Economic and social analyses for the Marine Strategy Framework Directive. Part 2: Program of measures

Theme: Marine Litter

Datum	Summer 2013
Status	Final version Background report for phase 2 ('towards a MSFD program of measures for marine litter')

Colofon

Uitgegeven door	
Informatie	Rob van der Veeren
Telefoon	0320 298938
Fax	
Uitgevoerd door	Rob van der Veeren en Xander Keijser
Opmaak	
Datum	Summer 2013
Status	Final version Background report for phase 2 (‘towards a MSFD program of measures for marine litter’)
Versienummer	1.0

Table of Contents

Short summary of the socioeconomic analyses for marine litter

According to the Initial Assessment presented in the 'Marine Strategy for the Netherlands part of the North Sea 2012-2020 Part 1', the expectation is that the quantity of litter from the key sources identified for the North Sea, i.e. shipping, fisheries, (beach) leisure activities and rivers, will not decrease in the coming years, despite prevailing and initiated policy. Although little is known about the environmental effects of microplastics in the sea, there are indications of potentially major risks for food webs. Therefore, the 'Marine Strategy for the Netherlands part of the North Sea 2012-2020 Part 1' presents as target for 2020 a decrease in the quantity of litter on the beach and a downward trend in the quantity of litter in marine organisms (Fulmars). The corresponding supplementary policy assignment until 2020 is thus to – at an international level – reduce litter and explore the presence and effects of marine litter, particularly micro plastics. With respect to the reduction of litter, the focus is mainly on prevention. Possible tracks being explored are an integrated source approach (including product development and more efficient use of plastics), raising awareness, a more efficient use and reuse, and collection. The feasibility of removal is also being investigated. Next to this policy assignment, there is also a knowledge assignment, since due to a lack of knowledge on the full scope and effects of litter on the ecosystem it is not possible to make any predictions on the achievement of good environmental status. The aim of the knowledge assignment is to accumulate more knowledge of the presence and effects of marine litter, particularly micro plastics.

Policy makers, stakeholders and citizens alike are well aware of the many caveats in the quantitative information on the functioning of the marine ecosystems. But at the same time, they all agree that it is important to protect the marine environment. This means that there is a common interest to implement measures in those areas that are in urgent need for improvement. However, over the past years, Europe has witnessed a serious economic crisis, which is well beyond compare, resulting in serious cuts in governmental budgets in various Member States, including the Netherlands. This makes it all the more important to look for measures that are likely to protect the marine environment at limited costs. This underlines the importance of the cost-effectiveness analyses that were performed of the past years and the results of which are presented in this report.

The fact that much is still unknown about the functioning of the marine ecosystems makes it impossible to quantify the impacts of potential measures on the marine environment with any degree of certainty. Therefore, a standard cost-effectiveness analysis, which aims at determining a unique set of measures that will achieve certain pre-set targets at least cost, is not possible. However notwithstanding this, it was possible to make a distinction between measures that are likely to be not cost-effective – either because they are far more expensive than alternative measures, less effective than alternative measures, or both – and more cost-effective ones. The results are presented in Table 1 (more details on the cost-effectiveness analyses can be found in Chapter 3).

Table 1: Overview of selected measures to reduce the amount of litter in the marine environment

Nr.	Specified measure	Annual costs (in million euros)	Cost-effectiveness
1	Impose the use of alternative material to protect beam trawler nets	0 to 1.1m	Very cost-effective
2	Part of touristic beaches designed for tourists who take away their litter	3.8m	By making the right stakeholders responsible for awareness, this will be cost-effective
3	Ban on mass releases of balloons	150 thousand	Awareness campaigns could be cost-effective
4	Better port facilities		Cost-effective measure if adopted internationally
5	Additional beach cleaning on non-bathing beaches (once a year)	1.5m	Depending on the timing and location very cost-effective
6	Deposit system on (parts of) used nets	Not known	Only cost-effective if (parts of) nets are caused by illegal or improper spills
7	Adding individually recognisable ID markers to fishing nets and wires	330 thousand	Only cost-effective if (parts of) nets are caused by illegal or improper spills
8	Fee on plastic bags in supermarkets	23.4m	Polluter pays, not targeted.
9	Deposit system on small plastic bottles	26m	Polluter pays, not targeted
10	Extra fishing for litter (primary goal is litter, not fish)		No[1], only cost effective if litter is collected during fishing activities.
11	Higher fines and more control on the beach and on sea.	0.9m	Not cost-effective at sea. At the beach, not cost-effective
12	Packaging resin pellets	Not known	
13	Compostable user plastic at bathing beaches	1.9m	No

One of the measures presented above that was found to be potentially cost-effective was to start a discussion on harmonisation of regulations regarding waste reception facilities in international harbours. The reason for this is it was found that regulations in individual harbours are diffuse. If there is no clarity on the financial systems in ports and on whether there is an obligation to deliver ship generated waste in that port, this doesn't contribute to compliance of ships. Therefore, the Netherlands has taken the initiative to write a discussion document on this topic, which has been submitted to the European Commission in order to contribute to the review of the European Directive on port reception facilities.

[1] This concerns active Fishing for litter, not the current practice where litter is collected during fishing activities

Another suggestion from the table above is that it might be cost-effective to impose an alternative material to protect beam trawler nets. Therefore, the Dutch have launched a study to investigate potential alternatives.

For the cost-benefit analysis the problems with quantification of potential effects of measures and consequent impacts on the marine environment prevents a proper estimate of the potential benefits in monetary terms. However, based on certain assumptions, at least some indication of the most important beneficiaries and an order of magnitude of potential benefits can be presented (see Table 2).

Table 2: Monetary benefits of a reduction in the amount of litter in the marine environment

Benefits	**Benefits (mln €/year)**
Reduced beach cleaning costs	0
Enhanced recreational value	p.m.
Attractiveness for housing	p.m.
Less damage to shipping	1 – 2
Less damage to fisheries	1 – 2
Less damage to recreational boating	0
Total	2 – 4

The main goal of the MSFD is to encourage the sustainable use of the marine environment and improving the functioning of the marine ecosystem. The improvement of the marine ecosystem is therefore the most important benefit of the MSFD. This study has tried to quantify the impacts of additional measures for marine litter on the marine environment in 'nature points', an indicator that combines habitat quantity, environmental quality and rarity. An analysis using the Nature Points Method shows that reduction of marine litter does not result in an increase in the number of Nature Points. In other words, litter in the marine environment is distressing for an individual, perhaps even fatal, but it is expected to pose no serious threads to the (performance of the) ecosystem as a whole. The best that can be done is to present the potential impacts in pictures, with a short description of the potential ecological consequences. This has been done in Chapter 4.

This report not only presents the main results of the various studies on socioeconomic analyses that have been performed in the Netherlands over the past years, which were mainly aimed at fact finding (the costs and benefits presented above), but it also describes the results of a representative survey under the Dutch population to investigate the public opinion on marine litter. Results show that citizens think that health care, employment and income are more important than environment. And within the various environmental themes, climate change and air pollution are more important than pollution and depletion of the North Sea. When zooming in on (potential) environmental problems in the North Sea, oil pollution and the possible extinction of fish and other species are more important than plastic pollution of the North Sea. All this suggests that problems surrounding litter are not that important to the Dutch public. However, the survey also shows that when people are asked explicitly, they think litter is an important topic. Half of the respondents would be willing to pay something to provide a financial contribution to the dissolution of environmental problems. But when as alternative measures are proposed, 1) higher taxes for additional checks and cleaning programs, 2) higher prices for plastic containing products, or 3) no plastic bags in the stores, citizens massively choose

for not providing plastic bags. This result seems to suggest that there is a discrepancy between socially desirable behaviour and willingness to pay on the one hand (politically corrects answers: "stated preference") and actual behaviour on the other ("revealed preference"). But it can equally well be seen as an indication that price incentives will affect behaviour, since part of them say they would pay for environmental measures, but they would rather not. More details on this survey can be found in Chapter 6. In that same chapter, also a brief description of the stakeholder process and involvement can be found.

Chapter 7 discusses the importance of international cooperation regarding the topic marine litter. The protection of the marine environment is a typical case for international cooperation, and therefore, throughout the process of the realization of the socio-economic analyses for the program of measures, a lot of international exchange of background studies and information has taken place. In order to stimulate this exchange, it was decided from the beginning to write the background reports as much as possible in English and put them on the internet as soon as possible.

Chapter 8 finalises this report with an overview of the main knowledge gaps with respect to marine litter. In the field of marine litter many knowledge gaps still exist. Due to a lack of knowledge and reliable research methods, it is difficult to get a complete picture of the trends and consequences of litter in the marine environment. As a result, not enough quantitative information is available to provide clarity on how measures can contribute to achieving good environmental status. For the cost-effectiveness analysis quantitative descriptions are needed for both the Business as Usual scenario and for the MSFD targets. This information is currently not sufficiently available for a full quantitatively cost-effectiveness analysis. Thus the amount of measures to be taken cannot be estimated.

Extended summary of the socio-economic analysis regarding a reduction in the amount of litter in the marine environment

Litter does not belong in the sea. However, still lots of marine debris washes ashore on the beaches and many more thrives around in the sea. Exactly where it comes from is often not exactly known, but the fact that it does not belong in the marine environment, is evident. The good news is, that over the past 10 years, the amount of marine litter has not increased. But with current and proposed policies alone, the amount of litter in the marine environment is not expected to decrease. The Dutch government has therefore decided that additional knowledge and policies are necessary. These policies should result in a cost-effective, efficient, feasible and affordable program of measures that will be adopted in 2015.

The purpose of this report is to provide and present all the information that is available on the possible socioeconomic and social advantages and disadvantages of possible additional measures in the field of reducing litter in the marine environment, in an objectively as possible way, in order to support the necessary trade-offs, considerations and decisions relevant for the determination of the program of measures. By presenting information on what is already known, it becomes clear what information is not yet known. By also presenting the research questions and knowledge gaps in the various fields, this report will not only support the decision making process (the policy statement), but also contribute to an overview of the remaining knowledge tasks.

Given the aim to reduce the amount of litter in the marine environment, the quest towards a cost-effective, efficient, feasible and affordable program of measures takes us along a large number of questions: What happens already? What additional measures are possible? What are the costs and effects of these measures? What are the benefits of reducing the amount of litter in the marine environment? What economic instruments are possible to stimulate the reduction of the amount of litter? Who pays what? What do the citizens and stakeholder organizations think of the various measures? And how can we make policies more effective and efficient by international cooperation?

This report provides an extensive report of this quest. Below is a summary of the main results.

CHAPTER 1: INTRODUCTION

The policy challenge for litter

The MSFD requires Member States to establish an internationally coordinated program of measures to achieve and maintain good environmental status and sustainable use of the marine environment. As a first step on the way, the Netherlands presented in 2012, the 'Marine Strategy for the Netherlands part of the North Sea 2012-2020 Part 1'. This document describes the current situation, the objectives and its main policy and knowledge statements. To address the issue of marine litter, the main focus is on prevention (source-oriented policy for litter from beach recreation, fishing, shipping and rivers), awareness-raising, product development, and

sustainable and efficient use of (especially) plastics. The most important knowledge task refers to the collection of information and knowledge about the effects of litter, in particular micro plastics.

The MSFD requires socioeconomic analyses of measures
The MSFD imposes a number of requirements to the programs of measures. These include a requirement that Member States should take account the social and economic effects of the planned measures when compiling the programs of measures. The Member States must also ensure that measures are cost-effective, and that a cost-benefit analysis is performed prior to the introduction of additional measures. However, the MSFD does not describe clearly how the different analyses should be carried out.

The approach of the social cost-benefit analysis
In the Netherlands the OEI guidance document prescribes how to perform social cost-benefit analyses (SCBAs). The basic principle is that the advantages and disadvantages of certain measures should be presented as unambiguous as possible, and as much as possible in one entity: Money. If that is not possible, the effects should in any case be presented quantitatively. For the Water Framework Directive in 2006 and 2008 this type of analyses were also performed. These showed that - due to a lack of reliable quantitative information on the relationship between measures and the magnitude of the expected effects - it is often not possible to estimate the costs and benefits of measures in monetary terms. In those cases, an indication of the costs and a description of the expected ecological effects was all that could be presented. For the SCBA for the MSFD this appeared to be largely the same. Hence, the SCBA in this report also mainly consists of a qualitative description of the expected effects, and thus not everything is expressed in monetary terms.

The approach with respect to the cost-effectiveness analysis
The main purpose of a cost-effectiveness analysis is to establish a ranking of measures, whereby measures that contribute most to a certain prefixed target at least cost are presented at the top of the list ("the biggest bang for the buck"). This is the measure, that when budgets are tight, should be taken first. With a slightly larger budget, the following measure on the list can be implemented, etc. A cost-effectiveness analysis can thus help to achieve a certain objective at least cost, or to achieve as many of the targets as possible, given a limited budget. With respect to the MSFD, the lack of clear quantitative relations between measures and their effects on the marine environment means that this type of analyses remain largely qualitative in nature, and are mainly based on expert judgment. Despite the more qualitative character, the main objective of the analysis remains to provide a distinction between, on the one hand, measures that are expected to have much impact at limited costs, and on the other hand measures that are costly and will have little effect. In situations where quantitative information is hardly available, capturing this type of information can already be very helpful to inform and support the decision-making process.

The approach to social analysis
The social analysis is probably the most difficult part, since no standard approach exists. As part of the Initial Assessment of the MSFD, a few Member States have performed an analysis or presented some text on this topic. The number is limited and the approaches are diverse. The reason why a large number of Member States

did not report anything explicitly on this topic is because – in line with the European guidance document on socioeconomic analyses for the MSFD – many Member States interpret 'social and economic analysis' as socioeconomic analysis and therefore argue that no separate social analysis needs to be performed since the SCBA is a socio-economic analysis, and should therefore be enough.

However, in this report, the social analysis is developed along different tracks. First, the results are presented of of a survey among the Dutch population about their perception of the (Dutch part of the) North Sea and what they think are important topics. Secondly, a brief description is presented of the various relevant stakeholders (stakeholder analysis), and how they are involved in the process towards the final program of measures (description of the stakeholder process). Thirdly, in the description of the costs and effects of the measures it is explicitly stated who bears the costs and the distribution of costs and benefits across sectors presents the social impacts.

Addressing disproportionality of costs
In the European Marine Framework Strategy it is stated that *"Member States shall develop and implement all the elements of marine strategies referred to in Article 5(2), but shall not be required, except in respect of the initial assessment described in Article 8, to take specific steps where there is no significant risk to the marine environment, or where the costs would be disproportionate taking account of the risks to the marine environment, and provided that there is no further deterioration. (Article 14 Exceptions)"* There is no standard approach or lower boundary for disproportionality of costs. What disproportionate costs are is ultimately a political consideration and decision, in which all (socio-economic) information collected in this report may eventually play a role.

CHAPTER 2: Current policy and costs

Tackling litter: Much is already done
At an international level, litter in the marine environment is recognised as a problem and the consensus is that plastic does not belong in the sea. In addition to formulating monitoring and research protocols, a number of international initiatives have been launched to limit waste. The United Nations International Maritime Organization (IMO) sets out the prevention of pollution of the sea by garbage from ships in Annex V of the MARPOL Convention. Annex V was recently revised and fine-tuned. The leading principle of the revised Annex V is that the discharge of garbage is prohibited, with a few exceptions. The revised MARPOL ANNEX V came into force on 1 January 2013. On the Netherlands' initiative, it has been agreed in IMO that the course on marine environmental awareness will become a mandatory part of maritime educational programmes all over the world. At EU level, the European Directive on port reception facilities applies, which aims at increasing the delivery of ship waste and cargo residues by enhancing the availability and use of port reception facilities. This Directive is currently being revised. The Netherlands is committed to further optimise the Directive by tightening the obligation to deliver waste for ships that leave for a port outside Europe. The Netherlands would also like to see a European information and monitoring system, and harmonisation of the enforcement and financing systems. Also at the national level much happens, including various initiatives and campaigns focusing on behavioural change and litter, such as the 'Schoonste Strand' [Cleanest Beach] campaigns.

The costs of current policies
It is difficult to present a complete overview of the costs of current policies. There are costs incurred for the collection of ships wastes, but in principle, one could also include part of the costs of the collection of household waste. But what part of this should be attributed explicitly to the reduction of the amount of litter in the marine environment? This is unknown. The only expense that can be attributed fairly unambiguously as costs to prevent litter from entering the marine environment and can be calculated relatively easy are the costs of beach cleaning. These costs are around 4-5 million € per year for the Dutch part of the North Sea.

Despite many efforts, litter remains a complex problem
The conclusion from the initial assessment is that litter, primarily plastics, constitutes a complex problem in the marine environment. There are a lot of unknowns regarding the sources, magnitude and effects on the ecosystem. Hereby notably plastic is a substance that is hard to remove from the environment, if at all. It is, therefore, not possible to judge whether good environmental status can be achieved in 2020. Formulating quantitative targets is problematic, because the impact of measures on the marine ecosystem is difficult to quantify.

In this case, setting a qualitative target that provides the right direction is more realistic. The Dutch Cabinet is of the opinion that litter does not belong in the sea. Internationally, awareness of the problem of plastics in the sea is also growing. At the same time, the initial assessment made it clear that, despite current policy efforts and many initiatives, litter in our part of the North Sea is not expected to decrease. Contamination with microplastics is likely to increase. To that end, a reduction target and supplementary policy assignment will have to be formulated for 2020. This has led to the following environmental objectives for 2020:

- In 20202 the quantity of visible beach litter has to be decreased (basic reference 2002-2009).
- There has to be a decreasing trend in the quantity of litter in marine organisms (basic reference 2005-2009).

Chapter 3: Cost-effectiveness analysis

How can environmental goals be achieved at least cost: cost-effectiveness analysis
At present, there is insufficient quantitative information on the amount of plastic in the sea and the contribution of the various sources (e.g. shipping, fisheries, recreationists) in order to perform a full quantitative cost-effectiveness analysis. However, based upon available information a distinction can be made between measures that seem to be cost-effective (much impact at little cost), and measures that are probably not cost-effective.

In 2010, DHV produced an initial inventory of for the MSFD potentially relevant measures, and established a draft database on the costs and effects of those measures. Based on this information, information from stakeholders and additional research in 2011, LEI performed a preliminary cost-effectiveness analysis (CEA). The purpose of this preliminary CEA was to gain insight into the application of this methodology, the availability of required data, but also to get a first idea of possible relevant measures and to determine for what measures additional information would

be required. For the most relevant measures additional research had been performed in 2012. Based on all this information, a cost-effectiveness analysis was performed in 2013. The results are presented in Table 3.

- The effect of an alternative for bundles of nylon wires is not quite clear, because nylons wire fragments from net protection bundles form one of the many sources of the rope and fragments that are found. Alternatives to nylon are available, such as cocos, and do not necessarily result in higher costs.
- The 'my beach' concept is a source oriented measure, in which the amount of litter left at the beach is reduced by tourists. Public awareness campaigns can be effective to keep beaches clean in the first place. However, it is unclear to whom 'yourself' refers. So the measure might be effective if the right stakeholders are made responsible.
- It is not easy to estimate the effectiveness of a campaign regarding a ban on mass releases of balloons. Public campaigns can be very effective, and people may choose alternatives to releasing balloons once they are aware of the consequences.
- The international harmonisation of the fees of port reception facilities and controlling the amount of garbage handed in, is a potentially cost effective measure to reduce litter in the marine environment from ships. However, this measure is only effective if adopted internationally.
- Additional beach cleaning of non-bathing beaches can be effective depending on the timing and location. According to Ecorys, most beaches in the Netherlands have an A+ status, so they are already very clean. In municipalities with crowded beaches and where it is policy to clean the beach every day with beach cleaners a reduction of waste on the beach will not soon lead to lower costs. The beach will be cleaned with the same frequency, also with less waste on the beach. However, this could be different for less crowded beaches where the beach is not cleaned on a daily basis. A reduction of the amount of waste could lead to less frequent mechanical cleaning, only cleaning when needed or a switch to manual cleaning.
- The effectiveness of a deposit system on nets is questioned by the sector. Nets are valuable to fisherman and they therefore take good care of not wasting nets. It is therefore doubtful that a deposit on the nets will lead to a change of behavior. Maybe effective for gill net fishing.
- Adding individually recognizable ID-markers to fishing nets and wires will only work if loosing nets can be limited at all. Nets are considered valuable by fishermen who often turn around to retrieve lost nets. Hence, this measure will be only cost-effective if spills of (parts of) nets in the marine environment are caused by illegal or improper action.
- A fee on the use of plastic bags in supermarkets is regarded as effective by some stakeholders, but one with a much higher impact than the marine environment alone. Hence, the polluters pay principle is not targeted. However, the measure might work in coastal communities and communities close to a river.
- A deposit system on small plastic bottles may result in fewer caps on the beach. However, this measure targets not only the polluters but the whole society. Hence, this measure should not be taken for the marine environment alone. However, the measure might work in coastal communities and communities close to a river.

- The measure fishing for litter is not effective if fishermen will only sail out to fish for litter. The measure will be effective if fisherman would take the litter with them to shore during their normal fishing activities.
- The effectiveness of higher fines depends on the level of enforcement and collection of fines. The effect of this measure on sea will be limited. A larger effect is expected on public beaches. However, for tourist beaches that are cleaned daily in bathing season the effect will be much smaller.
- The effectiveness of packaging resin pellets is unknown. It is unclear whether plastic pellets are still disposed at sea. According to the stakeholders it seems that the measure should focus on dealing with the pellets that are already in the sea instead of stopping the disposal of plastic pellets.
- Many stakeholders point out that biodegradable plastics may not be a good solution, because biodegradable plastics decompose in small particles (even fast than normal plastic) and this is even more difficult to remove from the marine environment.

Table 3: Overview of the most cost-effective Measures to reduce the amount of litter in the marine environment

Nr.	**Specified measure**	**Annual costs (in million euros)**	**Cost-effectiveness**
1	Impose the use of alternative material to protect beam trawler nets	0 to 1.1m	Very cost-effective
2	Part of touristic beaches designed for tourists who take away their litter	3.8m	By making the right stakeholders responsible for awareness, this will be cost-effective
3	Ban on mass releases of balloons	150 thousand	Awareness campaigns could be cost-effective
4	Better port facilities		Cost-effective measure if adopted internationally
5	Additional beach cleaning on non-bathing beaches (once a year)	1.5m	Depending on the timing and location very cost-effective
6	Deposit system on (parts of) used nets	Not known	Only cost-effective if (parts of) nets are caused by illegal or improper spills.
7	Adding individually recognisable ID markers to fishing nets and wires	330 thousand	Only cost-effective if (parts of) nets are caused by illegal or improper spills
8	Fee on plastic bags in supermarkets	23.4m	Polluter pays, not targeted.
9	Deposit system on small plastic bottles	26m	Polluter pays, not targeted

10	Extra fishing for litter (primary goal is litter, not fish)		No[2] only cost effective if litter is collected during fishing activities.
11	Higher fines and more control on the beach and on sea.	0.9m	Not cost-effective at sea. At the beach, not cost-effective
12	Packaging resin pellets	Not known	
13	Compostable user plastic at bathing beaches	1.9m	No

Source: based on LEI, 2011

Chapter 4: Cost-benefit analysis

What are the benefits of a reduction of the amount of litter in the marine environment?

Main benefit: Protection of the marine ecosystem

The main reason for taking action to reduce the amount of litter in the marine environment is to protect the marine ecosystem, so that it can function sustainable, and enhance sustainability. The protection of the marine ecosystem can therefore be seen as the main benefit of the reduction of the amount of litter. This covers the prevention of negative impacts on fish, birds and marine mammals, such as being entangled in debris, ingestion of particles causing poisoning and damage to organs, and (indirect) impact on other species through effects via the food web.

Litter reduction does not lead to a measurable improvement of the marine ecosystem

Studies show that marine litter has no significant impacts on the functioning of the marine ecosystem as a whole. Hence, no significant quantitative effects can be expected when effects are estimated on the basis of indicators. An analysis using the Nature Points Method shows that reduction of marine litter does not result in an increase in the number of Nature Points. In other words, litter in the marine environment is distressing for an individual, perhaps even fatal, but it is expected to pose no serious threads to the (performance of the) ecosystem as a whole.

Effects of marine litter on welfare are limited

Besides the potential impacts on the functioning of the marine ecosystem, litter in the marine environment may also have impacts on human welfare. For example, a reduction in the amount of litter being washed ashore may lead to a reduction in the costs for beach cleaning; less litter on beaches may make these beaches more attractive for recreation or to live there, and a reduction of waste in the marine environment can lead to fewer problems with screws and damage to nets and related costs.

Although these effects are likely to occur, when trying to express these impacts in monetary terms, the size of these benefits appear to be quite limited. Depending on the benefit category, there are several causes for this:

- (Bathing) beaches in the Netherlands are cleaned to a minimum level of "cleanliness". A (limited) change in the amount of litter washed ashore (or being left behind by recreating people) does not result in a significant

[2] This concerns active Fishing for litter, not the current practice where litter is collected during fishing activities

change in beach cleaning efforts (and therefore no reduction in costs (=benefits)).

- Because the beaches in the Netherlands are already kept relatively clean, a small change in the amount of litter on the beach will not or hardly be noted by recreating people (since it will already be removed before it is noticed by them). Therefore, a small change in the amount of litter on the beach will have only a negligible effect on the recreational attractiveness of the beaches. And therefore, the number of beach visitors is not expected to increase as a result of a change in the amount of litter. Hence these recreational benefits are included as a pro memory entry.
- Houses in the vicinity of clean beaches may be more popular than houses in the neighbourhood of more polluted beaches. This would be reflected in a higher price for the respective houses. However, because the difference in the degree of cleanliness of the beaches is expected to be not significantly affected by a change in the amount of litter (since the beaches are all being kept very clean), it is expected that the impact on house prices will also be negligible. Hence, also included as a pro memory entry.
- Damage caused by waste at sea appears to be a problem for small fishing boats, especially because of jammed propellers, the occurrence of damage to nets, and (to a lesser extent) also damage to the rudder. Problems with litter jamming propellers can usually be solved by skippers directly at sea, by moving successively rearward and forward, which makes the litter disappear from the screw. For deep-sea fishing, damage to nets is of minor importance, compared to the other types of fishing, because in the deep sea, floating nets are used that are not in contact with the seabed. It also appears that problems related to litter getting stuck in propellers occur especially close to the coastline. Litter could result in damage to the hull or the cooling water intake, but this is hardly ever reported. In addition, large vessels are less susceptible to damage than small ships, because a large part of the smaller vessels are used for trawl fishing, whereby nets drag over the seabed. The damage to the nets is usually caused by (unknown) shipwrecks and not so much due to marine litter. Damage in terms of additional time needed to remove waste from the nets and separate from the catch, is not mentioned by the Dutch fishing sector as a significant cost. The total damage to the Dutch fisheries sector as a result of litter in the marine environment is estimated to be around 2 to 3.5 million € per year. Assuming that by taking measures to reduce the amount of litter in the marine environment the amount decreases by 50% (which is likely to be a very positive estimate), and furthermore assuming that the costs related to litter in propellers and nets decrease proportionally with the amount of litter in the marine environment, then the maximum benefits for the fisheries sector can be estimated to be between € 1 and € 2 million per year.
- For shipping the size of the vessel appears to be an important factor determining the size of the potential damage due to the amount of litter at sea. Because most litter is located in the upper layers of the sea or floats to the surface, large ships are generally less sensitive to damage to propellers because these vessels float deeper than small vessels. The total damage that the Dutch shipping fleet experiences as a result of litter at sea within the Dutch Continental Shelf is estimated to be somewhere between € 1.5 and € 4 million per year. Based on the same assumptions as for fishing, the maxi-

mum benefits for shipping are estimated to be between € 1 and € 2 million per year.

Table 4: Monetary benefits of a reduction in the amount of litter in the marine environment

Benefits	**Benefits (mln €/year)**
Reduced beach cleaning costs	0
Enhanced recreational value	p.m.
Attractiveness for housing	p.m.
Less damage to shipping	1 – 2
Less damage to fisheries	1 – 2
Less damage to recreational boating	0
Total	2 – 4
Reduced beach cleaning costs and attractiveness of housing are not included in the summation, to prevent double counting.	

A reduction of marine litter does not make you rich, but is important because it just does not belong in the sea
The cost-benefit analysis shows that monetary benefits of reducing the amount of marine litter are relatively limited, and that the costs clearly outweigh the benefits of the measures. That in itself is a well-known phenomenon in environmental policy. The main objective is the protection of the functioning of the marine ecosystem, because litter does not belong in the sea.

An important question to be answered then is how far one wants to go with the introduction of additional measures. The list of measures presented in Table 3 gives a nice starting point for this discussion by showing what measures may have a serious impact at relatively low costs and what measures are less cost-effective.

CHAPTER 5: Economic instruments

Interesting economic instruments (to) encourage desirable behaviour
Economic instruments can be used to implement measures for the MSFD effectively and efficiently by giving economic incentives to the various actors. Economic instruments are, in the words of the MSFD, management measures for the users of the marine ecosystem to make them act in ways that achieve the objective of good environmental status. In the Netherlands, there is a long tradition in the use of economic instruments in water management. E.g. the wastewater treatment plants are paid for by means of a wastewater levy, which is paid for by the various households and industries that discharge their wastewater, and drinking water is paid for per m3 of drinking water. This report provides an overview of the various economic instruments that are currently used to protect the marine environment and the possibilities to expand and / or improve these existing economic instruments to achieve the purposes of the MSFD effectively and efficiently.

Examples of (new) economic instruments are tariff and tariff differentiations (e.g. clean ships can, according to the Clean Shipping Index, receive a discount on the port charges), changes in tax systems (e.g. it can be considered to reward ships with good environmental performance with a tax cut), rewarding systems (e.g. fish-

ing for litter and rewarding beach clubs that keep their beach clean) and subsidies for research.

CHAPTER 6: social analysis / stakeholder involvement

Social Analysis: Stakeholders more excited about litter reduction than citizens
According to a representative survey held in 2011 under the Dutch population, citizens find health care, employment and income more important than environmental issues. Environment is mentioned by only 5% of the respondents as the most important issue. Within the various environmental themes, pollution and depletion of the North Sea are less important than climate change and air pollution, but more important than improving water quality and the protection of forests and heathland. When zooming in on various environmental issues that are relevant for the (Dutch part of the) North Sea, oil pollution and the possible extinction of fish and other species are more important to Dutch citizens than plastic pollution of the North Sea, followed by eutrophication and disturbed seabed (soil integrity). All this suggests that problems related to marine litter do not really matter to the Dutch citizens. However, the survey also shows that when people are asked explicitly, they think that litter is an important topic. Half of the respondents would be willing to pay a financial contribution to the solution of environmental problems. At the same time, when the following alternative measures are proposed, 1) an increase in taxes to be able to have more monitoring controls and cleaning programs 2) a price increase for products that contain plastics, or 3) no longer having the opportunity to receive plastic bags and sachets in stores, citizens massively choose for not providing plastic bags. This result seems to suggest that there is a discrepancy between socially desirable behaviour and willingness to pay on the one hand ('stated preferences'), and actual behaviour on the other ('revealed preferences'). However, it can equally well be seen as an indication that price incentives will affect behaviour, since part of the population indicates that they are willing to pay for environmental measures, but they would rather not. Payment for plastic bags at stores might therefore be an effective measure.

The parties involved in the North Sea are officially represented in the Overleg Infrastructuur en Milieu (OIM, a consultative body on Infrastructure and the Environment, called Overlegorgaan Water en Noordzee [Consultative Body on Water and the North Sea] until 2011), a nationwide consultative body of stakeholders in issues related to water and the North Sea, of which the Ministry of Infrastructure and the Environment acts as secretary. Once a year, stakeholders provide advice on MSFD products in the regular OIM meeting. This advice is presented to the State Secretary. In March 2010, the OIM requested applications for a MSFD core group, with stakeholders who wanted to hone in on the details and discuss the establishment of the initial assessment, good environmental status, environmental targets and indicators. This core group has met seven times since 6 May 2010 to discuss the progress, products and policy of the Marine Strategy. This process was aimed at joint fact-finding during the formulation of the Deltares and IMARES scientific recommendations for the different components of the Marine Strategy Part I, and at proper coordination during formulation of the Cabinet's decision. The stakeholders represent all of the North Sea sectors: fisheries, shipping, nature and the environment, hydraulic engineering, the offshore industry and leisure activities. Three brainstorming workshops on initial assessment and good environmental status were also held in 2010 to allow experts with optimum knowledge and expertise to discuss these

issues. Where necessary, bilateral consultations were held with individual stakeholders.

Also after the completion of the Marine Strategy Part I this stakeholder group met regularly (approximately one every six weeks) to discuss the progress of the program of measures. In addition, specific thematic workshops were organised, including a workshop in November 2012 on marine litter. At this workshop, various representatives of different organizations and sectors presented examples of best practices, such as a cosmetics producer that replaces micro plastics in scrubs, the clean beach foundation presenting their 'most beautiful beach' election by beach visitors which not only stimulates pavilions to clean beaches in the direct vicinity of the pavilion at relatively low cost but also works to raise awareness, and a cruise company that presented their waste management plan. The stakeholders also discussed possible additional measures to reduce the amount of litter in the marine environment. This report has been used as one of the building blocks of their discussions which were still ongoing at the moment this document was finalized (June 2013).

Benefits and burdens unequally distributed?
In compiling the program of measures the distribution of the costs and expenses of the measures will be taken into account. Because the final package of measures is not yet known, the distribution of the burden can not (yet) be given.

CHAPTER 7: International cooperation

For environmental policies for the North Sea to be effective and efficient, international cooperation is an important prerequisite. International cooperation with regard to the program of measures is not only essential to increase the effectiveness of measures, but also to ensure a level playing field for different sectors. Therefore, the Netherlands tries to achieve harmonization of different measures, both within OSPAR (the regional sea convention in which the countries around the North Sea cooperate) and within different European working groups. Examples are:

- Partly based on the results of the socio-economic analyses presented in this report, The Netherlands have taken the initiative - in the context of the ongoing revision of the European Directive on Port Reception Facilities - to start a discussion for further harmonization on the way waste is collected and processed in international harbours, by preparing a discussion document which illustrates the differences in waste handling and management in various international ports.
- The Netherlands have been actively involved in the exchange of knowledge, information and experiences by giving presentations in e.g. the European Working Group on Economic and Social Analysis and by providing all reports and information in English and publish them on the internet. This made it possible for other Member States to benefit from the experiences and information gathered by the Netherlands.
- Within OSPAR, Netherlands works closely with Germany to further shape the OSPAR Regional Action Plan on marine litter by including regional measures.

CHAPTER 8: knowledge gaps

Still many knowledge gaps exists; towards a knowledge agenda

In the field of marine litter many knowledge gaps still exist. Due to a lack of knowledge and reliable research methods, it is difficult to get a complete picture of the trends and consequences of litter in the marine environment. The main knowledge gaps include the lack of a research protocol and data series for litter in the water column, on the seabed and regarding to microplastics in the marine environment. Furthermore, there is a lack of knowledge about the consequences of litter and plastics for marine organisms and ecosystems and there is insufficient knowledge for identification and standardization of sources of litter. Knowledge in these issues will be developed in the coming years and may result in the adaptation of the measures.

