Fossi *et al.,* 2012). Apart from whales, other planktivorous organisms also ingest plastic particles. Boerger *et al.* (2010) showed planktivorous fish taking up both plankton and plastic particles.

Cole *et al.* (2013) also did a study on the uptake of plastic particles by zooplankton. Thirteen of the fifteen taxa of zooplankton from the northeast Atlantic exposed to plastic particles showed the capacity for ingestion. The plastic was not only taken up by the zooplankton, but also adhered to their external surfaces. It was also shown that the uptake of plastic particles reduced the uptake of algae, implying the uptake of plastic particles can negatively impact zooplankton functioning and health. Figure 22 shows different species of zooplankton with ingested plastic particles, plastic particles in the faecal pellets and plastic on the exterior surface.

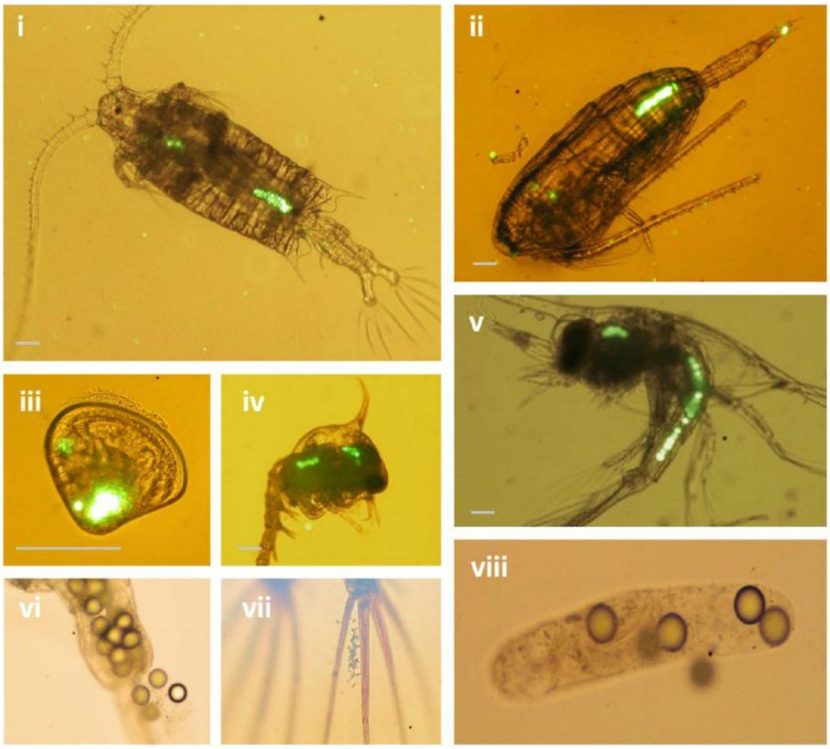


Figure 22: Fluorescence microscopy indicating plastic particles taken up by zooplankton: (i) the *copepod Centropages typicus* containing 7.3 µm polystyrene (PS) beads (dorsal view); (ii) the copepod *Calanus helgolandicus* containing 20.6 µm PS beads (lateral view); (iii) a D-stage bivalve larvae containing 7.3 µm PS beads (dorsal view); (iv) a *Brachyuran* (decapod) larvae (zoea stage) containing 20.6 µm PS beads (lateral view); (v) a *Porcellanid* (decapod) larvae, containing 30.6 µm PS beads (lateral view); (vi) 30.6 µm PS beads in the posterior-gut of the copepod *Temora longicornis* during egestion, (vii) 1.4 µm PS beads trapped

between the filamental hairs of the furca of *C. typicus*; (viii) a *T. longicornis* faecal pellet containing 30.6 μm PS beads. From: Cole *et al.* (2013).

Frias *et al.* (2014) sampled zooplankton from Portuguese coastal waters and tested them for the presence of microplastics. Out of a total of 152 samples, 93 contained microplastics, containing a total of 113.01 cm^3 and 684 microplastic particles. This study effectively indicates the presence and ingestion of microplastics by zooplankton in the natural environment. It was suggested to use zooplankton as an indicator species for microplastics in the context of implementation of the MSFD.

9.2.5.4 Mediterranean, reptiles

Of 54 loggerhead sea turtles (*Caretta caretta*) captured in the Western Mediterranean sea and studied by Tomás *et al.* (2002), 43 had marine debris in their stomachs. Plastic was the most common form of debris (75.9%) but tar, paper, Styrofoam, wood, reed, feathers, hooks, lines and net particles were also present. The uptake of marine litter by loggerhead sea turtles poses the obvious risk of obstruction and associated secondary negative effects such as loss of nutrient uptake and starvation. Campani *et al.* (2013) did a comparable study with loggerhead turtles found stranded or accidently by-catch in the North Tyrrhenian Sea. . In 71% of the samples marine litter was present, with plastic being the material found most often. Lazar & Cračan (2011) did another comparable study on loggerhead turtles found stranded or accidently by-catch in the Adriatic Sea. Of these turtles, 35.2% had marine debris in their stomachs, including a juvenile turtle which most likely died by ingesting marine litter.

Sea turtles are not the only species at risk from marine debris; sea snakes can also fall victim to litter at sea. Udyawer *et al.* (2013) describe a case of a sea snake *Hydrophis elegans* with a ceramic ring around its body found on the North-east coast of Queensland, Australia. As can be seen in Figure 23 the ring caused extensive damage to both the skin and the underlying tissues. Further study also showed the ring had caused the snake to be severely emaciated due to the restriction of food passing through the intestine.

Figure 23: A ceramic ring around the body of a sea snake, showing extensive damage. The arrow indicated the direction of the head of the snake. From: Udyawer *et al.* (2013).

9.3 Assessment of possible benefits for European Seas of reduced marine litter

9.3.1 Measures and their benefits

Measures to reduce sources of marine litter require additional spending by government, business (e.g. fishermen) and the community sector depending on which measures are ultimately taken forward. The results of the public stakeholder consultation suggest the following measures and actions, targeted at several groups:

1. Consumers: actions promoting litter avoidance and avoiding the use of plastic bags and bottles received the most support.
2. Local and subnational authorities: actions aimed at awareness-raising and the development of action plans received the most support.
3. EU policy makers: actions to further develop extended producer responsibility and setting EU targets received the most support
4. Tourism and recreational sector: actions to provide eco-friendly alternatives and raise awareness among tourists received the most support.

Currently, the costs associated with marine litter are largely borne by parties other than those causing the problem, i.e. the polluter usually does not pay. In line with the polluter pays principle enshrined in the EU Treaties, measures should in the first instance target the persons responsible for the source of the problem. However, the public consultation indicates that criteria like effectiveness and feasibility of the actions are more relevant than the application of the polluter pays principle. Stakeholders tend to attach more importance to the cleanliness of the beaches and marine environment itself than its price and who is paying for it.

In order to meet any reduction target for marine litter reduction, action will be needed to address both terrestrial and marine sources. For sea-based sources, it is of particular importance that the fishery sector is addressed, in order to tackle one of the most harmful aspects of the problem namely abandoned, lost or otherwise discarded fishing gear.

9.3.2 Benefit analysis for the preferred policy option

The degradation of the marine environment avoided by implementing certain measures can be used as a proxy to estimate the benefits from marine litter reduction. In parallel to the economic assessment of the current status (baseline) in heading 9.1, the benefits are made up of several components for each of the different sectors impacted.

- Reduced cost to the tourism and recreation sector:
  - Less beach cleaning by coastal municipalities and private actors (e.g. hotels)
- Reduced cost to fishery sector:
  - Fewer fouled propellers
  - Less damage of fishing nets and catch

We use the scenarios of the Commission's Impact Assessment and their projected impact on marine litter (see chapter 4) to make an overall assessment of the benefits of reduced marine litter. The calculations are based on the quantitative analysis of chapter 9.1. In what follows, the methodology is applied on the best policy option: option 3.4 combining options 3.1, 3.2 and 3.3. Under this option, the 2025 timeframe has been chosen in which marine litter inflow tends to decrease by 24,30% compared to 2015.

Using the scenarios of the impact assessment, an overall benefits assessment of reduced marine litter is presented within this chapter. The calculations are based on the quantitative analysis of chapter 9.1. In what follows, the methodology is applied on the best policy option: option 3.4 combining options 3.1, 3.2 and 3.3. Under this option, the 2025 timeframe has been chosen in which marine litter inflow tends to decrease by 24,30% compared to 2015.

9.3.2.1 Tourism and recreation sector

The total benefits of a reduced amount of litter on the sea bottom are assumed to be linear with a 24,30% reduction in average costs of beach cleaning.

Table 26: Avoided beach cleaning costs in the EU

	benefits per km (€)	length of EU beaches (km)	benefits for the EU (m€)
Average	*1.986*	50.600	100,47
Minimum	*930*	50.600	47,07
Maximum	*3.024*	50.600	153,04

It is estimated that municipalities and the tourism industry could save on average €100,47m annually in reduced beach cleaning (lower cleaning frequency, less waste treatment costs).

9.3.2.2 Fishing sector

a) Benefits related to marine litter on the sea bottom

The total benefits of 24,30% less litter on the sea bottom have been estimated based on the percentage reduction in average costs for the total number of EU trawlers.

Table 27: Avoided costs of removing litter from fishing gear in the EU

benefit per vessel (€)	# trawlers in the EU	benefit for the EU (m€)
233	12.238	2,85

Table 28: Avoided costs of reduced catch revenue in the EU

benefit per vessel (€)	# trawlers in the EU	benefit for the EU (m€)
569	12.238	6,96

Benefits to the EU fishing fleet (trawlers) associated with litter incidents that involve dumping catch, repairing fishing gear and lost earnings as a result of reduced fishing time are estimated at 9,8 m€ per annum.

b) **Benefits to marine litter in the water column**

The total benefits to the EU fishing fleet of fouling based incidents are calculated by applying a 24,30% reduction to the average cost per vessel for this category of incident.

Table 29: Avoided costs of broken gear & fouled propellers in the EU

benefit per vessel (€)	# fishing vessels in the EU	benefit for the EU (m€)
47	87.667	4,08

Table 30: Avoided costs of rescue services in the EU

benefit per vessel (€)	# fishing vessels in the EU	benefit for the EU (m€)
13	87.667	1,10

Benefits to the total EU fishing fleet associated with litter incidents that involve fouling (e.g. of propellers) are estimated at 5,2 m€ per annum.

c) **Aggregated benefits for the fishery sector**

Similar to the approach in the Dutch cost-benefit analysis for the MSFD (Reinhardt et al 2012), we assume that operational costs due to litter are proportional to the amount of litter. A reduction of litter by 24,30% would therefore result in a benefit of €14,9 m /year. The estimated benefits generated by the best policy marine litter targets is equivalent to a 0,227% reduction (approximately) in the total revenues that are generated by the EU fleet in comparison to the 2010 landed value of €6.6 billion. For the shipping sector, no cost data has been found (see paragraph 9.1.3).

Table 31: Marine litter avoided costs to the fishery sector as a % of fish sales in the EU

Loss in revenue	Fish sales EU (m€)	cost for the EU (m€)
0,227%	6.600	14,9

9.3.2.3 Total sectorial results

The benefits attributable to reducing marine litter have been assessed by looking at benefits from reduced beach cleaning costs and damage to fishing vessels. A reduction in the amount of litter of 24,30% results in aggregate benefits of between €62,06 m and €168,03 m per year for the EU.

Summary table benefits (price base: 2013):

- Low: 62,06 m€
- High: 168,03 m€
- Best estimate: 115,47 m€

The monetised benefits are attributed to the following 'main affected sectors':

- Tourism & recreation:

The total benefits of less beach cleaning ranges from €47,1 m to €153,0 m. With this sector enjoying between 76 and 91% of the savings related to marine litter reduction, it is the one which stands to benefit most.

- Fishery sector:

The fishing industry is projected to benefit by approximately €14,9 m per year through reduced marine litter levels in marine waters (and consequently reduced damage to vessels). This corresponds to 13% of total avoided costs within this analysis.

- Other key non-monetised benefits to other ‘main sectors’

It has not been possible to monetise the benefits of all the affected groups and sectors, such as voluntary beach cleaning, cleaning of harbours and marinas and the shipping sector.

9.3.3 Benefit analysis for the complete set of policy options

In this heading, the avoided costs of a yearly marine litter reduction of the policy options are calculated based on the quantitative analysis of chapter 9.1. For the BAU scenario and some policy options (e.g. option 2 for 2025 and option 1 and 2 for 2030), increasing marine litter will lead to net cost to the studied sectors.

For 2020:

	Marine litter inflow evolution 2015-2020				Marine litter reduction benefits (m€/year)[49]
	items 2015	items 2020	evolution		
BAU	100	104,4	4,40	%	-20,91
option 1 full implementation	100	95,4	-4,63	%	22,00
option 2 single calculation method	100	96,2	-3,77	%	17.91
option 3.1 higher mun. waste recycling targets	100	95,4	-4,63	%	22,00
option 3.2 higher packaging waste recycling targets	100	83,7	-16,26	%	77,26
option 3.3 landfill ban	100	96,2	-3,78	%	17,96
option 3.4 combination	100	83,1	-16,91	%	80,35
scenario maximum feasible	100	63,9	-36,11	%	171,58
scenario plastics only	100	87,8	-12,20	%	57,97

[49] Costs are represented by the "-"sign

For 2025:

	Marine litter inflow evolution 2015-2025				Marine litter reduction benefits (m€/year)[50]
	items 2015	items 2020	evolution		
BAU	100	108,5	8,53	%	-40,53
option 1 full implementation	100	99,3	-0,70	%	3,33
option 2 single calculation method	100	100,2	0,17	%	-0,81
option 3.1 higher mun. waste recycling targets	100	94,7	-5,31	%	25,23
option 3.2 higher packaging waste recycling targets	100	79,1	-20,93	%	99,45
option 3.3 landfill ban	100	99,4	-0,62	%	2,95
option 3.4 combination	100	75,4	-24,65	%	117,13
scenario maximum feasible	100	64,3	-35,72	%	169,73
scenario plastics only	100	82,7	-17,27	%	82,06

[50] Costs are represented by the “-“sign

For 2030:

	Marine litter inflow evolution 2015-2030				Marine litter reduction benefits (m€/year)[51]
	items 2015	items 2020	evolution		
BAU	100	112,3	12,29	%	-58,40
option 1 full implementation	100	102,9	2,92	%	-13,87
option 2 single calculation method	100	103,8	3,81	%	-18,10
option 3.1 higher mun. waste recycling targets	100	92,6	-7,40	%	35,16
option 3.2 higher packaging waste recycling targets	100	81,6	-18,41	%	87,48
option 3.3 landfill ban	100	102,5	2,50	%	11,88
option 3.4 combination	100	74,6	-25,42	%	120,79
scenario maximum feasible	100	64,6	-35,45	%	168,45
scenario plastics only	100	87,0	-13,03	%	61,91

[51] Costs are represented by the "-"sign

9.3.4 Limitations/critical review of the results

The relationship between the target reduction of the amount of marine litter generated annually (ranging from +3,81 to 36,11%) and the situation with the existing "stock" of litter in the sea is unknown. We assume a linear relation between the reduced marine litter input and the decrease in sectorial costs, but this assumption should be treated with caution. In the cost-benefit analysis for the MSFD framework for the Netherlands (Reinhard et al; 2012), a reduction by half of litter is estimated to result in a gain of only 10% of the maximum benefits for cleaner beaches (Reinhard et al. 2012). Applying this reasoning on the combination option 3.4, our calculated yearly cleaning benefits of on average €100,47m should be reduced to one fifth of its value, namely €20,09m.

For the fishery sector, the relationship between the density of litter at sea and the benefits from a reduction target is not straightforward. A more quantitative insight into the relation between catch, litter and economic losses would therefore contribute to a better estimation of the economic benefits of measures. Fishing grounds near shipping routes and close to the shore are more prone to litter than fishing in the open sea. Also different concentrations of marine litter per regional sea will affect outcomes. Another dependent factor is the fishing method. E.g. in the North Sea, trawling collects large amounts of litter from the seabed, but it is unclear if the same is true for trawlers in the Black Sea or the Mediterranean?

There are also likely to be additional benefits to other sectors (e.g. harbours, marinas, shipping) from reductions in marine sources of litter which it has not been possible to quantify.

10 Assessment of the potential of proper or improved implementation of other EU legislation and policies

10.1 Introduction and methodology

A broad range of EU policies and legislation are related directly or indirectly to marine litter. It is important to recognise that many of the policies relevant to marine litter interact with each other. The current chapter focuses on EU policies and legislation that can contribute to reducing the amount of littering in the marine environment. Some policies/measures may have broadened focus and also include removal of litter when already in the marine environment. Table 32 provides an overview of these existing European policies. This chapter first analyses whether these policies have the potential to reduce marine litter and then prioritizes them on their relevance and feasibility for further assessment in the year(s) to come. The analysis is based on the legislation and related policies, resolutions, regulations and communications in relation to the priority sources of marine litter and the (seven) most relevant loopholes in the flow of plastic packaging (summarized in Table 33). The priority sources of marine litter and the most relevant loopholes in the flow of plastic packaging are defined by three recent EC marine litter pilot projects:

- Study of the largest loopholes within the flow of packaging material.
- Feasibility Study of introducing instruments to prevent littering
- Case studies on the plastic cycle and its loopholes in the four European regional seas areas[52].

For each policy element, an overview of their relevance to improving marine litter management and the feasibility of their revision are provided, using a 1-5 scale. The relevance score is based on the types of marine litter dealt with in the legislation and its connection with the priority sources of marine litter and most relevant loopholes in plastic packaging. The feasibility score is based on the time and effort it would take to change the legislation and its current effectiveness in reducing marine litter. The priority score is the average of the relevance and feasibility score. With this approach all policies are scored relatively to each other.

Table 32: Existing European Regulations and Recommendations which are relevant for the analysis of the potential of European policies to reduce marine litter.

Marine Strategy Framework Directive (MSFD)	Directive 2008/56/EC
Waste Framework Directive	Directive 2008/98/EC
Packaging and Packaging Waste Directive	Directive 94/62/EC
Landfill Directive	Directive 1999/31/EC and Decision

[52] All three studies, along with a "common chapter" are available at: http://ec.europa.eu/environment/marine/good-environmental-status/descriptor-10/index_en.htm

	2003/33/EC
Water Framework Directive	Directive 2000/60/EC
Urban Waste Water Treatment Directive	Directive 1991/271/EEC
Bathing Water Directive.	Directive 2006/7/EC
Port Reception Facilities Directive	Directive 2000/59/EC
Ship-source Pollution Directive	Directive 2005/35/EC
Micro and nanoplastics in cosmetics	New EU Cosmetic Products Regulation (EC) No 1223/2009; REACH Regulation (EC) No 1907/2006
Eco-design Directive	Directive 2009/125/EC
Green Public Procurement and Eco-labelling	Communication "Public procurement for a better environment" (COM (2008) 400 Ecolabel Regulation (EC) No 66/2010
Integrated Coastal Zone Management (ICZM) Recommendation and Recommendation and Maritime Spatial Planning Directive	Recommendation 2002/413/EC Publication of MSP Directive pending

Priority sources of marine litter have been identified in Pilot project 4 seas: Case studies on the plastic cycle and its loopholes in the four European Regional seas areas. (European Commission, 2013c.)

Table 33: The priority sources and loopholes of marine litter.

Priority sources of marine litter
Land based
Tourism and coastal recreation
Household and general littering
Toilet and sewer overflow
Waste management and collection (incl. landfills)
Industrial activities (plastic industry, construction and demolition sector)
Sea based
Shipping sector
Fishing (professional and recreational)
Aquaculture
Port activities
Other offshore industries
Most relevant loopholes in plastic packaging
Lack of measures to reduce the production of plastic packaging (e.g. bags,

bottles, EPS fish boxes)
Production and consumption patterns based on single-use/disposable items rather than reduce and re-use
Inappropriate behaviour when disposing litter (e.g. during activities along the coast, particularly impact related to tourism, etc.)
Lack of awareness or incentives to separate waste for recycling
Decoupling between design/production and recycling – products are designed without its whole life-cycle in view
Inappropriate behaviour on waste management in industries and retailers (losses of material, etc.)
Deficient separate collection infrastructure for plastic packaging waste
Inappropriate waste collection and separation facilities (e.g. bins without lids in windy areas)
Inappropriate waste treatment facilities (e.g. landfills close to the coast, etc.)
Insufficient collection coverage of municipal waste

10.2 Marine Strategy Framework Directive

10.2.1 Summary

The Marine Strategy Framework Directive (MSFD) aims to protect and restore Europe's marine ecosystems and to ensure the ecological sustainability of economic activities linked to the marine environment in European Seas[53].

It establishes common principles on the basis of which Member States must draw up and implement their own strategies to achieve *Good Environmental Status* (GES) in the marine waters for which they are responsible. These strategies and actions should be developed in cooperation with other Member States and third countries, at the regional or even sub-regional level, and in cooperation with the relevant Regional Seas Conventions. GES is defined for a range of so-called 'descriptors' including a requirement that marine litter does not cause harm to the marine environment.

10.2.2 Context

The MSFD is the first EU legislative instrument related to the protection of marine biodiversity and ecosystems[54]. It enshrines in a legislative framework the ecosystem approach to the management of human activities having an impact on the marine environment, integrating the concepts of environmental protection and sustainable use.

The MSFD places special emphasis on regional cooperation and coordination and the implementation at national level entails: an initial assessment of the environmental status of national marine waters, the definition of GES and

[53] http://europa.eu/legislation_summaries/maritime_affairs_and_fisheries/fisheries_resources_and_environment/l28164_en.htm
[54] http://ec.europa.eu/environment/marine/eu-coast-and-marine-policy/marine-strategy-framework-directive/index_en.htm

establishment of targets and associated indicators to achieve it (2012); the establishment of a monitoring programme for the on-going assessment and the regular update of targets (by 15 July 2014); the development of a programme of measures designed to achieve or maintain GES by 2020, designed by 2015 and implemented in 2016; the review and preparation of the second cycle (2018 – 2021).

The Directive focuses specifically on eleven qualitative Descriptors of GES, around which the national marine strategies are developed and implemented. These are:

- Descriptor 1. Biodiversity is maintained
- Descriptor 2. Non-indigenous species do not adversely alter the ecosystem
- Descriptor 3. The population of commercial fish species is healthy
- Descriptor 4. Elements of food webs ensure long-term abundance and reproduction
- Descriptor 5. Eutrophication is minimised
- Descriptor 6. The sea floor integrity ensures functioning of the ecosystem
- Descriptor 7. Permanent alteration of hydrographical conditions does not adversely affect the ecosystem
- Descriptor 8. Concentrations of contaminants give no effects
- Descriptor 9. Contaminants in seafood are below safe levels
- Descriptor 10. **Marine litter does not cause harm to the coastal and marine environment**
- Descriptor 11. Introduction of energy (including underwater noise) does not adversely affect the ecosystem

10.2.3 Types of Marine Litter

The dedicated descriptor in the MSFD is the first EU policy that specifically refers to marine litter. To assist with the Directive's implementation, in 2010 the Commission adopted a set of detailed criteria and methodological indicators to help Member States determine what each descriptor means in practice and how to measure progress. For Marine Litter (D10), the Commission Decision (European Commission, 2011b) outlined two criteria: one on characteristics, amounts and spatial distribution in the coastal and marine environment (trends on coastlines, water column, and seafloor) and one in terms of impact on marine life (ingested litter). The MSFD covers “marine litter” in its broader sense but includes a specific indicator on micro-particles, with special attention to microplastics.

10.2.4 Potential on reducing marine litter

Since it addresses specifically marine litter and requires implementation of measures to reach what has been defined as GES, the MSFD has the potential in reducing marine litter and has already became one of the drivers of such efforts. Nevertheless, one of the main challenges for the first cycle is the lack of a proper baseline due to the lack of data on characteristics and origin of marine litter and/or their great variability, which limits the capacity for MS to establish concrete targets and measure progress. Furthermore, given that most of the marine litter originates from land, the implementation of measures becomes an issue under multiple competences and involving authorities and actors across society.

10.2.5 Revision of the legislation or policy

The MSFD implementation is currently half-way its first cycle, therefore in an early stage to consider revision. Nevertheless, the Commission shows continued interest in collecting views and experiences from Member States, including through its dedicated Technical Group on Marine Litter, in particular regarding the process and outcomes from the initial assessments and monitoring programmes. In its assessment of the first round of reporting on the Directive, the Commission proposed to revise, strengthen and improve the current Decision on GES which dates from 2010, by 2015. Such a revision offers the opportunity to improve the quality of marine litter-relevant data generated through MSFD implementation.

10.2.6 Relevance assessment

The relevance of the MSFD is beyond doubt, as it is the only directive dedicated specifically to the issue of marine environmental strategy and state. It could offer the framework for the establishment of a marine litter headline reduction target that could encourage Member States in their efforts to implement concrete policy measures.

The MSFD is however outcome-oriented and does not prescribe specific measures which must be implemented, leaving these choices to the Member States to determine.

Relevance score: 4

Table 34: Relevant priority sources and loopholes covered specifically by the Marine Strategy Framework Directive

Priority sources of marine litter	
Land based	
Tourism and coastal recreation	X
Household and general littering	X
Toilet and sewer overflow	X
Waste management and collection (incl. landfills)	X
Industrial activities (construction and demolition sector, plastic industry)	X
Sea based	
Shipping sector	X
Fishing (professional and recreational)	X
Aquaculture	X
Port activities	X
Other offshore industries	X
Most relevant loopholes in plastic packaging	

Lack of measures to reduce the production of plastic packaging waste (e.g. bags, bottles, EPS fish boxes)	
Production and consumption patterns based on single-use/disposable items rather than reduce and re-use	
Inappropriate behaviour when disposing litter (e.g. during activities along the coast, particularly impact related to tourism, etc.)	X
Lack of awareness or incentives to separate waste for recycling	
Decoupling between design/production and recycling – products are designed without its whole life-cycle in view	X
Inappropriate behaviour on waste management in industries and retailers (losses of material, etc.)	
Deficient separate collection infrastructure for plastic packaging waste	
Inappropriate waste collection and separation facilities (e.g. bins without lids in windy areas)	X
Inappropriate waste treatment facilities (e.g. landfills close to the coast, etc.)	X
Insufficient collection coverage of municipal waste	

10.2.7 Feasibility assessment

As this is a relatively new instrument, the MSFD needs further time to bed-down and roll-out the measures which it foresees before seeking to amend it. The major effort should be directed towards the further development and finalisation of guidance documents and in supporting marine Member States in its implementation. Member States have an important responsibility for the Monitoring Programmes, and in particular for their Programmes of Measures, to ensure that marine litter is adequately monitored and comprehensively tackled. However, the proposed review of the GES Decision provides an opportunity to strengthen the marine litter data generated through the Directive's implementation.

Feasibility score: 3

10.2.8 Priority score

Priority score: 3.5

10.3 Waste Framework Directive (WFD)

10.3.1 Summary

Directive 2008/98/EC[55] sets out the basic concepts and definitions related to waste management, such as definitions of waste, recycling, recovery. It explains when waste ceases to be waste and becomes a secondary raw material (so called end-of-waste criteria), and how to distinguish between waste and by-products. The Directive lays down some basic waste management principles: it requires that waste be managed without endangering human health and harming the

[55] http://ec.europa.eu/environment/waste/framework/

environment, and in particular without risk to water, air, soil, plants or animals, without causing a nuisance through noise or odours, and without adversely affecting the countryside or places of special interest. Waste legislation and policy of the EU Member States shall follow the waste management hierarchy:

- Prevention - reducing waste generation;
- Preparation for reuse – expanding lifespan and giving the products a second life before they become waste;
- Recycle - any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes composting and it does not include incineration;
- Recovery - some waste incineration based on a political non-scientific formula that upgrades the less inefficient incinerators;
- Disposal - processes to dispose of waste be it landfilling, incineration, pyrolysis, gasification and other finalist solutions.

The Directive is based on the "polluter pays principle" and the "extended producer responsibility". It incorporates provisions on hazardous waste and waste oils (old Directives on hazardous waste and waste oils being repealed with the effect from 12 December 2010), and includes two new recycling and recovery targets to be achieved by 2020: 50% preparation for re-use and recycling of certain waste materials from households and other origins similar to households, and 70% preparing for re-use, recycling and other recovery of construction and demolition waste. The Directive requires that Member States adopt waste management plans and waste prevention programmes.