In view of the absence of such quantitative information about the link between sources, causes and consequences of litter in the marine environment, the cost effectiveness analysis carried out in this report is necessarily largely based on currently available information and expert judgment. What can be done is indicate what measures might probably have a significant impact at limited costs, and which may not. That is exactly what this report has tried to do.

For the cost-benefit analysis the problem with the quantification of potential impacts of measures means that no reliable estimate can be made of the potential monetary benefits. However, the analyses presented in this report, show that monetary benefits are likely to be insignificant, so that a further analysis based on improved quantitative impact assessments in the future may not be appropriate. However, this is not to say that there are no benefits of a reduction in the amount of litter in the marine environment. Although the marine ecosystem may not collapse due to the presence of litter in the marine environment, it is clear that it does not belong there. This is maybe the most important reason to reduce the amount of litter in the marine environment.

Uitgebreide samenvatting van de sociaal economische analyses met betrekking tot een reductie in de hoeveelheid zwerfvuil in het marine milieu

Zwerfvuil hoort niet in zee. En toch spoelt er van alles aan op de stranden en drijft er nog veel meer rond in zee. Waar het precies vandaan komt is vaak niet goed aan te tonen, maar dat het er niet thuis hoort, is evident. Het goede nieuws is dat de laatste 10 jaren de hoeveelheid afval niet is toegenomen. Maar met het huidige en voorgenomen beleid alleen zal deze hoeveelheid naar verwachting niet afnemen. Het kabinet vindt daarom een aanvullende beleids- en kennisopgave noodzakelijk. Deze beleidsopgave dient te resulteren in een kosteneffectief, efficiënt, haalbaar en betaalbaar programma van maatregelen dat in 2015 zal worden vastgesteld.

Het doel van dit rapport is het op een zo objectief mogelijke manier inzichtelijk maken van wat er bekend is over de mogelijke sociaaleconomische en maatschappelijke voor- en nadelen van mogelijke aanvullende maatregelen op het gebied van zwerfvuil in het mariene milieu, om daarmee de afwegingen en de besluitvorming rondom het uiteindelijke maatregelenpakket ter invulling van de beleidsopgave te ondersteunen. Hierbij geldt dat door inzichtelijk te maken wat al wel bekend is, ook duidelijk wordt wat nog niet bekend is. Door tevens de kennisvragen en –lacunes op de verschillende terreinen in beeld te brengen, wordt in dit rapport niet alleen ondersteuning geleverd aan de invulling van de beleidsopgave, maar ook een bijdrage geleverd aan een overzicht van de overblijvende kennisopgave.

De zoektocht op weg naar een kosteneffectief, efficiënt, haalbaar en betaalbaar maatregelenpakket voert ons langs een groot aantal vragen: Wat gebeurt er eigenlijk al aan maatregelen om de hoeveelheid zwerfvuil op en langs de zee te verminderen? Welke maatregelen zijn er aanvullend mogelijk? Wat zijn de kosten en effecten van deze maatregelen? Wat zijn de baten van een vermindering van de hoeveelheid afval in het mariene milieu? Welke mogelijke instrumenten bestaan er om vermindering van de hoeveelheid afval te stimuleren? Wie betaalt wat? Wat vinden de burgers en stakeholderorganisaties van de verschillende maatregelen? En hoe kunnen we ervoor zorgen dat door internationale samenwerking het beleid nog effectiever wordt?

Dit rapport brengt uitgebreid verslag uit van deze zoektocht. Hieronder volgt een samenvatting van de belangrijkste resultaten.

HOOFDSTUK 1: Inleiding

De beleidsopgave voor zwerfvuil
De KRM vraagt van de lidstaten om te komen tot een internationaal afgestemd programma van maatregelen om een goede milieutoestand en duurzaam gebruik van het mariene milieu te realiseren en handhaven. Als eerste stap op weg hiernaartoe heeft Nederland in 2012 de Mariene Strategie Deel 1 opgesteld. Hierin wordt een beschrijving gegeven van de huidige situatie, de beoogde doelen en de daarbij horende belangrijkste beleids- en kennisopgaven. Voor zwerfvuil richt deze beleidsopgave zich op preventie (brongericht beleid voor zwerfvuil afkomstig van strandrecreatie, visserij, scheepvaart en rivieren), op bewustwording, op productontwikkeling, en op duurzamer en efficiënter gebruik van plastics in het bijzonder. De belangrijkste kennisopgave voor zwerfvuil heeft betrekking op het verzamelen van kennis en informatie over de effecten van zwerfvuil, en in het bijzonder microplastics.

KRM verplicht tot het uitvoeren van sociaaleconomische analyses van maatregelen
De KRM stelt een aantal eisen aan de maatregelenpakketten. Zo dienen de lidstaten bij het samenstellen van de maatregelenpakketten rekening te houden met de sociale en economische effecten van beoogde aanvullende maatregelen. Ook moeten de lidstaten ervoor zorgen dat de maatregelen kosteneffectief zijn, en dat er een kosten-batenanalyse wordt uitgevoerd voorafgaand aan de invoering van de maatregelen. De KRM geeft echter niet duidelijk aan hoe de verschillende analyses moeten worden uitgevoerd.

De aanpak van de maatschappelijke kosten-batenanalyse
Voor het uitvoeren van maatschappelijke kosten-batenanalyses (MKBA's) bestaat in Nederland de Leidraad OEI. Het basisprincipe is dat om de voor- en nadelen van bepaalde maatregelen zo eenduidig mogelijk in beeld te brengen, deze zoveel mogelijk onder 1 noemen moeten worden gebracht: Geld. Daar waar dat niet goed mogelijk is, moeten de effecten in ieder geval zoveel mogelijk kwantitatief worden gepresenteerd. Voor de Kaderrichtlijn Water zijn in 2006 en 2008 ook dit soort analyses uitgevoerd. Daaruit bleek dat – onder meer door gebrek aan betrouwbare kwantitatieve informatie over de relatie tussen de omvang van de maatregel en de omvang van het te verwachten effect – het vaak niet goed mogelijk is om de kosten en baten van maatregelen in geld uit te drukken, maar dat moet worden volstaan met een indicatie van de kosten en een beschrijving van de verwachte ecologische effecten. Voor de MKBA's voor de KRM geldt grotendeels hetzelfde. Vandaar dat de MKBA in dit rapport vooral bestaat uit een kwalitatieve beschrijving van de verwachte effecten, en dat niet alles in geld zal worden uitgedrukt.

De aanpak van de kosteneffectiviteitanalyse
Het belangrijkste doel van een kosteneffectiviteitanalyse is om te komen tot een rangschikking van maatregelen waarbij de maatregelen die het meeste bijdragen aan doelbereik tegen de laagste kosten bovenaan het lijstje komen te staan ('biggest bang for the buck'). Dit is de maatregel die, bij een beperkt budget, als eerste zou moeten worden genomen. Bij een iets ruimer budget, zou de volgende maatregel op het lijstje kunnen worden uitgevoerd, etc. Een kosteneffectiviteitanalyse kan op deze manier helpen om een bepaald doel tegen de laagste kosten te realiseren, of om met een beperkt beschikbaar budget zo veel mogelijk doelbereik te realiseren. Voor de KRM geldt dat het gebrek aan eenduidige kwantitatieve relaties tussen

maatregelen en hun effecten op het mariene milieu ertoe leidt dat ook dit soort analyses grotendeels kwalitatief van aard zijn en voornamelijk zijn gebaseerd op expert judgement. Ondanks het meer kwalitatieve karakter blijft het hoofddoel van de analyse het maken van onderscheid tussen aan de ene kant maatregelen die naar verwachting veel effect zullen hebben op doelbereik en weinig geld kosten, en aan de andere kant maatregelen die veel geld kosten en weinig effect zullen hebben. In situaties waarin weinig kwantitatieve informatie beschikbaar is, kan het vastleggen van dit soort informatie al heel behulpzaam zijn ter ondersteuning van de besluitvorming.

De aanpak van de sociale analyse
De sociale analyse is waarschijnlijk het meest lastige onderdeel, omdat daarvoor geen standaardaanpak bestaat. Als onderdeel van de KRM Deel 1 heeft een beperkt aantal lidstaten een analyse uitgevoerd of anderszins tekst opgenomen over dit onderwerp. Het gaat om een beperkt aantal lidstaten en de aanpak is divers. De reden waarom een groot aantal lidstaten hier niet iets expliciets over hebben opgenomen is omdat veel lidstaten onder een 'sociale en economische analyse' een sociaaleconomische analyse verstaan en daarom geen aparte sociale analyse uitvoeren (een MKBA is een dergelijke sociaaleconomische analyse).

In dit rapport is de sociale analyse uitgewerkt langs verschillende lijnen. Ten eerste worden de resultaten beschreven van een enquête onder de Nederlandse bevolking over wat zij belangrijke onderwerpen vindt voor de beleving van de Noordzee. Daarnaast wordt een korte beschrijving gegeven van de betrokken stakeholders (stakeholder analyse), en hoe zij zijn betrokken in het proces op weg naar de uiteindelijke maatregelenpakketten (beschrijving van het stakeholder proces). Ten derde wordt bij de beschrijving van de kosten en effecten van de maatregelen expliciet aangegeven wie de maatregelen uitvoeren en kosten maken, en waar de lasten en lusten uiteindelijk terecht zullen komen.

Aanpak disproportionaliteit van kosten
Indien sprake is van disproportionele kosten kunnen maatregelen (onder voorwaarden) achterwege worden gelaten. Er bestaat geen standaard aanpak of ondergrens voor disproportionaliteit van kosten. Wat disproportionele kosten zijn is uiteindelijk een politieke afweging en beslissing, waarbij alle (sociaaleconomische) informatie die in dit rapport is verzameld een rol kan spelen.

HOOFDSTUK 2: Huidig beleid en kosten

Aanpak van zwerfvuil: Er gebeurt al veel
Internationaal wordt zwerfvuil in zee als probleem erkend en de consensus is dat plastic niet in zee thuishoort. Naast het opzetten van protocollen voor monitoring en onderzoek, zijn er internationaal ook tal van initiatieven om de afvalproblematiek te beperken. Zo heeft de International Maritime Organization van de Verenigde Naties (IMO) het voorkómen van het lozen van vuilnis vanaf schepen vastgelegd in Annex V van het MARPOL-verdrag. Annex V is recentelijk herzien en verfijnd. Het leidende principe van de herziende Annex V is dat het lozen van vuilnis is verboden, met een aantal uitzonderingen. Op initiatief van Nederland is afgesproken dat wereldwijd de cursus marine environmental awareness een verplicht onderdeel wordt van de maritieme opleidingen. Een ander voorbeeld is de Europese Richtlijn Havenontvangstvoorzieningen die als doel heeft de afgifte van scheepsafval en ladingsresiduen te

vermeerderen door de beschikbaarheid en het gebruik van havenontvangstinstallaties te verbeteren. Nederland zet zich in om deze aanpak verder te optimaliseren door aanscherping van de afvalplicht van afval voor schepen die vertrekken naar een haven buiten Europa. Daarnaast zet Nederland zich in voor een Europees informatie- en monitoringsysteem en voor harmonisering van handhavings- en financierings-systemen. Op nationaal niveau gebeurt er ook veel. Zo zijn er diverse initiatieven en campagnes op het gebied van gedragsbeïnvloeding en zwerfafval, bijvoorbeeld de verkiezing 'Schoonste Strand'.

De kosten van huidig beleid
Het is lastig om een goed en volledig overzicht te geven van de kosten van huidig beleid. Er worden kosten gemaakt voor afvalinzameling van schepen en in principe zou men ook de kosten van het inzamelen van huishoudelijk afval voor een deel kunnen meerekenen. Maar welk deel hiervan expliciet aan de vermindering van de hoeveelheid zwerfvuil in het mariene milieu zou moeten worden toegerekend is onbekend. De enige kostenpost die redelijk eenduidig kan worden toegerekend en bovendien relatief eenvoudig kan worden geschat zijn de kosten voor het schoonmaken van stranden. Deze bedragen rond de 4 – 5 mln € per jaar.

Ondanks vele inspanningen blijft zwerfvuil een complex probleem
De conclusie uit de initiële beoordeling is dat zwerfvuil, vooral plastics, in het mariene milieu een complex probleem vormt. Over de bronnen, de omvang en de effecten op het ecosysteem is veel nog onbekend. Daarbij is vooral plastic een persistente stof die niet of nauwelijks uit het milieu is te verwijderen. Een oordeel of in 2020 de goede milieutoestand kan worden bereikt, is daarom niet goed mogelijk. Het formuleren van kwantitatieve doelen is problematisch aangezien de effecten van maatregelen op het mariene ecosysteem lastig zijn te kwantificeren.

Het stellen van een kwalitatief doel dat de gewenste richting aangeeft, is in dit geval realistischer. Het kabinet is van mening dat zwerfvuil niet in de zee thuishoort. Ook internationaal groeit het besef van het probleem van plastics in zee. Ondanks de huidige beleidsinspanningen en vele initiatieven, zal de hoeveelheid zwerfvuil in het Nederlands deel van de Noordzee niet afnemen. Aannemelijk is dat de verontreiniging met microplastics zal toenemen. Daarom zijn voor 2020 een reductiedoelstelling en een aanvullende beleidsopgave geformuleerd. Dit heeft geleid tot de volgende milieudoelen:

- De hoeveelheid zichtbaar zwerfvuil op de kust is in 2020 afgenomen (basisreferentie 2002-2009).
- Er is in 2020 een dalende trend in de hoeveelheid zwerfvuil in mariene organismen (basisreferentie 2005-2009).

Hoofdstuk 3: Kosteneffectiviteitanalyse

Hoe kunnen milieudoelen worden bereikt tegen laagste kosten: kosteneffectiviteitanalyse
Op dit moment is er nog onvoldoende kwantitatieve informatie beschikbaar over de hoeveelheid plastic in zee en de bijdrage van de verschillende bronnen (bijvoorbeeld scheepvaart, visserij, badgasten) om een volledige kwantitatieve kosteneffectiviteitanalyse te kunnen uitvoeren. Maar op basis van de beschikbare informatie kan wel

al een onderscheid worden gemaakt tussen maatregelen die naar verwachting kosteneffectief zijn (veel effect tegen weinig kosten), en welke dat waarschijnlijk niet zijn.

In 2010, heeft DHV een eerste inventarisatie uitgevoerd van mogelijk voor de KRM relevante maatregelen, en een concept database opgezet met daarin de kosten en effecten van deze maatregelen. Op basis van deze informatie, informatie van belanghebbenden en aanvullend onderzoek, heeft het LEI in 2011 een voorlopige kosten-effectiviteitsanalyse (KEA) uitgevoerd. Het doel van deze eerste KEA was om inzicht te krijgen in de toepassing van deze methode, de beschikbaarheid van de vereiste gegevens, maar ook om een eerste idee van mogelijk relevante maatregelen te krijgen en om te bepalen voor welke maatregelen aanvullende informatie nodig zou zijn. Voor de meest relevante maatregelen is in 2012 aanvullend onderzoek gedaan. Op basis van al deze informatie is in 2013 een kosten-effectiviteitsanalyse uitgevoerd. De resultaten zijn in Tabel 5 gepresenteerd.

- Het effect van een alternatief voor bundels nylondraden is niet geheel duidelijk, omdat nylon draadfragmenten van de netbescherming een van de vele bronnen van touwfragmenten zijn die worden gevonden. Alternatieven voor nylon zijn beschikbaar, zoals kokos, en deze leiden niet per se tot hogere kosten. De maatregel wordt daarom als erg kosteneffectief beschouwd.
- De 'my beach' concept is een brongerichte maatregel, waarbij toeristen helpen om de hoeveelheid zwerfvuil op het strand te verminderen. Voorlichtingscampagnes kunnen effectief zijn om stranden schoon te houden. Het is echter onduidelijk naar wie 'mijn' verwijst. De maatregel zou effectief kunnen zijn als de juiste stakeholders verantwoordelijk worden gemaakt.
- Het is niet gemakkelijk om de doeltreffendheid van publiekscampagne te beoordelen. Publiekscampagnes kunnen zeer effectief zijn. Mensen kunnen kiezen voor alternatieven als zij zich bewust zijn van de gevolgen van het loslaten van ballonnen.
- Internationale harmonisatie van tarieven voor havenontvangstvoorzieningen en het controleren van de hoeveelheid afval dat wordt ingeleverd is een potentieel kosteneffectieve maatregel om zwerfvuil in het mariene milieu als gevolg van schepen te verminderen. Echter, deze maatregel is alleen effectief als het internationaal wordt ingevoerd.
- Het extra schoonmaken van de niet badstranden kan effectief zijn afhankelijk van het tijdstip en de locatie. Volgens Ecorys hebben de meeste Nederlandse stranden een A+ status, en zijn de stranden dus al zeer schoon. Bij gemeenten met drukke stranden en waarbij het beleid is dat dagelijks het strand met de beachcleaner schoongemaakt wordt om dagelijks een schoon strand op te leveren, zal een vermindering van afval op het strand niet snel leiden tot minder kosten. Ook met minder afval wordt het strand met dezelfde frequentie gereinigd. Dit zou echter anders kunnen zijn voor de minder druk bezochte stranden waar het strand niet dagelijks machinaal wordt gereinigd. Een verminderde hoeveelheid afval zou kunnen leiden tot een minder frequente machinale reiniging, alleen reiniging bij behoefte, of tot het overstappen op handmatige reiniging.
- De effectiviteit van een statiegeldsysteem op netten wordt betwijfeld door de sector. Netten zijn waardevol voor vissers en vissers willen dan ook geen netten kwijtraken. Het is daarom twijfelachtig of een statiegeldsysteem op

netten zal leiden tot een verandering van gedrag. Misschien wel effectief voor staandwantvisserij.

- Individueel herkenbare ID- markers toevoegen aan visnetten en draden werkt alleen als het verlies van netten en draden kan worden beperkt. Netten zijn waardevol voor vissers die vaak nog omkeren om verloren netten op te halen. Deze maatregel is dan ook alleen kosteneffectief als (delen van) netten illegaal in zee worden gedumpt of als er niet zorgvuldig mee wordt omgegaan.
- Een vergoeding voor het gebruik van plastic zakken in supermarkten wordt als effectief beschouwd door sommige stakeholders, maar de maatregel heeft niet alleen impact op het mariene milieu. De maatregel richt zich dus niet op de vervuiler betaalt principe. Echter, de maatregel zou wellicht alleen in kustgemeenschappen en gemeenschappen in de buurt van rivieren kunnen worden toegepast.
- Een systeem van statiegeld op kleine plastic flessen kan resulteren in minder caps op het strand. Echter, deze maatregel is niet alleen gericht op de vervuilers, maar op de gehele samenleving. De maatregel richt zich dus niet op de vervuiler betaalt principe. Deze maatregel moet niet alleen worden genomen voor het mariene milieu. Echter, de maatregel zou wellicht alleen in kustgemeenschappen en gemeenschappen in de buurt van rivieren kunnen worden toegepast.
- De maatregel 'vissen naar zwerfvuil' is niet effectief als vissers alleen uitvaren om op zwerfvuil te vissen. De maatregel is wel effectief als vissers gewoon vissen en het zwerfvuil dat ze vangen inleveren aan wal.
- De effectiviteit van hogere boetes hangt af van het niveau van handhaving en de inning van boetes. Het effect van deze maatregel op zee zal beperkt zijn. Een groter effect kan verwacht worden op openbare stranden. Echter, voor toeristische stranden die dagelijks worden schoongemaakt in het badseizoen zal het effect veel kleiner zijn.
- Het is onduidelijk of verpakking harspellets nog steeds worden geloosd op zee. Volgens de stakeholders zou deze maatregel gericht moeten zijn op de plastic korrels die al in zee zijn in plaats van het lozen van plastic korrels.
- Veel belanghebbenden wijzen erop dat biologisch afbreekbare kunststoffen geen goede oplossing is, omdat biologisch afbreekbare kunststoffen zich ontleden in nog kleinere deeltjes (zelfs sneller dan normaal plastic), wat nog moeilijker uit het mariene milieu te verwijderen is.

Tabel 5: overzicht van de kosteneffectiviteit van geselecteerde maatregelen om de hoeveelheid zwerfafval te verminderen in het mariene milieu

Nr.	Maatregel	Jaarlijkse kosten (in euros)	Kosten-effectiviteit
1	het gebruik van alternatieve materialen om boomkor netten te beschermen (pluis)	0 - 1.1m	Erg kosteneffectief
2	My Own Beach concept	3.8m	Door de juiste stakeholders verantwoordelijk te maken, kan dit kosteneffectief zijn

3	Verbod op ballon lanceringen	150.000	Bewustmakingscampagnes kunnen kosteneffectief zijn
4	Internationaal geharmoniseerde afspraken m.b.t. havenontvangstinstallaties		Kosteneffectieve maatregel als het internationaal wordt opgepakt
5	Extra strand schoonmaak op niet badstranden (eenmaal per jaar)	1.5m	Afhankelijk van het tijdstip en de locatie kan dit zeer kosteneffectief zijn
6	Statiegeldsysteem op (delen) gebruikte netten	Onbekend	Alleen rendabel als (delen van) netten worden veroorzaakt door illegale of ongepaste lozingen
7	Het toevoegen van individueel herkenbaar IF markers aan visnetten en draden	330.000	Alleen rendabel als (delen van) netten worden veroorzaakt door illegale of ongepaste lozingen
8	Tarief op plastic zakken in supermarkten	23.4m	Niet gebaseerd op vervuiler betaald principe
9	Statiegeldsysteem op kleine plastic flessen	26m	Niet gebaseerd op vervuiler betaalt principe
10	Extra 'fishing for litter' (primaire doel is afval, niet vis)		Specifiek uitvaren om afval te gaan verzamelen is niet kosten effectief
11	Hogere boetes en meer controles op stranden en zee	0.9m	Niet rendabel op zee en op strand.
12	Verpakking harspellets	Onbekend	
13	Composteerbare gebruiker plastic op badstranden	1.9m	Nee

Bron: gebaseerd op LEI, 2011

Hoofdstuk 4: kosten-batenanalyse
Wat zijn de baten van minder zwerfvuil in het mariene milieu?

Belangrijkste batenpost: Bescherming van marien ecosysteem
De belangrijkste reden voor het nemen van maatregelen ter vermindering van de hoeveelheid afval in het mariene milieu is het beschermen van het mariene ecosysteem, zodat dat duurzaam (en) goed functioneert. De bescherming van het mariene ecosysteem kan daarom worden gezien als de belangrijkste baat van de vermindering van de hoeveelheid zwerfvuil. Het gaat hierbij dus om het tegengaan van negatieve ecologische effecten op vissen, vogels en zeezoogdieren zoals het verstrikt raken in afval, het inslikken van afvaldeeltjes waardoor vergiftiging en schade aan organen kan optreden, en doorwerking op andere soorten via effecten op het voedselweb.

Vermindering zwerfvuil leidt niet tot een meetbare verbetering van het marien ecosysteem

Studies tonen aan dat aangenomen mag worden dat zwerfvuil geen significant effect heeft op het functioneren van het mariene ecosysteem als geheel. Dit betekent dat als effecten worden geschat aan de hand van indicatoren, zoals met behulp van de Natuurpuntenmethode, er geen significant kwantitatief effect wordt verwacht. Een analyse met behulp van de Natuurpuntenmethode laat zien dat het terugdringen van zwerfvuil op zee niet resulteert in een toename in het aantal Natuurpunten. Met andere woorden, zwerfvuil in het mariene milieu is wellicht vervelend voor een individu, misschien zelfs dodelijk, maar het levert naar verwachting geen gevaar op voor het (functioneren van het) ecosysteem als geheel.

Studies show that marine litter has no significant impacts on the functioning of the marine ecosystem as a whole. Hence, no significant quantitative effects can be expected when effects are estimated on the basis of indicators. An analysis using the Nature Points Method shows that reduction of marine litter does not result in an increase in the number of Nature Points. In other words, litter in the marine environment is distressing for an individual, perhaps even fatal, but it is expected to pose no serious threads to the (performance of the) ecosystem as a whole.

Effecten van zwerfvuil op de mens; een beperkt bedrag
Naast de effecten op het functioneren van het mariene ecosysteem heeft zwerfvuil in het mariene milieu ook effecten op het welzijn van de mens. Zo leidt het aanspoelen van minder zwerfvuil mogelijk tot een vermindering in schoonmaakkosten, kan afval op het strand ervoor zorgen dat een strand minder aantrekkelijk wordt voor recreanten of om er te wonen, en kan afval op zee leiden tot problemen met schroeven en schade aan netten.

Hoewel het aannemelijk is dat deze effecten zullen optreden, blijkt, wanneer wordt geprobeerd om deze baten in geld uit te drukken, de omvang van deze batenposten vrij beperkt te zijn. Hiervoor zijn voor de verschillende batenposten verschillende oorzaken aan te wijzen:

- De (bad)stranden in Nederland worden standaard schoongemaakt tot een bepaald minimum niveau van 'schoonheid'. Een (beperkte) verandering in de hoeveelheid zwerfvuil dat aanspoelt (of wordt achtergelaten door recreanten) leidt daardoor niet tot een significante verandering in de schoonmaakkosten.
- Doordat de stranden in Nederland al relatief schoon gehouden worden, zal een beperkte verandering in de hoeveelheid zwerfvuil op het strand niet of nauwelijks opvallen en daarmee ook slechts een verwaarloosbaar effect hebben op de recreatieve beleving van de stranden. Ook zal het aantal strandbezoekers naar verwachting niet toenemen als gevolg van een verandering in de hoeveelheid zwerfvuil. Vandaar dat deze recreatieve baten als p.m. post worden opgenomen.
- Huizen in de buurt van schone stranden zijn mogelijk meer gewild dan huizen in de buurt van minder schone stranden. Dit zou tot uitdrukking kunnen komen in een hogere vraagprijs voor de betreffende huizen. Echter, doordat het verschil in de mate van schoonheid van de stranden niet noemenswaardig wordt beïnvloed door een verandering van de hoeveelheid zwerfvuil (door dat de stranden al schoon worden gehouden), is ook het verwachte effect op de huizenprijs verwaarloosbaar.
- Schade door afval op zee blijkt een probleem te zijn voor de kleine visserij, vooral door vastgelopen schroeven, het optreden van schade aan netten en (in mindere mate) ook schade aan de het roer. Schade aan de schroef is door schippers doorgaans direct op zee op te verhelpen, door achtereenvolgens achteruit en vooruit te varen, waarmee het zwerfafval uit de schroef verdwijnt. Voor de diepzeevisserij geldt dat schade aan netten meevalt, vergeleken met de overige visserij, doordat in de diepzeevisserij drijvende netten worden gebruikt die niet in contact met de zeebodem komen. Verder blijkt dat problemen met de schroef vooral voorkomen wanneer schepen dicht bij de kust varen. Schade aan de huid en de koelwaterinlaat komt zelden of nooit voor. Daarnaast geldt dat grote schepen minder gevoelig zijn voor schade dan kleine schepen, doordat kleine schepen voor een zeer groot deel met de boomkor vissen, waarbij de netten over de zeebodem slepen. De schade aan deze netten wordt meestal veroorzaakt door (onbekende) wrakken. De grote vissersschepen vissen doorgaans met een drijfnet (pelagische visserij) en hoeven dit niet over de bodem te slepen, met alle risico's van dien. Schade door eventueel extra tijd die men kwijt zou kunnen zijn doordat afval uit de netten moet worden gehaald bij het binnenhalen van de vangst, wordt door de Nederlandse sector niet als significante kostenpost genoemd. De totale schade voor de visserij als gevolg van zwerfvuil wordt geschat op 2 – 3,5 mln € per jaar. Wanneer wordt aangenomen dat door het treffen van maatregelen ter beperking van de hoeveelheid afval in het mariene milieu de hoeveelheid afneemt met 50%, en eveneens mag worden aan-

genomen dat de kosten als gevolg van afval in schroeven en netten evenredig afnemen met de hoeveelheid afval in het mariene milieu, dan kunnen de baten voor de visserij worden geschat tussen de € 1 en € 2 miljoen per jaar.

- Voor de scheepvaart geldt dat scheepsgrootte waarschijnlijk een rol speelt bij het oplopen van schade op zee. Grote schepen zijn over het algemeen minder gevoelig voor schade aan schroef en schroefas omdat deze schepen dieper steken dan kleine schepen. Aangezien de meeste afval in de bovenste zeelaag zweeft of aan de oppervlakte drijft, is het aannemelijk dat diep stekende koopvaardijschepen voor wat betreft schade aan schroef en schroefas minder risico lopen dan kleine, minder diep stekende schepen. De totale omvang van de schade die de Nederlandse vloot ondervindt als gevolg van afval op zee binnen het Nederlandse Continentale Plat wordt geschat tussen de € 1,5 en € 4 miljoen per jaar. Op basis van dezelfde aanname als voor visserij, kunnen de baten voor de scheepvaart worden geschat tussen de € 1 en € 2 miljoen per jaar.

Table 6: Monetary benefits of a reduction in the amount of litter in the marine environment

Benefits	**Benefits (mln €/year)**
Reduced beach cleaning costs	0
Enhanced recreational value	p.m.
Attractiveness for housing	p.m.
Less damage to shipping	1 – 2
Less damage to fisheries	1 – 2
Less damage to recreational boating	0
Total	2 – 4

Aanpak van zwerfvuil maakt je niet rijk, maar is belangrijk want hoort gewoon niet in zee

Uit de uitgevoerde kostenbaten analyse blijkt dat de in geld uitdrukbare baten van het verminderen van de hoeveelheid zwerfvuil in het algemeen zeer beperkt zijn, en dat de kosten duidelijk hoger zijn dan de baten van de maatregelen. Op zich is dat een algemeen bekend verschijnsel bij milieubeleid. Het primaire doel van milieumaatregelen is immers het beschermen van het milieu, niet om winst te maken. Sterker nog, als het mogelijk zou zijn om winst te maken met milieubescherming, dan zou dat waarschijnlijk allang zijn gedaan. Ditzelfde geldt voor het terugdringen van de hoeveelheid zwerfvuil in het mariene milieu: Het belangrijkste doel is de bescherming van het mariene ecosysteem, omdat zwerfvuil niet in zee thuis hoort.

Een belangrijke vraag die vervolgens moet worden beantwoord is hoever men wil gaan met het treffen van aanvullende maatregelen. De lijst met maatregelen die is gepresenteerd in tabel 5 geeft een aardige opzet voor deze discussie door het inzichtelijk maken van welke maatregelen veel effect leveren tegen relatief lage kosten (bovenaan) en welke maatregelen minder kosteneffectief zijn. Overwogen zou kunnen worden om de bovenste maatregelen als eerste te treffen, gevolgd door maatregelen die iets lager op de lijst staan. Op deze manier kan worden geprobeerd om tegen de laagst mogelijke kosten de hoeveelheid zwerfvuil te beperken.

HOOFDSTUK 5:

Interessante economische instrumenten om gewenst gedrag te stimuleren

Om maatregelen voor de KRM effectief en efficiënt te implementeren kunnen economische instrumenten worden gebruikt voor het geven van economische prikkels. Dit zijn, in de woorden van de KRM, beheermaatregelen die het voor de gebruikers van het mariene ecosysteem economisch interessant maken om zich zo te gedragen dat het bereiken van de goede milieutoestand wordt bevorderd. In Nederland is het gebruik van economische instrumenten in het waterbeheer al decennia lang gemeengoed. Zo worden de rioolwaterzuiveringsinstallaties betaald uit de zuiveringsheffing, wordt drinkwater betaald per m3 en bestaat er een grondwaterheffing voor het onttrekken van grondwater. In dit rapport wordt een overzicht gegeven van de verschillende instrumenten die momenteel worden toegepast ter bescherming van het mariene milieu en de mogelijkheden om het bestaande instrumentarium uit te breiden en/of te verbeteren ten einde de doelstellingen van de KRM effectief en efficiënt te realiseren.

Voorbeelden van (nieuwe) economische instrumenten zijn tarief en tariefdifferentiaties (bijvoorbeeld schone schepen kunnen volgens de Clean Shipping Index een korting krijgen op havengelden), veranderingen in fiscale systemen (bijvoorbeeld schone schepen kunnen een belastingkorting krijgen), beloningssystemen (bijvoorbeeld vissen voor zwerfvuil en strandclubs die hun strand schoonhouden belonen) en subsidies voor onderzoek. Zie ook tabel 15 in hoofdstuk 6.

HOOFDSTUK 6: sociale analyse / stakeholder betrokkenheid

Sociale analyse: Stakeholders enthousiaster over aanpak zwerfvuil dan burgers

Uit een representatieve enquête die in 2011 is gehouden onder de Nederlandse bevolking blijkt dat burgers gezondheidszorg, werkgelegenheid en inkomen belangrijker vinden dan milieu; milieu wordt door 5% van de ondervraagden als belangrijkste thema genoemd. En binnen de verschillende milieuthema's worden klimaatverandering en lucht verontreiniging belangrijker gevonden dan vervuiling en uitputting van de Noordzee. Maar het wordt wel belangrijker gevonden dan het verbeteren van de waterkwaliteit en de bescherming van bos en hei. Wanneer wordt ingezoomd op verschillende problemen die spelen op de Noordzee, zijn olieverontreiniging en het mogelijk uitsterven van vis- en andere diersoorten dan plastic verontreiniging van de Noordzee, gevolgd door eutrofiering en een verstoorde zeebodem. Dit alles suggereert dat burgers vinden dat problemen rondom zwerfvuil niet echt belangrijk zijn. Maar uit de enquête blijkt dat wanneer men het de burgers vraagt, ze zwerfvuil wel degelijk een belangrijk onderwerp vinden. De helft van de ondervraagden is ook bereid om meer te betalen om zo een financiële bijdrage te leveren aan het oplossen van milieuproblemen. Maar wanneer als alternatieve maatregelen worden voorgesteld, 1) meer belastinggeld voor extra controles en schoonmaakprogramma's; 2) duurder maken van producten waar plastic in verwerkt zit; of 3) geen plastic tasjes en zakjes meer te krijgen in de winkels, kiezen burgers massaal voor het niet meer beschikbaar stellen van plastic zakjes. Dit resultaat lijkt te suggereren dat er een discrepantie bestaat tussen sociaal wenselijk gedrag en betalingsbereidheid enerzijds en het feitelijk gedrag anderzijds. Maar het kan evengoed worden gezien als een indicatie dat prijsprikkels effect zullen hebben op het sturen van gedrag; immers een deel van de burgers zegt bereid te zijn om te betalen voor milieumaatregelen, maar doet dat liever niet. Het laten betalen voor plastic zakjes in de winkel zou daarom misschien wel een effectieve maatregel kunnen zijn.

Stakeholderorganisaties worden nauw betrokken bij de uitvoering van de Europese Kaderrichtlijn Mariene Strategie. Zo zijn de bij de Noordzee betrokken partijen officieel vertegenwoordigd in het Overleg Infrastructuur en Milieu, een rijksbreed belanghebbendenoverleg over water en Noordzeezaken. In het OIM geven belanghebbenden eenmaal per jaar advies over de KRM-producten. Dit advies gaat naar de staatssecretaris.

Sinds mei 2010 bestaat een kerngroep KRM, met daarin belanghebbenden die meer in detail willen meedenken en praten over de totstandkoming van de initiële beoordeling, goede milieutoestand, milieudoelen en indicatoren. Deze kerngroep is tussen mei 2010 en de oplevering van de Mariene Strategie Deel 1 in 2012 zeven keer bijeengekomen om de voortgang, producten en beleidslijn van de Mariene Strategie te bespreken. Dit proces was gericht op joint fact finding voor de verschillende componenten van de Mariene Strategie Deel I, en op goede afstemming tijdens het vervaardigen van het kabinetsbesluit. Van alle Noordzeesectoren zijn belanghebbenden vertegenwoordigd: de visserij, scheepvaart, natuur en milieu, waterbouwers, offshore industrie en recreatie. In 2010 zijn ook nog drie workshops met een brainstormkarakter gehouden over de initiële beoordeling en de goede milieutoestand, om deskundigen met zoveel mogelijk kennis en expertise te laten discussiëren over deze onderwerpen. Daarnaast is waar nodig bilateraal overlegd met afzonderlijke belanghebbenden.

Ook na de oplevering van de Mariene Strategie Deel I is deze stakeholdergroep regelmatig bij elkaar gekomen (ongeveer 1 keer per zes weken) om over de voortgang van het programma van maatregelen te spreken. Daarnaast zijn specifieke thema workshops georganiseerd, waaronder een workshop in november 2012 rondom het thema zwerfvuil (hoort niet in zee). Tijdens deze workshop is door vertegenwoordigers van verschillende organisaties en sectoren een aantal voorbeelden van best practices gepresenteerd, zoals de cosmetica producent die microplastics in scrubs wil vervangen, een stichting die door het uitschrijven van een schoonste strand verkiezing de strandbezoekers en – paviljoens tegen relatief lage kosten stimuleert om stranden schoon te houden en tevens werkt aan bewustwording, en een cruise maatschappij die actief bezig is met een eigen afvalbeheerplan. Tevens is gesproken over mogelijk aanvullende maatregelen voor zwerfvuil. Dit rapport is gebruikt als een van de bouwstenen in de stakeholder discussies, die na afronding van dit rapport (juni 2013) nog steeds gaande zijn.

Lusten en lasten ongelijk verdeeld?
Bij het samenstellen van het maatregelenpakket zal rekening worden gehouden met de verdeling van de kosten en lasten van maatregelen. Omdat het definitieve maatregelenpakket nog niet bekend is, kan ook de verdeling van de lasten (nog) niet worden gegeven.

HOOFDSTUK 7: internationale samenwerking

Voor effectief beleid is internationale samenwerking noodzakelijk. Internationale samenwerking met betrekking tot de maatregelen is van groot belang om de effectiviteit van de maatregelen te vergroten, maar ook om te zorgen voor een gelijk speelveld voor verschillende sectoren. Zowel binnen OSPAR (de regionale zeeconventie waarin de landen rond de Noordzee samenwerken) als binnen verschillende

Europese werkgroepen wordt daarom geprobeerd om te komen tot afstemming van verschillende maatregelen. Voorbeelden hiervan zijn:

- Nederland heeft mede op basis van de resultaten van de sociaaleconomische analyses het initiatief genomen om – in het kader van de lopende herziening van de Europese Richtlijn Haven Ontvangst Voorzieningen – door middel van het opstellen van een discussiedocument waarin een illustratie wordt gegeven van de verschillen tussen internationale havens in de manier waarop wordt omgegaan met afspraken rondom afvalinzameling en – afgifte een discussie te starten om te komen tot verdere harmonisatie.
- Daarnaast heeft Nederland een actieve bijdrage geleverd aan de uitwisseling van kennis en informatie over maatregelen door het geven van presentaties in de Europese Werkgroep Economische en Sociale Analyse en het (op internet) beschikbaar stellen van alle beschikbare informatie in het Engels. Dit heeft er mede toe geleid dat andere lidstaten gebruik hebben kunnen maken van de aanpak die Nederland heeft gevolgd.
- Binnen OSPAR werkt Nederland nauw samen met Duitsland om het Regionale Actieplan van OSPAR verder vorm te geven door hier (regionale) maatregelen in op te nemen.

HOOFDSTUK 8: kennisleemtes

Naast maatregelen ook nog veel kennis nodig; een aanzet tot een kennisagenda

Op het gebied van zwerfafval in het mariene milieu bestaan nog veel kennisleemtes. Door gebrek aan kennis en aan betrouwbare onderzoeksmethoden is het moeilijk om een compleet beeld te krijgen van de trends en gevolgen van zwerfafval in het mariene milieu. Dat bemoeilijkt ook het bepalen van de goede milieutoestand waarbij geen schade aan het mariene milieu optreedt. De belangrijkste kennishiaten zijn het ontbreken van een onderzoeksprotocol en datareeksen met betrekking tot zwerfvuil in zowel de waterkolom, op de zeebodem, als met betrekking tot microplastics. Wat ook in de sociaaleconomische analyses duidelijk naar voren kwam is dat er een gebrek aan kennis is over de gevolgen van zwerfvuil en plastics voor mariene organismen en ecosystemen. Tot slot maakt het gebrek aan kennis voor het identificeren en standaardiseren van bronnen van zwerfvuil het lastig om precies aan te geven welke bron voor hoe groot deel van het totale probleem verantwoordelijk is. Kennis over al deze onderwerpen zal de komende jaren worden ontwikkeld en kan vervolgens aanleiding zijn tot het aanpassen van het maatregelenpakket. Op deze manier wordt invulling gegeven aan het principe van 'adaptive management' dat centraal staat in de KRM.

Bij gebrek aan deze kwantitatieve informatie over de bronnen, oorzaken en gevolgen van zwerfvuil in het mariene milieu is de in dit rapport uitgevoerde kosteneffectiviteit analyse noodzakelijkerwijs grotendeels gebaseerd op momenteel beschikbare informatie en expert judgement. Hierdoor kan weliswaar de druk die wordt aangepakt door een maatregel evenals de fysieke effecten van deze maatregel worden geïdentificeerd, maar nog onvoldoende worden gekwantificeerd. Hierdoor is het niet mogelijk om te bepalen hoeveel maatregelen moeten worden genomen om de doelen te kunnen realiseren, en dus ook niet wat de kosten zijn van het realiseren van deze doelen. Wat wel kan is een indicatie geven van welke maatregelen waarschijnlijk veel effect zullen hebben en welke niet. Dat is exact wat in dit rapport is geprobeerd. Voor de kosten-batenanalyse leiden de problemen met de kwantificering van potentiële effecten van maatregelen ertoe dat er geen goede inschatting kan worden gemaakt van de potentiële voordelen in monetaire termen. Echter, op basis van de

uitgevoerde analyses lijken deze monetaire baten dermate insignificant te zijn dat een nadere analyse op basis van verbeterde kwantitatieve effectinschattingen ook in de toekomst niet zinvol lijkt. Echter, dit wil niet zeggen dat er geen voordelen zijn van een vermindering van de hoeveelheid afval in het mariene milieu. Hoewel het mariene ecosysteem niet zal instorten als gevolg van de aanwezigheid van zwerfvuil in het mariene milieu, hoort het er gewoon niet thuis. Dit is wellicht de meeste belangrijke reden om de aanwezigheid van zwerfvuil in het mariene milieu te verminden.

1 Introduction

This chapter starts with a brief description of the obligations in the European Marine Strategy Framework Directive (MSFD). Section 1.1 explains the process to arrive at a package of measures for the MSFD, together with the Dutch policy and knowledge challenges. Section 1.2 discusses the socio-economic analyses that should be performed for the MSFD. Subsequently, a brief description is given of how the Netherlands deals with the cost-benefit analysis, cost-effectiveness analysis and the social analysis for additional measures. Section 1.3 presents how the Netherlands deals with the issue of exceptions relating to Article 14 of the MSFD. Finally, in Section 1.4 the economic analyses in the international context are briefly discussed.

1.1 From a Marine Strategy to a program of measures

*1.1.1 From a Marine Strategy**...***

The European Marine Strategy Framework Directive (MSFD, 2008) obliges Member States to establish and implement the necessary measures to achieve and/or maintain good environmental status in their marine waters. In 2012 the Marine Strategy, Part I has been published. The Marine Strategy Part I encompasses the initial assessment, the good environmental status to be achieved, and the associated targets and indicators. It also presents in broad terms the policy assignments until 2020 and the knowledge and monitoring assignments. By 2014 at the latest, the Netherlands must report on the accompanying monitoring programme (Marine Strategy, Part II) and by 2015 at the latest on the programme of measures (Marine Strategy, Part III).

The Dutch ambition is to establish good environmental status of, and biodiversity in the North Sea for current and future generations, and safeguard it as a key resource for the economy and the food supply. The Marine Strategy sets out the Dutch course between 2012 and 2015. This inspirational aim is conform the National Water Plan (NWP): The North Sea is a healthy and resilient marine ecosystem that can be used in a sustainable manner. This way, the Marine Strategy serves to implement the NWP, setting the (spatial) preconditions for the sustainable, spatially efficient and safe use of the North Sea, in balance with the marine ecosystem's interests as documented in the Water Framework Directive, the Marine Strategy Framework Directive, and the Birds and Habitats Directives.

The MSFD is the European environmental cornerstone of the integrated maritime policy in the marine waters. The Cabinet's ambition is akin to that of the MSFD: the marine environment must be protected and maintained by preventing degradation and, where possible, restore damage. Contamination of, other disturbances to, and impacts on the ecosystem must be reduced to such extent that there are no further significant risks to the marine environment, biodiversity, public health and use of the sea. The use of the North Sea must be sustainable. Negative human impacts must be minimal, so that the marine ecosystem functions optimally and retains its resilience.

The Cabinet opts for a sensible and pragmatic approach aimed at managing the main risks to the marine ecosystem and the best opportunities for sustainable use in relation to achieving and maintaining good environmental status.

Where necessary, the Marine Strategy supplements existing and initiated policy as well as the implementation of international conventions and framework directives with new policy assignments and measures. Existing and initiated policy are the starting point and are integral to identifying new policy assignments and measures aimed at achieving good environmental status. As such, the Marine Strategy solely complements existing and initiated policy, thus not explicitly including it in the set of new policy assignments and measures.

Combined with the precautionary principle, the ecosystem based approach is the core of the establishment of supplementary policy assignments and the programme of measures. Through adaptive management, it is possible to learn from experiences and adjust policy during implementation. The process of learning and adjusting will be reflected in the monitoring programme and the formal six-yearly review of the whole Strategy. It is being fed by the progressive exchange of experiences in the international multi- and bilateral discussions and in the Strategy's knowledge assignments. This adaptive approach does not, therefore, rule out interim policy adjustments and/or new policy assignments.

1.1.2 …to a program of measures

The present report describes the costs and effects of possible additional measures related to new policy tasks described in the Marine Strategy Part I and collects the necessary background information for designing the most cost-effective and efficient measures, and by doing so, supports the decision-making process about the program of measures that has to be determined in 2015. The Marine Strategy Part I sets out the additional policy and knowledge statements defined (see Figure 1).

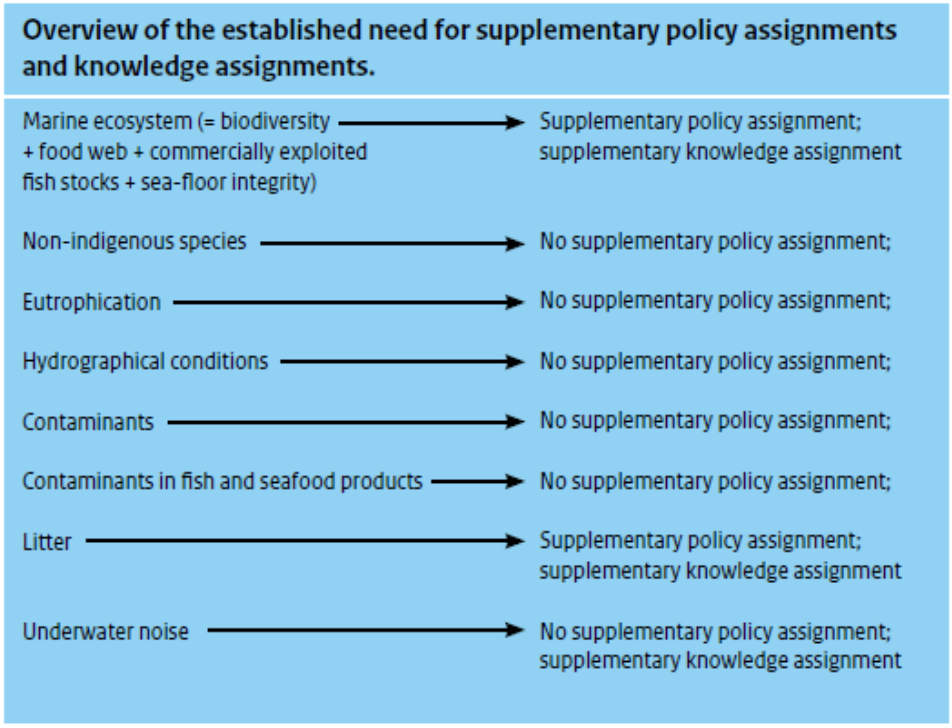


Figure 1: Overview of the established need for supplementary policy assignments and knowledge assignments. (Source: Marine Strategy part 1, 2012)

Marine ecosystem

The effects of physical, chemical and biogenic disturbances in the past century have contributed to the current status of the marine ecosystem to differing degrees. For certain is that vulnerable benthic ecosystems in particular have been affected by physical damage to the seabed as a result of bottom-disturbing activities, including traditional beam trawling in particular. The balance in the diversity of the fish stock has also been affected. Populations of some vulnerable species have declined; a number of shark, skate and ray species in particular has suffered heavily. Fish species that migrate up river have become rare due to the barrier effect of dykes and coastal structures. Discarding by-catches is an enormous waste. While alternative, more environmentally friendly fishing techniques are available, they are only allowed to a limited extent under the European Common Fisheries Policy (CFP). Non-indigenous species introduced by shipping or aquaculture affect the ecosystem.

The management plans being developed for Natura 2000 areas comprise such measures as fishing restrictions and mitigation of the barrier effect by engineering structures. These are intended to prevent an accumulation of disturbances in the coastal zone. Prevailing policy for non-indigenous species, pollution and eutrophication is resulting in a drastic decrease in the risks to the marine environment (see below). Consequently, improving the status of the marine ecosystem outside the protected areas will depend mainly on the ongoing sustainable exploitation of fisheries within the framework of revision of the CFP (expected term 2013-2022).

Supplementary policy assignment(s) until 2020:

- As regards the revision of the CFP, the Cabinet is focusing mainly on the sustainable use and preservation of natural marine resources and ecosystems. This includes the following: reducing the impact of bottom trawling and preventing the by-catch of vulnerable species.
- In addition to the existing Natura 2000 areas, the Friese Front (Frisian Front) and Centrale Oestergronden (Central Oyster Grounds) are considered search areas for protective measures aimed at reducing bottom trawling to be taken within the CFP framework. If necessary, other uses will also be explored. The negotiations on the CFP revisions are ongoing. It is difficult to evaluate in advance to what extent the new CFP will contribute to the Netherlands' ambitions. Collaboration with other Member States is another key condition given the international dimensions of fisheries and the transboundary distribution of some fish stocks. Expectations are that this effort will likely not lead to good environmental status in 2020 and possibly not even in 2027. This cautious estimate relates to both the uncertainty as to whether the CFP will produce the desired sustainability and the rate of recovery of the ecosystem, resulting from the reduction of fisheries pressure in general and specific area protection. The Cabinet's interim target for 2020: to reverse the trend of degradation of the marine ecosystem due to damage to seabed habitat and biodiversity.

Non-indigenous species

Non-indigenous species also pose a threat to biodiversity in the Netherlands part of the North Sea. The food supply of the common scoter, for example, has become more limited because its staple food, the bivalve Spisula subtruncata has been replaced by the Atlantic jackknife clam. The European flat oyster has been ousted by the Pacific oyster. Human intervention in these processes is virtually impossible.
Prevailing policy is expected to dramatically decrease the risk of new introductions between 2020 and 2030. With respect to the introduction of non-indigenous species the status in 2020 can be defined as good environmental status.

Supplementary policy assignment until 2020: none.

Hydrographical conditions

Large-scale interventions in the past, such as the construction of the Delta Project and Maasvlakte 1, brought about hydrographical modifications that mainly affect the North Sea coastal ecosystem (including upstream fish migration). These interventions are of national importance and are irreversible. The scope of a number of activities that may affect hydrographical conditions has increased: sand extraction for coastal defenses and filling sand, dredging waterways to seaports, construction of wind farms, sinking oil/gas pipelines and laying cables. The physical damage as a result of these activities is local and relatively minor. Where necessary, requirements stipulated for licensing based on environmental impact assessments provide for mitigating or compensatory measures. The conclusion is that the current situation is sufficient to safeguard good environmental status.

Supplementary policy assignment until 2020: none.

Pollution/eutrophication/contaminants in fish and other seafood products

Until recently, pollution and eutrophication of the North Sea posed a threat to the marine ecosystem. The expectation is that the risk of harmful effects of eutrophication and contaminants on the ecosystem will be minor between 2020 and 2027. This is the result of past and prevailing policy (based on the Water Framework Directive, MARPOL, OSPAR and European legislation on food safety). This is sufficient to achieve good environmental status.

Supplementary policy assignment until 2020: none.

Litter

The expectation is that the quantity of litter from the key sources, i.e. shipping, fisheries, leisure activities and rivers, will not decrease in the coming years, despite prevailing and initiated policy. Although little is known about the environmental effects of microplastics in the sea, there are indications of potentially major risks for food webs. The target for 2020 is a decrease in the quantity of litter on the beach and a downward trend in the quantity of litter in marine organisms.

Supplementary policy assignment until 2020: the aim, at an international level, is to reduce litter and explore the presence and effects of marine litter, particularly microplastics. In terms of reducing litter, the Cabinet is focusing mainly on prevention. Possible tracks being explored are an integrated source approach, raising awareness, a more efficient use and reuse, and collection. The feasibility of removal is also being investigated.

Knowledge assignments: due to a lack of knowledge on the full scope and effects of litter on the ecosystem, it is not possible to make any predictions on the achievement of good environmental status. The aim is to accumulate more knowledge of the presence and effects of marine litter, particularly microplastics.

Underwater noise

The underwater noise produced by shipping and other human activities has increased significantly since the mid-20th century. Due to lack of measurement data it is not known to what extent underwater noise poses a problem and what the possible cumulative effects are. The target for 2020 is to prevent adverse impact, at an ecosystem level, resulting from specific, isolated activities such as pile-driving and seismic surveys. Thereof as a precaution, the production of impulse noise from pile-driving for wind farms is regulated; where required, rules for other activities, such as the use of seismic for oil and gas exploration, will also be drawn up. Targets at an ecosystem level (cumulation and background noise) will be set in 2018, when more knowledge has been gathered. To date practically applicable methods to describe or predict cumulative effects are lacking. To counter or mitigate cumulative effects, the Cabinet opts for an applicable approach aiming at concrete decisions concerning (combinations of) activities related to specifically sensitive components of the ecosystem. The Cabinet wishes to explore whether this approach can be translated into a methodology to, at the level of the southern part of the North Sea, describe or predict the cumulative effects of various development scenario or policy strategies as they relate to the descriptors of the MSFD.

Supplementary policy assignment until 2020: none for the time being.

Knowledge assignments: due to a lack of knowledge about the effects of underwater noise on the ecosystem, good environmental status cannot be described exactly at this point in time. Aspects to be investigated are: determining the character of the sources of noise, noise levels (including temporal and spatial variations) and the nature of the main noise disruptions. The accumulation of the effects of different kinds of noise is also important.

1.1.3 Specification of supplementary policy assignments into a programme of measures

Through its commitment to supplementary policy assignments for fisheries, seabed protection and litter, the Cabinet wants to have reversed the downward trend in the marine ecosystem to one of recovery and to reduce the amount of litter in the marine environment by 2020. A decision on measures to be implemented will be taken by 2015 at the latest, in the successor to the National Water Plan.

A prerequisite for specification and implementation is a pragmatic approach, i.e. realism, a focus on the key risks, a balance between social costs and benefits, and seizing opportunities for development, innovation and social initiative instead of excluding and 'regulating'.

This sober approach applies to both the analysed measures, as well as the analyses themselves. Therefore, the level of detail of the analyses depends on the expected value added of additional efforts required to perform a more detailed analysis. With respect to the marine environment, there is (as yet) no clear and comprehensive quantitative insight into the functioning of the ecosystem. As a result, it is not possible to identify the exact quantitative relationship between the intensity of the measures, the extent of the desired effect and the related benefits. This is an important reason why in the Marine Strategy Part I the goals are not described in quantitative terms, but in terms of redirecting negative trends. As a result, the socio-economic analyses for the MSFD, presented in this report, and which are carried out to prepare and support decision making about the program of measures, are also necessarily a highly qualitative.

The Marine Strategy is not an isolated policy. Implemented on its own, it could never successfully achieve good environmental status. As with the implementation of existing and initiated policy, effective collaboration with other countries is of vital importance. Much will also depend on the willingness of the business community and NGOs to invest in innovative initiatives towards the sustainable use of the North Sea.

1.2 Cost-benefit analysis, cost effectiveness analysis and social analysis for additional measures

Article 13.3 of the Marine Strategy Framework Directive (2008/56/EC) states that:

- 'When drawing up the programme of measures pursuant to paragraph 2, Member States shall give due consideration to sustainable development and, in

particular, to the social and economic impacts of the measures envisaged.' (..).
- 'Member States shall ensure that measures are cost-effective and technically feasible, and shall carry out impact assessments, including cost-benefit analyses, prior to the introduction of any new measure.'

In addition, article 14 describes a number of potential reasons for exceptions. Since article 14.4 refers to disproportionate costs, another issue that one could relate to potential economic analyses, this article is presented here as well:

- 'Member States shall develop and implement all the elements of marine strategies referred to in Article 5(2), but shall not be required, except in respect of the initial assessment described in Article 8, to take specific steps where there is no significant risk to the marine environment, or where the costs would be disproportionate taking account of the risks to the marine environment, and provided that there is no further deterioration.'

These requirements to the Member States encompass five key terms that will be explained in the next sections:

- Cost-benefit analysis
- cost-effectiveness analysis
- social analysis
- additional measures
- disproportionate costs

The following sections describe how the Netherlands perform these analyses. Since, in part, these analyses also had to be performed for the European Water Framework Directive (WFD), where relevant, these sections will address the lessons learned from the WFD.

An important difference between the MSFD and the WFD is that where for the WFD often trade offs had to be made between different types of measures by one organisation (e.g. regional water authority) – e.g. should they focus on additional emission reduction from waste water treatment plants or focus on ecological reconstruction measures – for the MSFD this is clearly different. Therefore, for the MSFD, it was decided to perform economic analyses for the various environmental themes. E.g. economic analyses for litter, separate from economic analyses for additional fisheries measures, etc. In contrast to the WFD, for the MSFD no overall comprehensive analysis will be performed.

1.2.1 Cost-benefit analysis

The Marine Strategy Framework Directive is the first European directive that requires a cost-benefit analysis. The European Water Framework Directive (WFD) required the programme of measures to be cost-effective, and there was the possibility to use exceptions if it could be shown that the implementation of certain measures would lead to disproportionate costs. Some Member States have used cost-benefit analyses to support this argument.

The Netherlands have performed a number of cost-benefit analyses at the national level for the WFD. In 2006, a Strategic SCBA was performed (Ministerie van Verkeer en Waterstaat, december 2006). The focus of this analysis was at the more strategic

level, supporting the strategic political discussions on the desired level of ambition with respect to the different types of measures. This analysis showed that additional emission reductions are relatively more expensive and less beneficial than hydro-morphological measures. These results contributed to the decision to put the main emphasis in the programme of measures on the hydromorphological measures and less on emission control. In 2008, the Ex Ante Analysis performed which presented the costs, effects and benefits of the proposed programme of measures (PBL, 2008; http://www.planbureauvoordeleefomgeving.nl/sites/default/files/cms/publicaties/500140001.pdf).

The purpose of cost-benefit analyses is to support decision making by providing an objective overview of the positive and negative impacts of planned measures (or programme of measures). In order to do this as uniform as possible, it is attempted as much as possible to present these effects under one common denominator: money. However, in order to perform a cost-benefit analysis and support the decision making process, monetarisation (the translation of effects into money terms) of all effects is not always necessary, and even sometimes not even wanted. This is especially the case when the monetarisation itself might cause serious discussions, e.g. because of the use of potentially ambiguous assumptions and methods. These discussions could easily distract from the main purpose of the cost-benefit analysis; supporting decision making with respect to the pros and cons of implementing measures.

For the Strategic SCBA for the WFD that was performed in 2006, it was tried to present cost and benefits of WFD measures in monetary terms as much as possible. The costs could be presented in monetary terms rather easily, however, in order to be able to estimate the monetary value of the benefits many assumptions had to be made. This applies to both the ecological effects that were expected due to the proposed measures, as well as the monetarisation of those effects. In the Ex Ante Evaluation (PBL, 2008) it was argued that improving the ecological quality is the primary purpose of the WFD and therefore the main benefit of the program of measures. However, because of insufficient evidence in available studies the Ex Ante Evaluation did not express this benefit in monetary terms. Other (secondary) benefits, including effects on recreation, health and fisheries, were either small in size or difficult to substantiate. Therefore, the Ex Ante Evaluation concludes that it is not possible to perform a cost-benefit analysis, in which everything is expressed in money. However, the Ex Ante Evaluation did reveal the (undeniable) ecological benefits of the proposed measures by presenting those in ecological quality ratios and pictures, indicated which measures are decisive for these ecological benefits, and presented the potential costs involved for implementing those measures.

With respect to the MSFD there are many significant knowledge gaps for those areas where policy issues are expected. This means that, just like in the case of the WFD, at the moment no clear and full quantitative insights into the functioning of the ecosystem exist (yet). In the absence of quantitative information on the effects of measures, a cost-benefit analysis in which everything is expressed in monetary terms is not possible. For this reason it was decided to perform the social cost-benefit analyses presented in this report in a more qualitative way, focussing on a description of possible additional measures, the expected effects of these measures on the marine environment, and in this way to support the decision making process.

The Marine Strategy Part 1 indicates that the ecosystem approach - in combination with the precautionary principle – represent the core for establishing additional policy and measures. Adaptive management allows to learn from experiences that are gained during the implementation (e.g. by means of monitoring, but also knowledge gained from exchange of experiences in international meetings) and to adjust policies accordingly. This adaptive approach therefore may lead to intermediate adjustment of policies and / or new policy. It also means that, where quantitative information is not yet available now, this might change in course of time, and future analyses may be more quantitative as more information becomes available.

1.2.2 Cost-effectiveness

The aim of a cost-effectiveness analysis is to arrange a list of potential measures in such a way that measures that contribute most to a given objective at the least cost are located at the top of the list ("biggest bang for the buck"). This is the measure that – in case of a limited budget – should be taken first. With a slightly larger budget, the next measure on the list could be taken. A cost-effectiveness analysis can thus help to achieve a certain objective at the lowest cost, or will contribute to the target as much as possible given a limited available amount of money. The Strategic SCBA for the WFD, discussed in the previous section, could be regarded a cost-effectiveness analysis, finding how a limited budget can be used in such a way that it contributes most to goal attainment.

As previously indicated, there are still many knowledge gaps with respect to the functioning of the marine ecosystem. As a result, it is (still) not possible to establish clear quantitative relationships between measures and their impacts on the marine environment. However, based on expert judgment and literature, it will in many cases be possible to give at least a qualitative description of, on the one hand, measures that are expected to have much impact on targets at limited costs, and on the other side, measures that are costly and will have little or no effect. In situations with little quantitative information, capturing this type of qualitative information based on expert judgment may be very helpful to support decision making. Therefore, much of this type of information is included in this report.

1.2.3 Social Analysis

Article 13 of the MSFD requires 'When drawing up the programme of measures, Member States shall give due consideration to sustainable development and, in particular, to the social and economic impacts of the measures envisaged.'

According to the guidance document prepared by the European working group dealing with the Economic and Social Analysis for the MSFD a socio-economic analysis aims to identify the impact on human welfare of a given policy. This includes economic as well as social aspects, and may include consideration of the distribution of these impacts across stakeholders (e.g. a description of the possible effects on employment and the distribution of costs and benefits (advantages and disadvantages) across stakeholders). In light of this definition, an explicit distinction between „economic" and „social" analysis is not necessary.

In the Marine Strategy Part I, the Netherlands presented a section on 'social analysis', which included a description of a survey conducted among the Dutch population about their perception of the North Sea, their opinion on various (potential) environmental problems related to the North Sea, and their priorities with respect to different possible solutions (given consequences) (TNS NIPO, 2011). A number of other countries have also included a section on 'social analysis' in their Marine Strategy Part I. The United Kingdom has been very exhaustive, with a description of the possible effects of the (non) realization of a sustainable situation in the North Sea for different groups in society. Other countries such as Sweden, have presented a stakeholder analysis under the heading of 'social analysis'. This brief description of the social analyzes carried out in the various Member States shows that there has not been a uniform approach, but that each Member State has performed an analysis that suits the needs of their respective policy-makers best.

This report will present a combination of different tracks that have been followed:

- For each policy theme, the public opinion will be presented, based on the above-mentioned survey study by TNS NIPO.
- In the Marine Strategy Part I the Netherlands have described 'the costs of degradation of the marine environment' by presenting an overview of the costs already incurred by the various stakeholders for current measures to protect the marine environment. This gives an insight into the distribution of the current burden. It should however be noted that this is an underestimate of the actual total costs.
- For the different policy themes, the relevant stakeholders will be identified and described (stakeholder analysis). Also the stakeholder process will be described, showing how the various stakeholders have been involved in the process towards the final programme of measures. Especially with regard to the latter, the active involvement of stakeholders in the entire process, the Netherlands (seems to) have a fairly unique approach. Also for the WFD, the stakeholders have been actively involved throughout the process. This worked very well, resulted in a very pleasant and positive atmosphere, and led to a program of measures that was broadly accepted.
- For each of the measures proposed for the program of measures, it will be indicated who will incur the costs.

1.2.4 Additional Measures

The Marine Strategy Framework Directive requires the analyses presented above for so-called 'additional measures'. These are the measures that are in addition to (complementary to) existing policies, or, as stated in the Marine Strategy Part I: " Where necessary, the Marine Strategy supplements existing and initiated policy as well as the implementation of international conventions and framework directives with new policy assignments and measures. Existing and initiated policy are the starting point and are integral to identifying new policy assignments and measures aimed at achieving good environmental status. As such, the Marine Strategy solely complements existing and initiated policy, thus not explicitly including it in the set of new policy assignments and measures. "

This means that the various analyses presented in this report are focussed on measures that are in addition to existing policies. However, in order to provide a complete picture, also a short description will be presented on the current policy for each of the areas where additional policy challenges are identified.

1.3 Exceptions: overriding public interest and disproportionate costs

Article 14 of the Marine Strategy describes a number of possible exceptions. Exceptions that could be substantiated with socioeconomic information, are the exceptions based on overriding public interest (14.1.d) and disproportionate costs (14.4).[3]

Clear examples of overriding public interest could be the fact that the Dutch government will not accept that the Rotterdam port would become unreachable because it would not longer be possible to dredge the shipping channel in order to protect soil integrity. The activities in the port of Rotterdam are simply too important for the Dutch economy. A similar argument applies to the nourishments to protect the coastal foundation. Also, here the Dutch government will argue that it goes without saying that the Netherlands can not just stop it, because otherwise a large part of the Netherlands is at serious risk of flooding. This may all seem extremely trivial for Dutch native citizens who are used to live in a flood prone delta; even so obvious that there is no need for cost-benefit or other economic analyses to support these arguments. However, for non-Dutch people, part of these considerations may be less obvious. Therefore, especially in the final report towards other Member States and the European Commission, it may nevertheless be relevant to include a number of these recitals explicitly.

Also in the Water Framework Directive the argument of disproportionate costs could be used as one of the arguments why certain measures did not have to be implemented. In their guideline document, the European working group dealing with the economic analysis for the WFD did not give a clear description of how this element should be performed. This was partly because the determination of the exact quantitative value for the threshold, above which costs are assumed to be disproportionate, is not really an economical topic, but more a political issue (REF WATECO). For the WFD the Dutch view on disproportionate costs was that the decision on what level of costs is regarded to be disproportionate, is a political decision, possibly informed by economic information. For the MSFD the same stance applies. Therefore, this report will not provide explicit statements about the limit above which the costs are disproportionate. However, by indicating what measures seem very relevant (much effect at low costs) and what measures seem to be less meaningful (because

[3] Article 14.1.d reads: "A Member State may identify instances within its marine waters where, for any of the reasons listed under points (a) to (d), the environmental targets or good environmental status cannot be achieved in every aspect through measures taken by that Member State, or, for reasons referred to under point (e), they cannot be achieved within the time schedule concerned:

> d. modifications or alterations to the physical characteristics of marine waters brought about by actions taken for reasons of *overriding public interest* which outweigh the negative impact on the environment, including any transboundary impact"

Article 14.4 reads as followds: "Member States shall develop and implement all the elements of marine strategies referred to in Article 5(2), but shall not be required, except in respect of the initial assessment described in Article 8, to take specific steps where there is no significant risk to the marine environment, *or where the costs would be disproportionate* taking account of the risks to the marine environment, and provided that there is no further deterioration."

of a combination of very high costs and little effect), `this report may provide useful information for this discussion.

1.4 (Economic analysis in) the international context

The Netherlands plays an active role in international cooperation in the field of economic analysis. Both in the European Economic and Social Analysis Working Group, and in the OSPAR Intersessional Correspondence Group on Socio Economic analyses the Netherlands regularly give presentations in order to pay an active contribution to the exchange of knowledge and experiences on data and socioeconomic analyses.

However, not only in the field of economic and social analysis, it is important to collaborate with international partners. Also the programming of knowledge development is done as much as possible at the international level, leading to joint investigations for marine litter and other themes. The knowledge gathered in these (international) studies has been included in this report as much as possible. However, much of the research is ongoing and is therefore expected to significantly broaden the knowledge base (only) in the years to come. As previously indicated, adaptive management allows for the opportunity to learn from experience and adjust policies accordingly. This means that as more knowledge becomes available (e.g. from international research projects) this may give rise to future changes in the programs of measures, so as to adjust them based on the most recent insights.

1.5 Outline report

This report contains nine chapters. The second chapter gives an introduction of additional measures with respect to marine litter, conventions and legislation regarding marine litter and the costs of current policies. In chapter three the cost effectiveness analysis of additional measures with respect to marine litter is discussed. The information presented in chapter three is based on the LEI study (2011) and some additional studies performed in 2012 (see also the table below). Chapter four presents the cost-benefit analysis of additional measures with respect to marine litter. This chapter gives a qualitative description of the ecological benefits of improving the marine ecosystem, the quantification of environmental impacts using the Nature Point Method and a description of the social benefits. Chapter five describes the use of economic instruments with respect to marine litter. In chapter six an overview of the social analysis is given. This chapter discusses the results of a quantitative consultation under Dutch citizens (TNS NIPO survey), an overview of the stakeholders view regarding additional measures with respect to marine litter, and a description of the stakeholder meeting 'Litter at Sea.' Chapter seven describes the contribution to the program of measures. In chapter eight the international cooperation, cooperation within the European Union and OSPAR, with respect to marine litter is discussed. Chapter nine gives an overview of the knowledge gaps regarding marine litter and regarding the identified measures.