The Article 13 requirement waste management to be carried out without risk to water could be interpreted broadly to encompass both inland water bodies and the marine environment.

10.3.2 Context

Relevant measures related to marine litter are:

- Waste collection and treatment infrastructure;
- Application of extended producer responsibility (EPR);
- Establishment of national waste management plans and waste prevention programmes;
- Prohibition of dumping or uncontrolled management of waste;
- Target for reuse and recycling;
- Requirement for waste management to be carried out without risk to water.

10.3.3 Types of Marine Litter

The Waste Framework Directive focuses on all types of waste, minimising waste fractions ending up in the environment. Measures for better waste management mostly focus on land-based marine litter fractions.

10.3.4 Potential on reducing marine litter

The Waste Framework Directive can have a significant impact on marine litter, since it sets out the essential conditions for the management of all types of waste in the EU. If properly and fully implemented, the Directive should both help to prevent waste and deal with it once it has been created. Targets on reuse and recycling should ensure that less waste is disposed (e.g. through landfilling), reducing the risk of it reaching the marine environment as litter. At this moment, litter in the marine environment is not specifically mentioned in the Directive. The concept of marine litter could be introduced to provide a stronger framework for marine litter policy measures. The development of Member States' national waste prevention plans and the follow-up to the Green Paper on plastic waste create the opportunity to raise awareness about and encourage specific policy action on marine litter. The focus on prevention of waste production, prioritising repairable and reusable items rather than disposable ones is adequate but often marine litter reflects a different reality. Data analysed in this study shows that the fraction of marine litter corresponding to items designed for single-use varies between 47% (in North Sea) and 89% (Mediterranean).

10.3.5 Revision of the legislation or policy

The European Commission is currently reviewing the waste policy and legislation. The objective is to establish more effective design of waste legislation that further promotes the principle of the waste hierarchy, to remove ambiguity and improve legal certainty by setting long-term targets, thus making legislation clearer, more effective and more easily enforceable. The results of this review to be finalised in 2014 covers the following three elements:

1. A review of key targets in EU waste legislation (in line with the review clauses in the Waste Framework Directive, the Landfill Directive and the Packaging Directive);
2. An ex-post evaluation ("fitness check") of five of the EU Directives dealing with separate waste streams: sewage sludge, PCB/PCT, packaging and packaging waste, end of life vehicles, and batteries;
3. An assessment of how the problem of plastic waste can best be tackled in the context of the current waste policy framework, based on the publication of the Green Paper on a European Strategy on plastic waste in the Environment.

Chapter 4.3 of this study is dedicated on evaluating what the effect of the newly proposed recycling targets could be on marine litter.

10.3.6 Relevance assessment

The Waste Framework Directive drafts the general lines of an integrated waste management policy. All waste which is properly managed never ends up in marine litter, which makes this Directive very relevant to tackle the problem of marine litter. Nevertheless its relevance should be put in perspective as general waste management measures, like new recycling targets, have only a limited impact on littering behaviour which happens in an illegal context.

Incorporation of litter and more specifically of marine litter in the waste policy can nevertheless be very useful. Furthermore, actions on waste prevention and ecodesign can indirectly have an influence on the inflow of waste. Finally, chapter 2 and especially the analysis on the maximum feasible scenario (see paragraph 4.3.8) proves that decoupling of waste generation from economic of consumption growth is a key element for tackling the increase of marine litter inflow.

Relevance score: 4

Table 35: Relevant priority sources and loopholes covered specifically by the Waste Framework Directive

Priority sources of marine litter	
Land based	
Tourism and coastal recreation	X
Household and general littering	X
Toilet and sewer overflow	
Waste management and collection (incl. landfills)	X
Industrial activities (construction and demolition sector, plastic industry)	X
Sea based	
Shipping sector	
Fishing (professional and recreational)	
Aquaculture	
Port activities	
Other offshore industries	
Most relevant loopholes in plastic packaging	
Lack of measures to reduce the production of plastic packaging (e.g. bags, bottles, EPS fish boxes)	X
Production and consumption patterns based on single-use/disposable items rather than reduce and re-use	X
Inappropriate behaviour when disposing litter (e.g. during activities along the coast, particularly impact related to tourism, etc.)	X
Lack of awareness or incentives to separate waste for recycling	X
Decoupling between design/production and recycling – products are designed without its whole life-cycle in view	X
Inappropriate behaviour on waste management in industries and retailers (losses of material, etc.)	X
Deficient separate collection infrastructure for plastic packaging waste	X

Inappropriate waste collection and separation facilities (e.g. bins without lids in windy areas)	X
Inappropriate waste treatment facilities (e.g. landfills close to the coast, etc.)	X
Insufficient collection coverage of municipal waste	X

10.3.7 Feasibility assessment

Since the revision of the waste policy is under way, the feasibility to introduce specific marine litter related issues is assessed to be rather high. More focus on prevention of waste and littering should be possible, by the integration of actions on this issue in the Member States' Waste Prevention and Management Plans.

Feasibility score: 5

10.3.8 Priority score

Priority score: 4.5

10.4 Packaging and Packaging Waste Directive

10.4.1 Summary

This Directive aims to harmonise national measures in order to prevent or reduce the impact of packaging and packaging waste on the environment and to ensure the functioning of the internal market. It contains provisions on the prevention of packaging waste, on the re-use of packaging and on the recovery and recycling of packaging waste aiming to limit the amount of packaging waste going to final disposal. In 2004, the Directive was reviewed to provide criteria clarifying the definition of the term 'packaging' and increase the targets for recovery and recycling of packaging waste. In 2005, the Directive was revised again to allow new Member States transitional periods for attaining the recovery and recycling targets. On 4th November 2013, the Commission adopted a proposal amending the Packaging and Packaging Waste with a view to reducing the consumption of lightweight plastic bags in the EU.

10.4.2 Context

Packaging (e.g. cans, bottles, food wrappers) makes up a large proportion of marine litter. Relevant measures in terms of marine litter included in the Directive:

- targets to increase recovery and recycling (including 22.5% recycling by weight of plastic packaging waste by 2008);
- Requirement for return, collection and recovery systems;
- Essential requirement to limit packaging use to the minimum needed for safety, health and consumer acceptance.
- Essential requirements for packaging to facilitate reuse, recovery and recycling and to limit concentration limits for heavy metals.

10.4.3 Types of Marine Litter

Packaging waste is made up of plastics, paper/cardboard, glass, metal. Types of marine litter considered are cans, bottles, food wrappers, plastic bags, caps and lids etc.

Policies dealing with packaging waste are very relevant for marine litter, as packaging tends to corresponds to a significant fraction of all items, mainly primary (e.g. drink containers) and service packaging (e.g. carrier plastic bags, straws, etc.). The data analysed for the study (Chapter 4.2) shows that packaging can vary between 25% and 67% of the total identifiable items in the North Sea and Mediterranean and correspond to 5 and 8 out of 10 TOP items identified for these 2 regions, respectively.

10.4.4 Potential on reducing marine litter

The Packaging and Packaging Waste Directive has the potential to have a high impact on marine litter, because packaging comprises a large proportion of marine litter (more than half of the plastic fraction of marine litter is composed of plastic packaging waste such as bottles and bags (European Commission, 2013a). At this moment, marine litter is not specifically mentioned in the Packaging and Packaging Waste Directive. The first step is to recognise the strong relationship between packaging and marine litter, which could lead to specific targets or specific essential requirements (e.g. on behaviour – fragmentation, biodegradation) of packaging waste in a marine context. Ecodesign of packaging could also be a part of the solution.

The targets in Article 6 and the return, collection and recovery systems required by Article 7 should drive up the collection, recovery and recycling rates for packaging waste, thereby reducing final disposal and the risk of packaging ending up in the marine environment.

In addition, the essential requirements for packaging waste contained in Article 9 and Annex II should facilitate the reuse, recovery and recycling of packaging waste. Essential requirements for packaging cover:

- the reduction of packaging to a minimum to maintain the necessary level of safety, hygiene and consumer acceptance
- its design for reuse or recovery, including recycling
- the minimisation of the presence of noxious and other hazardous substances and materials as constituents

With regards to plastic in particular, full implementation of the Directive by the Member States is important to close loopholes in the plastic packaging cycle, and should have significant benefits for the quantities of marine litter generated (Newman et al., 2013).. The addition of a specific concept of marine litter/protection of the marine environment to the Directive could be considered to ensure that the importance of the issue is acknowledged and could generate a framework for specific policy measures.

Increasing the recycling targets for packaging waste (in particular plastics), possibly in tandem with the ban of plastics from landfills, is currently being assessed. Other policy options include encouraging greater efforts to prevent packaging at source and encouraging best-practice sharing between Member States on reducing packaging litter e.g. through litter-picking on coastlines, awareness-raising, and the provision of adequate recycling and disposal bins in tourist areas.

Furthermore, there is the possibility to include the responsibility for packaging waste ending up the marine environment in the extended producer responsibility schemes for packaging waste. In this way, costs for litter prevention and cleaning measures can be recovered and producers can be financially motivated to implement more appropriate design.

For those packaging types that are often found as marine litter there could be special provisions, in particular in coastal areas that either reduce its use or effectively encourage its collection. For example, disposable plastic stirrers and straws (a type of service packaging) are often given freely by default to customers in coastal HORECA and are a common marine litter item found in particular in more touristic areas.

10.4.5 Revision of the legislation or policy

In 2014, the Waste Framework Directive, the Landfill Directive and the Packaging and Packaging Waste Directive are to undergo review as part of an overall revision of all EU waste legislation by the European Commission in order to further develop stable recycling markets and increase collection rates, in line with the overarching aspirations in the European Commission's Roadmap to a Resource Efficient Europe.

10.4.6 Relevance assessment

The major driving force for marine litter reduction is the recycling performance of plastics, as shown in Chapter 4.4.1.The potential impact depends on the level of implementation of these targets in a specific Member State. If fully implemented, the Directive could help to prevent marine litter. This means that the enforcement of the Directive should be improved urgently to achieve a good environmental status of the marine environment in time. The Packaging and Packaging Waste Directive focuses on most of the relevant loopholes and given the significance of packaging items in marine litter is therefore assessed to be very important.

Relevance score: 5

Table 36: Relevant priority sources and loopholes covered specifically by the Packaging and Packaging Waste Directive

Priority sources of marine litter and most relevant loopholes in plastic packaging	
Land based	

Tourism and coastal recreation	X
Household and general littering	X
Toilet and sewer overflow	
Waste management and collection (incl. landfills)	X
Industrial activities (construction and demolition sector, plastic industry)	X
Sea based	
Shipping sector	
Fishing (professional and recreational)	
Aquaculture	
Port activities	
Other offshore industries	
Most relevant loopholes in plastic packaging	
Lack of measures to reduce the production of plastic packaging (e.g. bags, bottles, EPS fish boxes)	X
Production and consumption patterns based on single-use/disposable items rather than reduce and re-use	X
Inappropriate behaviour when disposing litter (e.g. during activities along the coast, particularly impact related to tourism, etc.)	X
Lack of awareness or incentives to separate waste for recycling	X
Decoupling between design/production and recycling – products are designed without its whole life-cycle in view	X
Inappropriate behaviour on waste management in industries and retailers (losses of material, etc.)	X
Deficient separate collection infrastructure for plastic packaging waste	X
Inappropriate waste collection and separation facilities (e.g. bins without lids in windy areas)	
Inappropriate waste treatment facilities (e.g. landfills close to the coast, etc.)	
Insufficient collection coverage of municipal waste	X

10.4.7 Feasibility assessment

Increasing the recycling targets for packaging waste (in particular plastics) is feasible but will have important implications for the stakeholders such as the Members States' governments, responsible for waste collection and management and further also for local government institutions as well as private companies.

Nevertheless the review procedure largely increases the momentum and the opportunity to adapt the recycling targets to the problems encountered with marine litter. Implementation may still take some time and will require a shift in mind-set of individuals and industry. Including the responsibility for packaging waste ending up the marine environment in the extended producer systems is a very efficient measure that has proven its effectiveness on other issues like source separate collection or like recycling rates.

Feasibility score: 5

10.4.8 Priority score

Priority score: 5

10.5 Landfill Directive

10.5.1 Summary

The European Union has laid down strict requirements for landfills to prevent and reduce as far as possible their negative effects on the environment, specifically on surface water, groundwater, soil, air and human health. Requirements are included about the standard waste acceptance procedure, especially in Decision 2003/33/EC. It is detailed which wastes can be accepted on a landfill and how wastes should be tested at the landfill gate.

The Directive obliges Member States to ensure that competent national authorities issue permits to operate the sites. Applications for permits must contain certain information, including, inter alia:

- the proposed methods for pollution prevention and abatement;
- the proposed operation, monitoring and control plan;
- the plan for closure and aftercare procedures;
- an impact assessment study, where required under the Environmental Impact Assessment Directive (Directive 2011/92/EU).

10.5.2 Context

Improper waste management is identified as one of the sources for marine litter. The practical implementation of the Landfill Directive remains highly unsatisfactory and considerable efforts are needed to improve it. Even by 2009 (no more recent reports from the Commission has been published on the Commission's website), ten years after the adoption of the Directive not all Member States report having transposed and implemented all of its provisions. Up to today the Commission continues to open a significant number of infringement cases against Member States for incomplete transposition or implementation of this legislation. The Commission receives a vast number of complaints related to illegal landfills and dumpsites lacking the permits required by EU waste legislation, causing serious adverse effects to the environment and risks to human health. The problem seems particularly acute in the Member States having joined since 2004, where landfilling remains a predominant option since alternative waste management infrastructure is insufficient. Despite quick progress in these countries in closing sub-standard landfills, efforts need to be stepped up to ensure full compliance (European Commission, 2009).

10.5.3 Types of Marine Litter

When landfills near the coast are not well managed, windblown waste may end up directly in the marine environment. At poorly managed landfills located inland, litter may escape in a diffuse way to surface waters and riverine ecosystems, and still end up in the marine environment.

10.5.4 Potential for reducing marine litter

The potential impact depends on the level of implementation in a specific Member State. If fully implemented, the Directive helps to prevent marine litter by seriously reducing landfill escapes. This means that the enforcement of the Directive should be improved. Proper implementation of the requirements included in the Landfill Directive and the banning of illegal dump sites has high potential for reducing marine litter. Landfill location must consider the proximity of water bodies and coastal waters and landfill design must avoid pollution of soils and water (Newman et al., 2013).

Less waste sent to inadequate landfill may mean less waste reaching the marine environment. Since plastic remains a significant fraction of marine litter, banning the disposal of plastics in landfills could be part of the solution. Global plastics associations have set up an initiative for combating marine litter, called “Marine Litter solutions” and ‘Zero plastic to landfill‘ is formulated to be one of their objectives[56].

10.5.5 Revision of the legislation or policy

Member States must report to the Commission every three years on the implementation of the Landfill Directive. On the basis of these reports, the Commission must publish a Community report on the implementation of the Directive.

In 2014, the Waste Framework Directive, the Landfill Directive and the Packaging and Packaging Waste Directive are under review as part of an overall revision of all EU waste legislation by the European Commission in order to further develop stable recycling markets and increase collection rates, in line with the overarching aspirations in the European Commission’s Roadmap to a Resource Efficient Europe.

10.5.6 Relevance assessment

In terms of solid litter, there is relevance to assess the implementation of the Landfill Directive. A certain proportion of marine litter comes from improper

[56] http://www.marinelittersolutions.com/our-objectives/promoting-best-policies/zero-plastics-to-landfill-europe.aspx?__utma=33388322.1729698445.1403870150.1403870150.1403870150.1&__utmb=33388322.10.10.1403870150&__utmc=33388322&__utmx=-&__utmz=33388322.1403870150.1.1.utmcsr=(direct)|utmccn=(direct)|utmcmd=(none)&__utmv=-&__utmk=90700248

management of landfill sites, and mostly consists of plastics. Banning plastics from landfills would greatly decrease this priority source. Furthermore banning plastics from landfills would stimulate higher collection coverage, separate collection infrastructure and improved recycling infrastructure for the plastic waste fraction, which is a valuable resource. The analysis in chapter 4.3 proves however that the impact of landfill bans is rather marginal compared to e.g. increasing recycling targets. The Landfill Directive is important for marine litter, in the first place because of failing implementation, and only in the second phase as an opportunity to add marine litter provisions to the legal instrument, apart from a ban on landfilling plastics.

Relevance score: 3

Table 37: Relevant priority sources and loopholes covered specifically by the Landfill Directive

Priority sources of marine litter	
Land based	
Tourism and coastal recreation	
Household and general littering	
Toilet and sewer overflow	
Waste management and collection (incl. landfills)	X
Industrial activities (construction and demolition sector, plastic industry)	
Sea based	
Shipping sector	
Fishing (professional and recreational)	
Aquaculture	
Port activities	
Other offshore industries	
Most relevant loopholes in plastic packaging	
Lack of measures to reduce the production of plastic packaging waste (e.g. bags, bottles, EPS fish boxes)	
Production and consumption patterns based on single-use/disposable items rather than reduce and re-use	
Inappropriate behaviour when disposing litter (e.g. during activities along the coast, particularly impact related to tourism, etc.)	
Lack of awareness or incentives to separate waste for recycling	
Decoupling between design/production and recycling – products are designed without its whole life-cycle in view	
Inappropriate behaviour on waste management in industries and retailers (losses of material, etc.)	
Deficient separate collection infrastructure for plastic packaging waste	X
Inappropriate waste collection and separation facilities (e.g. bins without lids in windy areas)	
Inappropriate waste treatment facilities (e.g. landfills close to the coast, etc.)	X
Insufficient collection coverage of municipal waste	

10.5.7 Feasibility assessment

A significant challenge for the Landfill Directive is to implement what is already agreed. Enhancing implementation is particularly challenging in the current economic climate, because of budgetary constraints in many of the Member States performing least well. Infringement cases as well as ERDF or Structural Fund subsidies might however enhance the closure of non-compliant landfills and the establishment of new compliant landfills. Full implementation, will however take time and will involve a change in mind set for the waste sector and the regulatory authorities. Significant efforts like large scale market reorganisations and intensive investments might be necessary.

Global plastics associations, among other, support the idea of a plastics landfill ban. Meanwhile the revision of EU waste policy targets is already on-going, with landfill diversion targets under assessment.

Opportunities exist both for enhanced implementation and for enhanced regulatory opportunities.

Feasibility score: 4

10.5.8 Priority score

Priority score: 3.5

10.6 Water Framework Directive

10.6.1 Summary

The European Union (EU) has established the Water Framework Directive to protect inland surface waters, groundwater, transitional waters and coastal waters[57]. It has a number of objectives, such as preventing and reducing pollution, promoting sustainable water usage, environmental protection, improving aquatic ecosystems and mitigating the effects of floods and droughts. Its ultimate objective is to achieve “good ecological and chemical status” for all community waters by 2015.

10.6.2 Context

The Water Framework Directive does not directly deal with marine litter. It deals with priority chemical substances selected from among those which present a significant risk to the aquatic environment. This list with chemical substances is set out in Annex 10. Some of the non-hydrophilic substances on the list however, tend to accumulate in marine litter (Hirai *et al*., 2011).

10.6.3 Types of Marine Litter

The Water Framework Directive could reduce marine pollution by reducing pollution from discharges and emissions of hazardous substances in surface

[57] http://europa.eu/legislation_summaries/agriculture/environment/l28002b_en.htm

waters and by closing the riverine pathway for litter. It mainly focusses on chemical pollutants, not solid litter such as plastics, wood, glass, rubber and clothing. Annex 8 of the Directive comprises the indicative list of main pollutants:

1. Organohalogen compounds and substances which may form such compounds in the aquatic environment.
2. Organophosphorous compounds.
3. Organotin compounds.
4. Substances and preparations, or the breakdown products of such, which have been proved to possess carcinogenic or mutagenic properties or properties which may affect steroidogenic, thyroid, reproduction or other endocrine-related functions in or via the aquatic environment.
5. Persistent hydrocarbons and persistent and bioaccumulable organic toxic substances.
6. Cyanides.
7. Metals and their compounds.
8. Arsenic and its compounds.
9. Biocides and plant protection products.
10. Materials in suspension.
11. Substances which contribute to eutrophication (in particular, nitrates and phosphates).
12. Substances which have an unfavourable influence on the oxygen balance (and can be measured using parameters such as BOD, COD, etc.).

These pollutants can in many cases be carried by solid litter.

10.6.4 Potential on reducing marine litter

The Water Framework Directive has significant potential to reduce marine litter where it focusses on inland surface waters, groundwater, transitional waters and coastal waters[58]. It can therefore regulate a large proportion of the inflow of land based litter into the marine environment, especially by stricter regulation of the inflow of solid litter via sewer systems and sewer overflows. Although solid litter is not among the actual pollutants covered by the Directive, its removal from wastewater is a side-effect of enhanced wastewater treatment efforts. Solid floating litter (including microlitter) could however be incorporated in the Water Framework Directive. Awareness raising on and monitoring and control of the pollution of solid litter associated with inland waters could be included.

10.6.5 Revision of the legislation or policy

In 2009, nine years after the Water Framework Directive entered into force, management plans were produced for each river basin district, taking account of the results of the analyses and studies carried out. These plans cover the period 2009-2015. The management plans for river basin districts are revised at a national level every six years. Based on new scientific insights, there may also be

[58] http://archive.defra.gov.uk/environment/marine/documents/legislation/msfd-factsheet1-waterdirective.pdf

revisions on chemical substances at a national level. The next revision of the management plans will be in in 2015 and then every six years thereafter (2021, 2027 etc.). The revision in 2015 could provide an opportunity for the incorporation of solid litter in the Water Framework Directive. However, these changes are not revisions of the Water Framework Directive itself but in the plans derived from it. A review of the Water Framework Directive is foreseen in 2019.

10.6.6 Relevance assessment

Marine litter is most directly regulated by the Marine Strategy Framework Directive; however a large fraction of marine litter originates from land-based sources and through the pathways of sewerage or inland waters. Currently, the Water Framework Directive does not directly cover solid litter and it does not target the most relevant loopholes in the flow of plastic packaging. If solid litter were to be included in the definition of good status, the Directive would have great potential for reducing the most relevant loopholes in the flow of plastic packaging.

Relevance score: 4

Table 38: Relevant priority sources and loopholes covered specifically by the Water Framework Directive

Priority sources of marine litter	
Land based	
Tourism and coastal recreation	X
Household and general littering	X
Toilet and sewer overflow	X
Waste management and collection (incl. landfills)	
Industrial activities (construction and demolition sector, plastic industry)	X
Sea based	
Shipping sector	X
Fishing (professional and recreational)	X
Aquaculture	X
Port activities	X
Other offshore industries	X
Most relevant loopholes in plastic packaging	
Lack of measures to reduce the production of plastic packaging (e.g. bags, bottles, EPS fish boxes)	
Production and consumption patterns based on single-use/disposable items rather than reduce and re-use	

Inappropriate behaviour when disposing litter (e.g. during activities along the coast, particularly impact related to tourism, etc.)	X
Lack of awareness or incentives to separate waste for recycling	
Decoupling between design/production and recycling – products are designed without its whole life-cycle in view	
Inappropriate behaviour on waste management in industries and retailers (losses of material, etc.)	X
Deficient separate collection infrastructure for plastic packaging waste	
Inappropriate waste collection and separation facilities (e.g. bins without lids in windy areas)	
Inappropriate waste treatment facilities (e.g. landfills close to the coast, etc.)	
Insufficient collection coverage of municipal waste	

10.6.7 Feasibility assessment

Changing a major Directive like the Water Framework Directive would result in large scale institutional, political and legal issues and require quite some time for implementation. New measures will generate benefits for some and higher costs for other stakeholders. The government, NGO's and the aquaculture, fisheries, tourism industry and landfill operators will likely be involved in future revisions. The revision of Member States' river basin management plans in 2015 provides a good opportunity to further integrate marine litter concerns already in national thinking, while a review of the basic text foreseen for 2019 could further strengthen the Directive's effectiveness in tackling marine litter.

Feasibility score: 4

10.6.8 Priority score

The Water Framework Directive manages the water quality of river basins and coastal ecosystems. A large proportion of marine litter enters the marine environment through these water bodies. However, the Directive only focuses on chemical pollution and not on solid litter. Including measures in the Directive to control solid litter in river basins and coastal ecosystems would greatly affect the input of litter in the marine environment. The introduction of solid litter (including microplastics) in the Directive is urgent and feasible in the next round of river basin management plans in 2015, and when the Directive itself is reviewed in 2019.

Priority score: 4

10.7 Urban Waste Water Treatment Directive

10.7.1 Summary

The Urban Waste Water Treatment Directive concerns the collection, treatment and discharge of urban waste water and the treatment and discharge of waste water from certain industrial sectors[59]. It aims to protect the environment from any adverse effects caused by the discharge of such waters. The Directive lays down specific requirements for discharges from certain industrial sectors of biodegradable industrial waste water not entering urban waste water treatment plants before discharge to receiving waters. Industrial waste water entering collecting systems and the disposal of waste water and sludge from urban waste water treatment plants are subject to regulations and/or specific authorisation by the competent authorities. The treatment of urban waste water is to be varied according to the sensitivity of the receiving waters. Member States are responsible for monitoring both discharges from treatment plants and the receiving waters. They must ensure that the competent national authorities publish a situation report every two years. This report must also be sent to the Commission.

10.7.2 Context

The Urban Waste Water Treatment Directive regulates how urban waste water is collected and cleaned before it enters the receiving waters[59]. Urban waste water means waste water from residential settlements and services which originates predominantly from the human metabolism and from household activities (domestic waste water) or a mixture of domestic waste water with waste water which is discharged from premises used for any trade or industry (industrial waste water) and/or run-off rain water.

10.7.3 Types of marine litter dealt with

The Urban Waste Water Treatment Directive focusses on the biochemical oxygen demand, the chemical oxygen demand, the total suspended matter and phosphorus and nitrogen concentrations[59]. This Directive does not directly focus on solid litter such as plastics, wood, metals, glass, rubber and clothing. Litter in urban waste water that may end up in the marine environment consists mainly of different kinds of packaging materials, cotton buds and micro- and nano-plastics. During the water purification process, larger litter particles are filtered from the urban waste water and discarded, except for accidental storm water overflows. However, micro- and nano-plastics can sometimes pass filtration systems and be present in the effluent water. In addition, overflows from waste water treatment plants (e.g. during heavy rainfall) are a major source of major source of marine litter, both microplastics, as well as larger items such as plastics, cotton buds, etc.

10.7.4 Potential on reducing marine litter

The Urban Waste Water Treatment Directive has significant potential to reduce marine litter in general, and microplastics in particular since a more intensive collection and treatment of urban waste water prior to discharge in open waterways is one way to reduce marine litter coming from household waste water. This can be done by increasing performance of existing treatment plants, and by reducing storm water overflows.

[59] http://europa.eu/legislation_summaries/environment/water_protection_management/l28008_en.htm

10.7.5 Revision of the legislation or policy

Although no revision of the Urban Waste Water Treatment Directive is foreseen in the near future, full implementation of the existing provisions is crucial in order to address this pathway.

10.7.6 Relevance assessment

The Directive is relevant for marine litter to the degree in which an expanded waste water treatment network can prevent litter from entering the marine environment through waste water and surface waters.

The main marine litter-related issue discussed in the Directive are microplastics. The treatment infrastructure may be improved to stop microplastics from entering receiving waters, which is not the case for all techniques applied in wastewater treatment plants.

Sewage overflow, particularly as a result of heavy rains is a priority source for marine litter. The Urban Waste Water Treatment Directive could thus help to close two loopholes in the flow of plastic packaging.