Table 7: The various steps on the way to the present document

	Economic analyses	Social aspects	Miscellaneous	Contribution to (literature refe
2010	1. The current cost of avoiding degradation of the Dutch North Sea Environment (LEI, 2010) 2. Measures for the Marine Strategy Framework Directive; First overview of potential measures, related costs and effects of implementing the Marine strategy (DHV, 2010)			Chapter 2: Additional measures w marine litter (1) Chapter 3: Cost effectiveness ana tional measures with respect to m
2011	3. How to achieve good environmental status in North Sea: Framework for cost effectiveness and cost-benefit analysis for the MSFD (LEI, 2011) 4. Evaluating biodiversity of the North Sea using Eco-points: Testing the applicability for MSFD assessments (Bureau Waardenburg, 2011) 5. Assessment of economic instruments for the Marine Strategy Framework Directive (Sterk Consulting, 2011)	6. TNS NIPO, Beleving van de Noordzee: Een kwantitatieve consultatie onder Nederlandse burgers over de Noordzee		Chapter 3: Cost effectiveness ana tional measures with respect to m Chapter 4 Cost-benefit analyses o measures with respect to marine litter (3, 4) Chapter 5: Instruments with resp litter (5) Chapter 6 Social analysis and stal volvement (6)
2012	7. Kostenkentallen voor opruimen zwerfafval langs de Nederlandse stranden (Ecorys, 2012a) 8. Bepaling van schade door afval in netten en schroeven (Ecorys, 2012b) 9. Discussion document: Managing undesirable ship generated waste discharges in Marine Environments (Oranjewoud, 2012) 10. Praatje bij een Plaatje (Bureau Waardenburg, 2012) 11. Recreational benefits of reductions of litter in the marine environment (Eftec, 2012)	12. Stakeholder workshop Zwerfvuil in Zee	13. Marine Strategy for the Netherlands part of the North Sea 2012-2020, Part 1	Chapter 1: Introduction (12) Chapter 2: Additional measures w marine litter (7, 10, 12) Chapter 3: Cost effectiveness ana tional measures with respect to m 7, 9) Chapter 4 Cost-benefit analyses o measures with respect to marine litter (3, 4, 7, 8 Chapter 5: Instruments with resp litter (5) Chapter 6 Social analysis and stal volvement (5, 6,12)
2013				Draft version of Economic and soc (present document)

2 Additional measures with respect to marine litter

This chapter describes the problems associated with litter in the marine environment. It starts with a description of the ecological impacts of marine litter. This gave rise to the formulation of the current policy. This is briefly described in the second paragraph. The third section examines the environmental goals that the Dutch government has set in the Marine Strategy, while in section 4 an overview is given of the costs of current policies. These give rise to additional policy, which is described in section 5. Before the next chapter starts with the economic analyses of these additional policy measures, the last section of this chapter presents a brief summary of the most important knowledge gaps. These knowledge gaps are, as already announced in the previous chapter, a major reason why the economic analyses will have a strong qualitative character.

2.1 Introduction: Impacts of litter on the marine environment

Litter in the marine environment may have negative effects on the ecosystem. Waste that ends up in the sea remains in the marine environment for a long time, particularly plastics, which decompose very slowly. Sea currents spread this material across the globe. Seabirds, fish and other marine animals may mistake it for food, and when they eat it, this indigestible material may cause an obstruction in their stomach and may have effects on the food chain level. In addition, animals can become entangled in larger pieces of plastic and other waste. Between 2002 and 2009, no significant change in the quantity of litter was measured; On average, 250 to 500 items of litter are found on a 100-metre stretch of beach. This is below the average for beaches of the Southern North Sea measured with the OSPAR method, which value was 700 items of litter, of which an average of 75% comprises plastics (Deltares, 2011).

In the period between 2005 and 2009, plastic was found in the stomachs of 90% of the fulmars examined throughout the North Sea. The target level of OSPAR's Ecological Quality Objective (EcoQO) is that no more than 10% of the fulmars have more than 0.1 grams of plastic in their stomachs. That target is not reached in the North Sea. The value measured near the Scottish islands was 48% and in the English Channel zone it was 78%. Of the birds that wash ashore in the Netherlands, an average of 58% has more plastic in their stomach than the target value. (Deltares, 2011)

The proximity of sources of waste and the prevailing directions of the wind and currents have a major impact on the presence of litter. Moreover, it spreads easily. As a result, no clearly discernible trends have been observed at the measuring locations. (Deltares, 2011) To date, there is no scientific measuring protocol or data series for litter in the water column and on the seabed.

Based on the Fulmar study and the monitoring of litter on the beaches, cautious conclusions can be drawn about the sources of litter in the marine and coastal environments. Shipping and fisheries are the key sources on the North Sea (see also Table 8). Sources on land include: beach recreation, supply from rivers and other, so-called diffuse sources. The monitoring data of litter on the beach suggests that 44% of waste comes from shipping and fisheries, 30% from sources on land, and

26% from unknown (or multiple) sources. (RWS Noordzee, Draft Monitoren zwerfvuil).The Fulmar study also indicates that fisheries and shipping are the main sources of litter in the sea (van Franeker, 2010).

Table 8: Overview of the top ten of the most frequently found items on the four Dutch reference beaches in 2010.

	Item	Item % of Total Litter	Number of items / 100 m
1	Rope and cord (diameter <1 cm)	22.3	86.3
2	Plastic or polystyrene from 0 to 2.5 cm	13.3	51.4
3	Nets or 3 pieces just <50 cm	5.7	22.1
4	Caps	5.5	21.4
5	PUR foam	5.2	20.2
6	Plastic or polystyrene 2.5 <5.0	5.0	19.2
7	Balloons	3.5	13.6
8	Bags of crisps and candy, lollipop sticks	3.5	13.5
9	Entangled nets / rope / cord	3.4	13.1
10	Other plastic or polystyrene items	2.5	9.9

Source: RWS Noordzee, Draft Monitoren zwerfvuil, 2005-2010 (2011).

The Fulmar study shows a significant decrease in industrial plastics (such as pellets) in litter in the 1979-2007 period. This decrease could be explained from the fact that the economic value of the pellets is an incentive for preventing loss during transport wherever possible. However, the share of consumer plastics – all non-industrial residues of plastic products, such as ropes, bottles or bags – increased significantly in the 1979-2000 period. In recent years, no increase or decrease has been found for either type of plastic. (van Franeker, 2011).

Microplastics require particular attention. These miniscule plastic parts are created when plastics decompose, or they end up directly in the environment as domestic litter. In addition, microplastics are increasingly being used in household products, cosmetics and the industry. They are also created as a result of wear and tear when synthetic clothing is washed. As only a few scientific studies have been performed, very little is known about the risks that microplastics pose in the marine environment. The wide variety of different types of particles also plays a role. (Deltares/IVM, 2011).

The potential toxic effects of contaminants in and on microplastics in the sea are a cause for concern. (Deltares/IVM, 2011). Microplastics can end up in the food chain. A study of this phenomenon and its ecological and toxic effects was launched recently. (Deltares/IVM, 2011). The share of microplastics in litter is likely to increase due to the decomposition of plastic litter already present and due to the increase of its use as a product.

Monitoring litter on the North Sea

The Netherlands monitors the current dispersion of litter on the North Sea in two different ways. The OSPAR method is used to inventory what washes ashore and what is left behind. This practice started in 2002 by taking a record of all litter over a distance of 100 metres between the waterline and the foot of the dunes on four reference beaches: Bergen, Noordwijk, Veere, Terschelling.

As indicated earlier, between 2002 and 2009, there has been no significant change in the quantity of waste found. On average between 250 and 500 pieces of debris is found per 100 meters of beach. Table 8 presents the top 10 litter items found on non-tourist beaches.

On the reference beaches 87% of all litter in 2010 consisted of plastic (similar to percentages in previous years). In reality, the percentage of plastic in the number of litter items is even higher because plastic pellets and small fragments are not included in these figures. The detected amount of crisps and candy bags and lolly sticks are considered to be an indicator of tourism. Their amount is striking (14 items/100 meters) because there are no beach cafes in the vicinity of the reference beaches and these beaches do not attract many tourists. In other years, similar amounts of crisps, candy bags and lolly sticks were found. The items larger than 50 cm are counted as a separate category. The top three items larger than 50 cm stem all from either fisheries or ships (see Table 9).

Table 9: Top three items on the Dutch reference beaches per 1 km (items larger than 50 cm)

Position 2009	Position 2010	TOP ITEMS 1 km (> 50 cm)	Total Litter (> 50 cm) (%)	Number of items / km
1	1	Nets or pieces of net	23.8	16.5
3	2	Packaging materials and coatings	16.1	11.1
2	3	Ropes and cord (diameter <1 cm)	14.5	10.1
		Top 3 items	54.5	37.7

Source: (Draft Monitoren zwerfvuil, 2005-2010) *Biota / Northern Fulmars*

The Fulmar study is the second method used to measure the nature and scope of litter on the North Sea: fulmars (Fulmar glacialis) only forage at sea. Analysis of the stomach contents of dead birds provides an indication of the quantity of (small) litter floating on the sea and how much the fulmars ingest.

In addition to the above indicators, the 'Fishing for Litter' initiative also provides information on waste picked up from the seabed in the Netherlands and Belgium by fishermen participating in the scheme. In 2010, 94 fishing boats brought in a total of 442 tonnes of waste. The percentage of plastic objects fished out of the sea is lower than the percentage of plastic objects found on the beaches. This can be explained by the fact that plastic is light and can wash ashore easily.

2.2 Present policies

At an international level, litter in sea is recognised as a problem and the consensus is that plastic does not belong in the sea. Hence, several international conventions and legislation are relevant to the topic marine litter, as well as a number of international initiatives have been launched to limit waste. The next paragraphs will briefly describe the different international agreements and legislation that are related to marine litter.

2.2.1 International conventions and legislation

Several international conventions and legislation are relevant to the topic of "marine litter", whether through an explicit focus on the topic (i.e. agreements specifically targeting waste discharge and reductions of marine litter), or as one topic among others aiming at a sustainable use and conservation of the marine environment. The key international agreements and legislation are briefly discussed below. Details of national and local legislation are not addressed here.

United Nations Convention on the Law of the Sea (UNCLOS) and General Assembly (GA) Resolutions, especially UN Resolution A/RES/60/30 – Oceans and the Law of the Sea

UNCLOS is a UN convention aiming at the management of marine resources. It includes various provisions, ranging from territorial sea limits and economic and commercial activities via protection, conservation and research issues to binding procedures for settling legal disputes. UNCLOS sets out the legal framework within which all activities in the oceans and seas must be carried out.

Protection and preservation issues are addressed by Part XII of the Convention (Articles 192-237), centred around pollution prevention and control of sea- and land-based activities, as well as atmospheric pollution. Marine litter was specifically mentioned in the UN General Assembly (GA), which carries out annual reviews of the law of the sea (Resolutions), based on annual comprehensive reports prepared by the Secretary-General. The GA's Resolution A/RES/60/30 – Oceans and the Law of the Sea (2005) , states:

"…The General Assembly…
65. Notes the lack of information and data on marine debris and encourages relevant national and international organisations to undertake further studies on the extent and nature of the problem, also encourages States to develop partnerships with industry and civil society to raise awareness of the extent of the impact of marine litter on the health and productivity of the marine environment and consequent economic loss;
66. Urges States to integrate the issue of marine debris within national strategies dealing with waste management in the coastal zone, ports and maritime industries, including recycling, reuse, reduction and disposal, and to encourage the development of appropriate economic incentives to address this issue including the development of cost recovery systems that provide an incentive to use port reception facilities and discourage ships from discharging marine debris at sea, and encourages States to cooperate regionally and sub-regionally to develop and implement joint prevention and recovery programmes for marine debris;…"

International Convention for the Prevention of Marine Pollution from Ships (1973) as modified by the Protocol of 1978 relating thereto (MARPOL 73/78)

The MARPOL convention is the most important international agreement covering pollution of the marine environment by ships. It has six annexes, of which Annex V specifically covers 'garbage'. The revised Annex V (2013) defines garbage as *"Garbage means all kinds of food wastes, domestic wastes and operational wastes, all plastics, cargo residues, cooking oil, fishing gear, and animal carcasses generated during the normal operation of the ship and liable to be disposed of continuously or*

periodically except those substances which are defined or listed in other Annexes to the present Convention".

Annex V contains regulations on types of garbage that are allowed or forbidden to be disposed, and specifications of the distances from the coast and the manner in which they may be disposed of. According to Annex V, the disposal of all kinds of garbage, excluding under certain circumstances food waste, is strictly forbidden in the North Sea (and adjacent areas), which is declared as a 'Special Area'. Other obligations include a comprehensive documentation of all garbage disposed of into the marine environment (Mouat et al. 2010).

As of October 2012, MARPOL Annex V has been ratified by 144 states, which cover 98.47% of the world's shipping tonnage. Despite these high figures, the impact of MARPOL Annex V is still quite limited (Dworak et al. 2011).

2.2.2 European agreements and legislation[4]

A broad range of EU policies and legislation relate to marine litter, addressing both its sources and impacts. This includes EU environmental legislation relating to waste management, urban wastewater or pollution from ships. Waste management legislation should be seen in the broader context of enhanced resource efficiency, now a key cross-cutting policy goal. The EU's resource efficiency policy should have a beneficial upstream impact by influencing the use and design of plastic products and particularly of packaging. In terms of legislation dealing with the impacts of marine litter on the coastal and marine environment, the EU Integrated Maritime Policy (IMP) and the Marine Strategy Framework Directive as its environmental pillar address the development of sea-related activities in a sustainable manner.

The Waste Framework Directive

The Waste Framework Directive sets out essential conditions for waste management and concerns all waste. It has thus a direct influence on marine litter. The Directive introduces a binding waste hierarchy, defining the order of priority for treating waste. Top of the list is waste prevention, followed by re-use, then recycling and then other recovery operations, with disposal such as landfill to be used only as the last resort. Beyond establishing waste prevention programmes by 2013, Member States must set up separate collection systems by 2015 as a minimum for paper, metal, plastic and glass. Member States must prepare for re-use and recycle 50 % by weight of at least paper, metal, plastic and glass from households, and possibly also from other origins as far as these waste streams are similar to waste from households and 70% of construction and demolition waste by 2020.

This Directive thus establishes key principles and requirements for the management of plastic packaging waste. The Directive introduces a procedure for defining end-of waste (EoW) criteria: criteria that a given waste stream must fulfil in order to cease to be defined as waste. The Commission, supported by the Technical Working Group on Waste Plastic, composed of experts from Member State administrations, indus-

[4] Test largely derived from European Commission, Commission Staff Working Document, Overview of EU policies, legislation and initiatives related to marine litter, SWD(2012) 365 final, Brussels, 31.10.2012.

try, NGOs and academia, is also preparing end-of waste criteria for plastic waste. Setting standards of equivalency between virgin material and recycled material through these criteria, is expected to provide a strong stimulus to industry to attune plastic production to achieving high recycling rates.

The Packaging and Packaging Waste Directive
The Directive sets a range of requirements to reduce the impact of packaging and packaging waste on the environment. It contains provisions on the prevention of packaging waste, on the re-use of packaging and on the recovery and recycling of packaging waste. Prevention of the production of packaging waste is the first priority.

The Directive requires Member States to ensure that preventive measures are implemented by, for example, national programmes, extended producer responsibility programmes, and to develop packaging reuse systems for the reduction of the impact of packaging and packaging waste on the environment. In addition, the Member States must introduce systems for the return and/or collection of used packaging to attain a set of targets (see the box below).

Packaging waste targets and requirements
- by no later than 30 June 2001, between 50 and 65% by weight of packaging waste to be recovered or incinerated at waste incineration plants with energy recovery;
- by no later than 31 December 2008, at least 60% by weight of packaging waste to be recovered or incinerated at waste incineration plants with energy recovery;
- by no later than 30 June 2001, between 25 and 45% by weight of the totality of packaging materials contained in packaging waste to be recycled (with a minimum of 15% by weight for each packaging material);
- by no later than 31 December 2008, between 55 and 80% by weight of packaging waste to be recycled;
- by no later than 31 December 2008, recycling targets for materials contained in packaging waste must be attained, *inter alia* 22.5% for plastics.

Moreover, the Directive sets requirements on the manufacturing and composition of packaging waste to enable its reuse, recovery and recycling. Member States must ensure that packaging placed on the market complies with the essential requirements of Annex II:
- to limit the weight and volume of packaging to a minimum in order meet the required level of safety, hygiene andacceptability for consumers;
- to reduce the content of hazardous substances and materials in the packaging material and its components;
- to design reusable or recoverable packaging.

Full implementation of the Directive by the Member States will play an important role in closing loopholes in the plastic packaging cycle, with important attendant benefits for the generation of marine litter.

The Landfill Directive
The Landfill Directive establishes technical requirements for the operation of landfills, with the goal of reducing their impact on the environment, including the pollution of surface water. This Directive, for example, requires that the location of landfill sites takes into account factors such as the proximity of water bodies and coastal

waters and that wind-blown materials are minimised. Such measures should reduce potential dispersal of plastic packaging waste and other debris in the marine environment.

Urban Wastewater Treatment Directive

The *Urban Waste Water Treatment Directive* requires that all sewerage discharges serving populations over 10,000 in coastal areas and 2,000 in estuarine areas, must receive secondary (biological) treatment prior to discharge. This Directive is relevant because discharge of urban waste water is one of the sources of marine litter. Sewage related marine debris includes, among other things, sanitary towels, tampons and plastic cotton wool bud sticks. In pre-treatment, stones, sand and other relatively large elements are removed; in this particular case, retained particles may range between 200 µm and even be above 100 mm of diameter. Micro-plastics and fibers from clothes washing might pass the waste water treatment plant. Also storm water overflows may be a significant source.

The Ship-source Pollution Directive (2009/123/EC)

The Ship-source Pollution Directive transposes into EU legislation the standards introduced by MARPOL 73/78 relating to the prohibition of polluting discharges into the sea, and specifies the sanctions to be imposed. The Directive requires Member States to consider discharges of polluting substances from ships in all sea areas, including the high seas, as a criminal offence if they are committed with intent, recklessly or by serious negligence. Minor discharges are infringements, but shall not automatically be considered as criminal offences, except where their repetition leads to deterioration in the quality of the water, including in the case of repeated discharges. Ship-source polluting discharges relate to discharges of substances covered by Annexes I (oil) and II (noxious liquid substances in bulk) to MARPOL 73/78.

The Directive provides for co-operation between port State authorities, which should make it possible for proceedings to be initiated in the next port of call. Furthermore, it aims at enhancing co-operation among Member States to detect illegal discharges and develop methods to identify a discharge as originating from a particular ship.

MARPOL 73/78 (The International Convention for the Prevention of Pollution from Ships 1973, as modified by the Protocol of 1978 relating thereto) is the main international convention for the prevention of pollution from ships. It forbids dumping at sea, as does the London Convention. MARPOL 73/78 regulates operational vessel source pollution generated during normal operation of ships, including pollution by garbage through its Annex V Regulations. These Regulations include a ban on discharge of all garbage into the sea, except if expressly provided otherwise13. MARPOL 73/78 imposes an obligation on the Parties to provide facilities for the reception of ship-generated residues and garbage (that cannot be discharged into the sea) and includes requirements on the delivery of ship-generated waste and cargo residues, at port reception facilities. In 2006, the IMO launched its "Action Plan on tackling the inadequacy of port reception facilities".

The London Convention 1972 and the 1996 Protocol thereto aims to promote the effective control of all sources of marine pollution and to take all practicable steps to prevent pollution of the sea by dumping at sea of wastes and other matter generated on land.

The Port Reception Facility Directive (2000/59/EC)

The Port Reception Facility Directive16 (PRFD) aims to reduce discharges of ship-generated waste and cargo residues into the sea, especially illegal discharges, by improving the availability and use of port reception facilities in all EU ports. The Directive applies to all ships, including fishing vessels and recreational craft, irrespective of their flag.

The Directive brings international requirements (MARPOL 73/78) into EU law and provides for additional obligations and mechanisms, especially the obligation on ports to develop and implement waste reception and handling plans, and the obligation on ships in deliver their waste at each port call within the EU.

This Directive addresses the legal, financial and practical responsibilities of the different operators involved in the delivery of waste and residues in ports. It provides for the implementation of a cost recovery system (applying a waste fee), that should provide no incentive for ships to discharge their waste at sea. All ships calling at a Member State port will bear a significant part of the cost (which the Commission interprets as meaning at least 30%), 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.

The Commission is currently reviewing the PRFD with a view to achieving the objective of 'zero discharges at sea' from ships calling at EU ports, a key objective to further reduce ship-borne debris. As part of the review of the Directive, EMSA was tasked to collect information on its implementation. The conclusions were overall positive but found that the current system is not optimal and that further progress could be achieved to achieve a greater protection of the marine environment. EMSA also conducted a study into the availability and use of port reception facilities to support the revision process. A new legislative proposal is planned for 2014.

The Integrated Maritime Policy (IMP)

The prime objective of the Integrated Maritime Policy (IMP) for the EU is to maximise the sustainable use of the oceans and seas while enabling growth of the maritime economy and coastal regions. Environment is a key component of the IMP. The European Commission commits, among other things, to take steps against discharges into the sea. A European network for maritime surveillance is one of the tools that can help to address such discharges and that the Commission will further develop jointly with the Member States. Other tools that the IMP refers to are Maritime Spatial Planning and Integrated Coastal Zone Management which can help through integrated planning to reduce the negative environmental impact of economic activities carried out in the marine and coastal areas. These activities include tourism, fishing and maritime transport, all sources of marine litter. The marine knowledge 2020 initiative aims to improve access to data on the sea, including the distribution and composition of marine litter. Work is underway to provide an initial service by the end of 2014.

Integrated Coastal Zone Management (ICZM)

The Integrated Coastal Zone Management Recommendation defines the principles of sustainable management and use of coastal zones. These include the need to base planning on sound and shared knowledge, the need to take a long-term and cross-sector (e.g. tourism, fisheries) perspective, to pro-actively involve stakeholders and the need to take into account both the terrestrial and the marine components of the

coastal zone. ICZM can help reducing the negative environmental impact of activities carried out in the coastal areas, including those activities which are sources of marine litter. The European Commission carried out a review of the ICZM Recommendation, with a view to presenting a follow-up proposal, together with an initiative on Maritime Spatial Planning in 2013.

The European Commission's ICZM Database compiles over 350 case studies of successful application of ICZM tools throughout Europe, including case studies related to marine litter management. In 2010, the EU took a significant step forward in strengthening the legal framework for ICZM in the Mediterranean, with the ratification of the ICZM Protocol to the Barcelona Convention.

Water Framework Directive
The Water Framework Directive (WFD), adopted in 2000, calls for surface water bodies (including coastal waters) to be ecologically sound by 2015 thus contributes to the goal of the MSFD. The *WFD* requires that Member States establish river basin districts together with a river basin management plan for each of them. The Directive envisages a cyclical process in which river basin management plans are prepared, implemented and reviewed every six years. There are four distinct elements to the river basin planning cycle: characterisation and assessment of impacts on river basin districts; environmental monitoring; the setting of environmental objectives, and; the design and implementation of the programme of measures needed to achieve them. Measures could relate to litter as it has an impact on water quality.

Bathing Water Directive
The Bathing Water Directive aims to guarantee bathing water quality, which may be threatened by pollution. In particular, the Directive provides that bathing waters must be inspected visually for pollution such as tarry residues, glass, plastic, rubber or any other waste as part of the beach profile. In case such pollution is identified, adequate management measures must be taken. All bathing waters in the EU must be at least of sufficient quality by the end of the 2015 bathing season. If quality is poor and/or when waste is visually detected, Member States must adopt the necessary measures to manage and reduce pollution, and to protect and inform bathers.

2.2.3 Regional Conventions – OSPAR

OSPAR, the "Convention for the Protection of the marine Environment of the North-East Atlantic", is the regional framework under which fifteen national governments of Europe, together with the European Community, cooperate to protect the marine environment of the North-East Atlantic. The convention contains a series of annexes, covering pollution prevention and elimination, and quality assessments of the marine environment. Whilst OSPAR has a remit to undertake programmes and measures on human activities, this excludes measures relating to management to fisheries, and shipping measures (which should be referred to the International Maritime Organization).

The activities of OSPAR presently concentrate more on assessment and the development of coherent methodologies to assess marine litter. The most important activities include (JRC IES 2011; Wurpel et al. 2011):

- In 2007, OSPAR launched a *Pilot Project on Monitoring Marine Beach Litter* (see OSPAR 2007) which was the first region-wide project in Europe to de-

velop a standard methodology for monitoring marine litter found on beaches.

- In response to call for action by the UN's General Assembly in 2005, UNEP's Global Marine Litter Initiative organized and implemented regional activities on marine litter, collaborating with 11 Regional Seas organizations. In the course of these activities, and based on previous work on marine litter, OSPAR prepared a regional assessment of marine litter, the *Assessment of the Marine Litter Problem in the North-East Atlantic Maritime Area and Priorities for Response.* (OSPAR 2009).
- Based on the pilot project on monitoring marine litter on beaches, OSPAR in 2010 launched the formal *Guideline for Monitoring Marine Litter on the Beaches in the OSPAR Maritime Area* (OSPAR 2010).
- Currently, OSPAR is heavily involved in the discussions about the definition of 'Good Environmental Status' (GES) according to the EU Marine Strategy Framework Directive (MSFD), specifically the discussions regarding indicators, target setting and monitoring activities. To this end, for each MSFD descriptor (including marine litter), a 'living document' containing advice on GES is developed, to be fed into the MSFD decision making process. The document - *MSFD Advice document on Good environmental status - Descriptor 10: Marine Litter* (OSPAR, 2012) - expands on OSPAR's experience in monitoring marine litter, not only on beaches, but also in the stomachs of the Northern Fulmar (*Fulmarus glacialis*).

However more consideration is now being given to the development of programmes and measures, such as the OSPAR Recommendation 2010/19 on the reduction of marine litter through the implementation of fishing for litter initiatives. The recommendation supports the fishing industry to voluntarily collect marine litter and bring it ashore for recycling or disposal. OSPAR is also currently considering the development of a Regional Action Plan on Marine Litter action plan to support the development of further common measures (John Mouat, pers. comm.).

2.2.4 Other international agreements with importance for marine litter

The policy context for marine litter is further shaped by a number of international agreements with a bearing on management of the marine environment and associated human activities. These agreements include:

- London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (1972) and the 1996 Protocol relating thereto.
- Agenda 21: The United Nations Programme of Action from Rio and the Johannesburg Plan of Implementation.
- Convention on Biological Diversity (1992), with the Jakarta Mandate on the Conservation and Sustainable Use of Marine and Coastal Biological Diversity (1995).
- Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (UNEP, regional seas program).
- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal.
- FAO Code of Conduct for Responsible Fisheries.
- There also are various initiatives and campaigns in place that focus on reducing litter on land, such as the 'Schoonste Strand' [cleanest beach] award.

2.3 Environmental status, -indicators and –targets for marine litter

Good environmental status

The conclusion from the initial assessment (section 2.4.1) is that litter, primarily plastics, constitutes a complex problem in the marine environment. There are a lot of unknowns regarding the sources, magnitude and effects on the ecosystem. Hereby notably plastic is a substance that is hard to remove from the environment, if at all. It is, therefore, not possible to judge whether good environmental status can be achieved in 2020; formulating quantitative targets is problematic. In this case, setting a qualitative target that provides the right direction is more realistic.

At any rate, the Cabinet is of the opinion that litter does not belong in the sea. Internationally, awareness of the problem of plastics in the sea is also growing. At the same time, the initial assessment made it clear that, despite current policy efforts and many initiatives, litter in our part of the North Sea is not expected to decrease. Contamination with microplastics is likely to increase. To that end, a reduction target and supplementary policy assignment will have to be formulated for 2020.

Environmental targets and trends

The quantity of visible beach litter has decreased (basic reference 2002-2009), and there is a decreasing trend in the quantity of litter in marine organisms (basic reference 2005-2009).

1. Trends in the amounts, composition, distribution and sources of litter found on beaches.
   Existing indicator: monitoring on beaches is recognised within Europe as the most important method of identifying the extent of pollution of the marine environment due to litter. (MSFD GES Technical Subgroup on Marine Litter, Marine Litter Technical Recommendations for the Implementation of MSFD Requirements (2011)). This method uses the OSPAR Beach Litter Monitoring programme, which measures the average amount of litter on four reference beaches (for instance on the basis of a five year rolling average). (Deltares Imares, Environmental targets and associated indicators)
2. Trends in the quantity and composition of plastics found in the stomachs of marine organisms. (Deltares Imares, Environmental targets and associated indicators)
   Existing indicator. The OSPAR-EcoQO 'quantity of plastics in fulmar stomachs' is used as indicator. This EcoQO is indicative of the quantity of litter found in marine organisms in the Netherlands part of the North Sea, and it provides information on the quantity of plastics floating on the sea. (Deltares Imares, Environmental targets and associated indicators)

These indicators are in line with the recommendations from OSPAR and the EU Technical Subgroup Marine Litter on the use of indicators for this descriptor. (MSFD GES Technical Subgroup on Marine Litter, Marine Litter Technical Recommendations)

2.4 Costs of current policies

The Marine Strategy Part I does not present many cost data that are directly related to marine litter. The main litter related item described for which cost data is presented, is cleaning of beaches.

Costs of cleaning beaches

In 2010, LEI performed an analysis of the cost of degradation of the marine environment (LEI, 2010). This analysis was carried out as part of the Initial Assessment (MSFD Article 8.1). LEI estimated the cost of cleaning up beaches to be approximately 9 million € per year. This estimation was based primarily on a study of Mouat et al (2010), which examined the cost of cleaning beaches in 10 municipalities in the Netherlands and Belgium.

Leisure activities[184] • clearing up beaches	9

Source: Marine Strategy part 1, 2012

In 2012, more detailed information was collected on the costs of beach cleaning along Dutch beaches. This was done through a combination of desk research supplemented by interviews with representatives of a representative sample of 16 (out of 28) Dutch coastal municipalities, complemented with some beach pavilion holders and representatives of interest groups.

The interviews with the coastal municipalities show that there is no standard recipe for waste management on beaches. There are large differences between coastal municipalities how they have organized their waste management, which parties are involved, and who is responsible for waste facilities and beach cleaning. This not only means that every situation is unique and should also be treated as such, but it also means that the necessary information to estimate cost figures had to be derived from different organisations. The information on costs related to litter on beaches is not always very transparent and easily obtainable. In addition, sometimes, 'third parties' incur part of the costs. This makes a good comparison of the costs between the various municipalities extremely difficult.

In total, 14 coastal municipalities were able to provide an estimate of the total cost of removing beach litter. The total cost of these municipalities adds up to approx. € 2.5 million per year. In this cost figure, all costs are covered, thus including the amount spend by commercial activities located on the beaches. Beach cleaning costs account for approximately 70% of the total costs. The management of waste facilities and waste disposal account for 20% and 10% of the costs, respectively.

Besides the costs of cleaning up beaches of municipalities also other sectors make costs in order to reduce the amount of marine litter. However, detailed quantitative information of these costs is unknown.

2.5 Policy assignment supplementary to existing and initiated policy

To reinforce the efforts being made, the Cabinet is committed to an integral approach, emphasising prevention. The supplementary policy assignment is aimed at:

- Supplementary source-oriented policy to tackle litter arising from beach recreation, fisheries, rivers and shipping. The Netherlands intends to pay attention to the waste flow in the rivers as part of reframing the WFD.
- Awareness about plastic waste in the sea is a key component of prevention. As such, the Cabinet will encourage awareness of plastic waste in the sea.
- More attention should be paid to product development and the more sustainable and efficient use of, in particular, plastics. This is in line with the 'green growth' concept favoured by the Cabinet in the sustainability agenda. Economy and environment can go hand in hand, which provides opportunities for the private sector. (Ministerie van Infrastructuur en Milieu, Agenda duurzaamheid).The cradle-to-cradle concept is worth mentioning in this context.

Given the international character of the problem, international collaboration is being sought to arrive at effective policy.

2.6 Exploration of knowledge gaps

Due to a lack of knowledge and reliable research methods, it is difficult to get a complete picture of the trends and consequences of litter in the marine environment. That also makes it difficult to establish good environmental status with no damage to the marine environment. The recommendation of the EU Technical Subgroup Marine Litter provides examples of possible research and monitoring methods to which every Member State can join up. The main knowledge gaps are:[5]

- There is no research protocol and data series for litter in the water column.
- There is no research protocol and data series for litter on the seabed. The expectation is that the existing International Bottom Trawl Survey (IBTS) can be extended to enable research into litter on the seabed.
- There is no research protocol and data series for microplastics in the marine environment.
- There is a lack of knowledge about the consequences of litter and plastics for marine organisms and ecosystems.
- There is insufficient knowledge for identification and standardization of sources of litter.

As a result, not enough quantitative information is available to provide clarity on how measures can contribute to achieving good environmental status. It is possible, however, to indicate which indicators are affected by the measures. In 2011, a cost-effectiveness analysis was performed based on expert knowledge. This led to a first possible ranking of potential measures (LEI, 2011). The results from these analyses can be used to elaborate the supplementary policy assignment into measures. The results of these and other studies are described in the following chapter. In chapter nine an overview of the existing knowledge gaps regarding marine litter and the additional measures with respect to marine litter is discussed.

[5] When developing knowledge and drafting the monitoring programme, the Netherlands will work with other Member States in the European Technical Subgroup Marine Litter.

3 Economic analyses: Cost effectiveness analyses of additional measures with respect to marine litter

The EU requires its member states to define good environmental status of their marine waters and to determine by 2015 a program of measures to arrive at this good environmental status. The MSFD requires a cost-benefit analysis of additional measures to assure that the MSFD objectives are set at the (socially) optimum levels and that the corresponding measures to achieve this goal are cost effective.

In the Marine Strategy Part I, the Netherlands have presented an overview of the costs incurred to achieve the current level of protection of the marine environment. This was done to arrive at a lower bound estimate for the 'costs of degradation of the marine environment' (one of the requirements of the MSFD). This information can be used to get a feeling of how any additional costs due to additional measures compare to the current costs already made to protect the marine environment. In addition, this information may also be used to gain insight into the potential impact on the capacity of individual sectors affected. In other words, it gives relief to the final cost numbers that will result from the economic analyses of the additional measures.

3.1 Cost-effectiveness analysis

In 2010, DHV produced an initial inventory of potentially for the MSFD relevant measures, and established a draft database on the costs and effects of those measures. Based on this information, information from stakeholders and additional research in 2011, LEI performed a preliminary cost-effectiveness analysis (CEA). The purpose of this preliminary CEA was to gain insight into the application of this methodology, the availability of required data, but also to get a first idea of possible relevant measures and to determine for what measures additional information would be required.

The physical impact of potential measures was identified based on pressures related to additional MSFD targets. The most important pressures related to litter, including plastic in the sea, are shown in Figure 2. Based on monitoring data of waste on beaches, 44 percent of the waste can be traced back to originate from shipping and fisheries, 30 percent to land-based sources, while 26 percent comes from unknown (or multiple) sources (Marine Strategy Part 1, 2012).