Relevance score: 4

Table 39: Relevant priority sources and loopholes covered specifically by the Urban Waste Water Treatment Directive

Priority sources of marine litter	
Land based	
Tourism and coastal recreation	
Household and general littering	
Toilet and sewer overflow	X
Waste management and collection (incl. landfills)	
Industrial activities (construction and demolition sector, plastic industry)	
Sea based	
Shipping sector	
Fishing (professional and recreational)	
Aquaculture	
Port activities	
Other offshore industries	
Most relevant loopholes in plastic packaging	
Lack of measures to reduce the production of plastic packaging (e.g. bags, bottles, EPS fish boxes)	

Production and consumption patterns based on single-use/disposable items rather than reduce and re-use	
Inappropriate behaviour when disposing litter (e.g. during activities along the coast, particularly impact related to tourism, etc.)	
Lack of awareness or incentives to separate waste for recycling	
Decoupling between design/production and recycling – products are designed without its whole life-cycle in view	
Inappropriate behaviour on waste management in industries and retailers (losses of material, etc.) in casu microplastics	X
Deficient separate collection infrastructure for plastic packaging waste	
Inappropriate waste collection and separation facilities (e.g. bins without lids in windy areas)	
Inappropriate waste treatment facilities (e.g. landfills close to the coast, etc.) in case waste water treatment plants unable to filter microplastics	X
Insufficient collection coverage of municipal waste	

10.7.7 Feasibility assessment

Microplastics are receiving increasing attention in recent years, starting from a base where there was little general awareness. Floating litter in waste water had up to now been regarded as a secondary issue for waste water treatment. Although no revision of the UWWT Directive is immediately apparent, greater awareness among policy makers and the general public could increase the possibility for further action in this area.

Feasibility score: 3

10.7.8 Priority score

Priority score: 3.5

10.8 Bathing Water Directive

10.8.1 Summary

The Bathing Water Directive aims to improve environmental quality and human health by strengthening the rules guaranteeing bathing water quality[60]. It supplements the Water Framework Directive on water protection and management.

10.8.2 Context

The Bathing Directive does not focus on solid litter such as plastics, wood, metals, glass, rubber and clothing. Like the Water Framework Directive, it does concern some effects of solid litter by looking at pollution and the source of pollution, the

[60] http://europa.eu/legislation_summaries/environment/water_protection_management/co0018_en.htm

proliferation of cyanobacteria and the proliferation of microalgae and plankton. Further context is not relevant for this report.

10.8.3 Types of Marine Litter

In parallel to the Urban Waste Water Treatment Directive and the Water Framework Directive, the Bathing Water Directive focusses on eutrophication and chemical and biological pollution. It does not focus on solid litter such as plastics, wood, metals, glass, rubber or clothing.

10.8.4 Potential on reducing marine litter

The Directive has marginal potential to further reduce marine litter. When marine litter has to be assessed for inland and coastal waters this could better be done under the Water Framework Directive or other Directives.

10.8.5 Revision of the legislation or policy

No signs of near-future revisions of the Bathing Water Directive have been observed.

10.8.6 Relevance assessment

The Bathing Water Directive does not affect any of the priority sources of marine litter or the most relevant loopholes. It is rather a tool to determine if waters are suitable for bathing. Therefore a better management of marine litter seems to be better regulated from the Water Framework Directive or other Directives. Yet, as bathing is linked to priority sources of marine litter such as tourism, lack of public awareness, inappropriate waste management and collection and treatment infrastructure, the Directive still has a potential to reduce marine litter.

Relevance score: 2

Table 40: Relevant priority sources and loopholes covered specifically by the Bathing Water Directive

Priority sources of marine litter	
Land based	
Tourism and coastal recreation	X
Household and general littering	
Toilet and sewer overflow	
Waste management and collection (incl. landfills)	
Industrial activities (construction and demolition sector, plastic industry)	
Sea based	
Shipping sector	

Fishing (professional and recreational)	
Aquaculture	
Port activities	
Other offshore industries	
Most relevant loopholes in plastic packaging	
Lack of measures to reduce the production of plastic packaging (e.g. bags, bottles, EPS fish boxes)	
Production and consumption patterns based on single-use/disposable items rather than reduce and re-use	X
Inappropriate behaviour when disposing litter (e.g. during activities along the coast, particularly impact related to tourism, etc.)	X
Lack of awareness or incentives to separate waste for recycling	
Decoupling between design/production and recycling – products are designed without its whole life-cycle in view	
Inappropriate behaviour on waste management in industries and retailers (losses of material, etc.)	X
Deficient separate collection infrastructure for PPW	
Inappropriate waste collection and separation facilities (e.g. bins without lids in windy areas)	X
Inappropriate waste treatment facilities (e.g. landfills close to the coast, etc.)	X
Insufficient collection coverage of municipal waste	

10.8.7 Feasibility assessment

No signs of near-future revisions of the Bathing Water Directive have been observed. Changing the Bathing Water Directive would not be an effective measure to reduce marine litter.

Feasibility score: 1

10.8.8 Priority score

To change the Bathing Directive has rather low feasibility and low relevance.

Priority score: 1.5

10.9 Port Reception Facilities Directive

10.9.1 Summary

The Port Reception Facilities Directive pursues the same goal as the 73/78 Marpol Convention on the prevention of pollution by ships, which all Member States have signed[61]. However, in contrast to the Convention, which regulates discharges by ships at sea, the Directive focuses on ship operations in European Union ports. The Directive addresses the legal, financial and practical responsibilities of the different operators involved in the delivery of ship-generated waste and cargo residues in detail. This Port Reception Facilities Directive covers:

- All ships, whatever their flag, including fishing vessels and recreational craft, calling at a Member State port, apart from warships and ships belonging to or operated by a State for non-commercial governmental purposes;
- All Member State ports.

10.9.2 Context

A waste reception and handling plan must be drawn up in each port, in order to ensure that adequate port reception facilities are provided for. These plans must be approved and assessed by the Member State it relates to. The plans must be re-approved at least every three years. Every ship calling on a Community port has the obligation to pre-notify the waste it intends to deliver and/or retain on board. Before departure from a Community port, the ship is obliged to deliver all ship-generated waste to a port reception facility (with certain exceptions based on storage capacity). Ships operating in an EU port may be inspected, and these inspections may be carried out in the framework of Port State Control (PSC). In selecting ships for inspection, in particular ships which have not complied with the notification requirement or have not delivered their waste in accordance with the Directive shall be selected for inspection. Where it is proven that a ship has left a port without having delivered its waste and without benefiting from an exemption, the next port of call is alerted. Moreover, the ship will not be authorised to leave the second port without the situation having been assessed.

10.9.3 Types of Marine Litter

The Port Reception Facilities Directive distinguishes between ship generated waste and cargo residues. Ship generated waste concerns all waste which is generated during the service of the ship and falls under Annex I, IV and V of MARPOL. This includes all kinds of solid litter such as plastics, wood, metals, glass, rubber and clothing (which is classified as garbage under Annex V MARPOL).

10.9.4 Potential on reducing marine litter

The legislation has the potential to significantly reduce marine litter. This could be done by:

1) Strengthening the obligation on the Member States to ensure that port reception facilities are provided which meet the needs of the ships using them without causing abnormal delays. These facilities must be tailored to the size of the port and to the categories of ship calling there. This is already provided in the Directive (article 4).

[61] http://europa.eu/legislation_summaries/environment/waste_management/l24199_en.htm

2) Improved enforcement. However, the enforcement issue is delicate, given the potential to encourage disposal at sea, which is hard to monitor and thus penalize. This is compounded by the fact that the waste is not easily linked to the polluter. Furthermore, enforcement is poor due to insufficient exchange of information between ports and authorities (egg. exchange of inspection reports to alert the next port of call).

The nature of the fee and incentive structure should also be examined: the introduction of an EU-wide, 100% indirect fee systems, whereby payment of a fee for port facilities is made irrespective of the quantities and types of waste delivered, would address the potentially skewed incentive whereby operators must pay to discharge waste legally in ports, but can discharge them (illegally) at sea with little risk of prosecution. However, it is difficult to reconcile such a system with the "polluter pays" principle, since the cost of dealing with the waste is socialised across all port users. In any case, the mandatory discharge of ship generated waste applies irrespective of the fees system in place, following article 7 of the Directive.

10.9.5 Revision of the legislation or policy

Member States shall submit to the Commission a status report concerning the implementation of this Directive every three years. Member states shall also evaluate and approve the waste reception and handling plan, monitor its implementation and ensure its re-approval at least every three years and after significant changes in the operation of the port. Even when the Port Reception Facilities Directive itself is not amended, the individual waste reception and handling plans are. The Commission is currently assessing the feasibility of reviewing the Directive and has just launched an evaluation of the Directive. In addition, the Commission is working on a set of Guidelines to improve the implementation of the Directive, as well as on the establishment of a common monitoring and information system.

10.9.6 Relevance assessment

Shipping, fishing and aquaculture contribute in an important way to marine litter; these industries are indicated as priority sources for marine litter (European Commission, 2013b). The Port Reception Facilities Directive deals with four loopholes in the flow of plastic packaging.

Relevance score: 4

Table 41: Relevant priority sources and loopholes covered specifically by the Port Reception Facilities Directive

Priority sources of marine litter	
Land based	
Tourism and coastal recreation	X
Household and general littering	

Toilet and sewer overflow	
Waste management and collection (incl. landfills)	X
Industrial activities (construction and demolition sector, plastic industry)	X
Sea based	
Shipping sector	X
Fishing (professional and recreational)	X
Aquaculture	X
Port activities	X
Other offshore industries	X
Most relevant loopholes in plastic packaging	
Lack of measures to reduce the production of plastic packaging (e.g. bags, bottles, EPS fish boxes)	
Production and consumption patterns based on single-use/disposable items rather than reduce and re-use	
Inappropriate behaviour when disposing litter (e.g. during activities along the coast, particularly impact related to tourism, etc.)	X
Lack of awareness or incentives to separate waste for recycling	X
Decoupling between design/production and recycling – products are designed without its whole life-cycle in view	
Inappropriate behaviour on waste management in industries and retailers (losses of material, etc.)	
Deficient separate collection infrastructure for plastic packaging waste	X
Inappropriate waste collection and separation facilities (e.g. bins without lids in windy areas)	X
Inappropriate waste treatment facilities (e.g. landfills close to the coast, etc.)	X
Insufficient collection coverage of municipal waste	

10.9.7 Feasibility assessment

Amending the Port Reception Facilities Directive would raise institutional, political and legal issues. Proposed amendments may meet resistance from some stakeholders such as ports and maritime industries, given the differences between administrative systems, size and geographical location of ports. A greater awareness of marine litter results in a significant decline of sea based conscious littering. Although awareness-raising also addresses littering through neglect or accidental (e.g. fishing nets), this kind of littering still persists. Sometimes accidental littering is caused by force majeure.

Ports can establish cost recovery systems to encourage the delivery of waste on land and discourage dumping at sea. According to the terms of the current Directive, all ships calling at a Member State port will bear a significant part (which should be at least 30%) of the costs, whether they use the facilities or not. This cost recovery system comprises this built-in, fixed element and, possibly, a variable element according to the amount and type of waste actually delivered, as long as cost avoidance through littering is prevented. However, it is unclear that this 30% system adequately disincentivises littering at sea, as in some cases the majority of the costs are still dependent on actual quantities of waste delivered. The Commission is currently assessing ways to strengthen the Directive, including from the point of view of reducing marine litter.

Feasibility score: 4

10.9.8 Priority score

The Port Reception Facilities Directive does affect some land-based sources of marine litter and all sea based priority sources. Better enforcement should be focussed on, especially regarding fishing nets or other more accidental or semi-accidental losses, and for littering which continues to occur even if ships and vessels earn no direct financial benefit from littering. Any effort to strengthen the Directive should carefully consider potential negative side effects, notably by incentivising (either through direct cost, or through additional time or administration burden) the disposal of waste at sea. In addition to better enforcement, an increase in awareness of marine litter within the sector is important.

Priority score: 4

10.10 Ship-source Pollution Directive

10.10.1 Summary

The Directive states that ship-source polluting discharges constitute in principle a criminal offence.[62] Minor discharges shall not automatically be considered as offences, except where they lead to the deterioration in the quality of the water, including in the case of repeated discharges. The persons responsible for discharging polluting substances may be subject to criminal penalties, if they have acted with intent, recklessly or with serious negligence[62]. The act of inciting, aiding and abetting a person to discharge a polluting substance may also lead to criminal penalties.

10.10.2 Context

Polluting discharges are forbidden in:

- The internal waters, including ports, of a European Union (EU) country;
- The territorial waters of an EU country;
- Straits used for international navigation subject to the regime of transit passage, as laid down in the 1982 United Nations Convention on the Law of the Sea;
- The exclusive economic zone (EEZ) of an EU country;

[62] http://europa.eu/legislation_summaries/environment/water_protection_management/l24123_en.htm

- The high seas.

According to the Ship-source Pollution Directive this relates to discharges of oil or other noxious substances from all types of vessels, irrespective of their flag. Exceptions are: warships or other ships owned or operated by a State and used only on government non-commercial service and situations where human safety or that of the ship is in danger.

10.10.3 Types of Marine Litter

The Ship-source Pollution Directive deals with oil and other noxious substances and transposes the MARPOL standards into EU law. Polluting discharges as defined and regulated in MARPOL and its Annexes are forbidden; this includes solid litter such as plastics, wood, metals, glass, rubber and clothing (Annex V – garbage), the discharge of which is illegal.

10.10.4 Potential on reducing marine litter

The Ship-source Pollution Directive has the potential to reduce marine litter by improving enforcement. Raising awareness of marine litter in the public and maritime sectors would also contribute, because most discharges are deliberate (tank-cleaning operations and waste oil disposal). The main sea-based sources of marine litter are shipping, fishing and the aquaculture industry (European Commission, 2013a) An extension of the Directive to solid litter, in line with MARPOL annex V garbage) could be envisaged, when there is a legal importance to do so on top of what is already provided for in MARPOL.

10.10.5 Revision of the legislation or policy

Member States have to report to the Commission on the application of the Directive every 3 years so that the Commission can assess the need for any revisions to its scope or to adapt it to technological progress. No indications were found on near-future revisions of the Ship-source Pollution Directive.

10.10.6 Relevance assessment

Shipping, fishing and aquaculture contribute in an important way to marine litter; these industries are indicated as priority sources for marine litter. Because most discharges are deliberate (tank-cleaning operations and waste oil disposal), enhanced enforcement against discharge may contribute to solving the problem of marine litter. The Directive has good potential to reduce the sea-based sources of marine litter.

Relevance score: 4

Table 42: Relevant priority sources and loopholes covered specifically by the Ship-source Pollution Directive

Priority sources of marine litter	
Land based	

Tourism and coastal recreation	
Household and general littering	
Toilet and sewer overflow	
Waste management and collection (incl. landfills)	
Industrial activities (construction and demolition sector, plastic industry)	
Sea based	
Shipping sector	X
Fishing (professional and recreational)	X
Aquaculture	X
Port activities	X
Other offshore industries	X
Most relevant loopholes in plastic packaging	
Lack of measures to reduce the production of plastic packaging (e.g. bags, bottles, EPS fish boxes)	
Production and consumption patterns based on single-use/disposable items rather than reduce and re-use	
Inappropriate behaviour when disposing litter (e.g. during activities along the coast, particularly impact related to tourism, etc.)	X
Lack of awareness or incentives to separate waste for recycling	X
Decoupling between design/production and recycling – products are designed without its whole life-cycle in view	
Inappropriate behaviour on waste management in industries and retailers (losses of material, etc.)	
Deficient separate collection infrastructure for plastic packaging waste	X
Inappropriate waste collection and separation facilities (e.g. bins without lids in windy areas)	X
Inappropriate waste treatment facilities (e.g. landfills close to the coast, etc.)	
Insufficient collection coverage of municipal waste	

10.10.7 Feasibility assessment

Amending the Ship-source Pollution Directive would include institutional, political and legal issues, while resistance is likely from stakeholders such as shipping, fishing and aquaculture. The link between polluter and marine litter could be made stronger by increasing the source traceability of marine litter. This could be done by a higher rate of inspection, but also by tagging the owners' names to fishing nets, aquacultural buoys etc.

Feasibility score: 3

10.10.8 Priority score

It is possible to aim for a better regulation for sea-based littering as most littering is deliberate and hence avoidable. A better enforcement in combination with greater awareness in the maritime sector may result in a decrease of sea-based marine littering. Additionally, an assessment on the reasons for discharge may contribute to creating more effective measures against illegal discharges.

Priority score: 3.5

10.11 Micro- and nano-plastics in cosmetics

10.11.1 Summary

There is evidence that microplastic particles which are found in cosmetic products (e.g. as exfoliants or cleansers) are finding their way into the marine environment, via the wastewater from consumers' baths, showers, sinks etc. Given the size of the particles, they are generally not filtered out at water treatment plants, and thus eventually end up in the sea, where they can be ingested by marine life, with potential negative health implications for the animals concerned and, if it is proven that they can then work their way back up through the food chain, ultimately posing a threat to human health. Consumers using such products are often either unaware that they contain plastics, or that such particles can end up in the marine environment.

Cosmetics suppliers (manufacturers/importers/exporters) who wish to place cosmetic products on the EU market must comply with the following regulations:

- Cosmetic Products Regulation (EC) No 1223/2009;
- REACH Regulation (EC) No 1907/2006;

A cosmetic product is defined in the Cosmetic Products Regulation as any substance or preparation intended to be placed in contact with the various external parts of the human body or with the teeth and the mucous membranes of the oral cavity, with a view exclusively or mainly to cleaning them, perfuming them, changing their appearance, and/or correcting body odours, and/or protecting them or keeping them in good condition. The original EU Cosmetics Directive (76/768/EEC) has been revised multiple times. Ingredients of cosmetics are to be reviewed on safety grounds. In case of product non-compliance, the responsible person shall take measures to render it compliant, withdraw it from the market or recall it to the manufacturing company in all Member States where the product is available. The Regulation includes harmonized notifications, provisions for the content and format of product safety assessments and product information files as well as strengthened coordination efforts of market surveillance activities among competent authorities of member states.

The Cosmetics Regulation takes into consideration some of the latest technological developments, including the possible use of nanomaterials. For example, nanomaterials in cosmetic products must be mentioned on the list of ingredients on the packaging, with the names of such ingredients followed by the word “nano” in brackets. The Regulation thus makes it possible for consumers to see if there are nano-plastics present in the products they purchase.

The REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals) Regulation was adopted to improve the protection of human health and the environment from the risks that can be posed by chemicals, while enhancing the competitiveness of the EU chemicals industry.[63]

REACH places the burden of proof on companies. To comply with the regulation, companies must identify and manage the risks linked to the substances they manufacture and market in the EU. They have to demonstrate to ECHA (the European Chemicals Agency) how the substance can be safely used, and they must communicate the risk management measures to the users. If the risks cannot be managed, authorities can restrict the use of substances in different ways. In the long run, the most hazardous substances should be substituted with less dangerous ones.

10.11.2 Context

The Cosmetic Regulation regulates how cosmetics are produced, which substances are allowed within cosmetics and ensures that they are safe for human health. The Regulation also regulates what must be stated in the product information file.

REACH requests information sharing on chemicals placed on the market or used in the manufacture of goods in order to guarantee safe use. Chemicals that are too hazardous and that can be replaced by substitutes can be restricted or forbidden. REACH covers all products and all chemicals, except wastes.

10.11.3 Types of Marine Litter

Micro- and nano-plastics are addressed, rather than the other types of marine litter such as packaging or other types of macro litter. Both the Cosmetics Regulation and REACH have the potential to cover nano-plastics.

10.11.4 Potential on reducing marine litter

Documentary scientific evidence is collected proving that a pathway through plankton and fish and up to human consumption is probable. Graham & Thompson (2008) showed the uptake of plastic particles in four different species of sea cucumbers. Boerger et al. (2010) studied the gut content of planktivorous fish and found plastic pieces in 35% of the examined fish. Choy & Drazen (2013) describe a study on pelagic predatory fish of which 19% were found to contain marine litter.

[63] http://echa.europa.eu/regulations/reach

Microplastics have been found to not only pass through the digestive system, but can also travel to the circulatory system, as seen in a study with blue mussels *Mytilus edulis* by Browne *et al.* (2008). Chemicals adsorbed from the environment, such as PBTs (Persistent Bioaccumulative and Toxic substances) and metals, are a real concern when entering the food chain as a part of ingested plastic particles, as they can harm the organism through their toxic properties (Rochman, 2012). See also chapter 9.2.

The Cosmetics Regulation focusses on human health. It obliges the cosmetics industry to indicate the presence of nano-plastics in the product information, though no similar provision exists for micro-plastics above the 100nm threshold identified in the Regulation for nanomaterials. It is unclear if the Regulation could ban micro- and nano-plastics in cosmetics as their impact on human health is only indirect through ingestion of marine life ultimately making its way back into the human food chain.

Recital 5 of the Cosmetics Regulation states that the environmental concerns that substances used in cosmetic products may raise are considered through the application of REACH (Regulation (EC) No 1907/2006), which enables the assessment of environmental safety in a cross-sectorial manner. REACH indeed has a broader field of application and could regulate substances in more than cosmetics but in multiple applications that could consider a comparable use of microplastics. REACH is however limited to ‘chemicals’ (the pure polymer) and not to more complex preparations or aggregates. Owing to the potentially extensive number of different polymer substances on the market, and since polymer molecules are generally regarded as representing a low concern due to their high molecular weight, this group of substances is exempted from registration and evaluation under REACH. Polymers may however still be subject to authorisation and restriction (ECHA 2012).

It is unclear if REACH will be able to restrict the use of microplastics in general in cosmetics, because of their varying composition and because the human hazard is not caused by the polymer itself but by the components adhered on it. The Cosmetics Regulation has more potential to regulate microplastics but is restricted to use in cosmetics.

10.11.5 Revision of the legislation or policy

NGO’s openly advocate the ban of micro- and nano-plastics from cosmetics as they can be replaced by natural ingredients. The 'Beat the microbead' campaign[64] has had some success in driving certain major companies to agree to voluntarily phase-out the use of microplastics in some of their products. However, there are those who argue that progress is not fast or comprehensive enough, and thus advocate an EU-level ban.

[64] http://beatthemicrobead.org/en/

As early as 2011, Members of the European Parliament were calling for such a ban in written questions.[65] In 2013, in the Green Paper on a European Strategy on Plastic Waste in the Environment (COM(2013)0123), the European Commission recognised the increasing use of virgin micro-plastics as a matter of concern, in particular in cosmetic products, and highlighted the challenges that they pose for water management systems. In its Resolution in response to the strategy (2013/2113(INI)), the European Parliament called for a phase-out or ban.

Beyond the EU process, the Regional Action Plans on Marine Litter Management for both the Mediterranean and North-East Atlantic regions call for action to tackle the problem of microplastics in cosmetics, while there action is also being taken internationally, including in the United States, where, for example in June 2014 Illinois introduced a state-wide ban on plastic particles in personal care products.[66]

10.11.6 Relevance assessment

Eventually all plastics that enter marine ecosystems will disintegrate into smaller plastic particles and then into micro- and nano-plastics. Only part of the micro- and nano-plastics in marine ecosystems originates from the cosmetic industry or from use in consumer goods. More research is to quantify the fraction of plastic in the marine environment which originates from such products. However, as plastic substances in cosmetic products can often be replaced by natural substances, a ban or phase-out represents potentially "low-hanging fruit" of actions to combat marine litter. The Cosmetics Regulation may be one avenue for closing this loophole while the use of REACH might be more complicated. The Cosmetics Regulation and REACH do not affect any other priority sources of marine litter or most relevant loopholes in plastic packaging.

Relevance score: 4

Table 43: Relevant priority sources and loopholes covered specifically by the Cosmetics Regulation

Priority sources of marine litter and most relevant loopholes in plastic packaging	
Land based	
Tourism and coastal recreation	
Household and general littering	X
Toilet and sewer overflow	X
Waste management and collection (incl. landfills)	
Industrial activities (construction and demolition sector, plastic industry)	X
Sea based	
Shipping sector	

[65] See for example P7_QE(2011)011720 http://www.europarl.europa.eu/RegistreWeb/search/simple.htm?relName=REFSOURCE&reference=E-011720/2011
[66] http://www3.illinois.gov/PressReleases/ShowPressRelease.cfm?SubjectID=2&RecNum=12313

Fishing (professional and recreational)	
Aquaculture	
Port activities	
Other offshore industries	
Most relevant loopholes in plastic packaging	
Lack of measures to reduce the production of plastic packaging (e.g. bags, bottles, EPS fish boxes)	
Production and consumption patterns based on single-use/disposable items rather than reduce and re-use	
Inappropriate behaviour when disposing litter (e.g. during activities along the coast, particularly impact related to tourism, etc.)	
Lack of awareness or incentives to separate waste for recycling	
Decoupling between design/production and recycling – products are designed without its whole life-cycle in view	X
Inappropriate behaviour on waste management in industries and retailers (losses of material, etc.)	
Deficient separate collection infrastructure for PPW	
Inappropriate waste collection and separation facilities (e.g. bins without lids in windy areas)	
Inappropriate waste treatment facilities (e.g. landfills close to the coast, etc.)	
Insufficient collection coverage of municipal waste	

10.11.7 Feasibility assessment

In light of the already on-going action to phase-out microplastics from cosmetics, as well as regional and international efforts to address the problem, we conclude that a phase out or ban on microplastics in cosmetics and other user goods is feasible, and that there is good political momentum to achieve this. Moreover, micro- and nano-plastics in cosmetics can be replaced by natural products. However, the legal mechanism for achieving such a goal needs further attention. Institutions and stakeholders involved the process of agreeing a phase out or ban would be the cosmetic industries, NGO's, research institutes, the media, citizens and governments.

Feasibility score: 5

10.11.8 Priority score

Because micro- and nano-plastics can be replaced by natural products, it is relevant and feasible to phase out their use.

Priority score: 4.5

10.12 Eco-design

10.12.1 Summary

The Eco-design Directive establishes eco-design requirements for energy-using products in the European Union[67]. Examples vary from smart phones to trains. Eco-design is a preventive approach, designed to optimise the environmental performance of products, while maintaining their functional qualities. This provides new opportunities for manufacturers, consumers and society as a whole. The Directive contributes to sustainable development by increasing energy efficiency and the level of protection of the environment, while at the same time increasing the security of the energy supply. There is no direct link to marine litter, only indirect through enhancing a zero-waste economy by using secondary raw materials.

10.12.2 Context

Products bearing the CE-label are presumed to comply with the Eco-design requirements stated in the applicable implementing measures. The Commission can decide whether other eco-labels are equivalent to the CE-label. Eco-design parameters relate to all different phases in the product life cycle:

- Raw material selection and use;
- Manufacturing;
- Packaging, transport, and distribution;
- Installation and maintenance;
- Use;
- End-of-life.

For each phase, the following aspects of the product must be assessed:

- Predicted consumption of materials, of energy and of other resources;
- Anticipated emissions to air, water or soil;
- Anticipated pollution (noise, vibration, radiation, electromagnetic fields);
- Expected generation of waste material;
- Possibilities for reuse, recycling and recovery of materials or of energy, taking into account the Directive on waste electrical and electronic equipment (WEEE).

All products covered by implementing measures must bear the CE marking before being placed on the market. Market surveillance is to be carried out by competent authorities designated by Member States that have the task of:

- Verifying product conformity;
- Requiring the parties concerned to provide the necessary information;
- Taking samples of products and subjecting them to compliance checks.

[67] http://europa.eu/legislation_summaries/enterprise/interaction_with_other_policies/en0018_en.htm
Ecodesign Directive (2009/125/EC)

10.12.3 Types of Marine Litter

By focussing on more sustainable production, usage and disposal of products (less energy and raw materials), eco-design contributes to the reduction of waste and hence also to the reduction of litter and marine litter. Its actual focus on energy using products limits the relevance for marine litter. WEEE can be found in marine litter but is not a major constituent. With a focus on recycled content of raw materials or on reusability and recyclability of consumer goods, an expanded scope for ecodesign rules could play a role in limiting the throw-away single use goods (e.g. lighters) and packaging.

10.12.4 Potential on reducing marine litter

The Eco-design Directive has the potential to reduce waste and hence also marine litter. Its effectiveness in reducing marine litter is limited because the Directive only addresses energy-using products, not all products e.g. packaging. Energy using products do not form a large fraction of marine litter.

10.12.5 Revision of the legislation or policy

During this study we found no information on future revisions of the Eco-design Directive, although the ecodesign concept is evolving steadily away from merely energy-efficiency to a much more broad approach including as well material resource efficiency. It can be expected that the link with only energy-using or energy related products will be broken in future.