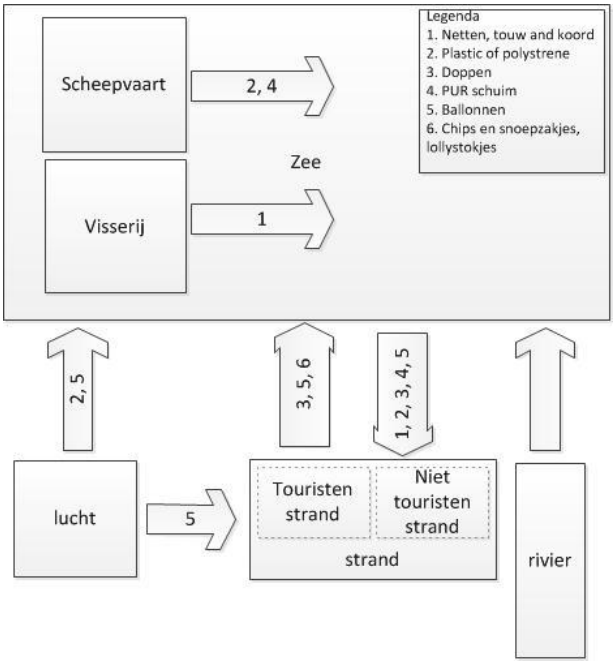


Figure 2: Sources of Marine Litter (LEI, 2011)

At present, insufficient quantitative information is available on the amount of plastic in the sea and the contribution of the various sources (e.g. shipping, fishing, swimmers) to allow for a full and detailed cost effectiveness analysis to be performed. However, based on the available information, at least some indication can be given as to which measures are expected to be more cost effective, although in order to achieve at a fully quantitative substantiated cost effective program of measures, further research is needed.

The following subsections briefly describe all the measures that have been examined, together with the costs and effectiveness of those measures. The information is derived from the analyses by LEI (2011), and additional research.

3.2 Shortlist of measures with an effect on marine litter

Table 10 gives an overview of the measures that were analysed in the preliminary CEA. These measures are classified according to the way they affect the litter quantity. Measures that effect the amount of litter disposed of in the (marine) environment are source oriented measures. They will reduce the pressure at the source. Another category of measures reduces the pressure (and its effect) reducing the amount of litter after it has entered the (marine) environment (the effect oriented measures).

Table 10: Measures divided into source or effect orientation, the driver (shipping, fishing, tourism) or the target (sea, beach biota).

Source oriented		
Shipping	**Fishing**	**Tourism**
Different packaging	Alternative for bundles of	Higher fines for littering

standards of plastic pellets	nylon wires used to protect fishing gear	
Higher fines for littering	Biodegradable nets	Ban on use of plastic bags in supermarkets
Stricter enforcement on the use of port reception facilities to collect waste	Higher fines for littering	Do it yourself beaches
	Adding individually recognisable ID-markers to fishing nets and wires	Biodegradable user plastics at beaches
	Deposits on all plastics	Biodegradable balloons, balloon valves and ribbons
		Deposits on all plastics
Effect oriented		
Sea	**Beach**	**Biota**
Fishing for litter	Additional Beach cleaning	

Source: based upon LEI, 2011

1: Alternative for bundles of nylon wires used to protect fishing gears

Measure
This measure deals with an alternative for the bundles of nylon-wires that are used to protect bottom trawling gear. In the Dutch North Sea, these bundles are used to protect the nets of conventional beam trawling and the new Pulse/ Sumwing technology.

Fishing gear protection, by definition, is wear-resistant. Alternatives that are 'softer' than current ones may not be supported by the fishing industry (because they are less effective). Degradable plastics are no alternative since these plastics will only break up in smaller pieces more easily, i.e. leading to micro plastics pollution. Metal (iron) would seem too heavy; teflar too expensive; wood/sisal too soft. Coconut matting is considered as a potential alternative. A life cycle analysis (impact analysis) is needed on the effects of use of coconut matting.

Type of measure
Regulation and enforcement

Effect on the gap
The effect of an alternative for these wires on the gap is not quite clear because nylon wire fragments from net protection bundles form one (but an important one) of the many sources for the rope and fragment category in Table 8.

Uncertainty/ certainty analysis
At this moment, no alternative is available on the market. However, the first steps are made to look for solutions. The sector considers potential alternatives as not feasible yet. However, the first steps are made to look for solutions.

The costs per measure

Currently 220 beam trawlers fish on the Dutch Continental Shelf (DCS). It is estimated that each of these ships annually spends around 0-5,000 euros on nylon wires to protect their gear. The 0-5,000 euros are the costs of replacing these bundles. This, however, does not mean that this amount of money is equivalent to that of the alternative, it seems plausible that the alternative is more costly (or has to be replaced more often). Therefore we assume additional costs from 0- 5,000 euros per beam trawler.

Who bears the costs?
The fishing industry will incorporate the extra costs for the alternative for bundles of nylon wires used to protect fishing gears.

Stakeholders view
Alternatives for bundles of nylon wires to protect fishing gear: alternatives to nylon are available (cocos) and do not necessarily mean higher costs. The fishing industry is positive towards this measure provided that it is made clear that this indeed is causing problems at the moment.

2: Do it yourself beaches

Measure
This measure originates from a comparable initiative where coastal communities take care of domestic beaches in New Zealand. Such a concept has been promoted elsewhere, including in the Netherlands, where The North Sea Foundation and the Scheveningen municipality have taken on the idea. Basically a public awareness concept that educates beach-goers to leave the beach the same as they found it, by taking home all the refuse they brought in.

MyBeach is the winning concept developed in a contest. The question was: How can the involvement of tourists in cleaning up the beach be increased? The MyBeach concept implies that if a recreant chooses to make use of a MyBeach, he is obliged to clean the beach himself (this is similar to the concept of silence coupe in Dutch trains, an initiative of The Netherlands Railways). The MyBeach concept is intended for beaches with beach pavilions. At these pavilions brochures, signs, and recognisable bins are available, to make the tourists aware of the fact that they are making use of a MyBeach. The employees of the beach restaurants wear t-shirts with a MyBeach logo. In the Netherlands, two MyBeach sites exist since the summer of 2011. Both are in Noordwijk, one at 'Take 2' and one at 'Buitengewoon'. According to the foundation Nederland Schoon (an organisation paid by the packaging industry), the first is a success the second not. The additional measure proposed is to expand this concept to more beaches in the Netherlands. This measure is elaborated by Nederland Schoon by their proposal to create a toolkit consisting of brochures, signs, tshirt and bins that the beach restaurant owner can acquire for €10,000.

In 2011 Blue Flags have been awarded to 50 Dutch beaches. The blue flag is a voluntary eco-label to stimulate sustainable development of beaches and marinas. The label is awarded through strict criteria dealing with Water Quality, Environmental Education and Information, Environmental Management, and Safety and Other Services. Criteria awarded within this eco-label with an effect on litter are (http://www.blueflag.org/):

- The beach must be clean;

- Algae vegetation or natural debris should be left on the beach;
- waste disposal bins/containers must be available at the beach in adequate numbers and they must be regularly maintained;
- Facilities for the separation of recyclable waste materials should be available at the beach;
- An adequate number of toilet or restroom facilities must be provided;
- There should be no unauthorised camping, driving or dumping of litter on the beach.

A significant, but yet unknown proportion of litter on beaches is left on site by the visiting public. A better attitude towards (not) littering would thus help reduce the problem. Note that the high-profile public beaches where this concept might catch on best, are only a minor part of the total length of the Dutch coastline. On the other hand, beaches that receive most tourists might also receive most public-related litter.

The foundation Nederland Schoon organised the cleanest beach election. The reward for participation in the election is wide publicity for the winner and also stars are awarding for clean beaches. For municipalities it is tempting to stand high on the list. A reliable, independent organisation (The ANWB) is responsible for inspection of the beaches. For the election, many different parties are involved for each municipality (local administrator, beach managers, pavilion owners and audience).

Since 2002, the cleanest beach election is organised on a yearly basis. The result of this campaign: within five years, the beaches are two times as clean (according to Nederland Schoon). The total cost of this election for Nederland Schoon is €150,000 per year. Other costs made due to this campaign are changes in the design of the beach, extra beach cleaning, distribution of litter bags with a message meant for a behavioural change, et cetera (paid by the local government, beach managers, pavilion owners).

The cleanest beach election is attractive as it contributes to environmental sustainability, even as to tourist attractiveness. Assuming that the result of a 50% cleaner beach results in 5% extra tourists. The turnover on beach pavilions is about €400m. With 5% extra guests, this results in an extra revenue of €20m. Assuming a margin of 10% for the beach pavilions owners this gives €2m.

Type of measure
Raising awareness

Effect on the gap
MyBeach is a source oriented measure, reducing the amount of litter left at the beach by tourists. Public awareness campaigns are effective to keep beaches clean in the first place.

Uncertainty/ certainty analysis
In the Dutch situation, with large high-use public beaches, where the 'tourist population' is refreshed weekly, it is unclear to whom 'yourself' refers. In the cleanest beach election 'Yourself' might thus mainly refer to the stakeholders: the coastal municipalities, caterers and ngo's. They must create a sense of common interest with the general public to achieve the concept of do in yourself beaches. There is

little concept of responsibility for one's own beach if the site is only visited occasionally or for a short period of time.

The costs per measure
The costs of a yearly Mybeach awareness-campaign are €10,000 per beach restaurant. For the 380 Dutch beach restaurants, the total costs are €3.8m (LEI, 2011).

Who bears the costs?
The costs of this measure are paid by beach restaurants/pavilions.

Stakeholders view
Do it yourself beaches: this is valued as an interesting concept. It is still in development. Mainly aimed at litter that is left at beaches (by the public), not at litter that washes ashore.

Measure 3: Biodegradable balloons, balloon valves and ribbons

Measure

Current legislation
Since January 1st, 1995 in the Netherlands the 'Regulation cable kites and small balloons' is statuary. These regulations were drafted by the Minister of Transport. The scheme is based on the Air Traffic regulation (Section 3 of Article 1a) and focuses on the launches of cable kites, small captive balloons, small free balloons and mood balloons. The scheme defines a mood balloon as a small free balloon, or a combination of small free balloons, the height or width not exceeding 75 cm and without metal objects.

The regulation states that 'permission is required from the local air traffic control service if 1,000 or more balloons are simultaneously launched within a distance of 8 km from the border of a controlled airport.' Air traffic control service 'may refuse permission if the speed of the balloons - given the prevailing wind direction - will take over the landing area or areas in the vicinity, which aircraft approaching or departing, and so the order and regularity of air transport is disturbed' (Section 3 of Article 3 of the Regulations). The same applies for launches within a distance of 3 km from the border of uncontrolled civil airport (source: Aviation News, 2011).

Specification of the measure
Of all the helium balloons that are yearly launched in The Netherlands, a part end up on the beach and in the North Sea. Balloons are the number 7 item on the list of beach litter; about 14 balloons are found per 100 meter of beach during monitoring (see Table 8**Fout! Verwijzingsbron niet gevonden.**). The balloons themselves are probably not the major problem as these (79%, excluding the 21% foil balloons) eventually break down. The attached nylon ropes and hard plastic balloon valves do degrade. Public aversion against the image of derelict balloons on beaches (or in sand dunes, forests, et cetera) is growing.

In 2010, Air Traffic Control Netherlands has permitted 21 times the simultaneous launch of 1000 or more balloons. The total was about 45,675 balloons.

The total for 2011 (until Nov. 1st) is estimated as 15 consents with about 45,900 balloons. These launches are mainly from May to September. It often starts with the Queen's 'birthday' on April 30 and the Liberation Festival on May 5. Massive 'invasions' of such balloons have been observed at distances over 800 km away from the Netherlands (Van Franeker and Le Guillou 2006; Van Franeker 2008). Air Traffic believes that their figures cover approximately 75% of the real mass balloon launches. That would mean that every year approximately 61,000 helium balloons are launched that need permission from the Air Traffic Control must give. So these are just the launches from towns within a radius of 8 km from Schiphol Amsterdam, Eindhoven Airport, Rotterdam Airport and Maastricht Aachen Airport. We estimate that this area (and population) is approximately 10% of the potential area (and population) of all massive (more than 1,000) balloon launches. This gives an estimation of about 600,000 balloons released annually in the Netherlands (in massive launches). To assess the total number of balloons launched in the Netherlands (including the smaller launches) a few assumptions have to be made. We take into consideration balloon launches related to Queen's day activities, weddings, school events and other events (see Table 11).

Table 11: Summary of computation of total helium balloon launches in the Netherlands

	Population	% that launches balloons	Estimated quantity per launch	Total balloons
Big launches	200 (15*1.33*10)		3000	600,000
Queen's day	1100	25%	100	27,500
Weddings	83.000	20% (during 5 months)	50	86,000
Schools	7500	5%	100	37,500
Other events	20 per day		100	730,000
Total				1481,000

This means that a total of approximately 1.5m helium filled balloons are yearly launched in the Netherlands. According to the KNMI Climate Desk on average about 10-15% will drift towards the North Sea. So between 150,000 and 225,000 balloon will annually fly towards the North Sea. Most of them will end up in the North Sea and a small percentage will reach England.

In 2010 on average per 100 meters of beach 13 pieces of balloons or balloon remnants were found (Draft monitoren zwerfvuil, 2005-2010). If these figures are convert into balloons along the entire 340 kilometres Dutch coast, 44,200 pieces from the North Sea washed to shore. Note, however, that the DCS also receives balloons from neighbouring countries. The number of balloons from the UK must be considerably larger. Suppose that in England also 1.5m balloons are launched annually, then the prevailing westerly winds will blow perhaps 85-90% of those balloons towards the North Sea. That means that about 1.3m balloons may end up in the North Sea.

This measure will be divided into 2 (sub) measures:

A. A ban on all massive balloon launches (more than 50 balloons simultaneously);
B. Substitute Plastic Balloon Strings for natural materials.

Measure 3a A ban on all massive balloon launches (more than 50 balloons simultaneously)

Measure
One option is a total ban of all massive balloon launches. This means a ban of balloon launches of 50 balloons or more.

Type of measure
Regulation and enforcement, raising awareness

Effect on the gap
A ban on all launches with 50 or more balloons simultaneously would first apply to most of the 1.5m balloons launched yearly. The launches during wedding parties, school festivities and other activities are not affected if they launch less than 50 balloons. Suppose that half of these events is prohibited, then the ban will reduce the annual balloon launches to about 300,000. This is a reduction of 80%.

Uncertainty/ certainty analysis
PM

The costs per measure
Assuming the cost of an average helium balloon is €0.60, meaning that revenues for this sector reduce approximately €720,000 (these do not equal the costs). However, it is expected that balloon launches will be substituted for other activities related to this sector. A ban on mass releases of more than 50 balloons is a quite effective measure because it reduces the airborne balloons (with nylon strings) with 80%. However, only a small part of these balloons would end up in the sea. This measure could be more effective if it is targeted to a strip of the Netherlands within 25 km from sea (or when eastern wind prevails). The costs will be reduced if alternative festivities substitute balloon launches (LEI, 2011).

Who bears the costs?
This measures results in less revenues for the (leisure) sector, if the expected balloon launches will not be substituted for other activities related to this sector.

Stakeholders view
Biodegradable balloons, balloon valves and ribbons: Many stakeholders point out that biodegradable plastics may not be a good solution as they still decompose in small particles (even faster than normal plastics) and therefore are also problematic. However, products are available and under development.

Measure 3b Substitute Plastic Balloon Strings for natural materials

Measure
Strings of coloured hard nylon, polypropylene or polyester ribbon are customary tied to helium balloons. These strings entangle birds and mammals. During mass releases of balloons no plastic ribbon or string should be attached to the balloons. Sisal is

an alternative for plastic strings. Sisal rope is resistant to moisture and is therefore adequate in humid environments. Other alternatives are strings made of hemp or flax. Natural balloon strings are three times as expensive as plastic ones.
(source: http://nl.wikipedia.org/wiki/touw).

Currently companies that deliver balloons for mass releases (an estimated 500 to 700 companies) use strings made of nylon, polypropylene or polyester. The desirable situation is that all these strings are replaced by biodegradable sisal, hemp or flax ropes. Furthermore, the companies and organisations (schools, associations, et cetera) that buy balloons for massive launch must consciously choose biodegradable strings. A change in behaviour is required by both event organisers, businesses, schools, et cetera. Another option is that in a mass release of balloons no longer a plastic ribbon or string should be attached to the balloons. The balloons without a ribbon should be held together in a large net. But without a string no name cart can be attached to each balloon to enable a contest. During festivities other contest possibilities exist. A campaign is necessary to achieve this (personal communication with Renate De Backer, Wadden Sea Society, October 2011).

Type of measure
Source oriented measure, raising awareness

Effect on the gap
It is not easy to estimate the effectiveness of such a campaign. It is assumed that less than half of all businesses, schools, clubs, et cetera. will choose and pay for the relatively more expensive biodegradable. However many may choose alternatives to releasing balloons once they are aware of the consequences.

Uncertainty/ certainty analysis
PM

The costs per measure
The total estimated cost for the entire campaign will be approximately €150,000 (personal communication with Renate de Backere, Waddenvereniging, October 2011). The extra costs for the ribbons are €0.0165 per balloon rope. Total annual costs are €175,000 (LEI, 2011).

Who bears the costs?
The measure will probably result in additional production costs, which are paid by the packaging industry. These extra costs can be included in the consumer prices.

Stakeholders view
Biodegradable balloons, balloon valves and ribbons: Many stakeholders point out that biodegradable plastics may not be a good solution as they still decompose in small particles (even faster than normal plastics) and therefore are also problematic. However, products are available and under development.

4: Stricter enforcement on the use of port reception facilities to collect waste

Measure

The MARPOL 73/78 Convention, and especially through its Annex V on garbage, is the primary international instrument to control marine litter pollution from ships, including fishing vessels and leisure crafts. According to these, ships should deliver all their wastes ashore, and…'the Government of each Party to the Convention undertakes to ensure the provision of facilities at ports and terminals for the reception of garbage, without causing undue delay to ships, and according to the needs of the ships using them.'

In the Netherlands, in 1995 under the Pollution Prevention Act by Shipping, 35 seaports are designated that shall provide adequate reception facilities for wastes from shipping. Different types of port reception facilities (PRF's) for waste receiving are available, for example mobile collection (rubbish boats, e.g. the port of Rotterdam have a big rubbish ship on its disposal), and there are specialised companies for waste collection and processing (such as Tank Cleaning Rotterdam). To keep the price as low as possible, the network of PRFs is designed to avoid monopoly positions as much as possible. In 2005, the European Directive on port reception facilities was implemented. Currently, enough port reception facilities are available in all Dutch harbours. It is not mandatory for ships to present their waste; they may keep this on board to be discarded in the next port. Amounts of garbage on board are logged and are checked at random. In Table 12, the amounts of Annex V garbage is given. From 2004 till 2010, the percentage of ships that deliver increased from 25% till 60%. Since the implementation of the Directive on port reception facilities in 2005, the delivery of the waste in the Netherlands increased by 50% (Atsma, 2011). Atsma (2011) indicates that the Netherlands are dedicated to further strengthen the waste delivery requirement for ships departing form a Dutch port to a port outside the EU.

From 2013 onwards, dumping of all solid household waste is banned under Marpol Annex V. The average amount of waste delivered has reduced to a bit less than 1 m3, while the delivery right without paying extra waste delivery costs is, depending of the size of the ship, 3 till 6 m3.

Despite all the current regulation and facilities, in the autonomous situation, still significant quantities of garbage, including materials classifying as litter are discarded by ships (merchant and/or fishing), as evidenced by the piles of litter on our beaches (see Textbox).

Textbox: Litter on Dutch beaches

Significant amounts of litter arrive from the North Sea on Dutch beaches, indication that large quantities are dumped at sea, rather than taken ashore to port reception facilities. Van Franeker (2005) studied possible sources by examining labels and barcodes on pieces of litter removed from a beach at Texel, NW Netherlands. Items produced in 15 different countries were found, but most were produced in the Netherlands themselves and neighbouring countries (Belgium, France, UK). This suggests a large local, or at most, regional origin of litter dumped at sea that later washes up on our beaches. Subsequent surveys (unpublished data), both by Van Franeker and by RWS Noordzee yielded largely similar results: most items had been produced in the Netherlands, Germany and Belgium.

Table 12: The delivery of waste in the port of Rotterdam

	2004	2005	2006	2007	2008	2009	2010
Average amount of Annex V ship waste (m^3)	5	2	1	1	1	3	2
Number of ships discharging ship-generated waste (Annex V)	4,398	15,462	22,026	29,646	34,346	14,161	14,711

Source: Port of Rotterdam, 2009

In an evaluation done by Franeker and the SNS fulmar study group (2011) a decline in foamed plastic is found, which might be an indication that at sea waste disposal from ships is somewhat decreasing. Unfortunately, the intended environmental improvement is not realised. This implies that additional action is needed.

The port must have a good waste plan. Each ship pays (as supplement to the harbour), a contribution to the collection system, even if the ship does no hand in any garbage. The additional measure 'stricter enforcement on the use of port reception facilities to collect waste' can be elaborated into two measure stimulating a better litter management:

- Standard fee instead of paying per unit waste in port reception facilities, combined with mandatory waste disposal in each port: Make garbage disposal mandatory in each port, with equal costs (preferably included in harbour fees) across Europe. (100% indirect financing for all Annex V waste);
- Less waiting time before waste can be delivered to the port facility. Rules could be tightened, but also service could be increased, to the same effect. It should be made a harbour standard to send a garbage collector along every ship entering port (fees to be included into the general harbour fees) so to stimulate the 'free' disposal of garbage. Any ship not handing in garbage under such a regime would be suspect (disposal at sea?) and should receive extra inspection. Clearly, such measures should be taken across Europe to create a level playing field. Preferably, such measures should be taken across Europe to create a level playing field, but the service level offered by a port could also act as a good marketing instrument.

Textbox: Managing undesirable ship generated waste discharges in Marine Environments (Oranjewoud, 2012)

The Ministry of Infrastructure and Environment has asked Oranjewoud to give substance to the advices and recommendations of the LEI study regarding the harmonisation of port facilities, by drafting a protocol that can be used in international discussions with other Member States, ports and the shipping sector regarding how to deal with waste collection in ports and explore opportunities together with the stakeholders to do something with economic incentives for waste collection in ports. This study shows amongst others that the implementation of international shipping legislation is not the same in all EU- member states and that the organisation of waste handling and collection divers widely between the harbours visited. This makes the various levels of legal hierarchy complex and difficult to understand by those who are required to adhere to this legislation.

Furthermore, this study shows that enforcement of the existing legislation is not carried out to its fullest potential. The division of the responsibility for enforcement of marine legislation between ports and national authorities gives rise to capacity problems and miscommunications, thus resulting in a reduced effectiveness and enforcement. This high degree of diversity provides incentives for non-compliant behaviour, such as littering. In most of the cases, non-compliant behaviour is caused by a low chance of detection and the high costs of delivery of waste to shore.

The study also shows that differences can be found in the methodology on how the waste processing costs are charged to the ship (polluter pays principle). There are systems where ships pay on delivery (direct financing) or systems where payment is made through an integrated or fixed fee (indirect financing). Although waste costs form a small percentage of the total harbour costs, which could imply that harmonising these limited costs will not change the behaviour of ships, shopping with waste and dumping of waste at sea does exist. Apparently for some ships even relatively low costs, possibly combined with low service level and lack off transparency, do seem to be an incentive to shop with waste and even dump waste at sea. Harmonisation of the financing systems of harbours can eliminate any financial incentive for unlawful behaviour and is therefore recommended.

According to Oranjewoud uniformity and transparency of laws and regulations on ship generated waste in all European countries with an international port would improve the disposal of waste to shore and discourage waste dumping at sea. For more information see Oranjewoud (2012).

Type of measure
Regulation and enforcement

Effect on the gap
The effect is unknown, but potentially large as a large proportion of litter on beaches and litter on the sea bed stems from passing ships. This measure does not have an effect on the amount of garbage produced on the ship. In the last ten years, the amount of litter found on Dutch beaches and in the stomachs of fulmars did not

increase significantly, while simultaneous the number of shipping movements and the quantity of goods and packaging has increased. If this is the result of the extra measures taken in the last 10 years, a significant effect of the proposed measures may be expected. Franeker et al. (2009) concluded that the current mode of implementation of the EU Directive on port reception facilities since 2004, has not led to a measurable ecological improvement of the southern North Sea (Algemene Rekenkamer, 2010).

Several years ago, Sweden started with free port reception facilities for all. This attracted so much litter, probably also from free-loaders, that the measure had to be withdrawn. The lesson here is that the measure of a fixed fee is potentially highly successful, but should be implemented at every North Sea Harbour (pan-European at the minimum). 'Stricter enforcement' might be perceived as top-down management. Rephrasing this as 'Facilitating better …' would help to gain support from those impacted by this measure.

Whether an effect can be expected from introducing a fixed fee depend on the reason why ships do not hand in their garbage at the port reception facilities are. Possible reasons are: a) the vessels have the required space for waste storage on board, and do not want to spent time to hand in their waste, b) the port reception facilities are not convenient for the vessels, handing in garbage takes too much time, c) handing in garbage is too costly and d) enforcement of existing regulation is not strict.

Reason a, if the vessels have the required space for waste storage on board, handing in can be postponed till a next port. If this is indeed the case, no effect is expected.

According to experts, the port reception facilities are not convenient for the vessels. The procedure for waste up is unnecessarily complicated because forms must be filled. Due to this, it remains for the shipping cheaper and easier to handle the waste overboard.

Fishing vessels do not use common port reception facilities, but they have their own means. For fishing vessels waste reporting obligations do not exist. This dichotomy makes it harder to estimate which parts of litter on beaches stem from merchant vessels and which parts from fishing vessels (unless one source is clear, i.e. fishing equipment). Also for marinas, a waste plan is obliged. The larger marinas typically have a container system for separate collection of waste. The waste disposal rules are obliged for the larger vessels.

In the EU directive on port reception facilities, it is required that the cost of waste collection to a substantial part (at least 30%) should be covered by indirect financing. The Netherlands take the most lenient way: 30% ('Wet Voorkoming Verontreiniging door Schepen', WVVS), to protect commercial trade interests. This implies that ships have to pay an amount for waste delivering, independent of whether waste is actual given off. In Table 12 waste delivery in the port of Rotterdam is given. In Table 13 the prices of waste delivery in the Port of Rotterdam is given. The price of waste delivery is a fixed fee per ship, within the waste delivery right. Big ships (more than 4.000 KW have a waste delivery right of 6 m3). A waste delivering ships receives a discount on the fee.

Table 13: Fee and discount for household waste, plastic and small chemical waste in the Port of Rotterdam

Category	Main engine	Fee (in euros)	Delivery right ship generated waste (Annex V) in m^3	Discount per waste delivery (in euros)
A	1 – 1.999 kW	195	3	80
B	2.000 – 3.999 kW	195	3	80
C-G	4.000 - ≥ 30.000 kW	275	6	150

Source: Port of Rotterdam, 2009

If ships do not hand in their garbage because it is too expensive, introduction of a fixed fee, this reason will disappear. In that case the costs for garbage disposal are made indirect, ships entering the port pay the full price for garbage disposal anyway, whether they have garbage to deliver or not. This would ultimately reduce costs of garbage disposal and increase effectiveness. Currently, Member States are to some extent free to manage harbour fees, resulting in differences between European countries and even between ports within the same country. Such differences are detrimental (Nijdam and De Langen, 2005). This measure should be taken at a European scale, but an effect of this measure may be expected.

The EMSA audit concluded that many ships only hand in the waste paid for within the indirect financing will limit (EMSA, 2008). Non harmonised regulations in different European harbours may be an explanation for the decline in the average amount of waste delivery. Two examples of non-harmonised regulation: 1) in harbours abroad the delivery right is different, for example in Hamburg the delivery right is about 1 m3 and 2) according to harmonised regulation, a ship with enough space for waste storage is not obliged to deliver waste in the harbour. It is remarkable that harmonised regulation on the required space for waste storage is missing.

Due to the MARPOL convention any skipper or captain must for entry into a port report how much and what waste he has on board. Better control on these reporting obligations could be an alternative measure as well, to stimulate the vessels to hand in their waste.

Uncertainty/certainty analysis
The European guideline on port reception facilities is currently being revised. Consultation rounds started in June 2011. It might be wise to use this momentum to make headway with respect to this measure.

Dutch shipping merchants have flagged up the problem that including garbage fees for 100% into the general harbour fees will mean that merchants get less insight in the actual costs of garbage disposal and of all other harbour costs. If this measure is only taken into account in the Netherlands, the effect may be that the harbour costs are relatively high. Taking in mind the competitiveness of the Dutch ports, the minister of Transport and Water Management decided in 2004 not to go for implementation of an 100% indirect harbour fee (Algemene Rekenkamer, 2010).

The costs per measure
PM

Who bears the costs?
This measure may result in extra enforcement costs. Furthermore, this measure may result in extra cost for the shipping sector and harbours.

Stakeholders view
Stricter enforcement on the use of port reception facilities to collect waste: It seems that especially the lack of uniformity and transparency among the harbours is a problem. In every harbour there are different rules and ships may 'shop' for the optimal waste conditions.

5: Additional beach cleaning

Measure
Beach cleaning during the bathing season is regularly carried out on high-profile, tourist beaches. Other beaches, receiving equal amounts of litter from the sea are not or less frequently cleaned and cleaning effort is low in winter. On-going monitoring of litter on North Sea beaches shows that about 30-40% is derived from marine-related activities such as shipping and fisheries (Atsma, 2011). Most beaches are cleaned mechanically. However, when mechanically removing the litter from the beach a large part of small litter items like cigarette butts, caps, candy wrappers, et cetera stays behind on the beach. Campaigns in the past reduced the amount of litter left on the bathing beaches. However small plastic elements are still left on the beach. To solve this problem, the focus should be on small litter prevention (cigarette butts, caps, candy wrappers, et cetera).

Additional (non-tourist) beach cleaning has been done at Ameland by beach wardens, under the Fishing for litter project, coupled to monitoring of litter (Coastwatch). Beachcombers in Ameland get a license if they remove litter from the beach (interview with Nederland Schoon). This could be an alternative for non-bathing beaches and other beaches that are only cleaned during the bathing season. Additional beach cleaning has been conducted at IJmuiden, Scheveningen and at various locations in the port of Rotterdam. Large quantities have been removed, to garbage processing plants.

The project 'Zwervend langs zee' (www.zwervendlangszee.nl) is meant to reduce the amount of litter on the beach within two years. Awareness is raised in nine beach location in the Netherlands. The type and amount of litter left on the beaches was initially monitored from an awareness point of view.

Municipalities along the Dutch and Belgium coast spend yearly about €10.4m to remove litter from the beach. The Hague has the largest costs; €1.25m in 2008 (Mouat et al., 2010), and also the most costs per km, about €100,000. Mouat et al. (2010) also advices to regularly emptying garbage bins and poster campaigns as the most effective measures to reduce litter. Even in case of abundant facilities to dispose of garbage, still tourist do not throw a large portion of their garbage in these bins.

Type of measure

Raising awareness, clean-up measure

Effect on the gap
A study on the island of Texel over summer 2005 indicated that that about 4.5 to 7.5 kg of litter may wash up per km per day on Dutch beaches (Van Franeker 2005). In this study 30 tonnes of litter was removed that had mostly accumulated over a single winter, indicating the high accumulation rates of debris if not periodically removed. Or will 'disappear' into the North Sea. Beach cleaning may thus change the appearance of a beach from heavily littered to 'clean'.

Monitoring of beach litter uses OSPAR protocols and results are forwarded to the Dutch Ministry of I&M and to OSPAR (KIMO, online). The effect of additional beach cleaning is clearly positive for the indicator litter on beach and for the indicator litter in sea.

Uncertainty/certainty analysis
Beach cleaning is clearly effective (litter might be removed in large quantities). A note of caution here is that mechanical beach cleaning is very detrimental to the beach natural environment (bird nests, shelter, primary dunes, microhabitats). From this point of view, cleaning by hand is much more environmental friendly and more effective as it also removes small litter that otherwise will be left on the beach.

Textbox: The costs for Dutch coastal municipalities for removing beach litter (Ecorys, 2012).

According to the LEI study of 2011, the removal of litter from Dutch beaches is a potentially cost-effective measure. Hence, in 2012 Ecorys has been asked to give substance to the recommendations of the LEI by performing of an in-depth study on the costs for coastal municipalities in the Netherlands of removing beach litter. This was done through a combination of desk research supplemented by interviews with representatives of a representative sample of 16 (out of 28) Dutch coastal municipalities, complemented with some beach pavilion holders and representatives of interest groups.

The interviews with the coastal municipalities show that there is no standard recipe for waste management on beaches. There are large differences between coastal municipalities how they have organized their waste management, which parties are involved, and who is responsible for waste facilities and beach cleaning. This not only means that every situation is unique and should also be treated as such, which means that generic policy measures are less desirable or effective, but it also means that the necessary information to estimate cost figures had to be derived from different organisations. The information on costs related to litter on beaches is not always very transparent and easily obtainable. In addition, sometimes, 'third parties' incur part of the costs. This makes a good comparison of the costs between the various municipalities extremely difficult (see furthermore chapter 2 or Ecorys, 2012).

The study also shows that policies aimed at reducing litter might be rewarding, because this is a saving of the current cost. However, the effectiveness of possible preventive measures is crucial. Only when these measures are 100% effective cost reductions are possible, because even if half of the litter is still present at the beaches mechanical or manual cleaning is required. The majority of the total costs are fixed costs, so a waste reduction will not result in a linear decrease of the costs. The processing costs are strongly related to the amount of waste. However, the share of processing costs in total costs is limited, so further reducing the amount of waste on the beach by taking additional measures will not soon be cost effective.

At the same time, most beaches in the Netherlands have an A+ status, so they are already very clean. Even cleaner beaches will probably not result in more beach recreation. The above means that the opportunities for municipalities to reduce costs or increase revenue are in generally limited. Hence, in municipalities with crowded beaches and where it is policy to clean the beach every day with beach cleaners a reduction of waste on the beach will not soon lead to lower costs. The beach will be cleaned with the same frequency, also with less waste on the beach. However, this could be different for less crowded beaches where the beach is not cleaned on a daily basis. A reduction of the amount of waste could lead to less frequent mechanical cleaning, only cleaning when needed or a switch to manual cleaning.

The costs per measure
Costs can be as low as 10 cents per meter of beach, if beach cleaning is embedded in schooling programmes, with help of locals (mainly for heavy transports of collected litter: Van Franeker, 2005). If managed commercially, costs are higher. Doomen et al. (2009) computed the cost of cleansing 1 ha of beach manually as €36. They assume that the beach is cleaned manually 120 times a year. Yearly cost per hectare amount €4,320 per year. Using a beach cleaner (tractor with beach cleaner), will cost around €45 per ha (a worker can clean 1.2 ha in 1 hour). They assume that 50 meters width of the beach is cleaned. So 0.2 km coastline is equal to 1 ha.

Bangura, 2011 interviewed 6 coast line municipalities. These municipalities cover 88 km of coastline. Of this coastline, 16 km is never cleaned-up. These municipalities pay €1.75m per year for beach cleaning. If we assume an equal spread of the clean-up costs over the other km, the cost per km is €24.000. For these 6 municipalities, 18% of the beaches is never cleaned.