10.12.6 Relevance assessment

The relevance of the eco-design Directive can be scored low to intermediate. Low because the Directive does not address all products, and those that it does address do not account for a significant portion of marine litter items. Intermediate because ecodesign as a concept is very important in the production of consumer goods less susceptible to ending up as litter. The relevance of the Directive may greatly increase if it were broadened to cover more items that are littered in the marine environment, notably packaging. All marine litter originates from the production of products and a more smart design may result in a more sustainable production, usage and disposal of products and thus eventually lead to less marine litter.

Relevance score: 3

Table 44: Relevant priority sources and loopholes covered specifically by the Eco-design directive

Priority sources of marine litter	
Land based	
Tourism and coastal recreation	X
Household and general littering	X

Toilet and sewer overflow	
Waste management and collection (incl. landfills)	
Industrial activities (construction and demolition sector, plastic industry)	X
Sea based	
Shipping sector	
Fishing (professional and recreational)	
Aquaculture	
Port activities	
Other offshore industries	
Most relevant loopholes in plastic packaging	
Lack of measures to reduce the production of plastic packaging (e.g. bags, bottles, EPS fish boxes)	X
Production and consumption patterns based on single-use/disposable items rather than reduce and re-use	X
Inappropriate behaviour when disposing litter (e.g. during activities along the coast, particularly impact related to tourism, etc.)	
Lack of awareness or incentives to separate waste for recycling	X
Decoupling between design/production and recycling – products are designed without its whole life-cycle in view	X
Inappropriate behaviour on waste management in industries and retailers (losses of material, etc.)	
Deficient separate collection infrastructure for plastic packaging waste	
Inappropriate waste collection and separation facilities (e.g. bins without lids in windy areas)	
Inappropriate waste treatment facilities (e.g. landfills close to the coast, etc.)	
Insufficient collection coverage of municipal waste	

10.12.7 Feasibility assessment

The Eco-design Directive depends on institutional, political and legal issues. There are strict international agreements in order to prevent unfair competition between enterprises. These enterprises are stakeholders that may disagree with new provisions that would have impact on their production. It will take time to change and then implement this Directive. Therefore it is less feasible to assess this Directive compared to other Directives that are more specifically aimed at reducing marine litter items.

Feasibility score: 3

10.12.8 Priority score

The priority score for this Directive, in its actual form, is rather modest, but may increase if broadened up to non-energy related consumer goods.

Priority score: 3

10.13 Green Public Procurement and Eco-labelling

10.13.1 Summary

Green public procurement

Green Public Procurement is a process whereby public authorities seek to procure goods, services and works with a reduced environmental impact throughout their life cycle when compared to those with the same primary function that would otherwise be procured. The Communication “Public procurement for a better environment” (COM (2008) 400[68] provides guidance on how to reduce the environmental impact of public sector consumption and show how to use Green Public Procurement (GPP) to stimulate innovation in environmental technologies, products and services. The Communication proposes instruments which should remove the main obstacles to increased take-up of Green Public Procurement. The Commission has identified ten priority sectors for GPP:

- construction;
- food and catering services;
- transport;
- energy;
- office machinery and computers;
- clothing and other textiles;
- paper and printing services;
- furniture;
- cleaning products and services;
- equipment used in the health sector.

Eco-labelling

The EU Ecolabel may be awarded to products and services which have a lower environmental impact than other products in the same group.[69] The label criteria are devised using scientific data on the complete life cycle of a product, from development to disposal. The label may be awarded to all goods or services distributed, consumed or used in the EU market whether in return for payment or free of charge. It does not apply to medicinal products for human or veterinary use, or to medical devices. The system was introduced by Regulation (EEC) No 880/92 and amended by Regulation (EC) No 1980/2000. The new Regulation (EC) No 66/2010 improves the rules on the award, use and operation of the label.

[68] http://europa.eu/legislation_summaries/environment/sustainable_development/mi0002_en.htm
[69] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:027:0001:0019:en:PDF

10.13.2 Context

Green Public Procurement

The Commission highlights the need to define common Green Public Procurement criteria. A preliminary set of criteria for products and services in the ten priority sectors has been established in the framework of a "Training Toolkit". The criteria have been based on criteria used in the granting of the European Eco-label in particular, or, in the absence of a European label, national ecolabels and are the result of cooperation between the Commission and a group of expert representatives from Member States.

GPP criteria are divided into two categories:

- The "core" criteria are designed to allow easy application of Green Public Procurement and are focused on the key area(s) of environmental performance of a product. They are aimed at keeping administrative costs to a minimum for suppliers who have to comply with the criteria and public authorities who have to use them in their procurement. The Commission proposes that by 2010, 50% of all public procurement should comply with these criteria;
- The "comprehensive" criteria take into account more aspects or are based on higher levels of environmental performance, for use by authorities that want to go further in supporting environmental goals.

An impact assessment study (Pueyo et al 2012) concluded that several EU Member States have established compulsory or indicative targets:

- 14 Member States have set targets for the percentage of public procurement that will comply at the national level:
    - Targets of 50% of public procurement, as the indicative target set at the EU level have been set by Belgium, Cyprus, Denmark, Ireland, Malta, Portugal, Slovakia and Slovenia.
    - More ambitious targets than the 50% have been set by Finland and the Netherlands.
    - Less ambitious targets than the 50% have been set by Italy, Lithuania, Poland and Romania.
    - Finland, the Netherlands and Denmark have also set targets at the regional and local level.

In order to monitor Green Public Procurement, the Commission establishes two types of indicators: quantitative indicators to assess the progress of the policy and its impact on the supply side, and impact-oriented indicators allowing assessment of the environmental and financial gains made. In 2010, the Commission evaluated the situation and produced a review which serves as the basis for setting future targets. The impact assessment study (Pueyo et al. 2012) proposed to introduce green procurement targets for Member States to be met by 2020, e.g. 75% at central level and 50% at local government; or to set a target of 100% for certain priority categories of goods, services and works, i.e. all products purchased by public bodies have to meet the criteria.

EU eco-labelling

Member States designate one or more bodies responsible for the labelling process at national level. Their operations are transparent and their activities are open to the involvement of all interested parties. They are specifically responsible for regularly checking that products comply with the label criteria. Their responsibility also includes receiving complaints, informing the public, monitoring false advertising and prohibiting products.

If the product complies with the label criteria, the competent body concludes a contract with the operator, establishing the terms of use and withdrawal of the label. The operator may then place the label on the product. The use of the label is subject to the payment of a fee when the application is made, and an annual fee. The Commission has created a catalogue of products which have been awarded the label.

The label is awarded in consideration of European environmental and ethical objectives. In particular:

- the impact of goods and services on climate change, nature and biodiversity, energy and resource consumption, generation of waste, pollution, emissions and the release of hazardous substances into the environment;
- the substitution of hazardous substances by safer substances;
- durability and reusability of products;
- ultimate impact on the environment, including on consumer health and safety;
- compliance with social and ethical standards, such as international labour standards;
- taking into account criteria established by other labels at national and regional levels;
- reducing animal testing.

The label cannot be awarded to products containing substances classified as toxic, hazardous to the environment, carcinogenic or mutagenic, or substances subject to the regulatory framework for the management of chemicals.

10.13.3 Types of Marine Litter

Green Public Procurement and EU eco-labelling has an impact on the reduction or the nature of all kinds of solid litter such as plastics, wood, metals, glass, rubber and clothing. The measures aim to provide a more sustainable way of providing goods and services.

10.13.4 Potential on reducing marine litter

Both policies have significant, but indirect potential to reduce marine litter. When products are produced and recyclable in a sustainable way, taking into account their whole lifecycle, there is a potential to reduce marine litter. Products that end up in a recycling chain – or for which it is beneficial to send it to recycling - are less likely to be littered. Ecodesign for more recyclability can be enhanced if a market is fostered both for recyclable goods and for the use of recycled material as an alternative for raw materials. Such a market could be supported through GPP or through ecolabeling. It works best for industrial goods or raw materials, or products needed by government bodies, and depends in the post-consumer phase on the willingness of consumers to enter even small fractions of material in the recycling chain, or on the willingness to buy ecolabeled products.

10.13.5 Revision of the legislation or policy

In its Circular Economy Communication (European Commission 2014b) the Commission states that in order to unlock investment in the circular economy, it will prepare guidance on the possibilities offered by the new public procurement directives in the field of Green Public Procurement, and a recommendation on monitoring Member States' performance in achieving the indicative 50 % GPP target, support innovative instruments, such as pre-commercial procurement and public procurement for innovation, and facilitate the establishment of GPP networks among public authorities.

In order to support design and innovation for a more circular economy, the Commission will demonstrate under the EU Research and Innovation Programme (Horizon 2020) the opportunities for moving towards a circular economy at European level with large scale innovation projects targeted at cooperation within and between value chains, fostering skills development and supporting the market application of innovative solutions. It will establish a reinforced partnership to support research and innovative policies for the circular economy, and it will facilitate the development of more circular models for products and services, including through a more coherent product policy, and further develop the application of the Ecodesign Directive by paying further attention to resource efficiency criteria, including for the future priority product groups in the 2015- 2017 Work Plan.

10.13.6 Relevance assessment

By creating markets for ecodesigned consumer goods and other goods, and by recreating a market for recycled raw materials, both instruments support ecodesign and enhanced recycling. Ecodesign (or the lack of it) is indicated as one of the major sources for marine litter.

Relevance score: 4

Table 45: Relevant priority sources and loopholes covered specifically by the Green Public Procurement and Eco-labelling policy instruments

Priority sources of marine litter	
Land based	
Tourism and coastal recreation	
Household and general littering	X
Toilet and sewer overflow	

Waste management and collection (incl. landfills)	
Industrial activities (construction and demolition sector, plastic industry)	X
Sea based	
Shipping sector	
Fishing (professional and recreational)	
Aquaculture	
Port activities	
Other offshore industries	
Most relevant loopholes in plastic packaging	
Lack of measures to reduce the production of plastic packaging (e.g. bags, bottles, EPS fish boxes)	X
Production and consumption patterns based on single-use/disposable items rather than reduce and re-use	X
Inappropriate behaviour when disposing litter (e.g. during activities along the coast, particularly impact related to tourism, etc.)	
Lack of awareness or incentives to separate waste for recycling	X
Decoupling between design/production and recycling – products are designed without its whole life-cycle in view	X
Inappropriate behaviour on waste management in industries and retailers (losses of material, etc.)	
Deficient separate collection infrastructure for plastic packaging waste	
Inappropriate waste collection and separation facilities (e.g. bins without lids in windy areas)	
Inappropriate waste treatment facilities (e.g. landfills close to the coast, etc.)	
Insufficient collection coverage of municipal waste	

10.13.7 Feasibility assessment

Both Green Public Procurement and EU eco-labelling depend on criteria for sustainable products. These criteria need frequent updating to be in line with technological progress and with the assessment of (new or formerly unknown) environmental impacts. Stakeholders involved in these processes are governments, NGO’s, expertise centres and academics, and industry. Changes are supported by growing public awareness on litter and recycling. This makes it feasible to introduce marine litter aspects into the criteria for ecolabels or for GPP. The Circular Economy Communication (European Commission 2014b) refers to both instruments as tools to be adapted and made stronger.

Feasibility score: 4

10.13.8 Priority score

Green Public Procurement and eco-labelling policies aim at a more sustainable use of resources in production and consumption. They represent a global change in resource use and the reduction of waste. The policies focus on a general transition towards a zero-less economy, and in this sense will contribute (although indirect) to a reduction of marine litter.

Priority score: 4

10.14 Integrated Coastal Zone Management (ICZM) and Maritime Spatial Planning

10.14.1 Summary

A European Parliament and Council Recommendation concerning the implementation of Integrated Coastal Zone Management in Europe was adopted on 30 May 2002 (2002/413/EC)[70]. It lists eight principles defining the essential characteristics of ICZM. Integration across sectors and levels of governance, as well as a participatory and knowledge-based approach, are hallmarks of ICZM. Based on these principles, the Recommendation outlines steps which the Member States should take to develop national strategies for ICZM. Because of the cross-border nature of many coastal processes, coordination and cooperation with neighbouring countries and in a regional sea context are also encouraged.

To support the implementation of the ICZM Recommendation, the Commission facilitated an Expert Group, which held its first meeting on 3 October 2002 (documents related to this group can be found on DG ENV website).

More recently, in 2013, the Commission launched a new joint initiative on integrated coastal management and maritime spatial planning which has resulted in the Maritime Spatial Planning Directive adopted in 2014[71].

10.14.2 Context

The 2002 Recommendation on Integrated Coastal Zone Management defined the principles of sound coastal planning and management and how to best implement them. Although the formal reporting and evaluation timeline of the Recommendation ended in 2006, the evaluation process concluded that the substance, approach and principles remained valid. Since its introduction in 2002, the majority of coastal Member States have developed National Strategies but the programmatic implementation of ICZM at this level has been very limited. Furthermore, ICZM now has to work within the context of other EU horizontal policy initiatives which have influence at the coast, like the Water Framework Directive (WFD), the Marine Strategy Framework Directive (MSFD) and the Integrated Maritime Policy Regulation (IMP). The relationship with the new

[70] http://ec.europa.eu/environment/iczm/home.htm
[71] An agreement was reached between the European Commission, Parliament and Council in March 2014 (see http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/EN/genaff/141450.pdf). Publication of the final text in the Official Journal of the EU is still pending at the rime of publication of this report.

Maritime Spatial Planning Directive, with its provision for maritime spatial planning taking into account "land/sea interactions" will also have to be considered.

The European Union is a contracting party to the Barcelona Convention, which established a Protocol on Integrated Coastal Zone Management that entered into force in March 2011. This Protocol makes Integrated Coastal Zone Management compulsory for EU Member States bordering the Mediterranean Sea, requiring them to develop national strategies.

During the development of the MSP Directive, the term "Integrated Coastal Management" (ICM) became commonly used by the European Commission. "ICM" and "ICZM" are interchangeable terms.

10.14.3 Types of Marine Litter

Integrated Coastal Management is a tool for the integrated management of all policy processes affecting the coastal zone, addressing land-sea interactions of coastal activities in a coordinated way with a view to ensuring the sustainable development of coastal and marine areas. It ensures that management or development decisions are taken coherently across sectors.

ICM does not addresses specifically any types of marine litter but rather addresses this problem as a cross-cutting issue.

10.14.4 Potential on reducing marine litter

Through project initiatives (*e.g.* FP 7 – *Pegaso*[72]) there are many examples that have addressed the marine litter problem within integrated projects on integrated coastal management, which might have produced some long-lasting results. Nevertheless, due to the current policy developments the potential for the Recommendation to address marine litter is limited.

10.14.5 Revision of the legislation or policy

On 12 March 2013, the Commission launched a new joint initiative led by DG MARE and DG ENV on integrated coastal management and maritime spatial planning. The proposal took the form of a draft Directive, which aimed to establish a framework for maritime spatial planning and integrated coastal management in EU Member States with a view to promote the sustainable growth of maritime and coastal activities and the sustainable use of coastal and marine resources.

Following negotiations between the Council of the European Union and the European Parliament, an agreement was reached on a Directive on Maritime Spatial Planning (MSP).However, the Integrated Coastal Management (ICM) dimension was not embraced by the Member States during the negotiations and was ultimately dropped although the Directive covers coastal waters, requires

[72] http://www.pegasoproject.eu/p/images/8/86/PEGASO_Coastal_and_marine_litter.pdf

Member States to take land/sea interactions into account and lists ICM as one of the processes by which planning of coastal and marine regions may take place.

The Directive requires Member States to develop spatial plans to better coordinate the various activities that take place at sea, ensuring they are as efficient and sustainable as possible. The European Parliament endorsed the draft text in April 2014[73] with approval from the Council taking place in July 2014. Publication in the Official Journal of the EU is pending at the time of finalisation of this report

10.14.6 Relevance assessment

ICM is a crucial process to manage the highly utilised but sensitive interface between the land and the marine environment. It is too early to assess the potential and extent to which the MSP Directive will address this. However, the opportunities for integration across sectorial interests, different governance levels and EU policies offer an important way for ICM, as a process, to add value to existing and on-going initiatives. Experiences and examples of good practice, as shown in the OURCOAST initiative, will contribute to a more fully integrated management process that is required to address the problem of marine litter.

Relevance score: 4

10.14.7 Feasibility assessment

The ICM elements of the draft Directive met with significant resistance during the negotiations with the Member States. As a result, it is not contained within the Directive as a legal instrument but ICM, as a process, was acknowledged as being useful in facilitating common understanding amongst stakeholders. The opportunity to use ICM mechanisms, where they exist, remains with Member States and may be highly relevant for issues connected with marine litter

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Feasibility score: 2

10.14.8 Priority score

Priority score: 3

10.15 Conclusions

An overview of the assessed relevance, feasibility, revision and priority score for each instrument is provided in Table 46.

Table 46: Overview of the relevance score, feasibility score and priority score to change Directives.

Directive	Relevance score	Feasibility score	Priority score

[73] http://europa.eu/rapid/press-release_IP-14-459_en.htm?subweb=347&lang=en

Packaging and Packaging Waste Directive	5	5	5
Waste Framework Directive	4	5	4,5
Micro- and nano-plastics in cosmetics	4	5	4,5
Port Reception Facilities Directive	4	4	4
Water Framework Directive	4	4	4
Green Public Procurement and Eco-labelling	4	4	4
Marine Strategy Framework Directive	4	3	3,5
Landfill Directive	3	4	3,5
Ship-source Pollution Directive	4	3	3,5
Urban Waste Water Treatment Directive	4	3	3,5
Eco-design	3	3	3
Integrated Coastal Zone Management (ICZM) Recommendation and Maritime Spatial Planning Directive	4	2	3
Bathing Water Directive	2	1	1,5

11 Conclusions

11.1 Definition and height of a headline reduction target

11.1.1 Definition

Based on

- the targets already in use at the level of Member States or regional seas
- the expectations of the general public and the stakeholders concerning an effective marine litter policy
- the analysed occurrence of key marine litter types, loopholes and pathways retrieved from 343 recent beach screenings in the four regional seas
- the modelled impact on marine litter of the different policy options included in the impact assessment study on the Commission's proposal for reviewing the European waste management targets
- the assessed impact on marine litter which dedicated policy measures for specific litter items can have

we developed following proposal for a headline reduction target:

"A -30% reduction of the number of items of the top ten litter categories found as coast litter in each regional sea, by 2020, compared with 2015, applying the screening method from the technical guidance documents on monitoring of marine litter and excluding fragmented or undefinable litter items with guidance document codes G75, G76, G134, G145, G158, G210"

11.1.2 Level of ambition

The level of ambition of the proposed target is slightly above what we expected as impact of the waste management options and recycling targets as described in the impact assessment.

Assessed impacts for the different options are:

	ML inflow evolution 2015-2020	ML inflow evolution 2015-2025	ML inflow evolution 2015-2030
	evolution (%)	evolution (%)	evolution (%)
Business as usual	4,40	8,53	12,29
option 1 full implementation	-4,63	-0,70	2,92
option 2 single calculation method	-3,77	0,17	3,81
option 3.1 higher mun. waste recycling targets	-4,63	-5,31	-7,40
option 3.2 higher packaging waste recycling targets	-16,26	-20,93	-18,41
option 3.3 landfill ban	-3,78	-0,62	2,50
option 3.4 combination	-16,91	-24,30	-25,42
scenario maximum feasible	-36,11	-35,72	-35,45

A reduction target of -35% reflects a situation in which all Member States reach a performance level concerning waste recycling and decoupling of waste generation from consumption, as in 2012 achieved by the top three Member States.

A reduction target of -35% reflects as well a performance of 10% above what can be expected as the outcome of the most effective policy option in the impact assessment, looking only at the contribution from the revised waste legislation. This means that above general waste management optimization also specific measures targeting individual litter items will be needed.

These specific measures can be very effective, which means that the -35% target may be rather moderate. Some effects on the total number of beach litter items generated by item-oriented measures are assessed as follows:

Policy measure	Effect on total number of beach litter items observed
Cigarette butts litter prevention	North sea : 0,7% Baltic sea : 4% Black sea: 16% Mediterranean sea: 18%
Plastic carrier bags reduction	North sea : 13% Baltic sea : 13% Black sea: 3% Mediterranean sea: 6%
Bottle caps collection enhancement	North sea : 1,5-3,7% Baltic sea : 1-2,5% Black sea: 1,1-2,7% Mediterranean sea: 2,8-7%
Cotton buds awareness raising	North sea : 1,8% Mediterranean sea : 2,0%
Deposit refund systems on single use beverage packaging	North sea: 2,7% Baltic sea: 3,6% Black sea: 8,5% Mediterranean sea: 11,9%

- Deposit refund scheme could be applied to other specific items. DRF is an effective approach that leads to significant return-rates of the target item. Commonly applied to drink containers, such a system could be extended or designed to other problematic items, for example, plastic bottle caps/lids.
- Innovative design of certain products can also lead to very positive impacts for reducing their occurrence in the marine environment. The bottle caps tend to appear decoupled from their container and in higher numbers than the bottles themselves. Given its small size caps can be easily transported across long distances. A similar approach to the one implemented for the aluminium drink can pullers could be considered for this specific item.
- Certain items, commonly used in coastal HORECA (e.g. plastic straws, stirrers, fast-food wrappers, food containers and drink containers) could also be subject to specific measures, at least in coastal, in order to either reduce their use and

improper disposal (e.g. ban of certain products in certain areas, taxing some products to rationalise use, voluntary agreements among local business and retailers to reduce availability of certain items, etc.)

11.1.3 Characteristics

The proposed target and its indicator:

- Uses 2015 as a benchmark year;
- Focuses on the top ten litter items;
- Are flexible with regard to the individual characteristics of each sea, whose list of top ten items may vary;
- Are based on common beach litter screening practices, and respect the nomenclature (Master List) and methodology of the Marine Litter Coordination Group Technical Guidance Documents on monitoring of marine litter.

11.2 Public opinion on marine litter and reduction targets

437 people responded to the public consultation. Most of them (62%) were interested individuals and/or consumers. A third of the respondents (33%) consider themselves very well informed on the subject while over half of them (55%) consider themselves fairly well informed. The most relevant criteria for actions to be taken are considered to be the effectiveness and feasibility of the actions. Cost and the stakeholder impact are considered less relevant.

On the impact side, ingestion and entanglement are considered as the most negative impact associated with marine litter, while beach clean-up costs and damage to vessels are considered the least negative.

The public consultation focused on twelve groups of stakeholders which can take actions to reduce the presence and impact of marine litter : consumers, local and subnational authorities, national authorities, EU policy makers, NGO’s, the plastic industry, the retail sector, the tourism and recreational sector, the waste management sector, the fisheries sector, the shipping sector and port authorities. In total 91 actions were suggested in this consultation for different groups. All of these except one were scored as ‘strongly recommended’. This means that across all sectors and all measures, large public support can be observed. The consultation found the highest support for marine litter targets, and high scores for transition towards circular economy, general waste management and waste management enforcement measures.

Full details of the results, including a detailed summary can be found at: http://ec.europa.eu/environment/consultations/marine_litter_en.htm

11.3 The relationship between key behavioural measures and key marine litter items

There is potential for prevention of certain types of marine litter based solely on awareness-raising campaigns (e.g. disposal of cigarette butts by beach-users based on targeted campaigns and sanitary waste based on strong proper-disposal campaigns, with the support from producers). However, they seem to require a massive outreach to become effective, either through large-scale campaigns involving industry and the media or through multiple small-scale, local initiatives;

Economic incentives such as the Deposit-Refund scheme for drink containers seem to be very effective in increasing collection rates of high-quality material to recycle and based on the results of short-term pilot projects, have a greater impact than those based on awareness and subsequent voluntary initiatives of the individual. Incentives do not necessarily need to be economic; a campaign in Turkey to collect bottle caps in order to raise money for charity demonstrated that an 'altruistic' incentive was also a possible driver.

A key measure to prevent littering of smaller items is providing dedicated infrastructure. The reduction in the number of littered cigarette butts as a result of providing dedicated butt bins and personal ashtrays is remarkable. Unfortunately, few results are available on the effect on marine litter of optimizing waste disposal infrastructure on littering of metal cans, food packaging, plastic bottles, etc. This could be an area for further research.

11.4 Effectiveness of marine litter measures

The following 21 measures are evaluated for their impact on marine litter:

1. Levy or tax on certain products
2. Phasing-out / Ban of certain items or materials
3. Eco-contribution / tax for producers
4. Green procurements
5. Smoking ban/zoning on beaches
6. Improved enforcement of current legislation
7. Substitution with washable / reusable crates
8. Deposit-refund scheme
9. Redesign of products
10. Improved cleaning operations in certain areas
11. Improved labelling of products
12. Promote collection at the port
13. Reporting time and site of loss fishing gear to authorities
14. Voluntary, centralised collection of certain products in exchange of a community benefit
15. Voluntary phasing-out or minimisation of certain products
16. Awareness raising in specific sensitive areas or targeting specific items

17. Awareness raising targeting littering and improper disposal of fishing gear
18. Awareness raising campaigns targeting improper disposal of items in the toilet
19. Awareness raising for good waste management offshore
20. Fishing for Litter
21. Underwater clean-ups in hot-spot areas

#	Measure	Short Description	Sector Targeted	Examples
1	Levy or tax on certain products	Charge or sur-charge on the price paid by the consumer on specific items. *E.g.* single-use plastic bags or giving the only option for consumer to pay for reusable, stronger plastic bags. The revenue produced through taxes and charges can go to the public purse or specific purpose, like environmental funds.	Retail / Consumers	Plastic carrier bags - *E.g.* Ireland Beverage bottles - *E.g.* Some cities in US, like Chicago
2	Phasing-out / Ban of certain items or materials	Gradual elimination of certain items or materials from the market or certain areas (and therefore the corresponding waste streams).	Producers / Retailers	Plastic water bottles ≤ 0.6L - San Francisco will phase out the sale of these containers in certain areas. Simultaneously, soft-drinks containers are taxed at $0.02. The legislation faced strong resistance from the Beverage Industry. Plastic drink straws - Ban in Miami (US)
3	Eco-contribution / tax for producers	Creating financial incentives for producers related to the impact of the goods produced on marine litter.	Producers	Different types of extended producer responsibility schemes

#	Measure	Short Description	Sector Targeted	Examples
4	Green procurements	Environmental considerations can be integrated into procurement decisions to reduce the usage of disposable items in lieu of reusable materials.	HORECA, consumers and events at coastal areas	Non-biodegradable cutlery in US National Parks - Many of the national public parks run by the US National Park Service require all food vendors to use biodegradable plates, cups, and other disposable food containers as opposed to items made from polystyrene. The vendors are also instructed not to distribute straws with drinks unless specifically requested by the customer. Even then, only paper straws are allowed.
5	Smoking ban/zoning on beaches	Prohibit smoking on beaches or restrict it to certain areas, to prevent passive-smoking and littering	Beach users (smokers)	Mainly USA
6	Improved enforcement of current legislation	Use enforcement as a tool to ensure stakeholders comply with existing legal provisions	Shipping	Enforcement of ship waste acceptance rules in harbours
7	Substitution with washable / reusable crates	Avoiding disposal and littering of single use packaging	Fishing sector	Avoid litter from EPS fish boxes in and near fishery harbours

#	Measure	Short Description	Sector Targeted	Examples
8	Deposit-refund scheme	Deposit refund schemes impose a deposit on a product (e.g., glass bottle) at the point of purchase, which is refunded upon return of the product container (e.g. empty bottle). This is an incentive scheme and not intended to raise revenue.	Retail / Consumers	Beverage bottles - in several of European countries (e.g. Germany, Denmark, Sweden, Malta); Plastic cups - some examples at coastal events
9	Redesign of products	Redesign of products that may reduce their environmental impact and/or the resource efficiency and/or promote circular economy *E.g.* design bottle cap to avoid their detachment from the bottle itself	Designers / Producers	*E.g.* Redesign bottle plastic cap to avoid detaching from main item - Previous experiences of aluminium cans pullers
10	Improved cleaning operations in certain areas	Improve cleaning operations and frequency in certain areas or at different points along the pathway of litter to the marine environment	Authorities	Tourist concentration zones, fishery harbours, marine activity concentration zones
11	Improved labelling of products	Improved labelling to clearly draw attention of consumer to dispose item properly, possibly highlighting some of the impacts and risks	Producers	Labels on single-use consumer packaging

#	Measure	Short Description	Sector Targeted	Examples
12	Promote collection at the port	Fishers are encouraged to bring ashore and dispose of their fishing material at the port/harbour. It usually implies reduction or absence of disposal fees for disposal of old gear and encouragement to reel in abandoned/old fishing gear and deposit it for free at designated points near fishing harbours. Costs of collection and treatment can be compensated by incineration or recycling of the material, some of which (e.g. nylon) are valuable.	Fishing sector	Some initiatives worldwide, including Healthy Seas Initiative and Fishing for Energy (USA). There is at least 1 case-study (Korea, 2003, described in UNEP/FAO report, 2009) where fishermen received economic incentives for the bringing ALDFG ashore. Amounts started at 587 tonnes in 2003 to over 5.000 in 2006. However, the incentives were paid by public funds.
13	Reporting time and site of loss fishing gear to authorities	UNEP/FAO report on ALDFG, 2009	Fishing sector	Already in practice in specific fishery harbours
14	Voluntary, centralised collection of certain products in exchange of a community benefit	Centralised collection of high-value recyclable item/material in exchange of a benefit for disabled or deprived people in the community. It follows an agreement with recycling companies, which will buy the material collected.	Consumers / Recyclers	Plastic bottle caps in Turkey - Community is encouraged to collect plastic lids, following an agreement with recycling company to exchange a certain amount of lids for wheelchairs for disabled people. In Turkey the Blue Lid Campaign collected over 500 tonnes between 2010 and 2013, resulting in almost 500 wheelchairs.

#	Measure	Short Description	Sector Targeted	Examples
15	Voluntary phasing-out or minimisation of certain products	Businesses (e.g. retailers) take initiative to phase-out, substitute or reduce to minimums certain packaging or service items, to prevent waste and improper disposal. *E.g.* plastic single-use cutlery, straws, stirrers	Retailers / HORECA	Ceasing providing straws in HORECA - Voluntary initiative whereby restaurants and bars agree to stop serving straws with the drinks, unless asked explicitly by costumer. An example is the "Straw-Wars" Campaign started by David Rothchild, which gathered already quite some support in London Some HORECA in London
16	Awareness raising in specific sensitive areas or targeting specific items	Awareness programmes and campaigns to foster change in behaviour. Should complement existing and appropriate infrastructures for waste collection	*E.g.* Beach-users	Chewing gum targets, portable ashtrays
17	Awareness raising against littering and improper disposal of fishing gear	Awareness programmes and campaigns to foster change in behaviour. Can complement any other initiatives	Fishing sector	"Fishing for Litter" with a side effect of bringing on land one's own waste as well.

#	Measure	Short Description	Sector Targeted	Examples
18	Awareness-raising campaigns against improper disposal in the toilet	Results from the 2007 MCS Beachwatch event marked a decrease in the number of cotton bud sticks observed on UK beaches, from 172 items/km in 2006 to 97,5 items/km in 2007, which was the year of start of the campaign	Consumers	UK - Campaign *Bag It, Bin It!*
19	Awareness raising for good waste management offshore	Awareness programmes and campaigns to foster change in behaviour.	Maritime activities	Complementing existing policies (*e.g.* MARPOL regulations)
20	Fishing for Litter	Fishermen voluntarily collect and bring ashore all waste that has been "by-caught" during their normal fishing operations	Fishing sector	Widespread in UK, NL, BE and being adopted in many other places
21	Underwater clean-ups in hot-spot areas	Divers remove ALDFG from accumulation areas (*e.g.* wrecks), with additional benefit of reducing the impact of ghost fishing. Divers can do this on a voluntary basis or be paid to do so.	Divers	A few examples (e.g. in NL, Healthy Seas Initiative)

Considering the list of top 15 identifiable items marine litter items, that represent between 73 and 86% of total items in a regional sea, we draft a matrix on which policy measure may benefit from which measure:

OSPAR ID	ITEM (*)	Average Occurrence (nr/100m)	Measure #
2	Carrier plastic bags	BALTIC - 5 MED - 43	1,2
3	Small plastic bags	NEA - 10 BLACK - 31	3
4	Beverage plastic bottles	NEA - 10 MED - 91 BLACK - 85	1, 2, 3, 8
6	Food containers, incl. fast food	BALTIC - 4 NEA - 11 MED - 15 BLACK - 12	1, 2, 4, 10, 15
15	Plastic caps/lids	BALTIC - 7 NEA - 43 MED - 110 BLACK - 49	9, 14, 16
16	Cigarette Lighters	MED - 11	5, 10, 16
19	Crisps / Sweets packets and lolly-sticks	BALTIC - 3 NEA - 23 MED - 26 BLACK - 86	1, 3, 10, 15, 16
21	Plastic cups	BALTIC - 3 BLACK - 12	1, 2, 4, 8, 15, 16
22	Plastic cutlery, trays, straws, etc.	BALTIC - 3 MED - 131 BLACK - 9	1, 2, 4, 15, 16
31	Rope diameter > 1 cm	BALTIC - 3 NEA - 20	6, 10, 12, 19, 21
32	String and cord diameter < 1 cm	NEA - 68	10, 16
40	Industrial Packaging and plastic sheeting	NEA - 8	1, 3, 6, 19
	Foam / sponge (total)	BALTIC - 7 NEA - 8	1, 2, 3, 6, 19
54	Clothing	BLACK - 11	16
60	Paper bags	MED - 35	1, 16
63	Cigarette Packets	MED - 12	5, 10, 16
64	Cigarette butts	BALTIC - 14 NEA - 9 MED - 112 BLACK - 326	5, 10, 16
70	Wood crates	BALTIC - 3	7, 8, 12, 17
77	Metal bottle caps	BALTIC - 4 BLACK - 10	14

78	**Aluminium drink cans**	MED - **11** BLACK - **44**	**8**
81	**Foil wrappers**	BLACK - **10**	**16**
98	**Cotton bud sticks**	MED - **37** NEA - **25**	**2, 3, 9, 11, 16, 18**
115	**Fishing nets and pieces of nets < 50 cm**	NEA - **19**	**9, 10, 12, 13, 1720, 21**

11.5 Benefits of reducing marine litter

11.5.1 Costs of degradation and benefits of reducing marine litter

The total quantified cost of degradation is estimated to be €258,9 million to €694,7 million. These however represent a small portion of actual costs as it has not been possible to quantify impacts to all economic sectors.

The monetised costs are attributed to the following ‘main affected sectors’:

- Tourism & recreation: The total estimated costs of EU wide beach cleaning range from 193,7 m€ to 629,8 m€
- Fishery sector: The total estimated costs to industry have been estimated to be €61,7 million per year.

It has not been possible to monetise the costs of all the affected groups and sectors, such as shipping and voluntary beach cleaning, cleaning of harbours and marinas.

Benefits of reducing marine litter are also assessed for these two sectors, taking into account:

- Less beach cleaning by coastal municipalities and private actors (e.g. hotels)
- Reduced cost to the fishery sector: Less fouled propellers and avoided damage to fishing nets and catch

	Marine litter inflow evolution 2015-2030	**Marine litter reduction benefits (m€/year)**
	evolution	
Business as usual	+12,29 %	-58,40
option 1 full implementation	+2,92 %	-13,87
option 2 single calculation method	+3,81 %	-18,10
option 3.1 higher mun. waste recycling targets	-7,40 %	35,16
option 3.2 higher packaging waste recycling targets	-18,41 %	87,48
option 3.3 landfill ban	+2,50 %	11,88
option 3.4 combination	-25,42 %	120,79

scenario maximum feasible	-35,45 %	168,45

11.5.2 Health and environmental effect of marine litter

Marine litter can affect marine organisms in a multitude of ways, either through physical damage such as entanglement and lacerations or through indirect health effects such as intoxication after ingestion.

Direct damage and entanglement pose serious threats to wildlife such as sea turtles, marine mammals, fish and invertebrates, as well as all kinds of birds and even sea snakes, which can be cut, trapped, strangled or drowned in the debris. “Ghost fishing” is one of the main ways that marine litter can cause direct physical harm and mortality within the marine environment. Marine litter can also cause direct environmental impacts in the form of alterations in or physical damage to important habitats such as shorelines, coral reefs, deep sea habitats and sea grass fields. Marine debris can also function as a means of transportation for a variety of different species, assisting in the distribution of non-native and even invasive species, which can in itself impact the local environment.

Another problem caused marine litter is the threat of ingestion. Many different species have been known to ingest pieces of debris, with far-reaching consequences including starvation and death. Plastics in the marine environment can pose a threat in the form of its physical components, chemical ingredients and adsorbed chemicals. Microplastics have been found to not only pass through the digestive system, but can also travel to the circulatory system of marine species. Chemicals absorbed from the environment, such as PBTs (Persistent Bioaccumulative and Toxic substances) and metals, are a real concern when entering the food chain as a part of ingested plastic particles.

Human health can be directly influenced by marine litter in the form of physical damage; anyone visiting a beach could get hurt from washed up degree on beaches such as broken glass, medical waste or other sharp objects. People entering the water can get entangled by floating or submerged debris such as fishing nets, ropes or fishing line. Indirect health effects can be caused by chemicals, toxins or other harmful particles in the water such as viruses or bacteria, all of which have entered the water column through anthropogenic sources. The risk of chemicals adhered to plastics in the marine environment transferring through the food web from marine organisms to humans has not yet been conclusively established and represents an important knowledge gap.

11.6 Potential of specific EU legislation and instruments to reduce marine litter

A broad range of EU policies and legislations are related to marine litter in a certain way. In an exploratory analysis we identified which of these instruments has the largest relevance for the marine litter and as well as assessing the feasibility for adaptation for more effective integrated marine litter policy.

Directive	Relevance score	Feasibility score	Priority score
Packaging and Packaging Waste Directive	5	5	5
Waste Framework Directive	4	5	4,5
Micro- and nano-plastics in cosmetics	4	5	4,5
Port Reception Facilities Directive	4	4	4
Water Framework Directive	4	4	4
Green Public Procurement and Eco-labelling	4	4	4
Marine Strategy Framework Directive	4	3	3,5
Landfill Directive	3	4	3,5
Ship-source Pollution Directive	4	3	3,5
Urban Waste Water Treatment Directive	4	3	3,5
Eco-design	3	3	3
Integrated Coastal Zone Management (ICZM) Recommendation and Maritime Spatial Planning Directive	4	2	3
Bathing Water Directive.	2	1	1,5

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Annex 2: Cases examined for the beach litter analysis

Case code	Case name	Date	Short case description	Sea code	River	Source	Country
1	NOR1	26/03/2012	Oostende oosteroever	NOR		ARCADIS pilot study 4 seas[74]	BE
2	NOR2	26/04/2012	Oostende oosteroever	NOR		ARCADIS pilot study 4 seas	BE
3	MED1	30/04/2012	Badalone 30/04/2012	MED	yes	ARCADIS pilot study 4 seas	ESP
4	MED2	18/07/2012	Badalone 18/07/2012	MED		ARCADIS pilot study 4 seas	ESP
5	MED3	15/03/2012	San Sebastian 15/03/2012	MED		ARCADIS pilot study 4 seas	ESP
6	MED4	22/03/2012	San Sebastian 22/03/2012	MED		ARCADIS pilot study 4 seas	ESP
7	MED5	12/07/2012	San Sebastian 12/07/2012	MED		ARCADIS pilot study 4 seas	ESP
8	MED6	16/05/2012	Prat de Llobregat 16/05/2012	MED		ARCADIS pilot study 4 seas	ESP
9	MED7	11/06/2012	floating 11/06/2012	MED		ARCADIS pilot study 4 seas	ESP
10	BLA1	26/04/2012	Constanta 26/04/2012	BLA		ARCADIS pilot study 4 seas	RO
11	BLA2	7/05/2012	Constanta 07/05/2012	BLA		ARCADIS pilot study 4 seas	RO
12	BLA3	28/04/2012	Navodari 28/04/2012	BLA		ARCADIS pilot study 4 seas	RO
13	BLA4	6/05/2012	Navodari 06/05/2012	BLA		ARCADIS pilot study 4 seas	RO
14	BLA5	1/05/2012	Tomis port 01/05/2012	BLA		ARCADIS pilot study 4 seas	RO
15	BLA6	29/05/2012	Channel 29/05/2012	BLA	yes	ARCADIS pilot study 4 seas	RO
16	BLA7	4/05/2012	Channel 04/05/2012	BLA	yes	ARCADIS pilot study 4 seas	RO
17	BAL1	27/03/2012	Daugavgriva 1 27/03/2012	BAL		ARCADIS pilot study 4 seas	LTV
18	BAL2	27/03/2012	Daugavgriva 2 27/03/2012	BAL		ARCADIS pilot study 4 seas	LTV
19	BAL3	31/05/2012	Daugavgriva 1 31/05/2012	BAL		ARCADIS pilot study 4 seas	LTV
20	BAL4	31/05/2012	Daugavgriva 2 31/05/2012	BAL		ARCADIS pilot study 4 seas	LTV
21	BAL5	20/04/2012	Vakarbulli 1 20/04/2012	BAL		ARCADIS pilot study 4 seas	LTV
22	BAL6	20/04/2012	Vakarbulli 2 20/04/2012	BAL		ARCADIS pilot study 4 seas	LTV
23	BAL7	30/05/2012	Vakarbulli 1 30/05/2012	BAL		ARCADIS pilot study 4 seas	LTV
24	BAL8	30/05/2012	Vakarbulli 2 30/05/2012	BAL		ARCADIS pilot study 4 seas	LTV
25	BAL9	14/04/2012	Vecaki 14/04/2012	BAL		ARCADIS pilot study 4 seas	LTV
26	BAL10	28/04/2012	Vecaki 28/04/2012	BAL		ARCADIS pilot study 4 seas	LTV
27	BAL11	1/04/2012	Vecaki 3	BAL		ARCADIS pilot study 4 seas	LTV
28	BAL12	14/04/2012	Daugava kremeri river bank 14/04/2012	BAL	yes	ARCADIS pilot study 4 seas	LTV
29	BAL13	28/04/2012	Daugava kremeri river bank 28/04/2012	BAL	yes	ARCADIS pilot study 4 seas	LTV
30	NOR3	19/12/2012	Sylt (island)	NOR		OSPAR	GE
31	NOR4	19/10/2012	Bergen	NOR		OSPAR	NL
32	NOR5	15/10/2012	Terschelling	NOR		OSPAR	NL
33	NOR6	9/10/2012	Veere	NOR		OSPAR	NL
35	NOR8	7/10/2012	Noordwijk	NOR		OSPAR	NL

[74] European Commission, 2013c.

Case code	Case name	Date	Short case description	Sea code	River	Source	Country
37	NOR10	1/10/2012	Baldaio	NOR		OSPAR	ESP
38	NOR11	1/10/2012	O Rostro	NOR		OSPAR	ESP
39	NOR12	1/10/2012	Porsmilin	NOR		OSPAR	FR
40	NOR13	1/10/2012	Trielen	NOR		OSPAR	FR
41	NOR14	1/10/2012	Le Stang	NOR		OSPAR	FR
42	NOR15	1/10/2012	Le Havre	NOR		OSPAR	FR
43	NOR16	1/10/2012	Dieppe	NOR		OSPAR	FR
44	NOR17	1/10/2012	Sein	NOR		OSPAR	FR
45	NOR18	1/10/2012	Koubou	NOR		OSPAR	FR
46	NOR19	1/10/2012	Kerizella	NOR		OSPAR	FR
47	NOR20	1/10/2012	Haby	NOR		OSPAR	SE
48	NOR21	1/10/2012	Edsvik	NOR		OSPAR	SE
49	NOR22	1/10/2012	Saltö	NOR		OSPAR	SE
50	NOR23	1/10/2012	Grönevik	NOR		OSPAR	SE
51	NOR24	1/10/2012	Edshultshall	NOR		OSPAR	SE
52	NOR25	1/10/2012	Gröderhamn	NOR		OSPAR	SE
54	NOR27	29/09/2012	Sylt (island)	NOR		OSPAR	GE
55	NOR28	28/09/2012	Minsener Oog (island)	NOR		OSPAR	GE
56	NOR29	26/09/2012	Juist	NOR		OSPAR	GE
57	NOR30	23/09/2012	Scharhörn (island)	NOR		OSPAR	GE
58	NOR31	16/09/2012	Sand Bay	NOR		OSPAR	UK
59	NOR32	15/09/2012	Cramond Beach	NOR		OSPAR	UK
60	NOR33	15/09/2012	Chilton Chine	NOR		OSPAR	UK
61	NOR34	15/09/2012	Tan-y-Bwlch Beach	NOR		OSPAR	UK
62	NOR35	2/09/2012	Raversijde	NOR		OSPAR	BE
63	NOR36	25/07/2012	Veere	NOR		OSPAR	NL
64	NOR37	23/07/2012	Terschelling	NOR		OSPAR	NL
66	NOR39	22/07/2012	Bergen	NOR		OSPAR	NL
67	NOR40	19/07/2012	Noordwijk	NOR		OSPAR	NL
68	NOR41	15/07/2012	Scharhörn (island)	NOR		OSPAR	GE
69	NOR42	15/07/2012	Sand Bay	NOR		OSPAR	UK
70	NOR43	12/07/2012	Sylt (island)	NOR		OSPAR	GE
72	NOR45	8/07/2012	Langland Bay	NOR		OSPAR	UK
73	NOR46	6/07/2012	Minsener Oog (island)	NOR		OSPAR	GE
74	NOR47	1/07/2012	O Rostro	NOR		OSPAR	ESP
75	NOR48	1/07/2012	Porsmilin	NOR		OSPAR	FR
76	NOR49	1/07/2012	Trielen	NOR		OSPAR	FR
77	NOR50	1/07/2012	Le Stang	NOR		OSPAR	FR
78	NOR51	1/07/2012	Le Havre	NOR		OSPAR	FR
79	NOR52	1/07/2012	Dieppe	NOR		OSPAR	FR
80	NOR53	1/07/2012	Sein	NOR		OSPAR	FR

Case code	Case name	Date	Short case description	Sea code	River	Source	Country
81	NOR54	1/07/2012	Koubou	NOR		OSPAR	FR
82	NOR55	1/07/2012	Kerizella	NOR		OSPAR	FR
83	NOR56	1/07/2012	Haby	NOR		OSPAR	SE
84	NOR57	1/07/2012	Edsvik	NOR		OSPAR	SE
85	NOR58	1/07/2012	Saltö	NOR		OSPAR	SE
86	NOR59	1/07/2012	Grönevik	NOR		OSPAR	SE
87	NOR60	1/07/2012	Edshultshall	NOR		OSPAR	SE
88	NOR61	1/07/2012	Gröderhamn	NOR		OSPAR	SE
89	NOR62	21/06/2012	Juist	NOR		OSPAR	GE
91	NOR64	9/06/2012	Cramond Beach	NOR		OSPAR	UK
92	NOR65	12/05/2012	Chilton Chine	NOR		OSPAR	UK
94	NOR67	30/04/2012	Minsener Oog (island)	NOR		OSPAR	GE
95	NOR68	29/04/2012	Tan-y-Bwlch Beach	NOR		OSPAR	UK
96	NOR69	28/04/2012	Sylt (island)	NOR		OSPAR	GE
97	NOR70	24/04/2012	Juist	NOR		OSPAR	GE
98	NOR71	22/04/2012	Sand Bay	NOR		OSPAR	UK
99	NOR72	21/04/2012	Cramond Beach	NOR		OSPAR	UK
100	NOR73	20/04/2012	Scharhörn (island)	NOR		OSPAR	GE
101	NOR74	15/04/2012	Langland Bay	NOR		OSPAR	UK
103	NOR76	1/04/2012	O Rostro	NOR		OSPAR	ESP
104	NOR77	1/04/2012	Porsmilin	NOR		OSPAR	FR
105	NOR78	1/04/2012	Larmor Plougastel	NOR		OSPAR	FR
106	NOR79	1/04/2012	Trielen	NOR		OSPAR	FR
107	NOR80	1/04/2012	Le Stang	NOR		OSPAR	FR
108	NOR81	1/04/2012	Le Havre	NOR		OSPAR	FR
109	NOR82	1/04/2012	Dieppe	NOR		OSPAR	FR
110	NOR83	1/04/2012	Sein	NOR		OSPAR	FR
111	NOR84	1/04/2012	Koubou	NOR		OSPAR	FR
112	NOR85	1/04/2012	Kerizella	NOR		OSPAR	FR
113	NOR86	1/04/2012	Blancs Sablons	NOR		OSPAR	FR
114	NOR87	1/04/2012	Bergen	NOR		OSPAR	NL
115	NOR88	1/04/2012	Noordwijk	NOR		OSPAR	NL
116	NOR89	1/04/2012	Veere	NOR		OSPAR	NL
117	NOR90	1/04/2012	Terschelling	NOR		OSPAR	NL
118	NOR91	1/04/2012	Haby	NOR		OSPAR	SE
119	NOR92	1/04/2012	Edsvik	NOR		OSPAR	SE
120	NOR93	1/04/2012	Saltö	NOR		OSPAR	SE
121	NOR94	1/04/2012	Grönevik	NOR		OSPAR	SE
122	NOR95	1/04/2012	Edshultshall	NOR		OSPAR	SE
123	NOR96	1/04/2012	Gröderhamn	NOR		OSPAR	SE
125	NOR98	28/01/2012	Cramond Beach	NOR		OSPAR	UK

Case code	Case name	Date	Short case description	Sea code	River	Source	Country
126	NOR99	22/01/2012	Sand Bay	NOR		OSPAR	UK
127	NOR100	15/01/2012	O Rostro	NOR		OSPAR	ESP
128	NOR101	14/01/2012	Minsener Oog (island)	NOR		OSPAR	GE
129	NOR102	14/01/2012	Tan-y-Bwlch Beach	NOR		OSPAR	UK
130	NOR103	13/01/2012	Sylt (island)	NOR		OSPAR	GE
131	NOR104	10/01/2012	Juist	NOR		OSPAR	GE
132	NOR105	8/01/2012	Chilton Chine	NOR		OSPAR	UK
133	NOR106	8/01/2012	Langland Bay	NOR		OSPAR	UK
134	NOR107	1/01/2012	Hvide Sande	NOR		OSPAR	DK
135	NOR108	1/01/2012	Porsmilin	NOR		OSPAR	FR
136	NOR109	1/01/2012	Larmor Plougastel	NOR		OSPAR	FR
137	NOR110	1/01/2012	Trielen	NOR		OSPAR	FR
138	NOR111	1/01/2012	Le Stang	NOR		OSPAR	FR
139	NOR112	1/01/2012	Le Havre	NOR		OSPAR	FR
140	NOR113	1/01/2012	Dieppe	NOR		OSPAR	FR
141	NOR114	1/01/2012	Sein	NOR		OSPAR	FR
142	NOR115	1/01/2012	Koubou	NOR		OSPAR	FR
143	NOR116	1/01/2012	Kerizella	NOR		OSPAR	FR
144	NOR117	1/01/2012	Blancs Sablons	NOR		OSPAR	FR
145	NOR118	1/01/2012	Long Strand	NOR		OSPAR	IR
146	NOR119	1/01/2012	Clogherhead - South	NOR		OSPAR	IR
147	NOR120	1/01/2012	Bergen	NOR		OSPAR	NL
148	NOR121	1/01/2012	Noordwijk	NOR		OSPAR	NL
149	NOR122	1/01/2012	Veere	NOR		OSPAR	NL
150	NOR123	1/01/2012	Terschelling	NOR		OSPAR	NL
151	NOR124	1/04/2012	Bjorkangs Havsbad	NOR		MARLIN	SE
152	NOR125	23/07/2012	Bjorkangs Havsbad	NOR		MARLIN	SE
153	NOR126	17/04/2013	Lillebybadet	NOR		MARLIN	SE
154	NOR127	29/04/2013	Bjorkangs Havsbad	NOR		MARLIN	SE
155	NOR128	3/11/2012	Bjorkangs Havsbad	NOR		MARLIN	SE
156	NOR129	16/07/2012	Lillebybadet	NOR		MARLIN	SE
157	NOR130	30/10/2012	Lillebybadet	NOR		MARLIN	SE
158	NOR131	19/04/2012	Orbyangar	NOR		MARLIN	SE
159	NOR132	28/07/2012	Orbyangar	NOR		MARLIN	SE
160	NOR133	13/10/2012	Orbyangar	NOR		MARLIN	SE
161	NOR134	20/04/2012	Lillebybadet	NOR		MARLIN	SE
162	NOR135	30/07/2013	Bjorkangs Havsbad	NOR		MARLIN	SE
163	NOR136	27/07/2013	Lillebybadet	NOR		MARLIN	SE
164	NOR137	22/04/2013	Gronevik, Overon	NOR		MARLIN	SE
165	NOR138	22/04/2013	Barrevik SE8	NOR		MARLIN	SE
166	NOR139	22/04/2013	Angklavebukten -Salto - SE6	NOR		MARLIN	SE

Case code	Case name	Date	Short case description	Sea code	River	Source	Country
167	NOR140	6/04/2013	Haby SE4	NOR		MARLIN	SE
168	NOR141	27/04/2013	Groderhamnsvik	NOR		MARLIN	SE
169	NOR142	22/04/2013	Edsvik SE5	NOR		MARLIN	SE
170	NOR143	16/10/2013	Bjorkangs Havsbad	NOR		MARLIN	SE
171	NOR144	3/11/2013	Lillebybadet	NOR		MARLIN	SE
172	BAL14	20/04/2012	Malarhusen	BAL		MARLIN	SE
173	BAL15	19/04/2013	Malarhusen	BAL		MARLIN	SE
174	BAL16	6/05/2013	Rullsand	BAL		MARLIN	SE
175	BAL17	21/09/2012	Rullsand	BAL		MARLIN	SE
176	BAL18	25/07/2012	Rullsand	BAL		MARLIN	SE
177	BAL19	18/04/2012	Rullsand	BAL		MARLIN	SE
178	BAL20	16/04/2012	Ekons Havsbad	BAL		MARLIN	SE
179	BAL21	5/11/2012	Ekons Havsbad	BAL		MARLIN	SE
180	BAL22	21/07/2012	Malarhusen	BAL		MARLIN	SE
181	BAL23	30/09/2012	Malarhusen	BAL		MARLIN	SE
182	BAL24	5/05/2013	Nattaro	BAL		MARLIN	SE
183	BAL25	26/07/2012	Nattaro	BAL		MARLIN	SE
184	BAL26	23/10/2012	Nattaro	BAL		MARLIN	SE
185	BAL27	5/05/2012	Nattaro	BAL		MARLIN	SE
186	BAL28	23/04/2012	Sjauster	BAL		MARLIN	SE
187	BAL29	1/07/2012	Sjauster	BAL		MARLIN	SE
188	BAL30	23/04/2012	Tofta	BAL		MARLIN	SE
189	BAL31	1/07/2012	Tofta	BAL		MARLIN	SE
190	BAL32	31/05/2013	Tofta	BAL		MARLIN	SE
191	BAL33	12/11/2012	Tofta	BAL		MARLIN	SE
192	BAL34	2/08/2012	Ekons Havsbad	BAL		MARLIN	SE
193	BAL35	10/11/2012	Sjauster	BAL		MARLIN	SE
194	BAL36	31/05/2013	Sjauster	BAL		MARLIN	SE
195	BAL37	25/04/2012	Viimsi	BAL		MARLIN	SE
196	BAL38	22/08/2012	Viimsi	BAL		MARLIN	SE
197	BAL39	22/10/2012	Viimsi	BAL		MARLIN	SE
198	BAL40	27/04/2013	Viimsi	BAL		MARLIN	SE
199	BAL41	2/05/2012	Orissaare	BAL		MARLIN	SE
200	BAL42	24/08/2012	Orissaare	BAL		MARLIN	SE
201	BAL43	15/10/2012	Orissaare	BAL		MARLIN	SE
202	BAL44	30/04/2013	Orissaare	BAL		MARLIN	SE
203	BAL45	30/04/2012	Kolga-Aabla	BAL		MARLIN	SE
204	BAL46	27/08/2012	Kolga-Aabla	BAL		MARLIN	SE
205	BAL47	11/10/2012	Kolga-Aabla	BAL		MARLIN	SE
206	BAL48	2/05/2013	Kolga-Aabla	BAL		MARLIN	SE
207	BAL49	26/04/2012	Loksa	BAL		MARLIN	SE