Who bears the costs?
The costs for additional beach cleaning have to be paid by the coastal municipalities.

Stakeholders view
Additional beach cleaning: could work well, this is a measure that may invoke good behaviour from others provided that the cleaners are well-recognisable for the public.

6: Biodegradable nets / deposit system on nets

Measure
A few decades ago natural materials like pure drawn hemp and flax have been used in the fisheries. As their failure, replacement, and repair rates were very high, these natural fibres have been replaced by artificial fibres, nylons. The life time of bottom-trawling nets is estimated to be 6-12 months (Taal, K., personal comment.). During this period many small repairs and adjustments are made on deck. Small wires or parts of these nets may get flushed into the sea instead of being collected in litter bags during the cleaning of the deck. This may be as much as 75% of the total amount during repairs at sea. The bigger parts of the nets will be handed over at the harbour and processed onshore. Repairs of set nets are mostly done onshore. Therefore, small pieces of set nets do usually not end up in the sea. However, larger pieces of set nets may be lost at sea during fishing operations. Based on current knowledge it is not possible to estimate the amount of set nets lost at sea.

To solve the problem of micro-plastics in the sea, the idea of compostable nets is worth considering, as an alternative for biodegradable nets. This idea of biodegradable nets goes against fishing standards: nets are expensive and should last. Biodegradable means: breaks easily up into smaller parts. This might solve the problem of ghost nets in the longer term, but will significantly increase the problem of micro plastics in the marine environment and will have adverse effects on fish, birds and marine mammals. Most compostables are compostable on industrial scale, between 65-70 degrees. That does not mean that this kind of compostable plastic

will break apart in water from 10 to 30 degrees Celsius. And if it does, it also happens during normal operation, which makes this kind of compostable plastic no alternative material for fishing nets. The alternative is to look for compostable plastic with a longer lifetime. In this case, it will take much longer before the material is fully composted. Let us assume the life time of a normal net is one year. Most probably, it will take at least 5 to 10 years before the net is composted. (For more information on the difference between compostable plastics, see measure 11).

As biodegradable nets will not have the expected effect on GES 10, marine litter, we specified the measure in stimulating fishermen to handle their nets, and the litter as a result of repairs and adjustments made on deck (small wires or parts of the nets) more carefully. This could be implemented by a deposit return system on used nets. Buying new nets should require handing in old ones. The objective of the return system is to discourage illegal or improper spill of nets. According to NCEE (2001) deposit-return systems appear best suited for products whose disposal is difficult to monitor and potentially harmful to the environment. If old nets are lost (or discarded) at sea, a new net would be more expensive to buy. Fishermen will then pay for the ecological damage they cause by losing their nets. Nets are already an expensive asset for fishermen, hence they will not easily spill their nets. A side effect of this measure is that fishermen are stimulated to return whole nets or big parts of the net. However, a considerable part of the problem is that often only parts of nets are lost or discarded. Little can probably be done about accidental losses, but active discarding can be discouraged by e.g. providing big bags in concert with the fishing for litter programme to all ships, and by education to fishermen: all rope and netting, large or small, should never be discarded as it is detrimental to the environment from which the fishermen themselves obtain their income. This elaboration of the measure is a kind of awareness raising. This alternative relates to measure 15 'adding individually recognisable ID-markers to fishing nets and wires'. The same deposit return system could apply to other items commonly used in fisheries, which are also commonly found discarded (washed up on beaches) such as fish boxes, gloves, et cetera.

Type of measure
Source oriented measure, raising awareness

Effect on the gap:
Currently 220 beam trawlers fish on the DCS (Dutch Continental Shelf). The question is what will be the effect of the return system on the percentage/amount of nets lost. In the autonomous situation, fishermen do not lose their nets on purpose. The nets are necessary for them to earn their income. The expectation is that the effect of a return system of nets will be small. A positive effect can be expected as the number of (parts of the) nets collected in litter bags increase. Pieces of net and nets entangled with other litter are number 3 and 9 of litter found at Dutch beaches (**Fout! Verwijzingsbron niet gevonden.**). Nets and pieces of net are also ranked first of the large pieces of litter found (Table 9). This measure is effective because it directly affects these important litter items.

Uncertainty/ certainty analysis
The amount of netting discarded and lost by fisherman is unknown, as are the impacts. The impact of this measure on fishermen behaviour is difficult to estimate.

The costs per measure
The costs of the specified measure deposit return system on (parts of) used net are the additional costs manufacturers or vendors of nets that will become subject to such a return system incur for handling the returned (parts of) nets. Returned nets are considered as litter without a market value. Furthermore, the administrative costs of this return system have to be determined (handling the fee that buyers have to pay who did not hand in enough nets).

Who bears the costs?
The manufacturers or vendors of nets that will become subject to such a return system incur extra costs for handling the returned (parts of) nets. Furthermore, the fishing industry can incorporate extra costs for handing in nets.

Stakeholders view
Biodegradable nets: Many stakeholders point out that biodegradable plastics may not be a good solution as they still decompose in small particles (even faster than normal plastics) and therefore are also problematic. An alternative measure that targets a deposit system on nets is questioned by the sector. Nets are valuable to fishermen and they therefore take good care of not wasting nets. it is therefore doubtful that a deposit on the nets will lead to a change of behaviour.

7: Adding individually recognizable ID-markers to fishing nets and wires

Measure
Nets and wires are the capital equipment used by fisherman to earn their income. By using the nets, there is a risk of damaging or losing their gear. The risk of damaging the nets depends on environmental conditions (e.g., weather, currents, tides, sea state, presence of sea ice, the makeup of the seafloor); the condition of the gear, equipment, and vessel; as well as a suite of economic pressures and regulatory factors. So, the fisherman is able to influence the risk (Ocean Studies Board, 2009). 'Fishing' encompasses a broad range of activities pursued with a variety of equipment; therefore, solutions to prevent and reduce nets and wires must be tailored to the different types of gear, their impacts, and the primary causes of loss. In this analysis we take into account: Beamtrawling, Bottom-setnets.

According to current MARPOL regulation it is now allowed to throw nets over board. The measure of ID markers, in cooperation with legislation, is a measure to reduce the discharge of unwanted fishing gear and the careless loss of waste gear. By a requirement to mark nets, these can be identified and traced to its source. Assuming that the measure of ID markers is technical possible, this does not immediately mean that this measure will have an effect. An effect can be expected in conjunction with accountability and/or liability law. MARPOL Annex V (Regulation 6c) states that 'Accidental' loss of synthetic fishing nets is allowed, provided that all reasonable precautions have been taken to prevent such loss' (International Maritime Organization, 2006c). At this moment MARPOL is being revised. This revision will be effective 1/1/2013. By then it is not allowed to dispose nets at sea. This revision of MARPOL will reduce the amount of nets in sea. So this revision (when being effective) will reduce the gap and contribute to the litter objective of MSFD.

For the time being and in addition to MARPOL we recommend to examine the scope of current laws. Although the regulations under public law are currently insufficient,

the chances to hold a fisherman liable for the loss of (parts of) his fishing gear on the ground of 'wrongful act' increase significantly when this event is attributable to the fisherman (which might be the case when using ID markers) and damage has occurred as a result of it. The scope of wrongful acts is not limited to illegal acts, but includes acts that are immoral or anti-social (like environmental pollution). Not only private parties but in certain cases, also governments have the possibility to recover damages by invoking civil law.

Fishing gear in beamtrawling mostly is marked (by welding beads) as this gear is expensive, large and heavy. Retrieving lost gear is thus important and if another fisher retrieves the gear owner's disputes are easily settled by these markings. ID-markers on nets are probably only feasible on very large, pelagic gear, i.e. gear used outside the North Sea. Bottom-setnets could in theory be marked, but often lengths of several km are set in one string (of 50 individual nets). This would mean that very large numbers of tags would be required; it also means that complete sets must be lost to be certain that the marker is lost with the net. In reality, many fragments of net are discarded at sea (such parts are the number 3 litter item on Dutch beaches, see Table 8); it would be easy to remove tags from pieces of torn netting before dumping these.

Type of measure
Regulation and enforcement

Effect on the gap
To create an effective measure, the nets found have to be analysed to determine the owner. Therefore, net litter found on the beach has to be sorted and identified.

Uncertainty/ certainty analysis
PM

The costs per measure
An option for making fishing nets and wires recognisable is the use of recognisable molecules. It is possible to put very specific kinds of molecule structures in nets. Two important technical problems arise. First, to avoid any effect on the properties of the nets, the amounts must be pretty small. Problem two is the number of licens-es. To make the nets per licensed fisherman recognisable, many different, unique molecules have to be made. Therefore, quite complex structures of molecules are needed. The larger a molecule, the more options you can vary. And large, complex molecules that must be made in small quantities are per definition expensive. Think of an order of at least €1,000 per gram (source: plastic expert).

A cheaper alternative for making fishing nets and wires recognisable is to build in an RFID chip. We assume that the properties of the net are not affected by RFID chips. Such chips are already in use for different purposes, for example in food packaging, tickets, et cetera. At an RFID chip it is relatively easy to store a lot of information, and they are very small. This makes it possible to add many of these chips (assume 250) in one net. Furthermore, they are cheap to make (selling price around €0.15 (http://blog.odintechnologies.com/bid/52341/What-do-RFID-Tags-Cost). An RFID scanner (selling price from €30) is needed to read information from those chips.

We assume that for 340 km beach, four litter inspectors are needed. The total annual costs are €328.500 for the 220 beam trawling nets. This measure could also be effective for other kind of nets (LEI, 2011).

Who bears the costs?
This measure may result in extra costs for nets and wires. These additional costs are paid by fishermen. Furthermore, litter inspectors are needed to collect the nets and wires. The costs of the litter inspectors are paid by the government.

Stakeholders view
Adding individually recognisable ID-markers to fishing nets and wires: This will only work if loosing nets can be limited at all. Nets are considered valuable by fishermen who often turn around to retrieve lost nets (see biodegradable nets).

8: Reduce the use of plastic bags in supermarkets

Current legislation in the Netherlands
In 1990 the Dutch government and the relevant economic sectors concluded the first covenant on packages, which primary objective it is to reduce the amount of packages including plastics. The first action to be undertaken in this voluntary agreement - leading to visible results in only one year - should be to 'stop issuing free bags in supermarkets' (Ministerie VROM, 2008). This measure was not implemented in the Netherlands until 2011. Due to EU-competition regulation, a ban on use of plastic bags provided by supermarkets in the Netherlands is not a feasible stand-alone measure. Plastic bags cannot be prohibited when they fulfil all norms (see European Parliament and Council, 1994), which is the case for free-issued plastic bags. The EU is investigating at this moment whether a sustainable packaging guideline is an option to supplement or replace the Council Directive 94/62/EC.

Specification of the measure
Plastic bags can be divided in free plastic bags weighing 3 to 6 grams (type 1) and plastic bags that are sold by supermarkets for €0.10 till 0.20, and weigh between 30 till 80 grams (type 2). This type of plastic bags is more frequently reused. The first type of plastic bags is light and vulnerable to be transported by the wind and water, and therefore end up as street litter and marine litter. Reducing the amounts released into the environment would thus help reducing amounts on beaches and presumably in the sea. Bans might be hard (total ban) or soft (environmental fee on plastic bags). The measure is specified in two directions, namely 9a 'Ban on issue of free plastic bags by retail', and 9b 'introduction of a fee on plastic bags'. The latter measure is based on the renowned example of the Irish PlasTax, see textbox below.

While European countries as Austria and Italy have a total ban on the issue of free plastic bags in the retail (Measure 9a), countries like Ireland, Switzerland, Germany, Sweden, Spain, Norway and the Netherlands have implemented a fee/ tax on issuing 'free' plastic bags to customers in the retail (Measure 9b). Portugal postponed the idea of plastic bag taxation, but some supermarkets starting taking initiatives themselves, by implementing a symbolic €0.02 fee for each bag (Perestrelo Luis and Spinola, 2010). In Denmark a tax is applied to producers and retailers. The taxes differ strongly between countries. Ireland installed a tax of €0.28 per bag. The Netherlands uses a general packaging tax affecting producers, which for a free plas-

tic bag in a supermarket, would mean a tax of €0.003 per bag. The costumer is not charged directly.

Type of measure
Regulation and enforcement, raising awareness.

Effect on the gap
To be able to quantify the effect of both measures, the number of plastic bags distributed per year and the number of plastic bags found on the beach are needed. The 5,600 Dutch supermarkets sell around 460m plastic bags (type 2) annually to clients. The share of supermarkets in the plastic bags that is paid for by clients is over 90%. Furthermore, 2 billion free plastic bags (type 1) are issued per year by retail. (Personal communication with different experts).

The share of plastic bags issued by the Dutch retailers (type 1) ending up as litter on Dutch beaches is unknown. What is known is that 87% of all litter found on beaches is plastic. Small pieces of plastic are ranked second and sixth (0 to 2.5 cm and 2.5 to 5 cm respectively (see Table 3.3). On basis of Table 3.3, approximately 700 pieces of plastic bags are found on a stretch of 1 km beach per year. Assume all these pieces are from different plastic bags (type 1), and only plastic bags that are issued in the Netherlands end up on the Dutch beaches, a quick calculation reveals that at most 1 in 8,000 issued plastic bags would end up scattered on 340 km of Dutch beaches.

Measure 8a: Ban on issue of free plastic bags by retail
Alternatives (paper bags, PP fibre bag, canvas bags, burlap bags, heavy duty bags) are available as are systems for reuse of plastic bags by consumers (tassenbol.nl). The question on the answer which bag has the least environmental impact depends on which environmental impact category is considered. For litter on the beach, paper seems to be more attractive, but as a result of pulp, the paper production process and the weight of the material per bag, paper is assessed the highest environmental impact (Lewis et al., 2010). The expected effectiveness of the measure 'ban on issue of free plastic bags by retail' for the indicator litter is low because this measure is not targeted at litter on the beach. The effect of this measure is limited to that portion of the plastic bags that end up in the sea and on the beach. This will be a small fraction of all plastic bags issued. For municipalities along the coast this fraction will be higher.

Type of measure
Regulation and enforcement, raising awareness.

Effect on the gap
PM

Uncertainty/ certainty analysis
PM

The costs per measure
Preparation-costs for 'a ban on issue of free plastic bags by retail' in the Netherlands in terms of decision-making costs are not high, since implementing such measure does not need adaptation of laws. Prevention-costs, the costs foregone after imple-

menting the measure - are considerable. This measure will reduce the costs for removal of both street and marine litter, and will reduce the costs for garbage-management. The annual costs of removing street litter (€250m per year) in the Netherlands (LEI, 2011)

Who bears the costs?
This measure may result in enforcement costs for municipalities.

Stakeholders view
Ban on use of plastic bags in supermarkets: this measure was later rephrased as a deposit or fee on the use of plastic bags in supermarkets. This is regarded as an effective measure by some stakeholders, but one with a much higher impact than for the marine environment alone.

Measure 8b: Fee on plastic bags in supermarkets
Introduction of a fee on plastic bags is an interpretation of the polluter pays principle, as it provides a financial incentive. It is an attempt to influence consumer behaviour (Ayalon et al., 2009). This measure is based on the renowned example of the Irish PlasTax, see bellow.

Textbox: the Irish PlasTax
In March of 2002, Ireland implemented a PlasTax of €0.15 on one-time use plastic bags (with exceptions for bags used for packaging meat and produce). The bags were claimed to create a negative visual impact and were obstructing drains. Within months, plastic bag consumption dropped over 90% and litter visibly decreased across the nation. (In a nation highly dependent on tourism, the aesthetic detriment of plastic bags was a main catalyst for this legislation.) In the next year, plastic bag consumption dropped from 1.2bn bags (more than 300 bags per inhabitant) to 60m bags while €9.6m were generated for environmental protection. After initial opposition to the tax, retailers ended up strongly supporting the bill as the average supermarket increased reusable bag sales while saving €50m/year from lower grocery bag stocking costs. Finally, enforcement costs borne by the Irish government were minimal as the tax receipts were provided to the government along with revenues from the national Value Added Tax (VAT) (Convery et al., 2007).

Ayalon et al. (2009) analysed the effect of various levies on the use of plastic bags in Israel. The effects can be divided in volume-, substitution- and innovation- effects. Two billion plastic carrier bags are used annually in Israel. A levy of about €0.20 will decrease the consumption of plastic bags with 88%. Since 6% of the bags used outdoors have a potential of creating an environmental nuisance, the levy will be effective if this number will also be reduced with 88% (or a smaller percentage). Experience in Ireland shows an erosion in the public's cooperation with the levy mechanism (Creagh, 2007). The first sharp reaction of the market to the levy has been moderate, and 5 years later consumption rose. Comparison of the 2006 usage rate with the one before the tax rate shows a decline from 94 to 91%. In July 2007, the levy was increased in Ireland from €0.15 to €0.22.

A tax seems to be effective to reduce the amount of plastic used and therefore reduces the chance on plastic being introduced in the marine environment. The example of Ireland is the most striking. The example of Portugal shows that a rather

symbolic charge to customers of €0.02 has a relatively large effect on the reduction of plastic bags consumption in supermarkets, namely 27% reduction in plastic bag consumption. Basically there are three effects of a fee/taxation on plastic bags:

- Increase in the abstention of plastic bags (because customer bring sustainable bags from home);
- The reutilisation rate of plastic bags increases;
- Filling optimisation of the used bags.

Type of measure
Regulation and enforcement, raising awareness.

Effect on the gap
Based on the Irish example, the effects and the costs of a fee on issuing plastic bags in retail for the Dutch situation are estimated. We expect consumer-behaviour between consumers in the Netherlands and Ireland to be comparable. A fee of €0.15 will lead to 90% reduction of used plastic bags. Assuming that the same holds for the Dutch situation, and a linear relationship between free plastic bags and litter on the beach, this will result in 90% less plastic bags or parts of plastic bags on the beach.

Uncertainty/ certainty analysis
PM

The costs per measure
In the Netherlands the estimated amount of free plastic bags issued is 2bn annually. The total costs of setting up and maintaining a fee system in the Netherlands will approximately be €6.6m per year. This measure results in an annual cost paid by the consumers of €23.4m. Whether this is indeed a cost depends on what happens with this money. If this amount adds to the general funds, only administrative costs are left (LEI, 2011).

Who bears the costs?
This measure results in setting up and maintaining a fee system. These costs have to be paid by the retail industry. Furthermore, the general public (c.q. consumers) will have to pay a fee for plastic bags.

Stakeholders view
Ban on use of plastic bags in supermarkets: this measure was later rephrased as a deposit or fee on the use of plastic bags in supermarkets. This is regarded as an effective measure by some stakeholders, but one with a much higher impact than for the marine environment alone.

Measure 9: Deposits on all plastics

Measure
'A deposit-refund system is the surcharge on the price of potentially polluting products. When pollution is avoided by returning the products or their residuals, a refund of the surcharge is granted.' (OECD, 2011) Deposit Return Systems (DRS) are reported, in the literature, to have a range of possible environmental
benefits. The key ones mentioned in the literature are:

1. Increasing the recycling of containers covered by deposits (for refill or recycling);
2. Reducing the extent of littering;

A review of Hogg et al. (2010) based on available theoretical literature, suggests that deposit return schemes (DRS) are an efficient means of increasing recycling rates and reducing litter, though a key issue in moving from theory to practice is determining the costs of administering and implementing the system (see Table 14).

Table 14: Overall Costs and Benefits of a Deposit Return System on all bottles in the UK, €millions

	Cost or Benefit (negative is a cost), in €millions
Financial Effects	
Deposit Refund System (to Producers)	-€233M
Collection and Treatment/Disposal (to Local Authorities)	€175M
Change in Cost of PRNs (conservative estimate)	€33M
Collection and Treatment/Disposal (to Commerce)	€19M
Consumers (unclaimed deposits)	-€540M
Net Financial Costs	-€547M
Environmental Effects	
without disamenity	€76M
with disamenity	€1,448M
Total Benefit to Society	
without disamenity	-€471M
with disamenity	+€902M

Source: Hogg et al. (2010)

Hogg et al. (2010) investigated the costs and benefits of a DRS for bottles in the UK-wide, through bottom-up modelling (Hogg et al., 2010). Their results show that based on the financial effects only, the costs exceed the benefits. If the amenity value of the litter reduction is valued the benefits are larger than the costs. This scheme proposed by CPRE (NGO in UK) includes both glass and plastic bottles - €92m setup cost, €770m annual running cost net of revenues (these figures differ from Table 3.7, in this table only the sum of costs and benefits is presented). The Deposit Return System has low cost to producers because of unclaimed deposits. Savings of €175m for local authorities due to reduced waste management needs were found in the UK. Significant net air pollution benefits and amenity benefits.

To focus this measure, it is specified into two measures, namely measure 17a; 'Deposit on fish crates' and measure 17b; 'Deposit on small plastic bottles'.

9a. Deposit on fish crates

The North Sea Foundation that monitors the litter on Dutch Beaches (e.g. see Table 8) estimates that annually 1,000 fish crates are found at the Dutch beaches. These can be either Dutch or foreign (Belgian, French or British due to southern current). The fish auction in Urk loses yearly 500 fish crates. These can be lost at sea, and wash at the Dutch coast (or northern beaches), but they can also be disposed of as garbage.

The Urk fishermen take empty crates when they sail off for fishing and return the crates with fish at the auction. They receive €0.10 per crate they return (free from VAT). The deposit differs among the Dutch auctions. If we assume that 100 beam trawlers bring in 300 crates per trawler weekly, the total deposit is €3,000 per week. It is not sure whether the amount of crates that end up in sea will be reduced if the deposit on crates increases. The current €0.10 per crate can be too small for a real incentive. A higher deposit per crate can quite easily be implemented, because the deposit system on crates is already functioning.

Type of measure
Source oriented measure

Effect on the gap
PM

Uncertainty/ certainty analysis
PM

The costs per measure
PM

Who bears the costs?
This measure will results in costs for a deposit return system. These costs are paid by the packaging industry.

Stakeholders view
Deposits on all plastics: this does not seem to be a measure acceptable to the Dutch (packaging) industry. Also it is a measure that should not be taken for the marine environment alone. However, the measure is successful in Scandinavian countries and Germany.

9b. Deposit on small plastic bottles
The problem with respect to the pressure resulting in litter on the beach are small plastic parts. However, monitoring touristy beaches for the 'Zwervend langs Zee' project shows that drinking units in any form: glass or plastic bottles, tetrapacks and cans are in the top of litter left behind on beaches by tourists. Not all beaches are cleaned all year round or even every day during the bathing season so especially plastic bottles have a high potential of ending up in sea. Also during busy days, beaches are cleaned after visitors have left and due to wind or the tide coming in, again, a part of this litter will be swept into the sea. Also, when at sea, a deposit system on all drinking units will help prevent them to be thrown overboard.; the caps are the problem, not the bottles. In the Netherlands, 650m big bottles (0.7, 1 and 1.5 litre) are sold per year. On top of this, at least 650m small bottles are sold. Based on Table 8, it is calculated that around 75,000 caps are found on Dutch beaches per year. If the origin of all these caps are Dutch small bottles, 0.01% of all the caps sold per year are found as litter on the beach.

A deposit return system does not solve the problem. In the existing deposit return system on bottles, bottles can be handed in without the caps of the bottles. To solve the problem of caps on the beach with a deposit system, the system should not only be extended to small bottles. The system should be adjusted in such a way that only

bottles with a cap can be handed in via the deposit system. The costs of a deposit system on bottles is estimated on 5.5 Eurocent per bottle, for big bottles. The value of the returned bottle is estimated on 2 cent. The net value of the material of small plastic bottles is lower than the net value of bigger plastic bottles (Lavee, 2010). As 95% of the bottles are returned (a €0.25 per bottle), the returns of this system for the retailer are 1.55 cent per bottle (Bureau B&G, online) Assuming that the cost of a deposit system on small bottles with cap is comparable with the current system for big bottles, and if the value of a small bottle is negligible, the costs of a return system for small bottles will be around €0.04 per bottle. Due to the refund system, benefits can be realised by savings in alternative treatment costs, clean public spaces, external effects of energy savings and smaller landfill volumes (Lavee, 2010).

An alternative to a deposit system is to ensure that the caps are fixed to the bottle. The price difference between a fixed cap, and a screw-cap is about 2 cent. The main reason is that the weight of a fixed cap is about double a screw cap. So the cost of producing the fixed cap costs more material and more energy, and in the end more waste. In order to process only fixed caps, production lines must be converted, an operation that cost tens of thousands of euros. Filling bottles with fixed caps is more complicated, this will increase the costs as well (Personal communication, 2011).

Other alternative measures are a ban on plastic candy wrappers, and other measures that reduce small plastic litter found on the beach.

Type of measure
Source oriented measure

Effect on the gap
PM

Uncertainty/ certainty analysis
Means to this end have been tried before in the Netherlands, and failed. Discussions sprang up on intake points, heights of taxes, logistics, public safety, et cetera. However, decreasing the amounts of plastics used overall is the only means to effectively reduce the problem at its source. There seems little sense in the fact that 1 litre and 0.7 litre bottles are under a return regime, while smaller bottles and other packaging items are not. The same applies to tetrapacks, tins, bags, and other items. It should be possible to recycle these items, as is proven in countries abroad.

The costs per measure
Based on the assumptions made above, the cost for 75,000 caps less in marine environment is €26m. This is almost €350 per cap. This is not a cost effective measure for less litter on the beach. This measure has also important positive side effects, it also reduces litter in urban and rural environment (LEI, 2011).

Who bears the costs?
This measure will results in costs for a deposit return system. These costs are paid by the packaging industry.

Stakeholders view
Deposits on all plastics: his does not seem to be a measure acceptable to the Dutch (packaging) industry. Also it is a measure that should not be taken for the marine

environment alone. However, the measure is successful in Scandinavian countries and Germany.

10: Fishing for litter

Measure
Directorate-General for Public Works and Water Management and the fisheries sector agreed in 1999 that fishermen will bring in the litter they catch during fishing activities. Before this project, the fishermen did not take this kind of litter to the port, because they had to pay for the disposal of litter. Since 2000, in the fishing for litter programme, fishermen have special big bags on board to store the litter they accidently catch. At their returning in the port, they deliver this litter to a waste collector that takes care of the waste processing, paid by Directorate-General for Public Works and Water Management. KIMO since, has expanded this project to all Dutch harbours.

Fishing for litter is viewed by the experts as an educational and public relations measure, not as a general solution to the problem. The environmental gain has not been evaluated yet. In defence of the measure, however, it might be said that fishing for litter greatly increases awareness of fishermen to the problem of litter. In this sense, it is not only an end of pipe measure (removal of litter) but it also helps to prevent the dumping of litter in the first place: it is easier to dump litter in the fishing-for-litter big bag on deck, than dumping it overboard, fishing it up later, and then dumping it into the same bag.

Initiatives (in southern Europe) to licence -obsolete- fishermen to fish for litter, i.e. target litter rather than fish, should be avoided. One cannot catch litter alone, biota will always be by-caught. Moreover, such measures are in fact subsidies to the fishing industry.

Type of measure
Raising awareness

Effect on the gap
In 2009, 69 different vessels from harbours across the country (Breskens, Colijnsplaat, Delfzijl, Den Helder/Texel, Den Oever, Eemshaven, Harlingen, IJmuiden, Lauwersoog, Scheveningen, Stellendam and Vlissingen) participated in the fishing for litter project. Together, they brought in 228,000 kg of litter. The project is to be broadened to include several Belgian ports (Rijkswaterstaat, online). These figures have apparently increased to 80 vessels and 300,000 kg of litter in 2010 (Rijkswaterstaat, online).

Uncertainty/ certainty analysis
There is no information on the amounts of litter present at sea. Most litter brought in by fishermen was caught by beamtrawling, i.e. originates from the seafloor. Floating litter (surface and mid-water) is largely left untouched. Some incidents at sea generate large quantities of (floating, visible) litter. Suggestions are sometimes heard to have fishing for litter fishermen deal with this problem (and pay them to do so). This might seem cost-effective, but one has to realise that the netting used by these fishermen (beam trawls) might not be the most suitable removal tools. On the other hand, the authorities do not have better means at its disposal.

The costs per measure
The price of a big bag is €10, waste treatment costs are €200 per 20 tonnes, and monitoring €4,000 per 20 tonnes. Additional costs: the time of civil servants to manage the project, litter disposal.

Who bears the costs?
This measure may result in additional costs for civil servants to manage the project. Furthermore, the big litter bags have to be paid and the collected waste have to go to a treatment plant. These costs are paid by the government.

Stakeholders view
Fishing for litter: this is a successful concept (130 ships at the moment) but scale-up would be welcome. Additional financing is needed. Also it is seen as a problem that collected chemical waste is charged to the fishermen (fills up the quota). Possible (economic) incentives to promote this practice are welcome (e.g. special treatment during waste delivery).

11: Higher fines for littering

Measure
This measure stems from the high fines for littering in for instance Singapore. To maintain this clean and green city, there are strict laws against littering of any kind. First-time offenders face a fine of up to USD1,000 (approximately €575). For repeat offenders it is a fine of up to USD2,000 and a Corrective Work Order (CWO). The CWO requires litterbugs to spend a few hours cleaning a public place, for example, picking up litter in a park. The litterbugs are made to wear bright jackets, and sometimes, the local media are invited to cover the public spectacle. Naturally, the authorities hope that public shame will make diehard litterbugs think twice about tossing their scrap paper or cigarette butt on the roadside (Singapore, 2011). The Singapore National Park Board issued 8300 fines for littering in their various parks (Singapore, 2010). Hence, although the high fines and strict enforcement, still a lot of offenders are caught.

Current legislation in the Netherlands
According to the Dutch legislation *'Besluit bestuurlijke boete overlast in de openbare ruimte'* a fine of €90 is issued if a recreation area is used against the rules valid for that area, by disposing of litter, garbage, remains of foodstuff, paper, cans, bottles or packaging material (Staatsblad 2008 580). In the Netherlands 69% of respondents is in favour of higher fines as a solution for the litter problem (Agentschap NL, 2009). While many support the use of enforcement, studies show that few jurisdictions are able to enforce littering laws effectively for two reasons: (i) Lack of personnel available for such a low priority issue and (ii) the fact that it is difficult to 'catch' offenders in the act.

Littering at sea cannot be controlled directly: policing the seas is nearly impossible. Aerial surveillance is applied to enforce legislation on dumping garbage (primarily oil). The number of observed oil slicks has reduced, despite a fourfold increase in the number of flights (Carpenter, 2007). Enforcement of legislation for dumping oil in sea is more easily than that for litter. Where clear evidence of illegal disposal of litter is available, alleged offenders can be prosecuted under The Merchant Shipping

Regulations 1998 (Prevention of Pollution by Garbage). The maximum fine in the UK was increased in 1997 from €5,500 to €27,500 in a Magistrate's Court and is unlimited on conviction before the Crown Court. But there have been very few successful prosecutions in the UK for illegal dumping of litter at sea, especially when compared with those for oil spills, due to the difficulty in obtaining enough evidence to undertake a successful prosecution. The main difficulty with enforcement, and hence prosecution of MARPOL offences, is acceptability of evidence - photographs or video footage are rarely available but are the best way of securing a conviction. Beachwatch report 2005 (Marine Conservation Society, 2006) reports 3 convictions in the UK during a period of almost 10 years. In a US case in 2003, the Captain of the Muskegon Clipper was sentenced to two years in prison as the 'person responsible' for dumping trash bags full of asbestos and renovation debris.

Littering at sea should be tackled in ports, by port waste reception facilities, education and increased fishing for litter programmes. Maximum fines can be applied to act as a sufficient deterrent to illegal discharges of litter. These fines should secure greater use of port reception facilities for oil and garbage by visiting ships, bringing the shipping industry in line with terrestrial industries. Additional evidence may now be available with the introduction of mandatory ships' waste management plans and garbage record books, required under the Merchant Shipping (Prevention of Pollution from Garbage) Regulations 1998. Inspection of garbage record books should reveal anomalies in the amount of waste present on ships, as compared with benchmark surveys of the predicted amounts of waste, which should be on board. Unfortunately, this will always be compounded by limited resources and pressing schedules.

Controlling littering on beaches (by the general public) is a matter of education, setting rules, and enforcing them. The levels of fines (or penalties, penalty charges and non-compliance fees) are set using different criteria - in some cases on the costs of damage, or on an 'affordability basis', or on other factors such as legal limits or precedents set elsewhere. Sometimes non-compliance fees are significantly higher than the costs associated with compliance if done correctly. Fines and penalties can focus specifically on beaches (e.g., for littering specific items, including cigarette butts), fishing-related gear (e.g., illegal disposal of unwanted fishing gear, bait boxes, line, sinkers and hooks) or illegal dumping. Penalties range very widely depending on the country and scope of the problems. Revenues can be used to help awareness campaigns or to provide additional waste receptacles and other infrastructure support. In Washington State a litterbag in vehicle or watercraft was mandatory (RCW 70.93.100). The USD95 fine for failing to have this litterbag was repealed in July of 2003. One of the two important reasons was that patrol officers felt that persons who were not littering met the intent of the law whether or not they had a litterbag. Because of these concerns, the 2003 Legislature increased the fines for littering and repealed the litterbag law. In 2008 on state highways in Washington State (USA) 344 citations were issued for throwing litter; 202 warnings and 144 tickets (Washington State 2009). Hence, a lot of offenders are caught, but most of them get away with a warning.

Type of measure
Regulation and enforcement

Effect on the gap

An advantage of this measure is its source based orientation, directly reducing the amount of litter in sea and on beaches. The effectiveness of this measure depends on the level of enforcement and collection of fines. The measure can be elaborated for the sea and for beaches. The effect at sea will be limited. A larger direct effect is expected on public beaches. For tourist beaches that are cleaned daily in bathing season, the effect will be much smaller, because (most of) the litter would be removed that night.

Uncertainty/ certainty analysis
The effectiveness of this measure is unknown. At sea the effect is small, on the beach is can be considerable if it is enforced and if enough possibilities to dump litter are available (e.g. garbage bins).

The costs per measure
Tentative cost statement: 23 coastal communities, times 1 police officer for 6 months per year, times a yearly salary. Note that in the US life guards have the authority to hand out fines: this would enhance the stature of life guards in the Netherlands and would probably be more cost-effective. This results in extra annual costs of €0.9m (LEI, 2011).

Who bears the costs?
This measure results in extra enforcement costs for coastal communities. However, this can also results in extra income received from fines.

Stakeholders view
Higher fines for littering: all stakeholders that had an opinion on this measure feel that this measure will have no effect. It would be better to improve enforcement of the already quite high fines.

12: Different packaging standards of plastic pellets

Measure
Plastic (resin) pellets are the raw materials for plastic products. Plastic may be formed into pellets of various shapes, sizes and colours. The most commonly produced resins include polyethylene, polypropylene, and polystyrene. After being formed, the pellets are packaged and transported to processors for molding into plastic products (US EPA, 1993).

Trends of marine pellet pollution worldwide are negative. New players, i.e. companies producing pellets from recycled plastics are apparently less regulated and constitute a growing part of the problem (Van Franeker, pers. comment). A level playing field, i.e. applying the same rules to newcomers, would further reduce the gap. All industrial plastics taken together are only a minority (20%) of current mass of plastics in stomachs of northern fulmars (showing a negative trend). The expert opinion is that the inflow of plastic pellets will decrease autonomously, reducing the pressure of plastic pellets in sea.