Case code	Case name	Date	Short case description	Sea code	River	Source	Country
208	BAL50	23/08/2012	Loksa	BAL		MARLIN	SE
209	BAL51	18/10/2012	Loksa	BAL		MARLIN	SE
210	BAL52	29/04/2013	Loksa	BAL		MARLIN	SE
211	BAL53	24/04/2012	Valgeranna	BAL		MARLIN	SE
212	BAL54	21/08/2012	Valgeranna	BAL		MARLIN	SE
213	BAL55	16/10/2012	Valgeranna	BAL		MARLIN	SE
214	BAL56	26/04/2013	Valgeranna	BAL		MARLIN	SE
215	BAL57	23/04/2012	Saka	BAL		MARLIN	SE
216	BAL58	30/08/2012	Saka	BAL		MARLIN	SE
217	BAL59	19/10/2012	Saka	BAL		MARLIN	SE
218	BAL60	24/04/2013	Saka	BAL		MARLIN	SE
219	BAL61	16/04/2012	Uto	BAL		MARLIN	SE
220	BAL62	14/08/2012	Uto	BAL		MARLIN	SE
221	BAL63	23/10/2012	Uto	BAL		MARLIN	SE
222	BAL64	14/04/2012	Bjorko	BAL		MARLIN	SE
223	BAL65	28/07/2012	Bjorko	BAL		MARLIN	SE
224	BAL66	19/10/2012	Bjorko	BAL		MARLIN	SE
225	BAL67	18/04/2012	Abo	BAL		MARLIN	SE
226	BAL68	16/08/2012	Abo	BAL		MARLIN	SE
227	BAL69	23/10/2012	Abo	BAL		MARLIN	SE
228	BAL70	19/04/2012	St. Karins	BAL		MARLIN	SE
229	BAL71	3/08/2012	St. Karins	BAL		MARLIN	SE
230	BAL72	16/10/2012	St. Karins	BAL		MARLIN	SE
231	BAL73	20/04/2012	Helsinki	BAL		MARLIN	SE
232	BAL74	1/08/2012	Helsinki	BAL		MARLIN	SE
233	BAL75	18/10/2012	Helsinki	BAL		MARLIN	SE
234	BAL76	10/05/2012	Kotka inner	BAL		MARLIN	SE
235	BAL77	6/08/2012	Kotka inner	BAL		MARLIN	SE
236	BAL78	9/11/2012	Kotka inner	BAL		MARLIN	SE
237	BAL79	10/05/2012	Kotka outer	BAL		MARLIN	SE
238	BAL80	6/08/2012	Kotka outer	BAL		MARLIN	SE
239	BAL81	9/11/2012	Kotka outer	BAL		MARLIN	EST
240	BAL82	22/07/2012	Vakarbulli	BAL		MARLIN	EST
241	BAL83	17/11/2012	Vakarbulli	BAL		MARLIN	EST
242	BAL84	18/11/2012	Ventspils	BAL		MARLIN	EST
243	BAL85	9/04/2012	Ventspils	BAL		MARLIN	EST
244	BAL86	7/07/2012	Ventspils	BAL		MARLIN	EST
245	BAL87	27/04/2012	Kolka	BAL		MARLIN	EST
246	BAL88	14/07/2012	Kolka	BAL		MARLIN	EST
247	BAL89	18/11/2012	Kolka	BAL		MARLIN	EST
248	BAL90	29/04/2012	Jaunkemeri	BAL		MARLIN	EST

Case code	Case name	Date	Short case description	Sea code	River	Source	Country
249	BAL91	21/07/2012	Jaunkemeri	BAL		MARLIN	EST
250	BAL92	19/11/2012	Jaunkemeri	BAL		MARLIN	EST
251	BAL93	30/04/2012	Zvejniekciems	BAL		MARLIN	EST
252	BAL94	24/07/2012	Zvejniekciems	BAL		MARLIN	EST
253	BAL95	16/11/2012	Zvejniekciems	BAL		MARLIN	EST
254	BAL96	20/04/2012	Vakarbulli	BAL		MARLIN	EST
255	BAL97	22/07/2013	Nattaro	BAL		MARLIN	EST
256	BAL98	30/07/2013	Malarhusen	BAL		MARLIN	EST
257	BAL99	12/04/2013	Uto	BAL		MARLIN	EST
258	BAL100	13/04/2013	Bjorko	BAL		MARLIN	EST
259	BAL101	23/04/2013	St. Karins	BAL		MARLIN	EST
260	BAL102	22/05/2013	Helsinki	BAL		MARLIN	EST
261	BAL103	15/05/2013	Kotka inner	BAL		MARLIN	EST
262	BAL104	15/05/2013	Kotka outer	BAL		MARLIN	EST
263	BAL105	18/04/2013	Abo	BAL		MARLIN	EST
264	BAL106	15/08/2013	Helsinki	BAL		MARLIN	EST
265	BAL107	13/08/2013	Kotka inner	BAL		MARLIN	EST
266	BAL108	13/08/2013	Kotka outer	BAL		MARLIN	EST
267	BAL109	15/08/2013	Uto	BAL		MARLIN	EST
268	BAL110	2/08/2013	Bjorko	BAL		MARLIN	EST
269	BAL111	27/05/2013	Ekons Havsbad	BAL		MARLIN	EST
270	BAL112	2/08/2013	Ekons Havsbad	BAL		MARLIN	EST
271	BAL113	22/08/2013	St. Karins	BAL		MARLIN	EST
272	BAL114	2/09/2013	Abo	BAL		MARLIN	EST
273	BAL115	27/08/2013	Viimsi	BAL		MARLIN	EST
274	BAL116	30/08/2013	Orissaare	BAL		MARLIN	EST
275	BAL117	23/08/2013	Kolga-Aabla	BAL		MARLIN	EST
276	BAL118	29/08/2013	Loksa	BAL		MARLIN	EST
277	BAL119	28/08/2013	Valgeranna	BAL		MARLIN	EST
278	BAL120	26/08/2013	Saka	BAL		MARLIN	EST
279	BAL121	5/05/2013	Vakarbulli	BAL		MARLIN	EST
280	BAL122	28/07/2013	Vakarbulli	BAL		MARLIN	EST
281	BAL123	26/04/2013	Ventspils	BAL		MARLIN	EST
282	BAL124	15/07/2013	Ventspils	BAL		MARLIN	EST
283	BAL125	28/04/2013	Kolka	BAL		MARLIN	EST
284	BAL126	21/07/2013	Kolka	BAL		MARLIN	EST
285	BAL127	29/04/2013	Jaunkemeri	BAL		MARLIN	EST
286	BAL128	1/08/2013	Jaunkemeri	BAL		MARLIN	EST
287	BAL129	2/05/2013	Zvejniekciems	BAL		MARLIN	EST
288	BAL130	5/08/2013	Zvejniekciems	BAL		MARLIN	EST
289	BAL131	26/08/2013	Rullsand	BAL		MARLIN	EST

Case code	Case name	Date	Short case description	Sea code	River	Source	Country
290	BAL132	16/07/2013	Tofta	BAL		MARLIN	EST
291	BAL133	14/08/2013	Tofta	BAL		MARLIN	EST
292	BAL134	16/07/2013	Sjauster	BAL		MARLIN	EST
293	BAL135	14/08/2013	Sjauster	BAL		MARLIN	EST
294	BAL136	29/09/2013	Viimsi	BAL		MARLIN	EST
295	BAL137	1/10/2013	Orissaare	BAL		MARLIN	EST
296	BAL138	25/09/2013	Kolga-Aabla	BAL		MARLIN	EST
297	BAL139	24/09/2013	Loksa	BAL		MARLIN	EST
298	BAL140	26/09/2013	Valgeranna	BAL		MARLIN	EST
299	BAL141	30/09/2013	Saka	BAL		MARLIN	EST
300	BAL142	25/10/2013	Nattaro	BAL		MARLIN	EST
301	BAL143	4/10/2013	Kotka outer	BAL		MARLIN	EST
302	BAL144	4/10/2013	Kotka inner	BAL		MARLIN	EST
303	BAL145	10/10/2013	St. Karins	BAL		MARLIN	EST
304	BAL146	10/10/2013	Abo	BAL		MARLIN	EST
305	BAL147	11/10/2013	Uto	BAL		MARLIN	EST
306	BAL148	13/10/2013	Bjorko	BAL		MARLIN	FIN
307	BAL149	2/10/2013	Helsinki	BAL		MARLIN	FIN
308	BAL150	13/11/2013	Ekons Havsbad	BAL		MARLIN	FIN
309	BAL151	8/11/2013	Rullsand	BAL		MARLIN	FIN
310	BAL152	19/10/2013	Malarhusen	BAL		MARLIN	FIN
311	MED8	1/07/2013	Las Salinas de Cabo de Gata	MED		MARNOBA	ESP
312	MED9	1/07/2013	Poniente (Adra)	MED		MARNOBA	ESP
313	MED10	1/07/2013	Calahonda (Motril)	MED		MARNOBA	ESP
314	MED11	1/07/2013	La Herradura	MED		MARNOBA	ESP
315	MED12	1/07/2013	Molino de Papel	MED		MARNOBA	ESP
316	MED13	1/07/2013	Campo de Golf	MED		MARNOBA	ESP
317	MED14	1/07/2013	Calahonda (Mijas)	MED		MARNOBA	ESP
318	MED15	1/07/2013	Sabinillas	MED		MARNOBA	ESP
319	MED16	1/07/2013	Palmones	MED		MARNOBA	ESP
320	MED17	1/07/2013	Bolonia	MED		MARNOBA	ESP
321	MED18	1/07/2013	Zahara de los Atunes	MED		MARNOBA	ESP
322	MED19	1/07/2013	Benitez	MED		MARNOBA	ESP
323	MED20	1/01/2013	Las Salinas de Cabo de Gata	MED		MARNOBA	ESP
324	MED21	2/01/2013	Poniente (Adra)	MED		MARNOBA	ESP
325	MED22	3/01/2013	Calahonda (Motril)	MED		MARNOBA	ESP
326	MED23	4/01/2013	La Herradura	MED		MARNOBA	ESP
327	MED24	5/01/2013	Molino de Papel	MED		MARNOBA	ESP
328	MED25	6/01/2013	Campo de Golf	MED		MARNOBA	ESP
329	MED26	7/01/2013	Calahonda (Mijas)	MED		MARNOBA	ESP
330	MED27	8/01/2013	Sabinillas	MED		MARNOBA	ESP

Case code	Case name	Date	Short case description	Sea code	River	Source	Country
331	MED28	9/01/2013	Palmones	MED		MARNOBA	ESP
332	MED29	10/01/2013	Bolonia	MED		MARNOBA	ESP
333	MED30	11/01/2013	Zahara de los Atunes	MED		MARNOBA	ESP
334	MED31	12/01/2013	Benitez	MED		MARNOBA	ESP
335	NOR145	1/03/2003	Koksijde	NOR		MUMM	BE
336	NOR146	1/06/2003	Koksijde	NOR		MUMM	BE
337	NOR147	1/09/2003	Koksijde	NOR		MUMM	BE
338	NOR148	1/12/2003	Koksijde	NOR		MUMM	BE
339	NOR149	1/03/2004	Koksijde	NOR		MUMM	BE
340	NOR150	1/06/2004	Koksijde	NOR		MUMM	BE
341	NOR151	1/09/2004	Koksijde	NOR		MUMM	BE
342	NOR152	1/12/2004	Koksijde	NOR		MUMM	BE
343	NOR153	1/03/2003	Oostende	NOR		MUMM	BE
344	NOR154	1/06/2003	Oostende	NOR		MUMM	BE
345	NOR155	1/09/2003	Oostende	NOR		MUMM	BE
346	NOR156	1/12/2003	Oostende	NOR		MUMM	BE
347	NOR157	1/03/2004	Oostende	NOR		MUMM	BE
348	NOR158	1/06/2004	Oostende	NOR		MUMM	BE
349	NOR159	1/09/2004	Oostende	NOR		MUMM	BE
350	NOR160	1/12/2004	Oostende	NOR		MUMM	BE
351	MED32	10/10/2009	Helmepa (Athens) - geen 100 M	MED		MIO-ECSDE	GR
352	MED33	24/09/2011	Helmepa (Athens) - geen 100 M	MED		MIO-ECSDE	GR

Annex 3: Default likelihoods final

This annex consists of an excel document, added in a separate file under the name “Default likelihoods final.xlsx”.

Annex 4: Beach litter results final

This annex consists of an excel document, added in a separate file under the name “Beach litter results final.xlsx”.

Following results can be identified for each regional sea:

Baltic Sea

<u>Litter composition – material type</u>

When looking at the material types of different beach litter items, the dominant fraction in the Baltic Sea is made of plastic (58%), followed by items made of paper/cardboard (17%), metal (7%) and ceramic (6%).

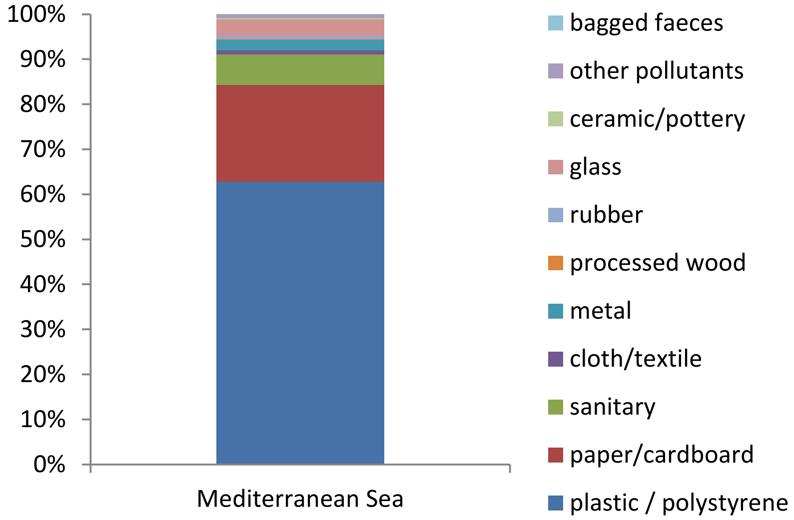


Figure 24: Material types of different beach litter items in the Baltic Sea region.

We should take into account that sanitary waste (e.g. cotton bud sticks) are also largely composed of plastics. The figures for plastics may thus be an underestimate.

Figure 25 analyses the different aspects of the pathways for beach litter items. The figure shows that, on average, 42% of the items were likely discarded on site, 39% could have been transported over a short distance of the site and only 19% are potentially transported over a longer distance. Direct littering accounts for 48% of the beach litter items, whereas 22% arrives via inland waterways and 6% from sewerage sources. Regarding the origin of beach litter items, 71% is likely to originate from land-based activities, whereas 29% is likely to originate from sea-based activities. Moreover, 37% of beach litter items are likely to be left by accident, whereas 63% are likely to be left intentionally.

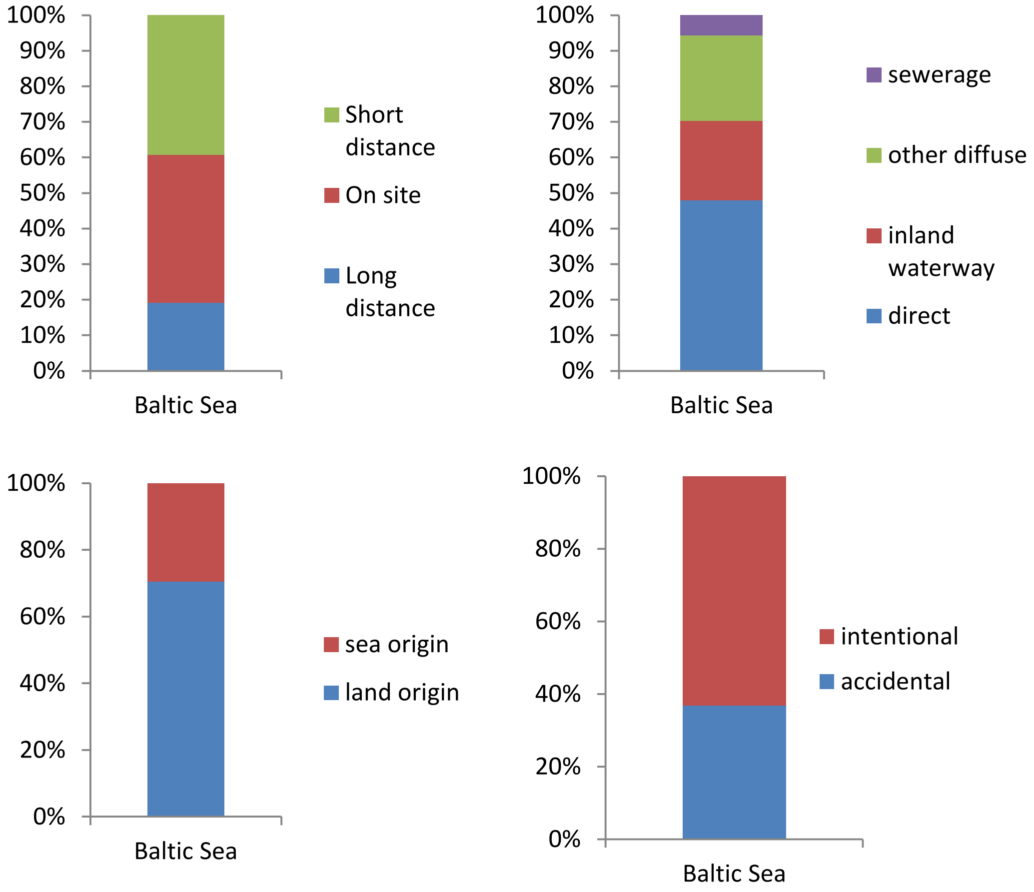


Figure 25: Different pathways for beach litter items in the Baltic Sea.

<u>Litter sources</u>

The most important sectors in the Baltic Sea region contributing to beach/marine litter are the coastal/beach tourism sector (the probability of beach litter items being related to this sector is 24%) and the recreational fishing sector (14%). Other important sectors are households (10%), the construction and demolition sector (7%) and the fishing sector (7%). The results are shown in Figure 26.

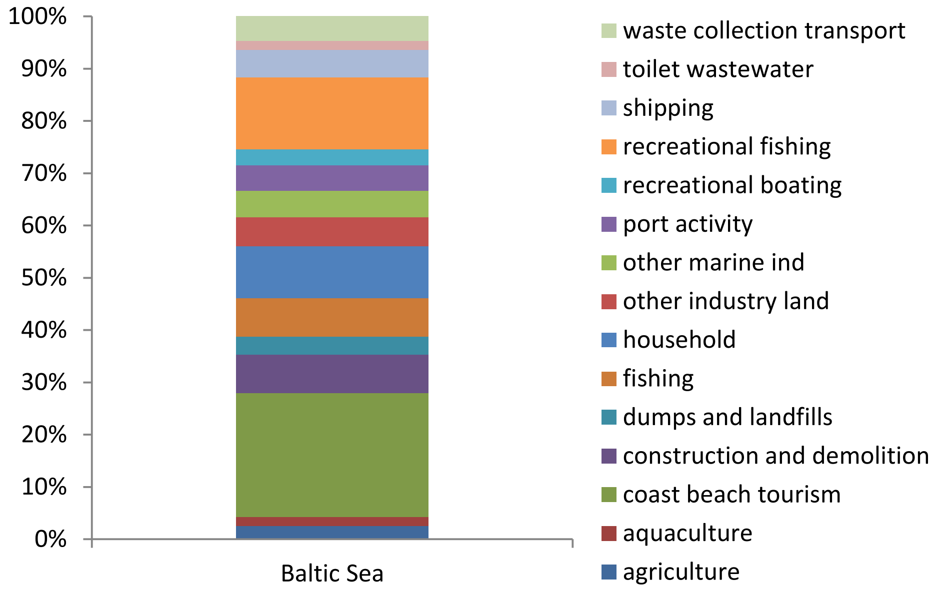


Figure 26: The contribution of different sectors to beach/marine litter in the Baltic Sea region.

Life cycle aspects

Figure 27 shows the life-cycle aspects, i.e. at which life-cycle stage the littered item is released into the marine environment. It shows that 46% of beach litter items are released during the consumption phase of the item, 24% during its industrial production phase, 23% during its post-disposal phase (like landfill escapes or failing waste management) and only 8% during the transport and distribution phase.

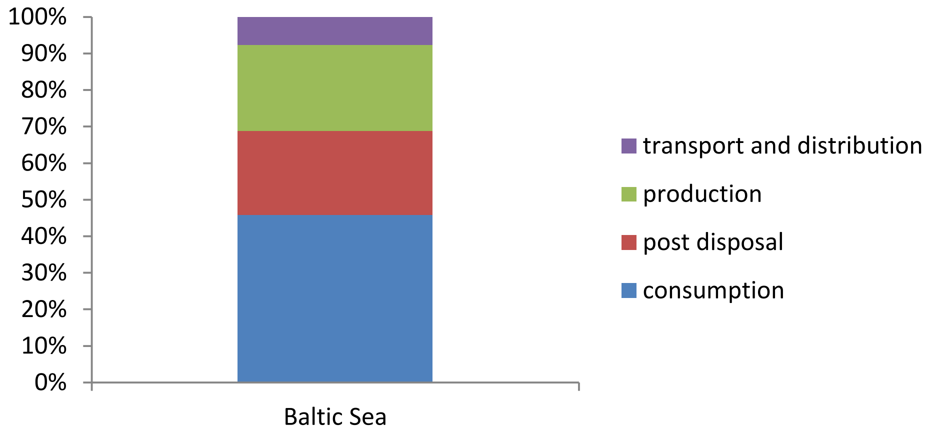


Figure 27: Life cycle phase of the generated litter items in the Baltic Sea region.

Nature of littered item and its generator.

Consumers have a high contribution to beach/marine litter (48%) while 17% of the items are related to professional activities (35% remain unknown). This is also reflected in the fact that 62% of beach litter items can be categorized as use items, while 36% are packaging items. The durability of the beach litter items is likely to be evenly divided between short life/single-use good (49%) and long lasting goods (49%).

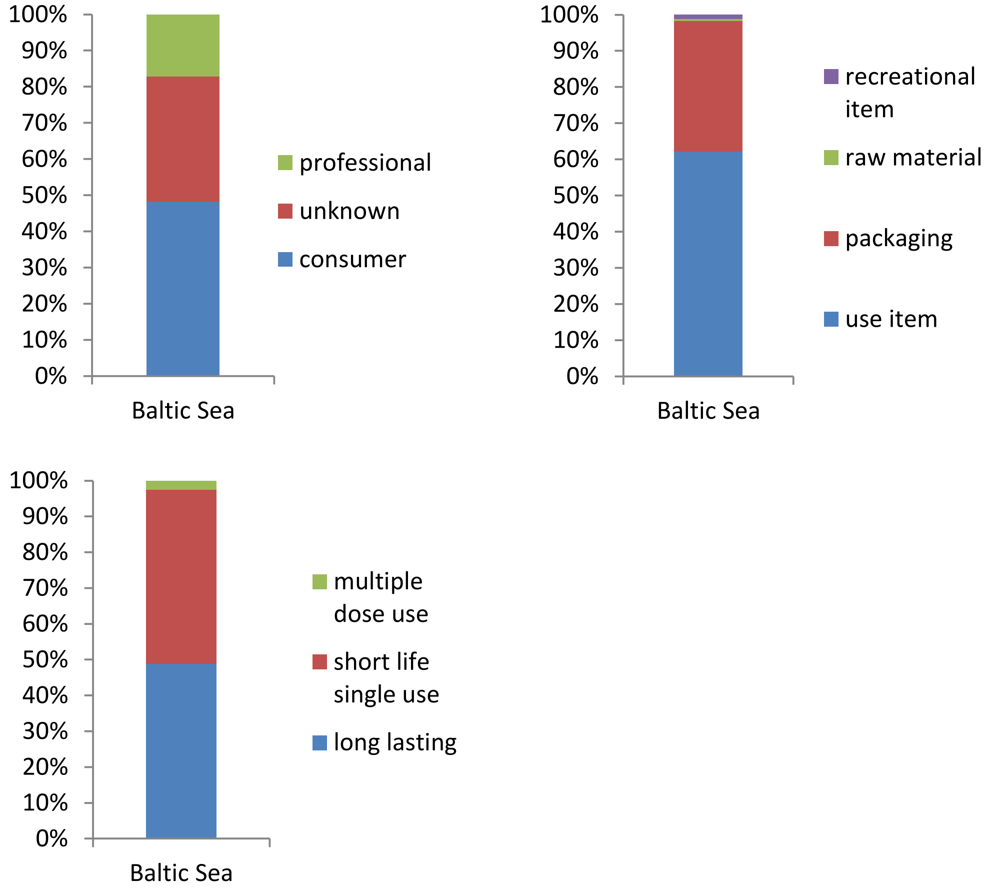


Figure 28: Nature of littered item and its generator in Baltic Sea.

<u>Packaging type</u>

Figure 29 shows the different packaging types of packaging beach litter items in the Baltic Sea region. Primary packaging or individual consumption packaging (47%) forms the largest part of the packaging beach/marine litter, followed by service packaging such as shopping bags and packaging of freshly prepared food (36%) and tertiary packaging (transport packaging lake pallets and strapping bands) (12%). Secondary or grouping packaging like six-packs, some cardboard and some foils are less prevalent (5%).

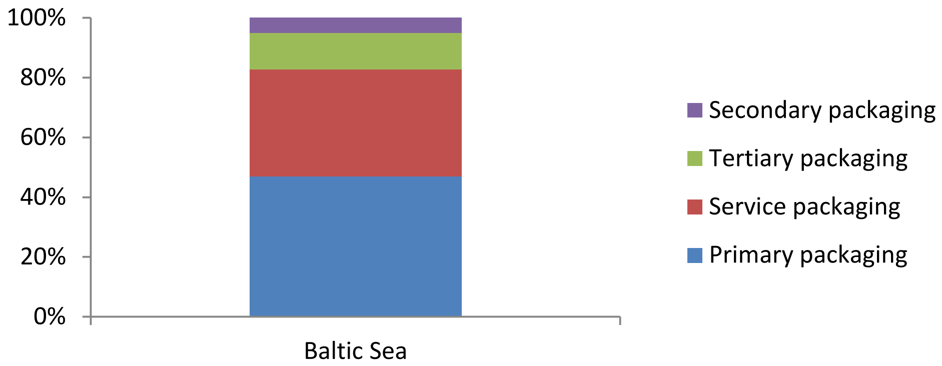


Figure 29: Packaging types of packaging beach litter items in the Baltic Sea region.

Conclusions Baltic Sea

- Based on numbers, plastic pieces with sizes between 2,5 cm and 50 are the dominant fraction (24%) having an average frequency of 34 items per 100 m of coast line, followed by cigarette butts (10%) and other items such as plastic bottle caps/lids (5%), foam sponges (5%), ceramic/pottery items (5%) and plastic (shopping) bags (4%).
- Plastic items are the dominant fraction in the Baltic Sea (58%), followed by items made of paper/cardboard (17%), metal (7%) and ceramic (6%).
- The most important sectors contributing to marine/beach litter are the coast beach tourism sector (the probability of beach litter items being related to this sector is 24%) and the recreational fishing sector (14%).
- Individual consumers (48%) tend to make a larger contribution to marine/beach litter than professionals (17%). 35% remains unknown.

Black Sea

Litter composition – material type

In terms of the material types of different beach litter items found in the Black Sea region, the dominant fraction is made up of plastic (42 %)[75], followed by items made of paper/cardboard (38 %) and metal (8 %).

[75] Possibly an slight underestimate, when taking into account that sanitary waste (cotton bud sticks) are mainly composed of plastics

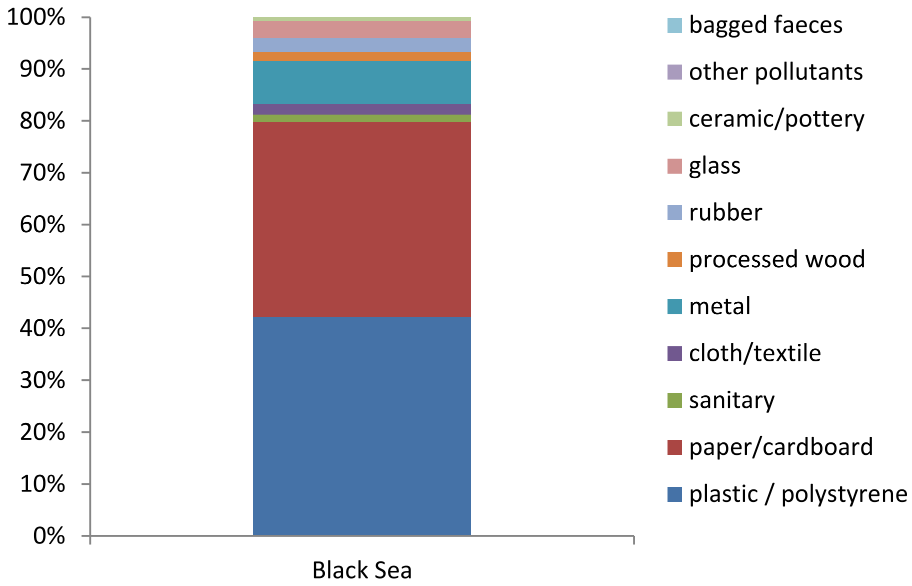
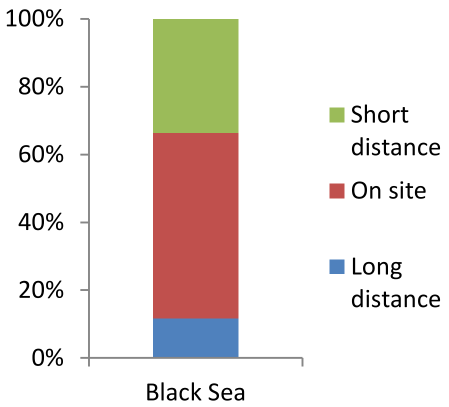
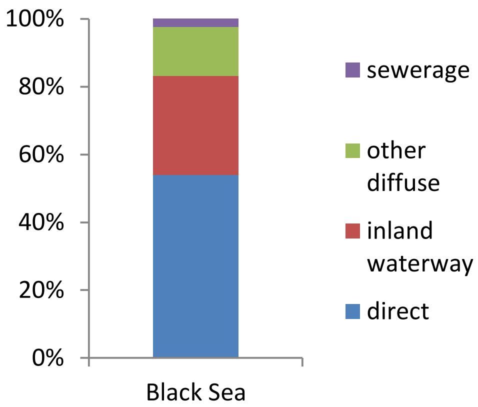


Figure 30: Material types of different beach litter items in the Black Sea region.

Pathways

Figure 31 analyses the different pathways for beach litter items. These figures demonstrate that on average, 54% of the items are likely to be produced/discarded on site, 34% are likely to be transported over a short distance to the site and only 12% are potentially transported over a longer distance. Direct littering accounts for 54% of the beach litter items, whereas 29% is coming via inland waterways and 2% from sewerage sources. Regarding the origin of the beach litter, 79% is likely to originate from land-based activities, whereas 21% is likely to originate from sea based activities. Moreover, 13% of beach litter items are likely to be left by accident, whereas 87% are likely to be left intentionally.





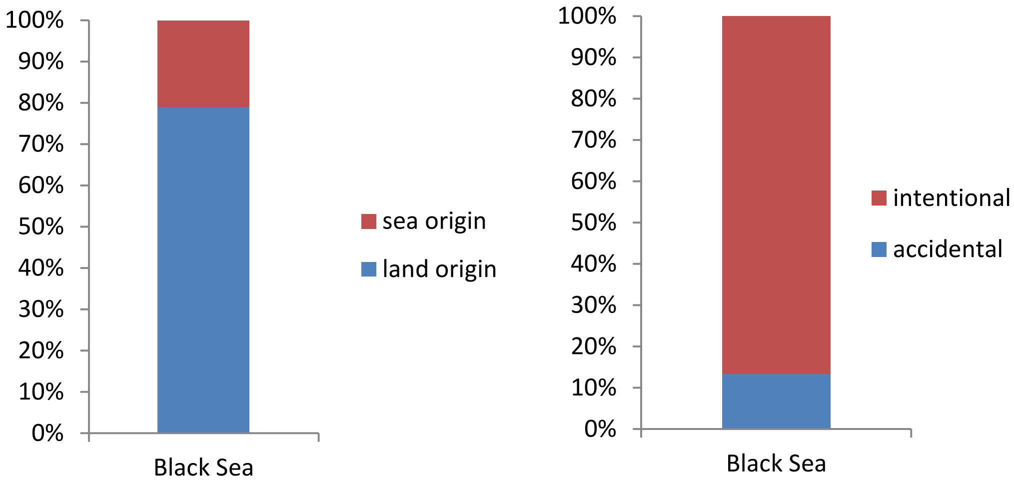


Figure 31: Different pathways for beach litter items in the Black Sea.

Litter sources

The most important sectors in the Black Sea region contributing to beach/marine litter are the coastal / beach tourism sector (42%), households (12%) and the recreational fishing sector (12%). The results are shown in Figure 32.

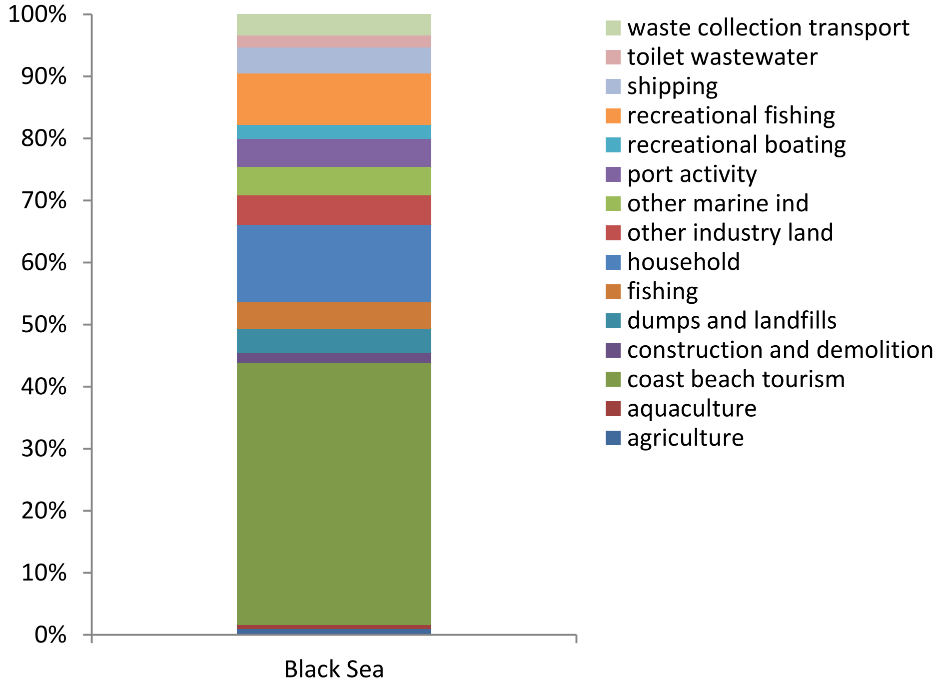


Figure 32: The contribution of different sectors to beach/marine litter in the Black Sea region.

Life cycle aspects

Figure 33 shows the life-cycle aspects, i.e. at which life-cycle stage the littered item is released into the marine environment. It shows that 62% of beach litter items are released during the consumption phase of the item, 25% during its post-disposal phase (like landfill escapes or failing waste management) and only 8%

during its industrial production phase and 4% during the transport and distribution phase.

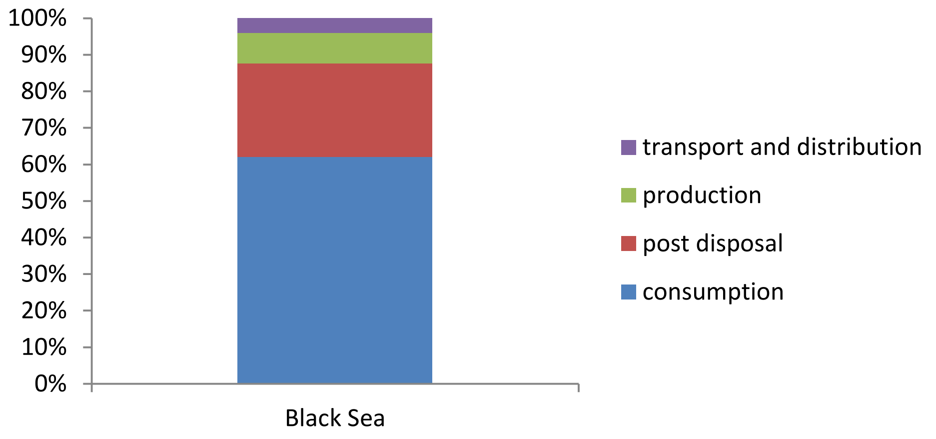
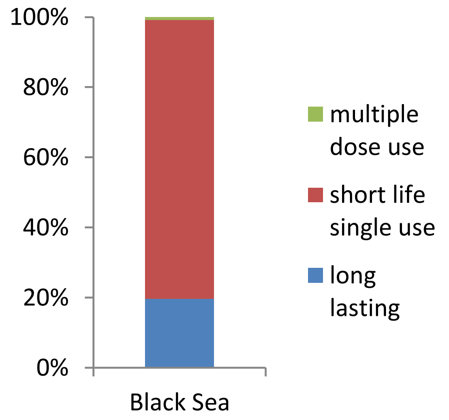
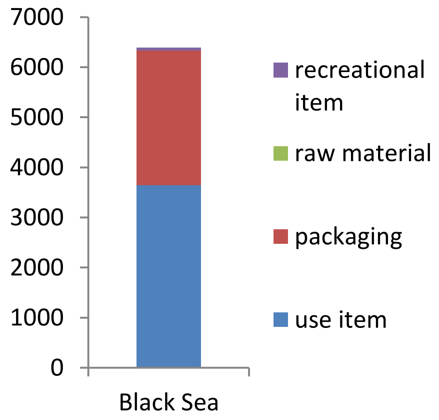


Figure 33: Life cycle phase of the generated litter items in the Black Sea region.

Nature of littered item and its generator.

Consumers make a very high contribution to beach/marine litter (82%) as against 5% of items related to professional activities (the origin of 13% remains unknown). This is also reflected in the fact that 57% of the beach litter items can be categorized as use items and 42% as packaging items. In terms of durability, beach litter items are mainly (80%) categorized as short-life/single-use goods. Long lasting goods represent a comparatively small fraction (20%).





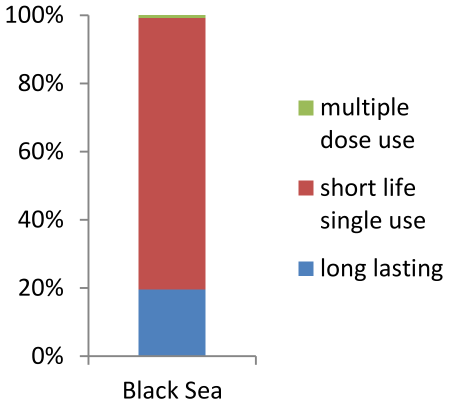


Figure 34: Nature of littered item and its generator in the Black Sea region.

Packaging type

Figure 35 shows the different packaging types of packaging beach litter items in the Black Sea region. Primary packaging is the largest fraction (87%), followed by service packaging (12%). Secondary and tertiary packaging items (transport packaging lake pallets and strapping bands) (<1%) were hardly reported at all in the screenings.

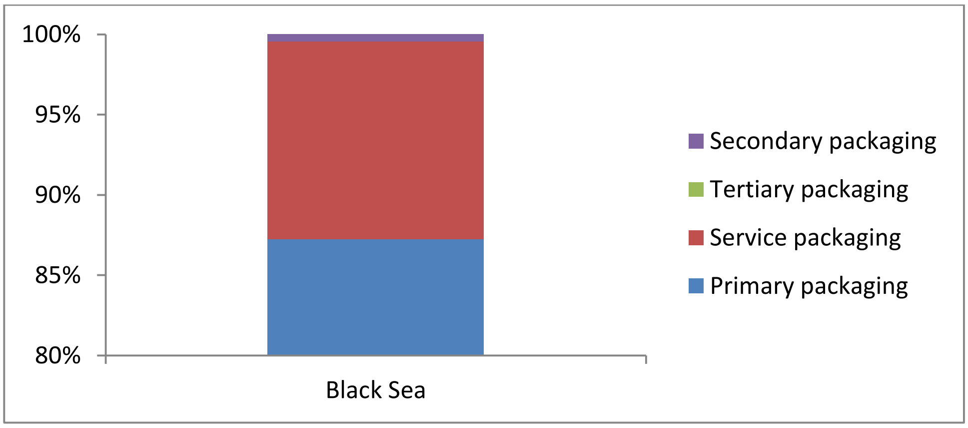


Figure 35: Packaging types of packaging beach litter items in the Black Sea region.

Conclusions Black Sea

- Only a few screenings of the Black Sea region were available, which makes it hard to draw definitive conclusions;
- Based on the available data, cigarette butts is the dominant fraction (36%) having an average frequency of 326 items per 100m coast line, followed by crisp/sweet packets and lolly sticks (9%) and drink bottles (9%) and other items as plastic pieces (6%), plastic caps/lids (5%), drink cans (5%), etc.?
- Plastic items are the dominant fraction (42%) of beach litter, followed by items made of paper/cardboard (38%, including cigarette butts) and made of metal (8%).
- Beach litter seems to be a mainly regional matter in the Black Sea region, since only 12% of the items were likely to be transported over a longer distance;

- The most important sectors contributing to marine/beach litter are the coastal/beach tourism sector (42%), households (12%) and the recreational fishing sector (12%).
- 62% of the beach litter items are generated during the consumption phase of life cycle of the item;
- Individual consumers tend to make a very high contribution (82%) to marine/beach litter than professionals (5%), mostly short life/single use items and primary and secondary packaging.

Mediterranean Sea

Litter composition – material type

In terms of the material types of different beach litter items found in the Mediterranean Sea region, the dominant fraction is made of plastic (63 %)[76], followed by items made of paper/cardboard (22 %), sanitary waste (7 %) and items made of glass (4 %).

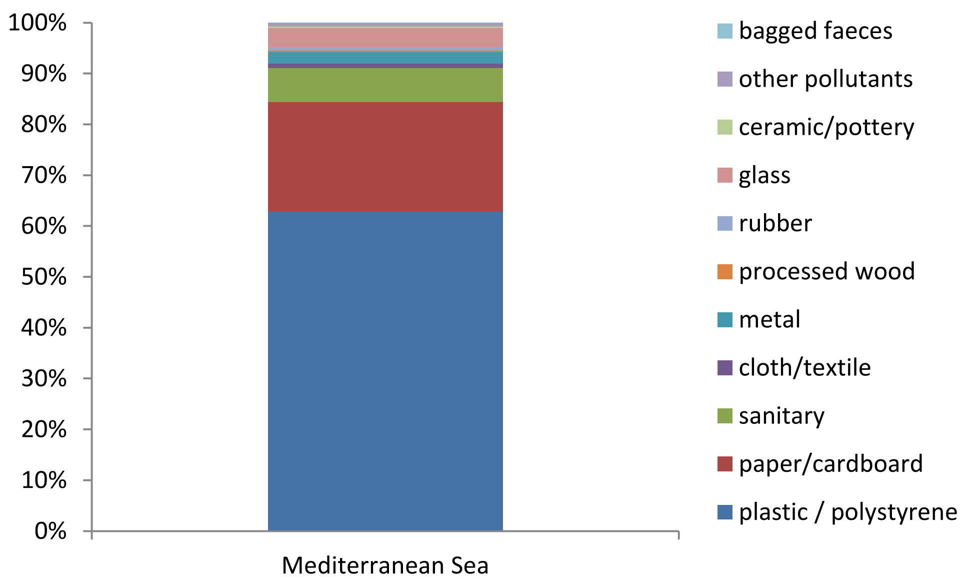


Figure 36: Material types of different beach litter items in the Mediterranean Sea region.

Pathways

Figure 37 analyses the different pathways for beach litter items. These figures demonstrate that, on average, 53% of the items are likely to be produced/discarded on site, 35% are transported over a short distance to the site and only 13% are potentially transported over a longer distance. Direct littering accounts for 48% of beach litter items, whereas 27% comes via inland waterways, 6% from sewerage sources and 18% from other diffuse sources. Regarding the origin of the beach litter items, 86% are likely to originate from land-based activities, whereas 14% are likely to originate from sea-based activities. Moreover, 14% of beach litter items are likely to be left by accident, while 86% are likely to be left intentionally.

[76] Possibly an underestimate, when taking into account that sanitary waste (cotton bud sticks) are mainly composed of plastics

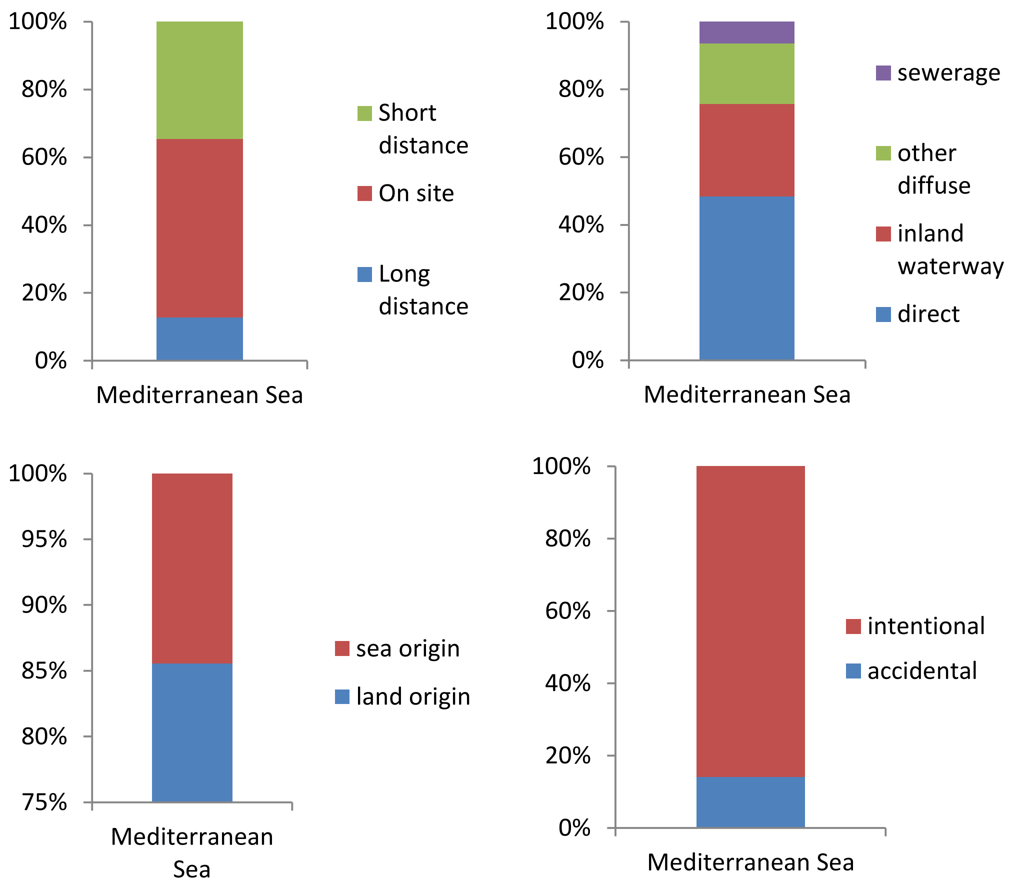


Figure 37: Different pathways for beach litter items in the Mediterranean Sea.

<u>Litter sources</u>

The most important sectors in the Mediterranean Sea region contributing to beach/marine litter are the coastal/ beach tourism (52%) and the households (11%). Other important sources are the toilet wastewater (6%), recreational fishing (5%), dumps and landfills (4%), port activities (4%) and waste collection transport (4%). The results are shown in Figure 38.

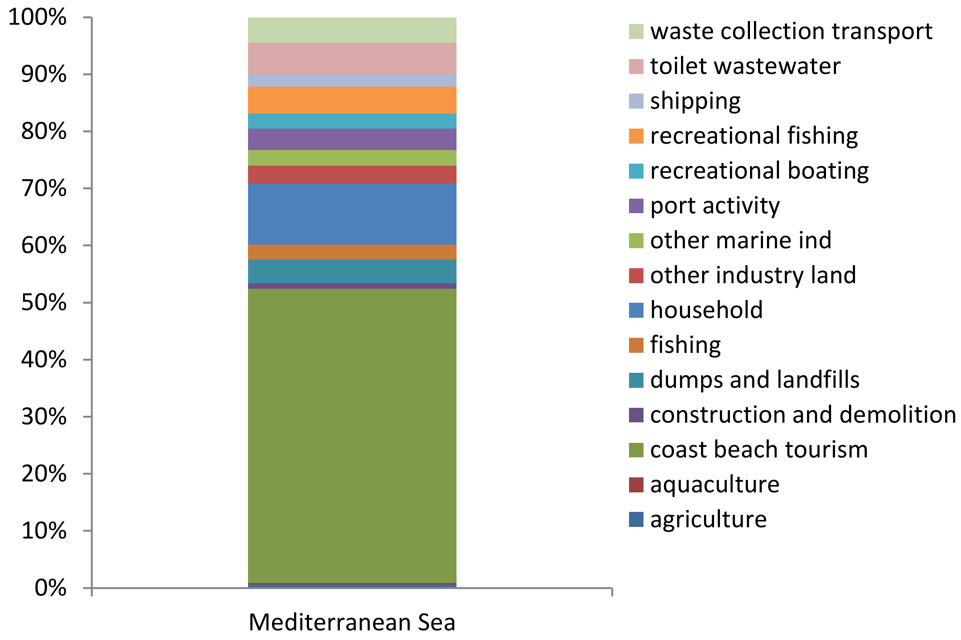


Figure 38: The contribution of different sectors to beach/marine litter in the Mediterranean Sea region.

Life cycle aspects

Figure 39 shows the life-cycle aspects, i.e. at which life-cycle stage the littered item is released into the marine environment. It shows that 70% of the beach litter items are released during the consumption phase of the item, 21% during its post disposal phase (like landfill escapes or failing waste management) and only 4% during its industrial production phase and 5% during the transport and distribution phase.

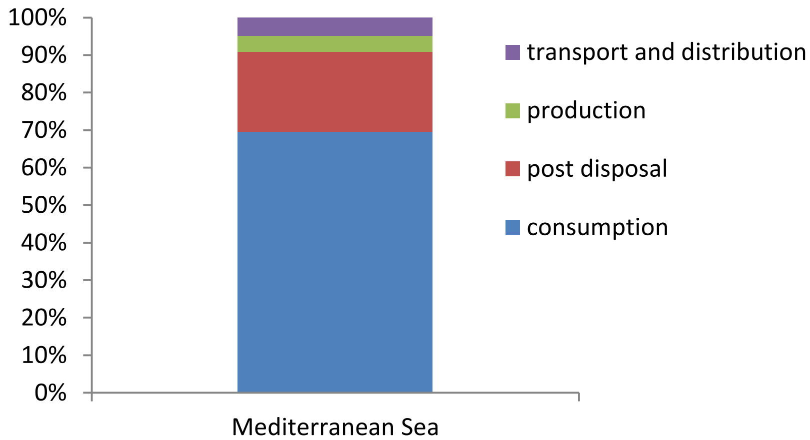


Figure 39: Life cycle phase of the generated litter items in the Mediterranean Sea region.

Nature of littered item and its generator.

Consumers make a very high contribution to beach/marine litter (91%) while only 3% of items are related to professional activities (6% remains unknown). This is also reflected in the fact that 67% of beach litter items can be categorized as packaging items and 32% as use items. In terms of durability, beach litter items are mainly (89%) categorized as short life/single use goods. Long-lasting goods are hardly present at all (8%).

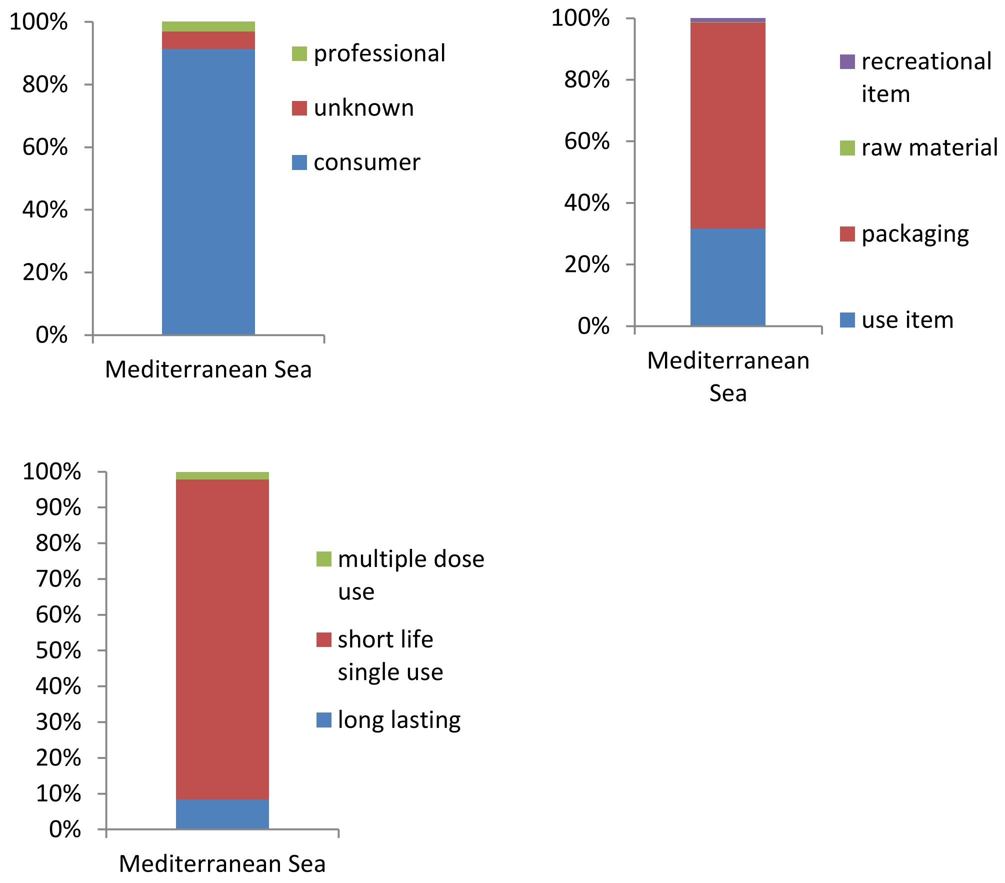


Figure 40: Nature of littered item and its generator in the Mediterranean Sea.

Packaging type

Figure 41 shows the different packaging types of packaging beach litter items in the Mediterranean Sea region. Primary packaging or individual consumption packaging represents the most significant part (55%) of packaging beach/marine litter, followed by service packaging such as shopping bags and packaging of freshly prepared food (43%) and tertiary packaging items (e.g. transport packaging like pallets and strapping bands) (1%). Secondary packaging items were not reported in the indicated screenings.

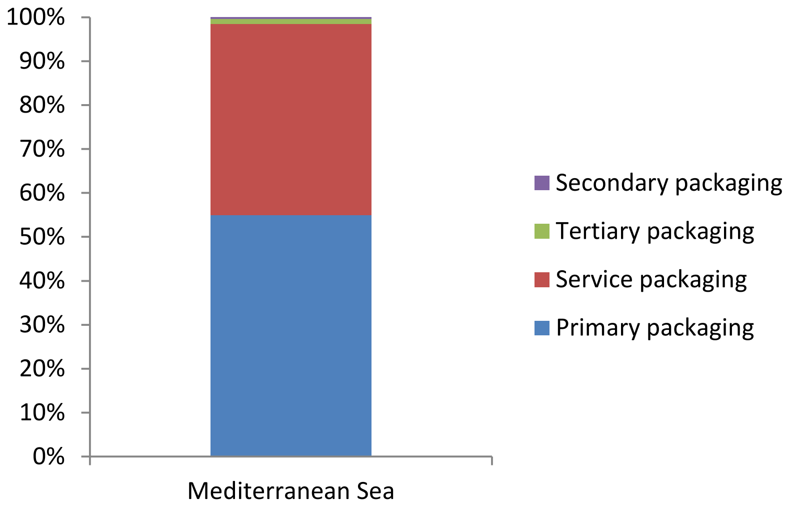


Figure 41: Packaging types of packaging beach litter items in the Mediterranean Sea region.