Pellet loss can occur at any stage of operations. Open valves, outlet caps and top hatches are frequent causes of material spills (Source Operation Clean Sweep, Oc-

tober 2010). In terms of transports of plastic pellets - for which a different packaging standard might yield in less pellet loss - large bags conveyed in ocean containers are currently mainly used. These containers are transported on containerships over the oceans.

Type of measure
Raising awareness, regulation and enforcement.

Effect on the gap
Compared with larger forms of litter, plastic production pellets are more difficult to clear from a beach but are aesthetically less obtrusive. The main ecological risk associated with pellets, however, appears to be their inadvertent (or sometimes selective) ingestion by animals, including birds, fish and invertebrates, resulting in diminished foraging ability and feeding stimulus, loss of nutrition and intestinal blockage (Ashton et al., 2010).

Uncertainty/ certainty analysis
The effectiveness of the measure is unknown. Plastic resin pellets are produced in a very high production volume all over the world. Worldwide production of plastic grew by more than 500 per cent over the last 30 years till approximately 80m tonnes in 2010. Current annual global plastic resin pellet production is estimated at over 244 billion kilogrammes and is expected to increase by 3 per cent a year (World Plastic Market Review and Plastics Europe Market Research Group 2010). A tiny percentage of this production volume spilled in the marine environment already constitutes a large volume, with potentially negative effects on biota.

Experts indicate another production method for plastics, evading the use of plastic pellets in the production-process globally, might be more effective to decrease the introduction of plastic pellets in the marine environment. Another less drastic measure with some effectively to direct spillage of pellets in the sea according to Operation Clean Sweep is to: Place resin containers in ship holds and avoid or even prohibit stowing resin containers on deck. Both measures are not further elaborated here.

The source and age of resin pellets is hard to identify. Hence the relative contribution of separate industries and transporters is unknown, which makes it difficult to determine effective source based measures. More stringent rules would mainly affect new industries.

The costs per measure
The costs of this measure are not elaborated.

Who bears the costs?
The package industry will incorporate part of the costs due to different packaging standards of plastic pellets. Furthermore, sectors using plastic pellets will incorporate the extra costs for the alternative.

Stakeholders view
Different packaging standards of plastic pellets: the problem is known to both the shipping industry and the harbours. Plastic pellets are present at the bottom of the sea and flush ashore. It is however unclear whether plastic pellets are still disposed

of at sea. Under IMO it is already regulated that no plastic may be discharged to the sea. Flushing bulk cargo is regulated already and is no longer a problem due to different construction techniques of ships. It seems that measure should focus on dealing with the pellets that are already in the sea instead of stopping the disposal of plastic pellets.

13: Biodegradable user plastics at beaches

Measure
The annual turnover of all beach pavilions is on average €500.000,- per year (2008). This is generated by about 54,000 visitors per pavilion (branchprofiel 2008). The total amount of plastic packaging sold annually by beach pavilions in the Netherlands is unknown. The trend is that more customers are eating at the beach-pavilion venues, instead of taking food (including the packaging) from the beach-pavilions to consume at the beach (personal communication).

As mentioned in the specification of the biodegradable nets measure (5), it is important to make the distinction between degradable, biodegradable and compostable. These terms are often used incorrectly and interchangeably. Biodegradable plastic is plastic which will degrade from the action of naturally occurring microorganism, such as bacteria, fungi, et cetera over a period of time. Note, that there is no requirement for leaving 'no toxic residue', no requirement towards the material in which the plastic degrades (e.g. toxic or poisonous environments) and no requirement for the time it needs to take to biodegrade. Biodegradable plastic is therefore plastic that will undergo a significant change in its chemical structure under specific environmental conditions resulting in a loss of some properties. Compostable plastics (shortly biocompostables) are a new generation of plastics which are both biodegradable and compostable. They are derived generally from renewable raw materials like starch (e.g. corn, potato, tapioca, et cetera), which is made into a resin, cellulose, soy protein, lactic acid, et cetera are not hazardous/toxic in production and decompose back into carbon dioxide, water and biomass when composted. Some compostable plastics may not be derived from renewable materials, but instead derived made from petroleum or made by bacteria through a process of microbial fermentation. In order for a plastic to be called compostable, three criteria need to be met under semi-industrial composting condition:

1. Biodegrade - break down into carbon dioxide, water, biomass for at least 90% over 6 months;
2. Disintegrate - after 3 months at least 90% of the original material should pass a filter of 2 mm;
3. Eco-toxicity - the biodegradation does not produce any toxic material and the compost can support plant growth.

A plastic therefore may be degradable but not biodegradable or it may be biodegradable but not compostable (that is, it breaks down too slowly to be called compostable or leaves toxic residue). Current standards (from the European Standardization Committee (CEN) EN13432) are that compostable plastics need to be broken down for 90% within 6 months whereas biodegradable plastics need to be broken down for 90% in 2 years.

It is required - due to the shorter breakdown time and the importance of a lack of toxic residue (see GES 8 pollutants) for the marine environment - to rephrase the

measure 'Biodegradable user plastics on beaches' in a more ambitious measure 'Compostable user plastics on beaches'. Our analysis towards effects focuses on the latter.

Type of measure
Raising awareness, source oriented measures

Effect on the gap
Being green on the beach is mostly a matter of public awareness and education. As such, measures such as providing (truly) biodegradable packaging materials, specially geared to be used on beaches, will help both the public, the local retailers (green image) and coastal municipalities, if managed properly. Overall effects are small, as the material concerned are only a fraction of all litter on beaches, but only a changing attitude to the general problem will ultimately solve it.

Uncertainty/ certainty analysis
The discussion on compostable plastics - in relation to effects on marine environment - continues on several themes.

A. Compostable standards indicate that residues could remain after 3 to 6 month industrial composting conditions; degradation and composting under natural conditions will be much slower.
B. Are there really no residues of all compostable plastics after biodegrading and disintegrating in the marine environment. Striking is that disintegration tests include an analysis of the effect of the remaining residues (biomass) for plant growth. So the re-use potential is investigated. However, the compounds and substances in biomass are not measured, and unknown (North Sea Foundation).
C. Compostable plastics don't digest like normal food when eaten by marine animals. The microbes that digest micro-plastics are available in stomach and digestive tract environments, but will need, depending on the size and type of compostable plastic, at least 6 months to digest compostable plastics. The gap for marine litter - via the indicator of ingestion of plastics by Northern Fulmar - is not reduced with this measure.
D. What are the marine ecosystem benefits when plastics disintegrate faster but microscopic parts - taken up by algae - remain in the water. The smaller the parts the more difficult to remove, and the smaller the parts the more susceptible to get into the food chain. Disintegration of plastics is not the solution, but the problem. Residues of compostable plastics might be non-toxic but can still be hazardous for marine life.
E. 'Paper' packaging might be a multi-layer composite of paper and thin plastic. This, in combination with fatty substances such as mayonnaise, meant to be kept within limits by the plastic lining, are a fast vector into a gull's stomach. As this example indicates, alternatives should be carefully checked by an independent agency before they are put onto the market.

The costs per measure
The additional costs in the production of compostable plastics compared with synthetic is 30-60% depending on technology and the scale on which biodegradable products is used already (www.bdpplastics.com). Since packaging costs constitute only a fragment of the price of sold consumer goods, these extra costs to substitute plastic for biodegradables are feasible. In terms of expected effects on the target,

via the indicator 'litter shows a negative trend on the beach compared to the level in 2008' the expectations are low. Adverse effects, due to changing consumer behaviour, need to be taken serious. Overall the cost-effectiveness for this measure is considered low by experts.

Who bears the costs?
The measure will probably result in additional packaging costs, which are paid by the packaging industry. These extra costs can be included in the consumer prices.

Stakeholders view
Biodegradable user plastics at beaches: Many stakeholders point out that biodegradable plastics may not be a good solution as they still decompose in small particles (even faster than normal plastics) and therefore are also problematic.

Extra measures with an effect on GES 10 (Marine Litter)
Several alternative, additional measures to reduce litter at sea and on beaches were brought up:

1. Stop the usage of microplastics in cosmetics and use biodegradable alternatives in e.g. peelings;
2. Clean up sewage overflow points, by installing filters;
3. Set regulations on plastics usage (return systems!) in marine aquaculture, where currently large numbers of items, such as floaters, are lost;
4. Start studies on the drainage of microfibers from clothing, via our washing machines (http://pubs.acs.org/cen/news/89/i39/8939scene1.html);
5. Development of improved information systems and fisheries management measures that reduce conflicts between fishing gear and other user groups (Ocean Studies Board, 2009);
6. Documentation of position and reasons for gear loss (Ocean Studies Board, 2009);
7. Inclusion of degradable elements in synthetic gear to reduce the potential of entanglement and ghost fishing. (Ocean Studies Board, 2009).

Table 15: Overview of the most cost-effective measures to reduce the amount of litter in the marine environment

Nr.	Specified measure	Effect on the gap	Annual costs (in euros)	Cost-effectiveness
1	Impose the use of alternative material to protect beam trawler nets	Reduces the biggest source of litter washed on the beach. Impact of coconut is expected to be smaller than plastic (but not scientifically analysed)	0 to 1.1m	Very cost-effective
2	Part of touristic beaches designed for tourists who take away their litter	Less litter on the beach	3.8m	By making the right stakeholders responsible for awareness, this will be cost-effective
3	Ban on mass releases of balloons	Relatively small part of launched balloons end up in sea. More effective in combination with weather	150 thousand	Awareness campaigns could be cost-effective

		forecast (rise awareness)		
4	Better port facilities	The effect is unknown, but probably large as large proportion of litter stems from passing ships		Cost-effective measure if adopted internationally
5	Additional beach cleaning on non-bathing beaches (once a year)	Less litter on the beach	1.5m	Depending on the timing and location very cost-effective
6	Deposit system on (parts of) used nets	Reduce illegal or improper spill of nets, the biggest source of litter on the beach	Not known	Only cost-effective if (parts of) nets are caused by illegal or improper spills
7	Adding individually recognisable IF-markers to fishing nets and wires	Reduce illegal or improper spill of nets, the first source of litter on the beach	330 thousand	Only cost-effective if (parts of) nets are caused by illegal or improper spills
8	Fee on plastic bags in supermarkets	Reduce the second source of litter on the beach	23.4m	Polluter pays, not targeted.
9	Deposit system on small plastic bottles	Less caps on the beach	26m	Polluter pays, not targeted
10	Extra fishing for litter (primary goal is litter, not fish)	Negative effect: decreased seafloor integrity		No[6]
11	Higher fines and more control on the beach and on sea.	Reduce illegal discharges of litter. It depends on the level of enforcement and collection of fines. In-creasing control on sea will hardly increase the risk of being caught	0.9m	Not cost-effective at sea. At the beach, not cost-effective
12	Packaging resin pellets	Autonomous development shows a reduction of pel-lets spilled by ships	Not known	
13	Compostable user plastic at bathing beaches	Overall effect are small, as the material concerned are only a fraction of all litter on beaches	1.9m	No

Source: based on LEI, 2011

[6] This concerns active Fishing for litter, not the current practice where litter is collected during fishing activities

4 Economic analyses: Cost-benefit analyses of additional measures with respect to marine litter

The previous chapter discussed various measures that can be implemented to reduce the amount of waste in the marine environment. The main focus was on the costs and effectiveness of those measures and also an attempt was made to prioritize them on the basis of cost effectiveness. This chapter discusses the benefits that can be expected if the amount of litter in the marine environment decreases.

The main objective of the Marine Strategy - and Dutch policy - is the protection of the marine environment by preventing deterioration and, where possible, to repair damage (see also Chapter 1). In addition, pollution and other disturbances of the ecosystem have to be reduced to a level where there is no significant risk to the marine environment, biodiversity, human health and the use of the sea. The use of the North Sea should be sustainable. Negative human influences should be minimal, so the marine ecosystem can function optimally and retains its resilience.

The main reason for taking action to reduce the amount of waste in the marine environment is the protection of the marine ecosystem, so that it can function well (and) sustainable. As stated earlier, the Dutch government did not state clear quantitative targets for the reduction of the amount of waste, but considers that litter does not belong in the sea anyway. At the same time, it is expected that, despite current policy efforts and many initiatives, the amount of litter in the marine environment will not decrease. Therefore, a reduction target has been formulated for 2020, together with supplementary policy.

The protection of the marine ecosystem can therefore be seen as the main benefits of reducing the amount of waste. The valuation (or quantification) of the benefits to the ecosystem is very difficult. Hence, the valuation of benefits is done in different ways. Section 4.1 describes the benefits of a reduction of litter in the marine ecosystem through pictures and narrative stories. Section 4.2 tries to quantify environmental impacts by means of the Nature Point Method. Section 4.3 provides a description of the more indirect social benefits. Finally, section 4.4 presents a summary of the various benefits.

4.1 Qualitative description of the ecological benefits of improving the marine ecosystem; a story with pictures[7]

One of the main goals of MSFD is to encourage the sustainable use of the marine environment and improving the functioning of the marine ecosystem. An improvement of the marine ecosystem can therefore be seen as the major benefit of the MSFD. This section will give a brief description of the environmental impacts of different types of waste:

- Litter on beaches;
- Waste floating at sea and in the water column;
- Waste on the seabed;
- Micro Plastics

Litter on beaches

The ecological impacts of waste on the beach depend on the type of waste and the ecological values of the respective beach. Quantitative data on the ecological effects of waste on beaches are not known, but (protected) animals can be entangled in debris on the beach (Figure 3) and can swallow smaller waste particles. Due to entanglement, animals may not longer be able to move freely, so that for example, they are no longer able to forage. Ingestion of waste may cause damage to organs, but also result in poisoning, or animals can become clogged. In addition, there may also be indirect ecological effects via the food chain (animals with waste are eaten by other animals). When waste from the beach enters the sea, for example by rising tide or by wind, then there may also be effects in and on the water (see next sub sections).

Figure 3: Waste tangled bird © Ecomare

Waste floating on sea and in the water column

Ecological effects depend on the quantities and types of waste. Known effects of lost fishing gear on the water surface or floating in the water column (Figure **4**), are the entanglement of marine mammals (Figure 5), fish and birds. Worldwide, hundreds of species have been identified to have been entangled in fishing gear. However, quantitative data for the North Sea are not available.

[7] Text largely derived from Bureau Waardenburg (2011), Praatje bij een plaatje.

Figure 4: Floating rubbish at sea © Cor Kuyvenhoven

Figure 5: Seal entangled in fishing nets. © Ecomare

It is also known that animals can swallow floating debris particles (Figure 6 and Figure 7). A frequently cited example of this type of effect is the amount of plastic in the stomachs of fulmars. During the period 2005-2009 916 stomachs of beached Fulmars in the Netherlands were investigated, of which 95% was found to contain plastic. On average, each petrel contained 30 pieces of plastic in its stomach, with an average weight of 0.33 grams per bird (Franeker, 2011). In the most polluted areas of the North Sea that level rises to almost double. Plastics contain harmful substances and also absorb pollutants, such as PCBs and pesticides from seawater. These substances are then released into the stomachs of fulmars, which in turn may poison the birds. In addition, when the stomach is full of debris, this takes away their natural hunger feeling away, and organs may be damaged, and constipation may occur (Franeker, 2011).

On floating litter various organisms can attach, including non-native species. This allows floating debris to contribute to the introduction and / or spread of non-native

species (Gregory, 2009). However, there are no known cases in which a non-native species entered the Dutch part of the North Sea in this way.

Figure 6: Seagull eating a balloon © Countingcoots.blogspot.nl

Figure 7: Micro Plastics from a stomach of a petrel. © IMARES Jan van Franeker

Waste on the seabed

Waste on the seabed has different adverse impacts on the marine ecosystem:

- Negative effects on benthos:
  Covering of the seabed by waste can lead to entanglement of soil animals. When waste moves back and forth on the seabed, it may also damage the benthos (Macfadyen et al, 2009).
- Ghost Fishing:
  Marine organisms, especially fish and crustaceans, can become entangled in lost gear (Figure 8 and Figure 9), as a result of which they might eventually die. The dead animals then attract scavengers, which then also get stuck (Macfadyen et

al, 2009). Particularly fish species that occur in deeper water – that are often growing slower and living longer – are very vulnerable to the effects of this so-called ghost fishing. During a collection campaign in Norway, in 600 nets 9,000 pounds of fish and crustaceans was found (Brown et al, 2005). Other species such as marine mammals, sharks and turtles can also become entangled in lost gear.

- Ingestion of waste:
  Smaller waste particles, in particular plastics, can easily end up in the stomachs of marine organisms.
- Growth on waste:
  Waste offers new possibilities for the establishment of various indigenous marine organisms, including barnacles, anemones, snails eggs, hydroids and bryozoans (Nicolaus, nd), but theoretically also for (invasive) non-native species.
- Toxic substances in the marine environment:
  Waste on the seabed is a potential source of toxic chemicals in the marine environment (including lead and plastics products).

Figure 8: A fish caught in a lost fishing net © Bureau Waardenburg, Wouter Lengkeek

Figure 9: An Edible crab caught in a lost fishing net. © Bureau Waardenburg, Wouter Lengkeek

Ecological effects of micro plastics

Plastics degrade very slowly (it takes hundreds of years). As a result, once in the marine environment, plastics remain there for a very long time, and therefore also cause ecological impacts for a very long time. An illustration of the long residence time of plastic in the marine environment is the example of a container ship that lost nearly 30,000 plastic ducks in the Pacific Ocean east of China in 1992. These ducks floated first with the dominant currents towards Australia, but fifteen years later, they were still found in the British Isles (Sciencepalooza, 2012).

Worldwide, there are several studies on the impacts of micro plastics in different organisms (Leslie et al, 2011), but to date there is little information available on micro plastics in the Dutch part of the North Sea.

In 2011, the intestines of over 1,500 North Sea fish were examined for the presence of plastics. Preliminary results indicate that 12% of the fish have waste in their stomach. About half of this is plastic waste (Wegner et al, 2012). Plastics have so far been found in herring, mackerel and cod, species also eaten by people (Foekema et al, 2011). Plastics in fish can lead to organ damage, poisoning and / or constipation. Effects on fish could then lead to effects on fish-eating birds, such as fulmars and mammals.

Furthermore, the Netherlands recently started investigating the reaction of lugworms on the presence of plastic particles in the seabed and the presence of nano plastics in mussels (Foekema et al, 2011). Mussels exposed to such particles seem to eat less, thus reducing growth (Wegner et al, 2012). The results of the study on lugworms are not available yet.

The international 'Pellet Watch project' is trying to gain some insight into the distribution of plastic pellets on beaches worldwide and the level of pollutants in the pellets (pellets absorbing substances) (pelletwatch.org). For the study of Dutch beaches also pellets were delivered (see also Figure **10** and Figure **11**).

Figure 10: Mermaids Tears on the beach of Terschelling. © North Sea Foundation, Merijn Hougee

Figure 11: Micro Plastics on the beach and in the water. © Deltares, Dick Vethaak

Conclusion

The examples above clearly show that marine debris has adverse ecological effects on the marine environment. Marine debris, including plastics, can lead to suffocation and death of fish, birds and marine mammals, and may impact on other species through impacts in the food web. In addition, marine debris may contribute to the introduction of non-native species. A reduction in the amount of litter in the marine environment has thus a direct positive effect (benefit) on the marine environment. Unfortunately there are still knowledge gaps about the extent of the impact (see chapter 8).

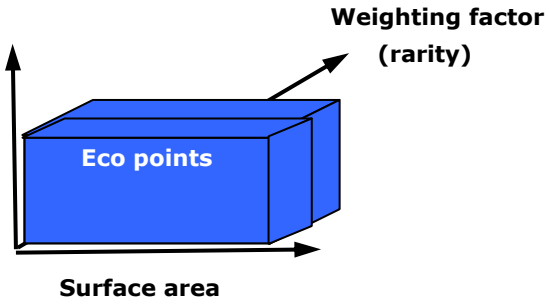
4.2 Quantification of environmental impacts using the Nature Point Method

For the purpose of the Social Cost Benefit Analysis, it was attempted to quantify the ecological impacts described in the previous subsection. The annex of the MSFD presents 11 elements (descriptors) that are important for the description of the good environmental status. In turn, these descriptors are expressed in various indicators (in total approximately 40). As a SCBA is designed to support the decision making process by providing clear and objective insight into the possible trade offs, it is undesirable to have one side of the equation 1 number representing the costs and on the other side (the benefits side) goal attainment being displayed in 40 different ecological indicators. That does not contribute to transparency. For this reason, a clear and structured approach had to be found to illustrate the impacts of various measures on the marine ecosystem. To explore this, the nature point method, developed by PBL, was applied to possible measures for the MSFD. (Http://www.rivm.nl/bibliotheek/rapporten/500141004.pdf)

The basic principle of the nature point method is that biodiversity of habitats is expressed in three factors: 1) habitat quantity, 2) habitat quality and 3) a weighting factor representing the importance of the respective habitat for biodiversity. The number of nature points is calculated according to:

Nature Points (total) = Σ all habitats (Surface x Quality × weighting factor)

In order to calculate habitat quantity a classification was made into 11 habitat types based on factors determining differences in species composition (grain size, depth and wave action). In order to quantify habitat quality, parameters ('metrics') were selected that correspond to the indicators for MSFD descriptor 1 'biodiversity' and for which data are available for the entire Dutch Continental Shelf (DCS).



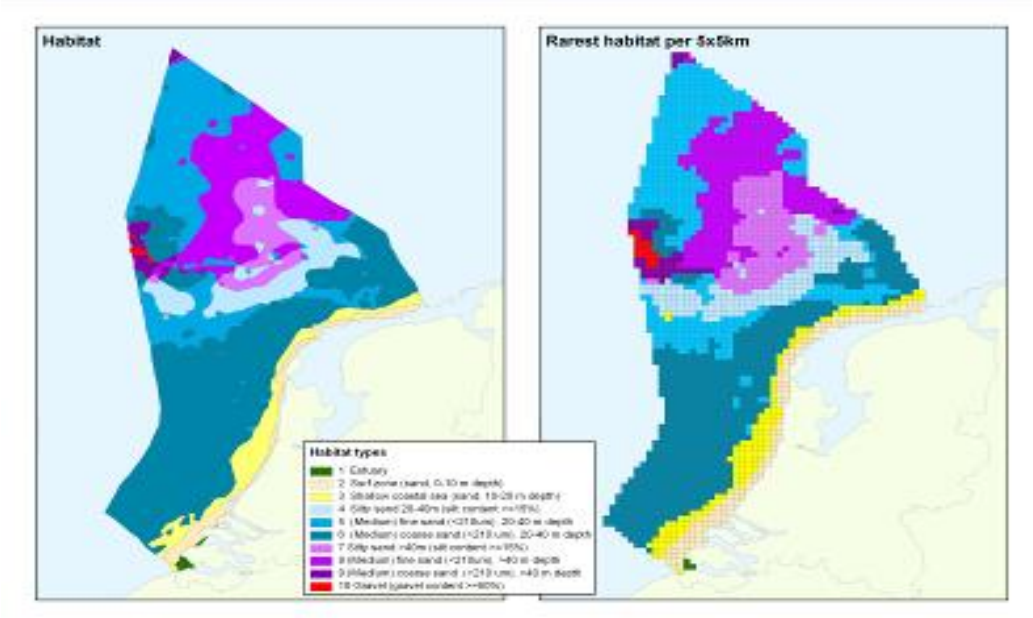


Figure 12: Classification of habitat types (Source: Bureau Waardenburg, 2011)

Habitat quality is expressed on a scale of 0 to 1 for each metric. Because MSFD descriptor 1 'biodiversity' focuses on maintaining the current level of biodiversity, the maximum quality per metric per habitat was defined as the highest value in the data set for each metric and each habitat. For the weighting factor different possibilities were explored: 1) Habitat Rarity. The principle is that each community has its own life habitat and that a rare habitat contributes most to biodiversity. 2) Number of habitat bound species. Habitats with many species that are highly dependent on that one habitat score higher (this approach is consistent with previous studies). 3) Social weighting, based on the social viewing directions ('maatschappelijke kijkrichtingen') of the Nature Outlook 2010-2040 of PBL.[8]

Table 16 shows the results for the reduction of waste at sea. This table shows that the reduction of waste at sea does not result in an increase in Nature Points. This means that a quantification of the most important benefits is unfortunately not possible. This is because there is no evidence that a reduction in the amount of litter in the marine environment has a significant effect that is reflected in the used metrics for biodiversity. This is not a disqualification of the nature point method, but an inherent result of the fact that plastic in the marine environment may be inconvenient for an individual, perhaps even fatal, but does not endanger the (performance of) the ecosystem as a whole.[9]

Although the effects on the functioning of the ecosystem as a result of reducing the amount of litter can not be quantified, a large part of the Dutch population - and the government - believes that the protection of the marine ecosystem is important and that waste does not belong in the marine environment.

[8] See http://themasites.pbl.nl/natuurverkenning/kijkrichtingen-voor-natuur

[9] The calculation is also applied to the introduction of hard substrate as soil conservation. See elsewhere in this report the results of that analysis.

Table 16: Eco points for reduction of marine litter

			Habitat type									
Factor			1	2	3	4	5	6	7	8	9	10
1	**Area (km2):**		**75**	**3225**	**3475**	**4950**	**12800**	**18975**	**5125**	**8800**	**1325**	**425**
	Benthos	Density	100	58	52	70	65	39	81	79	58	68
		biomass	100	74	71	73	57	46	85	71	71	92
		rarity	100	80	86	72	75	53	88	81	85	99
		large species	100	95	91	75	81	55	89	84	89	97
		species richness	100	44	38	75	69	35	87	88	75	75
	benthos total		*100*	*70*	*68*	*73*	*69*	*46*	*86*	*81*	*76*	*86*
	fish	rarity	100	22	22	28	36	19	34	31	35	38
		large ind. within species	100	60	63	68	65	57	57	53	57	100
		large species	100	64	68	71	57	51	73	59	61	63
		species richness	97	92	89	85	78	80	83	77	84	88
	fish total		*99*	*60*	*61*	*63*	*59*	*52*	*62*	*55*	*59*	*72*
	marine mammals	density	100	96	87	80	85	85	80	76	92	96
	mammal total		*100*	*96*	*87*	*80*	*85*	*85*	*80*	*76*	*92*	*96*
	birds	bird value	85	85	64	60	47	51	53	47	54	58
	bird total		85	*85*	*64*	*60*	*47*	*51*	*53*	*47*	*54*	*58*
2	**Total quality**		**96**	**79**	**70**	**75**	**70**	**63**	**76**	**72**	**76**	**79**
3	**Habitat fidelity**		**0,24**	**0,58**	**0,3**	**0,21**	**0,07**	**0,04**	**0,3**	**0,11**	**1,15**	**7**
	Eco-point total		17	1444	722	717	618	460	1087	643	1074	2320
	Eco-point gain		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

(Source: Bureau Waardenburg, 2011)

4.3 Social benefits

On top of the possible impacts of marine litter on the functioning of the marine ecosystem, litter in the marine environment may also have also impacts on human welfare (see figure below). E.g. waste on beaches may make beaches less attractive for recreation, and waste at sea can lead to problems with screws and damage to nets. Some of these effects can be expressed in monetary terms relatively easily; however, for other effects this may be more difficult. This section describes each of these benefit categories whether and how they can be expressed in monetary terms.

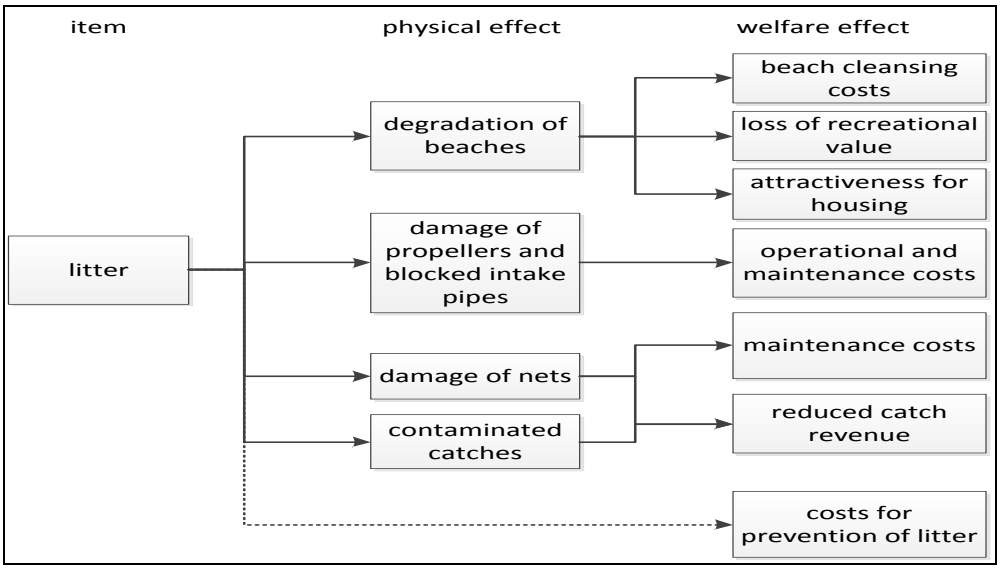


Figure 13: Use value related effects of litter. Sources: Mouat et al (2010), McIlgorm et al (2011)

4.3.1 Beach cleaning

A reduction of the amount of litter in the marine environment can lead to a decrease in the cost of cleaning up the beaches. In order to determine whether it is realistic to expect that these benefits will actually occur, and how large these benefits would be, an analysis of the costs of cleaning up beaches in the Netherlands has been performed in 2012 (see also the section the cost of current policies). These costs amount to approximately € 3.7 - € 5.3 million per year. It is estimated that around € 2.5 to € 3.5 million was spent on beach cleaning, thus removing litter.

This amount is considerable less than the amount the LEI estimated in their study. LEI (2011) estimates the benefits of beach cleaning using data of Mouat et al (2010), who provide data on the average costs of beach cleansing in the Netherlands (and Belgium) or about € 34,400 / km / year, with large deviations (e.g. a peak of € 97, 300 / km / year). These data are derived from a sample of 10 municipalities in Belgium and the Netherlands, and based on activities on the entire length of the coastline of their territory[10]. Assuming a beach length of 340 km, the total

[10] These values are comparable to the ones given by McIlgorm et al. (2001) for mechanical shoreline clean-up for France of € 32 600 /km/year The data for France are based on a litter density of 4

costs associated with beach cleansing would be of the order of € 11.0 million / year. This is close to the value of € 10 million / year by Ecorys (2007).

Because the numbers of LEI (2011) are partly based on budget figures and are also based on a smaller sample than Ecorys (2012), it is decided to use the figures of Ecorys 2012 for the current study. Below, a short description of how the cleanup of beaches is now organized.

Because mostly annual contracts with contractors are used because of the relatively high investments made in machinery, regular staff and organisation, a moderate reduction in litter is unlikely to result in proportional benefits. Furthermore, even moderate contamination levels could distract tourists, who could move to neighbouring beaches. Therefore, it can be expected that only a substantial reduction of litter would generate larger benefits. In particular in situations with an intense program of litter removal, for example in the case of Den Haag (Scheveningen/Kijkduin), with annual costs of over € 1.25 million (Mouat et al., 2010), the relation between the amount of litter and the total costs for beach cleansing will presumably be highly non-linear.

Furthermore, the effectiveness of possible preventive measures is crucial. In other words, how far is the fraction of litter by these measures reduced? For many measures, such as campaigns, garbage bags, etc. it is unknown what their effect is. Only at 100% effectiveness it is possible to talk of avoided costs, because even if half of the waste on the beach is still present mechanical or manual cleaning is still required.

Furthermore it is only possible to save costs for beach cleaning. The cost of container management and processing are not directly affected. However it is possible that a shift can occur of beach cleaning to container management.

For municipalities with crowded beaches, that have a policy to clean their beaches every day with a beach cleaner, a reduction of waste on the beach will not easily lead to lower costs. Also with less waste on the beach, the beach will be cleaned with the same frequency. However, this would be different for the less crowded beaches where the beaches are not cleaned every day. A reduced amount of waste could lead to less frequent machine cleaning, cleaning only when needed, or to switch to manual cleaning.

Finally, beach cleaning is heavily customized. There is no standard recipe for waste management on beaches. Every coastal municipality has good arguments on why they do it their way. This also means that any additional policies aimed at reducing waste on beaches is should be customized, and that the use of generic policy is less desirable or effective. The distribution of waste bags to visitors does not work always and everywhere, but it is dependent on the admissibility of the visitor for this kind of initiative. Also placing additional containers in one municipality works well, but on other beaches the risk of extra litter would increase. Offering tailor made solutions in the implementation of the policy, could avoided undesirable (opposite) effects.

tonne/km/year, whereas the Dutch/Belgian date are based on a litter removal intensity of approx. 10.5 tonne/km/year (724 tonne/year on 68.8km).

From the above it is clear that the total actual costs are not the benefits for implementing the measures. As has been remarked (and verified quantitatively by detailed studies about the operational activities and the intensity of the programmes), even a substantial reduction of the amount of litter will not attain appreciable benefits. In view of the above arguments, it seems unrealistic to assume that a reduction of the amount of litter on the beach as a result of additional measures to prevent the amount of waste in the marine environment will lead to a significant reduction in the costs of cleaning up the beaches. In other words, the size of the benefits is negligible.

Recreational value

In 2012 an extensive literature review has been conducted to collect all the information that is available on the recreational value of less waste in the marine environment. Three questions were important: First, are there studies that show a direct correlation between the number of times that people visit a beach and the amount of waste on the beach? Second, is there a link between the expenditures of visitors and the amount of waste on the beach? And finally, are there enough studies available that make a reliable estimate of the value that people attach to less waste on the beach possible?

In total 458 studies were found that say something about the recreational value of less waste in the marine environment. Of these, 44 studies were found to have conducted an original study (the rest was referring to earlier studies, or were translations of the original study).

Table 17: Overview results literature review

Language	**EN**	**FR**	**ES**	**NL**	**DE**	**NO**	**DK**	**SE**	**Total**
Full reviews	**30**	**4**	**6**	**0**	**2**	**0**	**1**	**1**	**44**
Economic valuation	11	0	0	0	0	0	0	0	11
Expenditure/economic impact	5	0	0	0	1	0	0	0	6
Behavioural Intentions	6	0	2	0	0	0	0	1	9
Attitudes and preferences	8	4	4	0	1	0	1	0	18
Short reviews	**155**	**30**	**6**	**7**	**10**	**8**	**8**	**9**	**233**
Brief/anecdotal evidence	90	30	5	4	2	3	8	7	149
No link from litter-recreation	65	0	1	3	8	5	0	2	84
No evidence	**47**	**40**	**21**	**0**	**41**	**5**	**21**	**6**	**181**
Original sources	**232**	**74**	**33**	**7**	**53**	**13**	**30**	**16**	**458**

Source: EFTEC, 2012

Table 17 shows the breakdown of sources found in the literature search. The searching produced 458 original sources: this includes those identified from the original web-searching and also additional references located through studies reviewed and individuals contacted. Of these, 44 presented evidence worthy of a full review. The studies selected for full reviews presented relevant information of some sort on the key "litter → recreation value" relationship of interest. In a few cases this was evidence on some measure of economic value. In some others, evidence is presented on expenditure or the impact on visitor economies. No studies were found that directly assessed impacts on actual visit numbers following changes in litter conditions – this would require 'before' and 'after' surveying, or comparison of sites that differ in litter levels but are otherwise similar, and no such studies were found. However, some studies did address 'hypothetical' behaviour, i.e. statements about behavioural intentions under changed conditions – for example, the level of litter presence at which a respondent would stop visiting an area, or the anticipated change in visit frequency if litter were cleaned up. And some presented evidence on

reported determinants of visit choices – i.e. the factors that respondents' state were/are important in selecting their visit destinations.