Conclusions Mediterranean Sea

- Based on numbers, plastic cutlery/trays/straws are the dominant fraction (17%) with an average frequency of 131 items per 100m, followed by cigarette butts (14%), plastic caps/lids (14%) and plastic drink bottles (12%);
- Plastic items are the dominant fraction (63%) of beach litter, followed by items made of paper/cardboard (22%, including cigarette butts) sanitary waste (7%) and items made of glass (4%);
- Beach litter seems to be a rather regional matter in the Mediterranean Sea region, since only 13% of the items were likely to be transported over a longer distance;
- Regarding the origin of beach litter items, 86% are likely to originate from land-based activities, whereas 14% are likely to originate from sea-based activities;
- The most important sectors contributing to marine/beach litter are the coastal/beach tourism (52%) and households (11%). Other important sectors are toilet wastewater (6%), recreational fishing (5%), dumps and landfills (4%), port activities (4%) and waste collection transport (4%);
- A large share of beach litter items (70%) is generated during the consumption phase of the item's life-cycle;
- Individual consumers tend to make a much larger contribution (91%) to marine/beach litter than professionals (3%), with litter mostly made up of short-life/single-use items (89%). Packaging forms 67% of all beach marine litter items, and is made up mostly of primary and service packaging.

North Sea

Litter composition – material type

In terms of the material types of different beach litter items found in the North Sea region, the dominant fraction is mainly made up of plastic (80%)[77], followed by

[77] Possibly an underestimate, when taking into account that sanitary waste (cotton bud sticks) are mainly composed of plastics

sanitary items (6%), clothes (5%) and items made of paper/cardboard (2%), processed wood (2%), rubber (2%) and metal (2%).

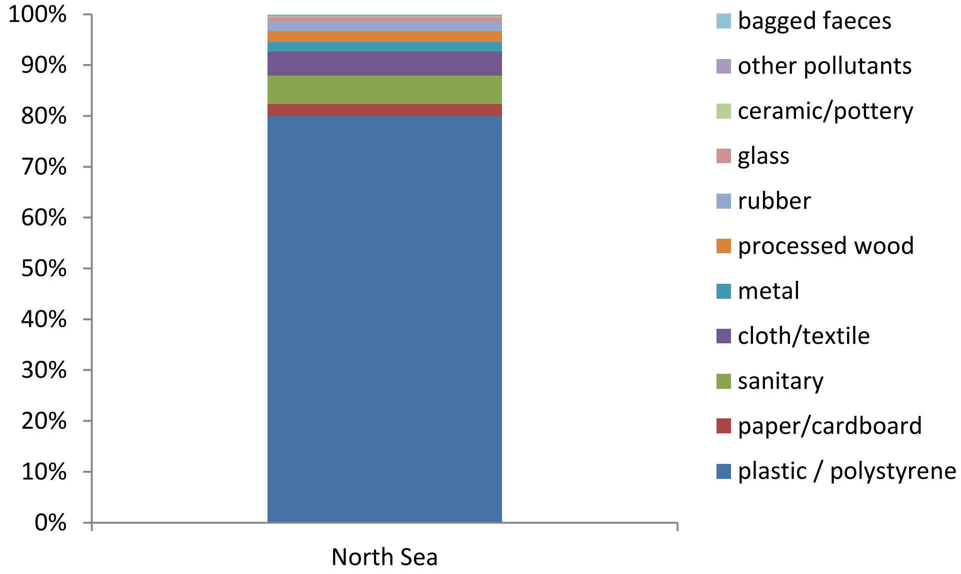
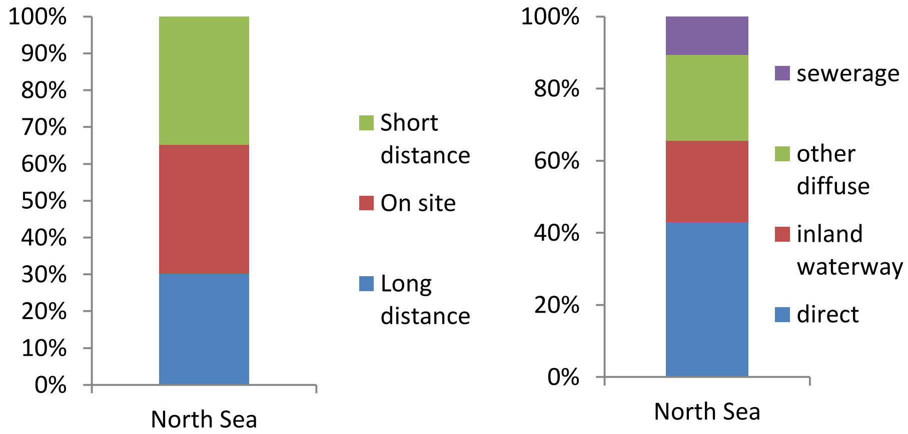


Figure 42: Material types of different beach litter items in the North Sea region.

Pathways

Figure 43 analyses the different pathways for beach litter items. These figures show that, on average, 35% of items are likely to be transported over a short distance of the site, 35% are likely to be produced/discarded on site, and 30% are likely to be transported over a longer distance. Direct littering accounts for 43% of beach litter items, whereas 23% comes via inland waterways, 11% from sewerage sources and 24% from other diffuse sources. Regarding the origin of the beach litter items, 57% is likely to originate from land-based activities, whereas 43% is likely to originate from sea-based activities. Moreover, 44% of beach litter items are likely to be left by accident, whereas 56% are likely to be left intentionally.



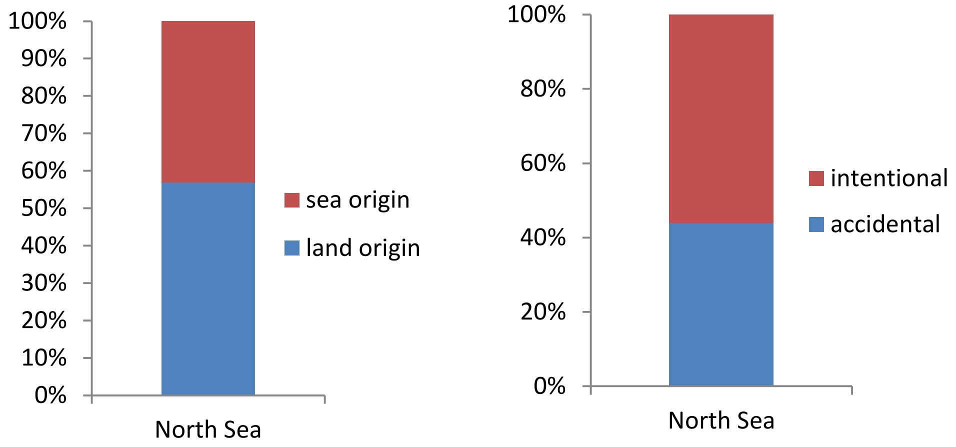


Figure 43: Different pathways for beach litter items in the North Sea.

Litter sources

There are several sectors in the North Sea region contributing to beach/marine litter, but the main contributors are the coastal / beach tourism (18%), professional fishing (13%) and the shipping sector (9%). Other important sectors are port activities (8%), households (7%), and other marine industries (8%). The results are shown in Figure 38.

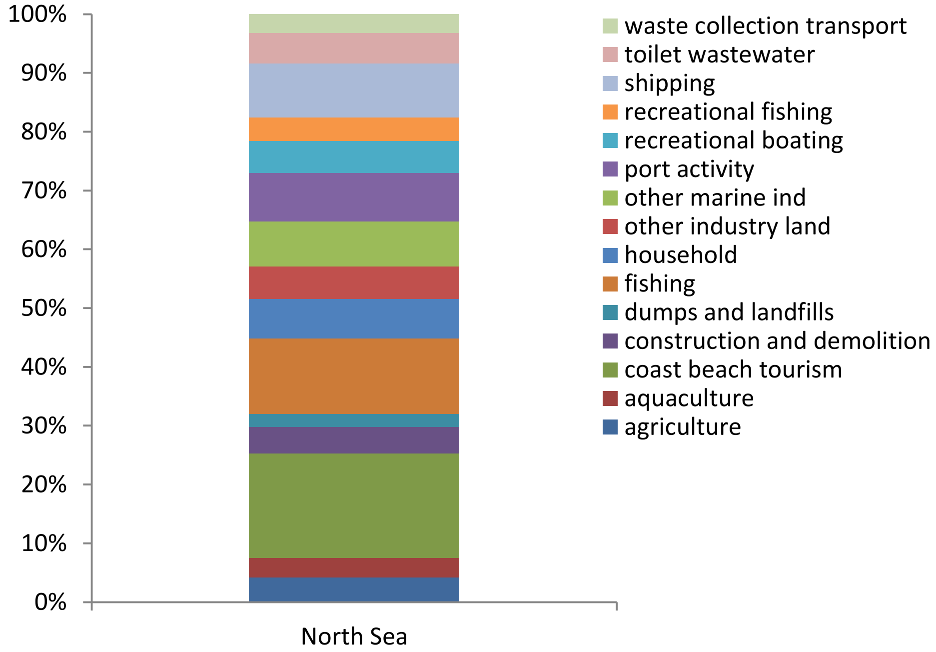


Figure 44: The contribution of different sectors to beach/marine litter in the North Sea region.

Life cycle aspects

Figure 45 shows the life- cycle aspects, e.g. on where the litter is generated in the life-cycle of the product in question. It shows that 32% of beach litter items are generated during the industrial production phase of the item, 32% during its consumption phase, 19% during its post disposal phase (like landfill escapes or failing waste management) and 16% during its transport and distribution phase.

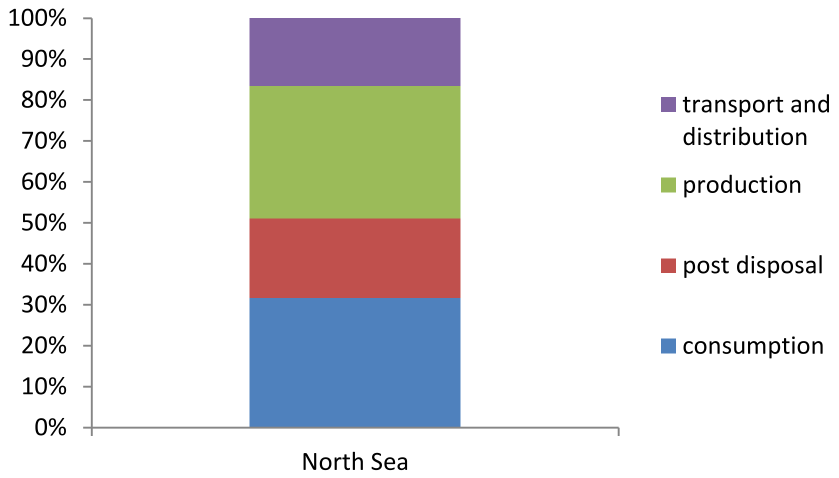
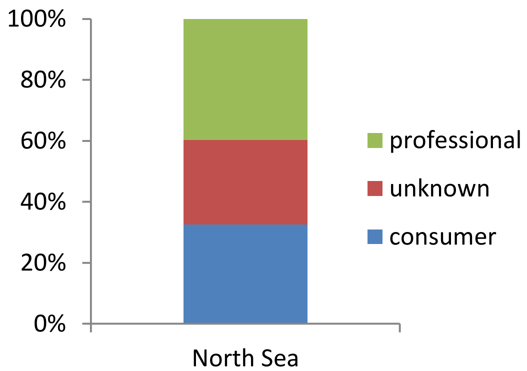
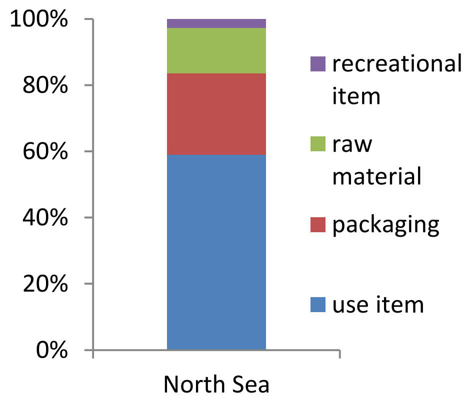


Figure 45: Life cycle phase of the generated litter items in the North Sea region.

Nature of littered item and its generator.

Items have a high probability (40%) of being related to professional activities, while consumers have a rather low contribution to beach/marine litter (33%), with 28% remaining unknown. This is also reflected in the fact that 59% of the beach litter items can be categorized as use items, 14% as raw material and only 25% as packaging items. The durability of the beach litter items is likely to be more or less evenly divided between short-life/single-use goods (47%) and long lasting goods (51%).





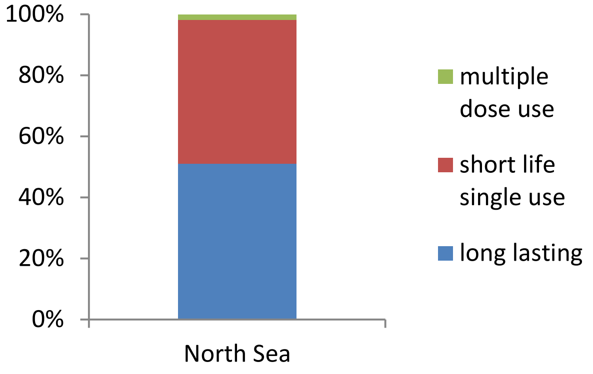


Figure 46: Nature of littered item and its generator in the North Sea.

Packaging type

Figure 47 shows the different packaging types of packaging beach litter items in the North Sea region. Primary packaging or individual consumption packaging forms the largest proportion (71%) of the packaging beach/marine litter, followed by service packaging like shopping bags and packaging of freshly prepared food (18%) and tertiary packaging items (transport packaging like pallets and strapping bands) (11%). Secondary packaging items were hardly reported at all (1%) in the indicated screenings.

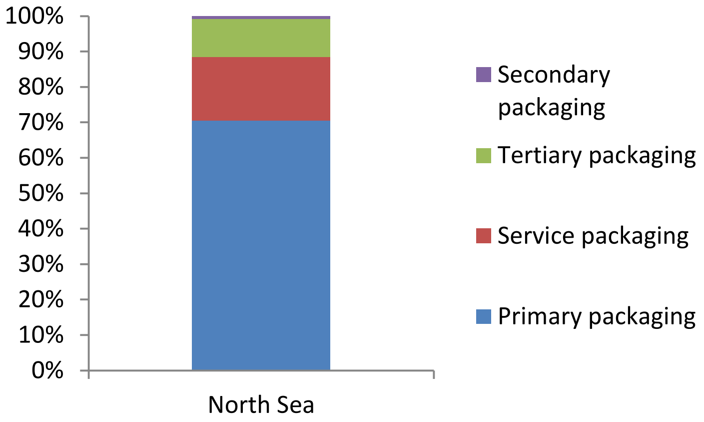


Figure 47: Packaging types of packaging beach litter items in the North Sea region.

Conclusions North Sea

- Based on the analysis, plastic/polystyrene pieces of both small (18%) and medium (14%) size were found to be the dominant fraction, followed by string and cord items (12%) and plastic caps/lids (7%).
- The dominant fraction is mainly made of plastic (80%), followed by sanitary items (6%), clothes (5%) and items made of paper/cardboard (2%), processed wood (2%), rubber (2%) and metal (2%).
- A considerable fraction of the beach litter items (30%) is potentially transported over a longer distance, 35% of the items is transported over a short distance from the site, with 35% produced/discarded on site;
- The main contributing sectors are coastal/beach tourism (18%), professional fishing (13%) and the shipping sector (9%). Other important sectors are port

activities (8%), households (7%), and other marine industries (8%). This is also reflected in the numbers showing that professional activities tend to have a larger contribution (40%) to marine/beach litter than consumers (33%), resulting in a higher share (51%) of long lasting use goods than in other regional seas.

- The same proportion (32%) of beach marine litter items is likely to be generated during the consumption phase of the life-cycle of the item as during the production phase.

Annex 5: Calculations waste scenario indicators final

This annex consists of an excel document, added in a separate file under the name “Calculations waste scenario indicators final.xlsx”.

Annex 6: Target value calculation final

This annex consists of an excel document, added in a separate file under the name “Target value calculation final.xlsx”

Annex 7: Calculating the effect of specific marine litter policy measures

This annex consists of an excel document, added in a separate file under the name “Effectiveness of behavioural measures.xlsx”.

Annex 8: Preliminary results of MARLISCO stakeholders' survey

The MARLISCO project (2012-2015), funded through the EU's 7th Framework Project, has conducted an extensive survey to gather information on the level of awareness within European society of the characteristics, sources and impacts of marine litter as well as the attribution of responsibility for its prevention and management.

A total of 3748 respondents completed the survey across Europe, from a range of stakeholder groups. Respondents (n>100) originated mainly from Cyprus, Denmark, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Romania, Turkey and United Kingdom.

How concerned is society with the issue of marine litter?

Overall, the majority of respondents reported noticing litter on most or every visit to the coast and showed concern about marine litter, perceived as having several negative impacts. More specifically, respondents believed that the quantity of marine litter is increasing, and that it represents a present threat, will cause lasting damage, and is a problem for everyone, not only to coastal communities.

Some differences in perceptions did emerge between stakeholder groups and between countries. For example, environmental organisations were most concerned about marine litter, whereas respondents working in design, manufacturing and retail sectors were slightly less concerned than other stakeholder groups. Similarly, respondents from Portugal, Slovenia, the UK, Germany and Greece were more concerned about the problem of marine litter compared to other countries, particularly Romania, the Netherlands, Cyprus and Denmark who reported being the least concerned about the problem.

What is marine litter composed of and where does it come from?

On average, respondents believed that plastic represents 45.5% of marine litter. Respondents correctly perceive the majority of marine litter is plastic but largely underestimate the proportion, which typically constitutes around 75% (UNEP, 2005).

Although all stakeholder groups underestimated the plastic fraction, environmental organisations and coastal and marine industries reported the highest percentage of plastic compared to other stakeholders, particularly those from retail and design and manufacturing sectors who reported the lowest percentage composition of plastic.

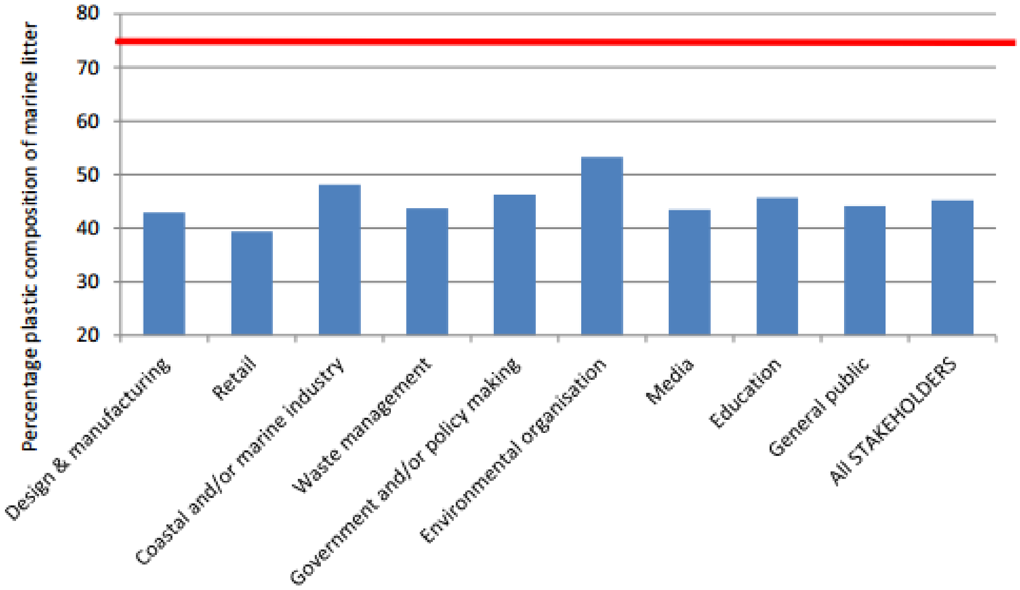


Figure 48: Perception about the percentage of marine litter that is composed of plastic by stakeholder group. The reference line at 75% here indicates the 'actual' proportion of plastic that is commonly reported in the literature (MARLISCO, 2013)

As shown in the figure below, survey respondents perceived 'direct release in the sea' as contributing the most to how litter ends up on the coast and in the sea. It is clear that respondents also understood that land-based sources contribute to litter entering the marine environment but they seem to underestimate their importance.

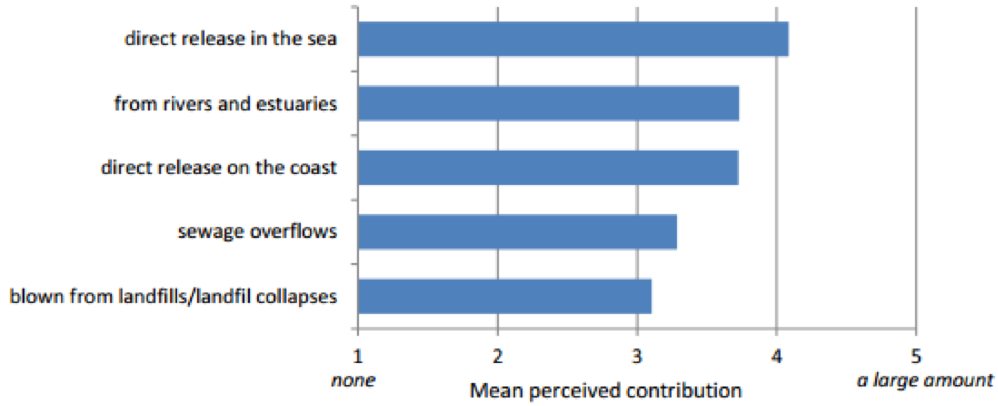


Figure 49: Perceptions about the different pathways that contribute to marine litter reaching the coast and sea (total of respondents) (MARLISCO, 2013)

Respondents from different stakeholder groups and different countries shared many of the same perceptions about marine litter. For example, there was a similar pattern of results across stakeholder groups and participating countries when considering the relative quantity of litter across the different marine environments, the contribution of different pathways by which litter can enter the marine environment, and the relative severity of the different impacts.

Who is responsible for marine litter and which factors contribute to this problem?

Respondents believed government, industry, commercial users and the general public share most responsibility for the problem of marine litter. However, the general belief is that there is a low level of competence, and an even lower level of motivation to take action to minimise it. This is in comparison to independent scientists and environmental groups who were perceived as least responsible, yet most competent and motivated.

Respondents reported being likely to take several actions themselves to reduce marine litter and perceived that it would be reasonably easy to take these actions.

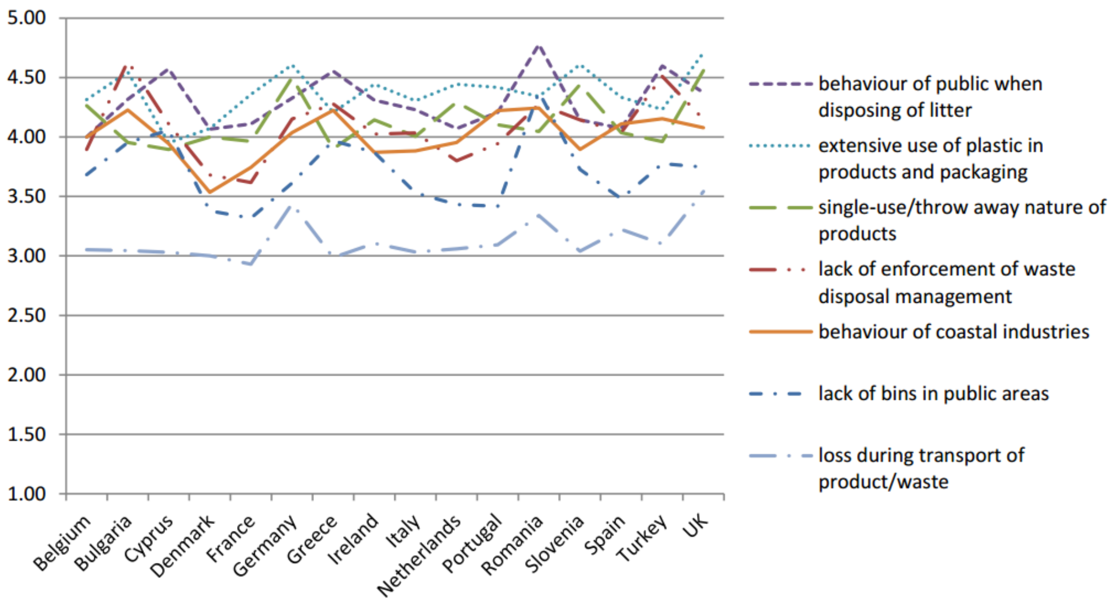


Figure 50: Perceptions about the importance of different factors in contributing to marine litter, by country of residence (1-5 scale: not at all important – very important), (MARLISCO, 2013).

The factors considered most important in contributing to marine litter were the behaviour of the public when disposing of litter, as well as the extensive use of plastic in products and packaging and the single-use nature of products.

How likely and feasible is it for people to take particular actions?

The survey included four questions which assessed how likely individuals would be to take key actions to reduce marine litter, and how feasible these would be for them to implement (Figure below). Respondents reported being likely to take all actions, but had least intention to ask people to pick up litter if they saw them littering. All actions are considered to be slightly easier to achieve (in terms of effort and feasibility) than they are likely to be put in practice personally by the respondents, with the exception of “buying reusable, rather than single-use disposable, non-biodegradable products”, for which people seem to have a stronger inclination than the perceived feasibility score.

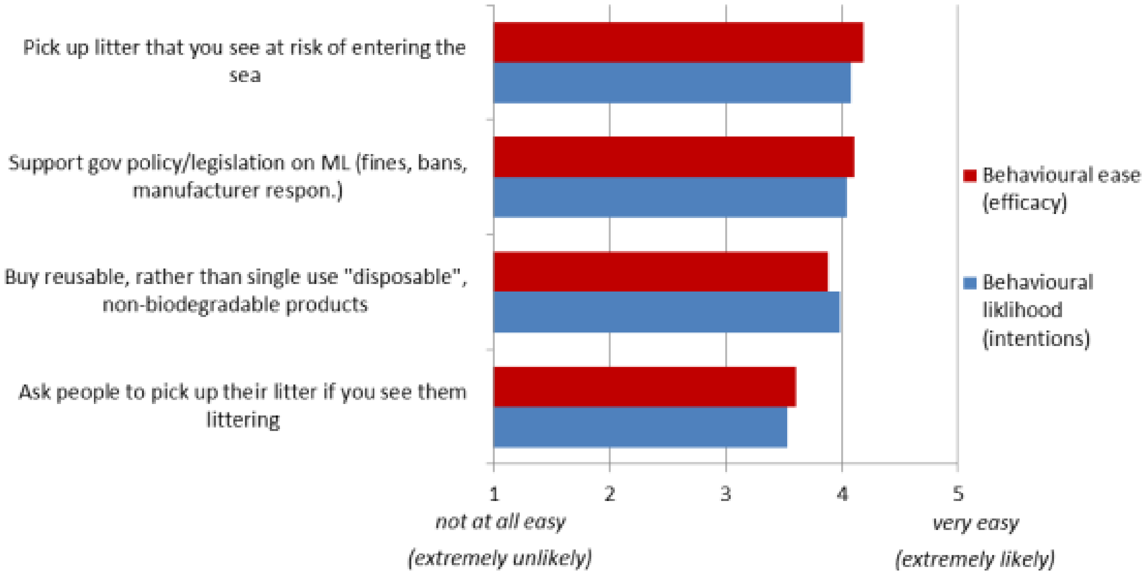


Figure 51 : Behavioural intentions of individuals regarding how likely they are to take key actions to reduce marine litter, and how easy it would be (MARLISCO, 2013)

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