The largest group of studies reviewed provides quite general information on attitudes. Mostly these confirm the common-sense presumption that visitors prefer clean beaches, but there is little scope for using the numerical results for valuation purposes.

More or less the same applies to the evidence found for changes in beach visit frequency or location arising through reductions in litter. This information was patchy and largely hypothetical, and therefore, transfer of numerical results would not be appropriate.

Evidence on the local economic impact due to changes in litter (and associated changes in visitor numbers) was limited. While it appears clear that reductions in marine litter can lead to changes in visitor numbers and therefore visitor expenditures, there is no hard evidence that would allow estimation of the numerical impact.

Relatively few economic valuation studies were found in the literature review. Most that were found did not fully separate litter from other more general environmental quality issues, and this seriously reduces their suitability for transfer to evaluation of a policy specifically focused on litter reductions. It also means – as discussed further below – that there is no real scope for meta-analysis on this issue.

The most recent studies, by Tinch and Hanley, have been designed to allow separate consideration of litter ('debris'). These studies yield a range of values from different areas (Scotland, Northern Ireland, Republic of Ireland) with slightly different characteristics that, across the range, could be considered as reasonably close to the range of situations in the Netherlands, both climatically and in terms of populations. Within the limitations of the methods, and accepting the uncertainties, transfer of these values to the Dutch context would appear reasonably justified as a first approximation (see textbox below for a short description of the study).

To be conservative, the value for litter collection only (calculated as the value for 'collection and prevention' minus the value for 'prevention') should be used. The value for the Republic of Ireland is €0.60 per trip, while that for Northern Ireland is £1.35 (€1.64 in 2011). Thus, the values found in this study range from €0.60 to €1.60 per trip, for moving from partly littered to fully clean beaches.

One option for using these numbers would be to attempt to determine similarity between areas, using the Northern Irish values for more densely populated areas and more heavily used beaches in the Netherlands. Alternatively, the figures could be used as a high-low range across the whole country. This range should be considered alongside estimation of likely impacts of policy: if a policy of litter collection on beaches will not result in 'fully clean beaches', the values should be scaled back accordingly. The spread of values could be considered as a reflection of the uncertainty in valuation and transfer.

Starting from the 0.60 to 1.60 € / visitor that this one study shows, and 40.8 million visitors per year (ECORYS, 2012), this amounts to 25 to 65 million € per year. This would be the amount visitors are willingness to pay for an improvement of a somewhat clean beach to a very clean beach. The beaches in the Netherlands are already relatively clean and by reducing the amount of waste in the marine environment it may be expected that the amount of waste on these relatively clean beaches will be reduced only to a limited extent.

Visitors themselves are largely responsible for the waste on beaches (see also the section on the costs of cleaning up beaches). E.g. according to Ecorys (2012), the amount of waste that comes from the marine environment at busy beaches is 10% (or put differently, 90% of the waste comes from the recreational itself), with this proportion rises to two thirds in quieter parts of the beach. Since most visitors are located on the busiest beaches, a conservative estimate can be based on a share of litter of between 10 and 20%. When, as in the LEI study, it is assumed that additional measures will ultimately lead to a 50% reduction in the amount of litter, which leads to a value of 10% of this willingness payment, the recreational value can be estimated to be 10% (reduction of litter in the marine environment as a result of 50% reduction at source in the Netherlands)* [10% - 20%] (proportion of litter on beaches originated from the sea) * [25 to 65 million € / year] = 0.3 to 1.3 million € / year.

The value mentioned above is significantly lower than the 6-12 million € / year mentioned in the study of the LEI (2011). The calculations of LEI (2011) are based on data from Mourato (2003). This study made an estimate of 8.64 - € 17.28 / household / year for England / Wales. When using 7.1 million households for the Netherlands, this results in € 61-122 million / year. Assuming that in this case also 10% of the maximum benefits could be reached by a reduction of litter by half, the benefits would amount to € 6-12m/year.

As by PBL (2008) indicated, different studies often incorporate very different aspects and are often location specific. Because the study of Tinch and Hanley (2012) is more similar to the situation in the Netherlands, it is more obvious to use these figures for this present study instead of using the higher figures found in Mourato (2003) and the resulting figures of LEI (2011).

It is often assumed that larger attractiveness of the beaches also may lead to new visitors. E.g. LEI (2011) states that, based on the deterrence or swimmers due to low water quality, Ruigrok (2008) estimates this effect, with a large degree of uncertainty, at € 3 million / year for the Dutch North Sea shore. In contrast, Lindell (2010) (for near Stockholm) had correctly found that "less littering 'could be the second most important factor, after' Fewer visitors', in promoting additional visits. This suggests that, here, overcrowding is more of a problem than litter – and this might suggest, paradoxically, that any litter-related boost to visits could be counterproductive, through worsening a congestion problem that is seen as more important. This may be because current litter is relatively low and also because the type of nature-based recreation on offer requires relative peace and quiet. However, for the Dutch context the possible dis-benefit of increasing congestion should at least be considered when evaluating any possible increase in visitor numbers arising through litter reductions on specific beaches.

The calculation and discussion above clearly shows which arbitrary assumptions have to be made in order to make an estimation. Hence, in this report the description of the recreational value of a reduction of the amount of waste in the marine

environment will not be used. But the results do indicate that the amount of waste on the beaches is an important issue for visitors.

Textbox: results of UK and Eire choice experiments (Tinch and Hanley, 2012)

Recent work by Dugald Tinch and Nick Hanley (University of Stirling, 2012-2013) provides the most useful source of potential value transfer results. In 2011 data was collected from individuals visiting beaches in the UK and Eire (the Republic of Ireland) in order to identify preferences for beach management and the 2015 Revised Bathing Water Directive (rBWD). The sample covered Northern England, Scotland, Northern Ireland and the Republic of Ireland – all areas with relatively clean water and beaches on the whole. The methodology adopted was a choice experiment with a payment vehicle of the additional cost per trip of reaching a beach with a particular set of attributes. A non-tax payment vehicle was adopted due to the range of taxation regimes in the countries considered and the ability for it to be an entirely inclusive payment alternative. Within the Irish sample only active recreational users (those entering the water) were sampled, the other country samples included non-active recreational users (those not entering the water). The attributes considered were management of beach litter and debris, health risks of entering the water and the benthic health of the coastal environment. Finally a sample of the general public in Scotland was taken via a postal survey, in this case water rates were used as a payment vehicle as this was applicable to non-use value and was relevant given the sample.

Table 18: Results of UK and Eire choice experiments

Willingness to pay	Northern Ireland	Republic of Ireland	Scotland: Onsite	Scotland: Gen. Public
Benthic Health – small increase	£4.67*** (±£1.03) (€5.66) (±€1.25)	€4.77***	£6.77*** (€8.20)	£23.84*** (€28.87)
Benthic Health – large increase	£5.97*** (±£1.03) (€7.23) (±€1.25)	€4.84***	£12.00*** (€14.53)	£29.32*** (€35.51)
Health Risk 5%	£5.36*** (±£1.42) (€6.49) (±€1.72)	€4.08***	£13.13*** (€15.90)	£30.38*** (€36.79)
Health Risk – very little	£7.22*** (±£1.31) (€8.74) (±€1.59)	€9.03***	£15.72*** (€19.04)	£54.09*** (€65.51)
Debris – Prevention (A)	£7.37*** (±£1.01) (€8.93) (±€1.22)	€6.60***	£9.91*** (€12)	£52.97*** (€64.15)
Debris – Collection & Prevention (B)	£8.72*** (±£1.19) (€10.56) (±€1.44)	€7.20***	£13.19*** (€15.97)	£65.36*** (€79.16)
Collection only (B-A)	£1.35 (€1.64)	€0.60	£3.28 (€3.97)	£12.39 (€15.01)

Source: EFTEC, 2012

It should be noted that there are different payment vehicles used in different parts of this study. The Scotland General Public study uses an increase in annual water rates (bills), thereby covering on both use and non-use values associated with the marine environment. The three other countries' on-site studies consider the additional cost of visiting a beach, focusing on the use-value associated with recreation.

Results are relatively consistent across groups in terms of the relative scales of the parameter values. Willingness to pay values are relatively lower in the Republic of Ireland, perhaps unsurprisingly given the economic conditions in the country at the time of the survey. Scottish on-site values are relatively higher than the Northern Irish values. However, these Scottish values were for a specific subsample (those surfing or kite surfing on the day), and when compared to the same subsample in the Northern Irish sample, results are similar.

The specific debris scenarios are 'prevention', which would reduce the levels of sewage related waste and prevent fly tipping, and 'collection and prevention', which also includes collection of general waste from the beach. Therefore, a conservative assumption for transfer to the Netherlands would be that the *additional* WTP for collection relates to the WTP for moving from a somewhat littered situation to a litter-free situation, focusing specifically on beach litter, and excluding WTP for reductions in sewage related debris (which are not part of the policy proposals considered in this study). It is conservative because some part of the WTP for debris prevention will also relate to reducing beach litter.

Attractiveness for housing

People assign a high value to a good neighbourhood, which is reflected by prices of houses and apartments. Houses in the vicinity of beaches derive a part or their value from sea sight, provided that the quality of the beaches is conserved attractively. Although this logic is evident, estimations of the exact relation between the presence of a clean beach and the price of houses are largely depending on circumstantial evidence. Based on Ruigrok (2008), who assumes an increase in value of 0.5% and a volume of 56 300 houses affected by improvement of beach quality, LEI (2011) presents a value for the potential annual benefit of € 2.2 million.

However, as indicated by PBL (2008), there are serious concerns about the reliability and quality of the underlying studies. This was one of the reasons why they decided not to include this type of data in their calculations of the monetary benefits as part of the ex ante evaluation for the European Water Framework Directive. The objections put forward by PBL (2008) to include this type of data for the WFD also apply to the MSFD. Therefore, it is decided not to include a number attractiveness of housing.

Litter at sea: damage to ships, fishery and recreational boating

Litter at sea may cause damage in different ways. It may cause additional operational costs, for ships due to the fact that waste gets stuck in propellers, which have to be cleaned, but also for fisheries, due to damaged nets and time used for separating litter from the catch. A reduction of litter in the marine environment may result in a reduction of these costs. If these cost reductions are significant, they produce relatively hard numbers for benefits of reductions in the amount of litter. Therefore, these impacts are studied in some what more detail.

In recent decades, several studies have focused attention on the economic impact of marine debris in shipping and related sectors. Just a few of these have attempted an empirical research to estimate also the costs of marine debris for shipping.

In the review of Thompson et al. (2011), various studies that bring economic costs of marine debris are uncovered. The fisheries, transport and tourism sectors are identified as those experiencing the greatest negative economic impact due to marine debris. For fisheries, the costs come primarily from the time taken away from fishing. Much time must be spent instead on removing debris from the nets, the screw and cleaning the cool water feed system. Several other studies give a good reference point for establishing possible damage measures.

There are almost no studies that give a complete insight into the total costs of marine debris for shipping and other uses of the sea. Two studies have done this: a Scottish study conducted by Hall (2000) and a Japanese study by Takehama (1990)

In this Scottish study, an estimate is made on the basis of information gathered in interviews with individual ports and shippers. Of the fishermen interviewed, the majority (92%) indicated suffering from debris in their nets and damage to the nets caused by debris on the sea floor. Additionally, a great deal of fishers (69%) has regular problems with contaminated catches (due to paint or oil residue for example). Finally, many admitted to having problems with the screw and the cool water feed system because of debris. Damage for fisheries in the United Kingdom is estimated to be about £6,000 - £30,000 per ship per year (ca. € 7.500 - € 37.500). Assuming that the entire fleet of 164 Shetland fishing vessels experience damage,

the yearly damage would be a maximum of between £984,000 and £4,920,000 (ca. € 1,2 - € 6,2 million).

In the study of Takehama (1990), insurance data is used to make an estimate of the costs for fisheries. With these figures, a distinction can be made between damage caused by collision with floating objects, jamming of the screw because of debris and engine problems as a result of litter in the cool water feed system. For damage to vessels by floating objects, incidents occur almost just as often for ships of any vessel size. For other forms of damage, incidents occur more often among smaller vessels, with the exception of the smallest vessels (less than 5 GT; GT stands for gross tonnage, an index that is used to express the volume of a vessel).The total annual costs as a consequence of marine debris is based on the data for Japan, estimated at 0,3% of the total income for the fisheries sector. This is equivalent to an amount of 6,6 billion Yen in damages per year (ca. € 60 million).

Because these cost figures cannot easily be transferred to the Dutch situation, it is decided to perform a study to the damage to ships, fishery and recreational boating as a result of marine litter for the situation in the Netherlands. For this, interviews were held with representatives of the Dutch stakeholder organisations for shipping (e.g. KNVR), fisheries (PVIS, VisNed), recreation (HISWA), but also with the stakeholder organisation for the protection of the North Sea (SdN). Next to stakeholderorganisations, also individual fishermen, shipping companies, shipyards, ship repairers, freight organisations, cargo companies were asked for their experiences and cost data.

Shipping
The shipping sector is made up of multiple clusters, of which commercial shipping, offshore and hydraulic engineering (dredging) are the most prominent. From each cluster, at least one shipyard has been approached; from commercial shipping all shipyards have been included in the study. In addition, contact was established with the Loodswezen, the Rijksrederij and the Royal Netherlands Sea Rescue Institute (Koninklijke Nederlandse Redding Maatschappij, or KNRM). Also, the Royal Association of Netherlands Shippers (Koninklijke Vereniging van Nederlandse Reders, or KVNR) was approached to find out if it often receives reports of damage from its members. Unfortunately, the KVNR was not able to confirm this.

Of the 11 shippers participating in this research, 4 have reported damage due to marine litter. Five shippers, among which both offshore shippers are included, indicated to experience the types of damages listed rarely to not at all. It is worth noting that the cause of many damages is difficult to determine. Often these damages are just discovered at the port or dock and then the cause is often impossible to trace. It is then difficult to determine where the damage was sustained, on the Dutch Continental Shelf or beyond. Damages that lead directly to docks, are not reported.

The interviews show that vessel size probably plays a role in the accumulation of damage at sea caused by marine litter. Large ships are less susceptible to damage to the screw and screw shaft, because these ships sink deeper into the water than small ships. Considering that most debris floats at or near the surface of the water, it can be assumed that larger vessels with hulls extending into deeper waters are at less risk than small vessels in terms of damage to the screw and screw shaft.

The areas along the North Sea with a heightened risk of damage due to marine litter were not uncovered in this study. Just one shipper was able to point out problem

areas throughout the North Sea, but the most of the individuals interviewed were of the opinion that shallow waters such as river mouths, rivers and port areas in general have a greater risk for damage due to litter. None of the sectors makes an effort to avoid certain areas of the North Sea, a conclusion that is more or less confirmed by the above mentioned finding that there are no reports of litter 'hotspots'.

The damages recorded by the companies that were interviewed constitutes yearly costs of € 475,000. There were 320 vessels affected by the damage reported. The Dutch fleet (commercial shipping, offshore and hydraulic engineering) under Dutch administration and a foreign flag consisted of 1700 ships during the base year. Assuming that these numbers have remained constant, the total costs for the entire Dutch fleet could be as much as € 2.5 million per year (1700/320 x € 475,000).

An assumption underlying this estimate is that the proportion of reported damages identical is to the portion actually measured by the fleet. Taking this assumption into account and the fact that the exact location of reported damages is often unknown, a safe estimate is made by taking a standard bandwidth within which the total cost of damage lies. On the basis of these assumptions, the total damage to the Dutch fleet due to litter at sea within the Dutch Continental Shelf is between € 1.5 and € 4 million per year.

If by taking measures to reduce the amount of litter in the marine environment, the amount decreases by 50%, and it may be assumed that the costs resulting from marine litter decrease proportionally with the amount of litter in the marine environment, then the benefits for shipping are expected to be between € 1 and € 2 million per year.

Fisheries

Within the fisheries sector, a distinction is made between small fisheries and deep-sea fisheries. To gain a better understanding of potential damages for small fisheries, the branch association Productschap Vis (PVIS) and Visned were approached. Visned represents fishermen from the cutter and shrimp fisheries. It appears that damage suffered from litter at sea is a very prominent problem for small fisheries. The most frequent incidents include jammed screws, damage to the nets and, to a lesser extent, damage to the helm. It is possible to address damage to the screw while still at sea and fishermen can usually resolve the problem themselves by driving backwards and forwards to release debris from the screw. Damage to the skin and the cool water feed due to litter never occur, or only rarely. Also, there are no reports of contaminated catch due to oil or paint residue for example[11]. The shared impression is that the North Sea has become much cleaner in recent decades. In the past, the problems reported in interviews were far more serious.

To gain a more complete picture of damage suffered by the fisheries, four large shippers were approached. One of these shippers indicates as rarely having incidents of damage due to litter at sea. Another shipper reports damage to nets a few times per year. Other types of damage seem to rarely occur. One of the shippers for a deep-sea vessel indicated that damage to nets is not as big of a problem in comparison to other (smaller) fisheries. This is because of the floating nets used that do not come in contact with the debris at the sea floor. This is in contrast to the nets

[11] This is in contradiction with LEI (2011), who states that losses are reported to amount € 2,200 /year/vessel (based on Mouat et al., 2010). For 220 vessels, therefore, the actual costs for the Netherlands could be estimated to be around € 0.5 million.

used by smaller fisheries that commonly suffer damage to the nets. Furthermore, from the interviews with the fishery ports it becomes apparent that there are incidents with damage to the screw or water feed system. The exact number proves difficult to specify, given that many shippers solve such problems themselves at sea and do not report these to the ports. Problems with the screw occur primarily among vessels active along the coast.

Given a value of € 1.8 million in cost of damage on an annual basis to the companies interviewed, the total cost to the Dutch fleet (small and deep-sea fisheries) under the Dutch flag and with a foreign flag could theoretically be almost € 2.5 million per year. Here it is assumed that during the timespan of the study, the total Dutch fisheries fleet, including vessels with a foreign flag under Dutch administration consisted of about 355 vessels (340 from small fisheries and 15 from large deep-sea fisheries). The proportions of reported damages are assumed here also to be identical to actual measured damages to the fleet. Since not all vessels necessarily run the same risk of damage proportional to other vessels and the exact location of reported damages is often unknown, a safer estimate can be made taking a bandwidth within which the total damage can lie. With the assumption that the damage could be 50% higher or lower than what is found in this study, the annual damage for fisheries caused by litter at sea within the Dutch Continental Shelf is € 1.2 to € 3.5 million.[12]

When applying the same assumption as for the shipping industry, if it is believed that by taking measures to reduce the amount of litter in the marine environment, the volume decreases by 50%, and if also can be assumed that the costs resulting from litter in screws and nets decreases proportionally with the amount of litter in the marine environment, then the benefits for the fishing industry lies between € 1 and € 2 million per year.

Recreational boating

Damage that occurs to recreational boating is caused primarily by error of the shipper, for example by his own fishing line becoming caught in the screw. When something occurs, many shippers contact a diver directly to clear a screw or repair the damages. The shipyard is not informed in such instances. Because many shippers / recreationists fix the problems themselves, marinas and shipyards have not a full picture of the possible costs of marine litter in screws.

The damage suffered by recreational boating is difficult to specify based on scarce information that was gathered from the interviews. Various water sport unions and shipyards indicate to not be aware of any problems with marine litter, a tentative conclusion can be drawn here that marine litter does not cause great problems for recreational boating, or at least none that leads to noteworthy costs for the sector.

From the fact that in the current situation litter is not a problem for recreational boating, it automatically follows that a reduction of the amount of litter in the marine environment for this sector poses no significant benefits.

4.4 Summary of benefits

[12] This amount is lower than an estimation of LEI (2011) that is based on a estimate of Mouat et al. (2010), who estimate the damage costs of fouling incidents due to litter at € 180 /year/vessel, based on data of Scottish fishing vessels . For the total fishery float on the Dutch Continental Shelf (220 vessels), this amounts to an annual economic effect of € 40.000/year.

In order to be able to present a monetary number for the potential benefits of a reduction of litter in the marine environment, it was assumed that the various measures aimed at reducing the amount of litter would together result in a reduction of the amount of litter by 50%. Based on this assumption, the monetary benefits of reducing the amount of litter are estimated for the various benefits discussed in the paragraph above.

Table 19: Monetary benefits of a reduction in the amount of litter in the marine environment

Benefits	**Benefits (mln €/year)**
Reduced beach cleaning costs	0
Enhanced recreational value	p.m.
Attractiveness for housing	p.m.
Less damage to shipping	1 – 2
Less damage to fisheries	1 – 2
Less damage to recreational boating	0
Total	2 – 4
Reduced beach cleaning costs and attractiveness of housing are not included in the summation, to prevent double counting.	

When looking at the benefits presented in the table above, it should be noted that the most important benefit of the MSFD is not presented here: the improvement of the marine ecosystem.

The total amount of € 2-4 million per year in the table above is clearly less than the € 7-14 million per year presented by LEI (2011). This is due to the fact that LEI (2011) assumes € 6-12 million per year in recreational benefits, whereas in this study, it was decided not to include figures for this potential benefits category, based on a more in depth analysis into this topic.

Both the costs of cleaning up beaches, as well as the cost shipping and fishing experience as a result of waste in nets and screws, could be reduced if due to additional measures, the amount of litter in the marine environment would decrease. In this way, the costs incurred in the previous two sections are presented can be used as an indication of the potential benefits as a result of less waste in the marine environment. However, as indicated earlier, there are still many knowledge gaps regarding the relationship between actions and possible effects. Moreover, a reduction in the amount of waste does not lead to the total redundancy of cleaning beaches. As a a matter of fact, a large part of the litter on beaches is left behind by recreating people themselves and does not come from the sea. Nor will a reduction of the amount of litter lead to the elimination of damage to screws, since a large proportion of the relevant damage is not caused by the entanglement of waste into the screw, but due to entanglement of anchor chains. This means that the cost figures presented above can not simply be used as potential benefits, but it gives a first insight into the order of magnitude or the upper limit for these potential benefit categories.

5 Economic analyses: Instruments with respect to marine litter[13]

Economic instruments can be used to implement measures effectively and efficiently. This is the reason why the MSFD mentions economic incentives as potential policy measures, to make it attractive for the users of the marine ecosystem to act in ways that that stimulate the achievement of the good environmental status. In the Netherlands, the use of economic instruments in water management has been commonplace for decades. E.g. wastewater treatment plants are paid by users by charging them a wastewater treatment levy, the consumption of drinking water is paid for per m3 of drinking water, and for groundwater use there is a charge for the abstraction of groundwater.

In recent years a large number of studies has been performed in the field of economic instruments in water management. This included an inventory of instruments that are already deployed, but also looked at possibilities to make the current tools more effective and efficient. See the following link for more details: http://www.helpdeskwater.nl/onderwerpen/wetgeving-beleid/nationaal/economische-aspecten/economische-0/
These studies were conducted partly in response to the requirements from the European Water Framework Directive (WFD) and therefore primarily focus on instruments aimed at influencing the use of fresh water.

For the marine environment such an analysis was not performed yet. Therefore, as part of the requirements of the MSFD, and because of the search for efficiency in water policy, in 2012 an analysis has been performed on the economic instruments that are currently in use in the marine environment, and potential opportunities for intensification and adaptation of these existing or new economic tools to eventually achieve a more efficient and effective management of the marine environment.

This analysis was performed in close cooperation with representatives of different sectors and stakeholder organisations to maximize the use of their specific knowledge, and to get an overview of measures and instruments that can count on support among the various sectors. In this way, the debate that was conducted on instruments and measures formed a logical transition from the economic analysis - cost-effectiveness analysis and cost-benefit analysis described in the previous sections - and the social analysis that will be described in the next section.

5.1 What are economic instruments?

Economic instruments stimulate voluntary behaviour that has financial consequences (in other words: is financially not optional). Examples are subsidies (e.g. beneficiary receives money for the construction of a wastewater treatment), payment for green-blue services (e.g. beneficiary receives money for construction of water storage), levy (e.g. beneficiary pays money for receiving a service, such as use of the sewer), fines (beneficiary must pay a fine for not meeting the goals of water), water price (beneficiary pays money for receiving water), markets (artificial market for CO2 trading).[14]

[13] Text largely derived from Sterk Consulting (2012), assessment of economic instruments for the Marine Strategy Framework Directive (MSFD).
[14] Experimenten met nieuwe praktijktoepassingen van economische instrumenten voor duurzaam waterbeheer, Witteveen en Bos, 2010.

The use of economic instruments can serve different goals such as to:

- finance the costs of measures;
- create price incentives (and change behaviour);
- generate revenues.

Economic instruments are a well-proven means of water management all over Europe, relying in most Member States on charges for water supply and sanitation services and on environmental (abstraction & pollution) charges. In recent years, the emergence of the concept of environmental costs, the recognition of the need to apply more fully the polluter-pays principle and the adoption of the Water Framework Directive (WFD) are elements that have widened the scope of economic instruments. Economic instruments, for example, are applied today to reduce morphological alterations or the management of excess water. Public budget constraints have furthermore motivated the search for innovative instruments, turning away from purely public investments and subsidies towards more elaborated economic mechanisms for environmental aims.

These conclusions apply to the inland water management. The marine environment faces us with different boundary conditions which may lead to different conclusions on the role of economic instruments. In general conditions that improve the chances for economic instruments or incentives to function well are:

- the user is known: to know the user of the marine environment is a boundary condition for interaction with this user;
- the user is accountable: only when a user can be hold accountable for its behaviour, it is possible to influence its behaviour;
- there is a stable and measurable entity for the economic instrument: an economic instrument will only work if the entity that it relies on is stable and measurable (such as tons of fish, m^3 of sand et cetera);
- it is possible to monitor the behaviour of the user: reliable monitoring of behaviour through self regulation by sectors or by authorities is a boundary condition for the instrument to work.
- the risk of violation is acceptable: economic instrument that involve a high risk of violation should be avoided.

In the marine environment several of these conditions differ significantly from the conditions for inland waters. The size and more difficult accessibility of the North Sea, the international character of the users, the diversity and mobility of users and the lack of ownership of the property can form a barrier for the functioning of (economic) instruments. This argumentation is laid down with an example in the textbox below.

Textbox: Tariff for drinking water on land

The owner of a house is known to the water company and is accountable for its behaviour. There is a stable and measurable entity to measure the use e.g. M^3 drinking water. Also the behaviour of the household is measured by a simple measuring device (a water meter). This device can be checked every year so the risk of violation is relatively small. The boundary conditions for economic instruments to function well (a known and stable user with ownership whose behaviour can be monitored and who is accountable for what he does) work out almost perfectly well for this economic instrument. This is the reason why this instrument is widespread and successful.

Tariff for fishermen at sea

At sea, the picture is quite different. Suppose we would like the fishermen to pay for their use of the North sea. A first question would be whether or not we know the users? For the national fishermen this would probably be quite easy, but for international ships this would be more difficult. Also the monitoring of the behaviour of these ships is more difficult. This has to do with the size of the sea, the more difficult accessibility of the sea for supervision, but also the users are more mobile and move around which makes it more difficult to monitor them. Then one would also have to identify a measurable entity that is a good descriptor for the 'use' of the North Sea (such as the m^3 price for drinking water). For the fishermen one could think of the tons of fish that the fishermen catch. Then one has to deal with issues as differentiation for different species of fish and how one should monitor if some of the fish were caught outside of the north sea. Monitoring behaviour is probably partially possible. Ships could be tracked by satellite and GPS devices, but exactly how the fish are caught and what they do with it cannot be seen with a satellite. Enforcement and supervision are harder at sea than on land. The risk of violation of rules is also larger as the users are more mobile and operate in a vast area. Also the users do not have legal ownership of the sea which imposes requirements on good housekeeping. Naturally modern technology can help to partially solve the barriers mentioned. Modern ICT and GPS satellite techniques can make a large sea look 'small' again. However the boundary conditions for economic instruments to function well (a known and stable user with ownership who's behaviour can be monitored and who is accountable for what he does) work out poorly.

Source: Sterk Consulting, 2011

5.2 Current use of instruments in the marine environment

A broad variety of instruments is in use to protect the marine environment; legal, communicative, and economic instruments. Communicative instruments encourage voluntary change of behaviour. Communicative instruments play a vital role in the protection of the North Sea. All relevant stakeholders such as governments, environmental NGO´s, syndicates for the different industrial sectors use communicative instrument to reach their goals. Communication is organised through many different ways such as education, conferences, web sites, intervision, networking et cetera. There are many international consultative organisations that play a vital role in communicating agreements throughout their sectors.

Textbox: Example of a communicative instrument

An example of a communicative instrument initiated by the industry itself is a course on Marine Awareness. First the Dutch Shipping Sector (the NVRD) initiated the organisation Prosea. Prosea is an independent non-profit educational organisation specialized in marine awareness and sustainability. Prosea initiated a course in the Netherlands that was so successful that is has been internationally implemented. The course Marine Awareness is now internationally well known.

Source: Sterk Consulting, 2011

This paragraph focuses on the economic instruments (stimulate voluntary behaviour that has financial consequences) and economic incentives (any incentive that has a financial consequence) in the marine environment that were mentioned by the stakeholders.

Tariffs and taxes

Tariffs and taxes are standard examples of economic instruments. Environmental considerations may influence the height of these tariffs and taxes:

- Sand: for the winning of sand a tariff is charged per m^3 sand. Currently the tariff is regionally differentiated. Winning of sand in inland waters is charged with 2.11 euro whereas winning of sand at sea is charged with 0.88 euro per m^3. This type of differentiation turns environmental preferences into financial incentives.
- Gas and oil: for the exploration of oil and gas similar elements are part of the legislation. In this case the Mining Act regulates that the government takes part in the winning of gas and oil and receives a fee per unit extracted. A company that proves that there are recoverable reserves can apply for a permit to extract it. Subsequently, the Minister of Economic Affairs, Agriculture and Innovation (ELI) will decide on the permit (requires financial, technical and quality criteria). When the extraction is carried out effectively, the government participates in the production and gets paid an amount per unit extracted. This results in a yield of 8 to 13 billion euro per year for the Dutch government. Differentiation within these fees could be used to improve protection of the marine environment.
- Shipping: adequate port reception facilities play a vital role in the policy of "zero tolerance of illegal discharges from ships". Ships pay a tariff for the use of these reception facilities. At the moment the way ship are charged (variable and fixed costs) differs per port. This tariff could be used for a better protection of the marine environment
- The shipping tonnage tax is a tax levied on the taxable profits from shipping. The profit is determined on the basis of the net tonnage of the taxable vessels.

Fines

Another economic incentive is the fine or penalty. The penalty is linked to the offence of the agreements in legislation. Virtually all legislation holds penalties that apply when rules are violated. Examples are penalties for:

- dumping waste;
- fishing in forbidden areas, on the wrong days, too many fish (above the quota);
- oil spills;
- Stocking hazardous substances

Penalties can be costly for companies and at the same time they can be very critical in terms of negative media attention. Think of the penalties for BP for violating environmental regulation. The following examples illustrate this.

Textbox 6: example of a fine in the marine environment

Textbox: Example of a fine in the marine environment

The Exxon Valdez oil spill occurred in Prince William Sound, Alaska, on March 24, 1989, when the Exxon Valdez, struck Bligh Reef and spilled 260,000 to 750,000 barrels (41,000 to 119,000 m3) of crude oil. It is one of the most devastating human-caused environmental disasters. The region is a habitat for salmon, sea otters, seals and seabirds. The oil, covered 1,300 miles of coastline, and 11,000 square miles of ocean.

Exxon mobile was convicted to pay $4.5 billion as a result of the accident, including compensatory payments, clean-up payments, settlements and fines. The accident dominated the world news for months.

(source: several news items summarised by Sterk Consulting)

Textbox: Another example of a fine for an oil company

WASHINGTON - The British oil company BP will pay another $ 50 million (over 36 million euros) in fines in connection with an explosion in 2005 at a Texas refinery.

These penalties have to be paid because of violations of environmental regulations in the years during and after the explosion. BP has not pleaded guilty, but has agreed to pay the amount, in addition to the previously imposed $ 100 million.

(source: several news items summarised by Sterk Consulting)

Fund

NOx fund Norway: reduced NOx emissions are the primary objective of the Environmental Agreement relating to NOx and the Business Sector's NOx Fund. The Fund is a cooperative effort where participant enterprises may apply for financial support for NOx reducing measures. Payments made to the Fund replaces the governmental NOx tax for participant enterprises. The NOx fund is established by 15 cooperating business organisations. The Fund is managed in accordance with the full cost principle (non-profit), i.e. all the financial means which the Fund receives will be utilized in accordance with its purpose of reducing NOx emissions in a cost-effective way with the exception of necessary administrative costs.

Labelling

A true market based economic incentive is voluntary labeling. Ecolabels can give companies a competitive advantage. Two ecolabels were mentioned for the marine environment:

- **The Blue Flag** is a voluntary eco-label awarded to beaches and marinas. The Blue Flag Programme is owned and run by the non-government, non-

profit organisation the Foundation for Environmental Education (FEE). The Blue Flag works towards sustainable development of beaches and marinas through strict criteria dealing with water quality, environmental education and information, environmental management, and safety and other Services.

- **Clean Shipping Index (CSI)** is also a label and takes into account the major part of environmental effects connected to shipping, such as emissions to air and water, use of chemicals, antifouling etc. The index rank vessels or shipping companies according to the most relevant issue, decided by the viewer. If you are a cargo owner seeking shipping companies with the best performance when it comes to carbon dioxide (CO2) emissions, or any other issue close to your heart, you can make that choice in the database.

Rewarding or compensation

- **Payments for Environmental Services (PES):** PES is the practice of offering incentives to parties in exchange for some sort of ecological service. There is a growth in demand and willingness to pay for environmental services at global, regional and local level. Most of the PES schemes so far are led by the public sector, at national and international level, although private sector is increasingly involved in paying to promote environmental service provision. Fishing for litter does not fit the definition of a PES just now. Ships that pick up litter are stimulated to take this litter with them (instead of throwing it back into the sea) and hand it in on land without costs. An extra step would be to reward the fishermen financially for this activity. Then fishing for liter would qualify as a PES.
- **Rewarding system for clean ships**: a very recent initiative, related to the CSI label is a good example of an economic instrument. The instrument is based on the CSI labeling system and initiated by the Port of Rotterdam. The essence is that clean ships (CSI)) receive a discount on the port charges of up to 15.000 euro per visit. Initiatives like this one can count on media attention. The following article was published on nu.nl (see textbox).
- **Plastic bag tax in Ireland** that is successful in reducing plastic bag litter. The effect on the marine environment was not specifically measured;
- **Deposit refund schemes for plastic bottles in the UK and Denmark**. This instrument has lowered costs and pollution with waste.

Textbox: Example of an economic instrument based on rewarding

ROTTERDAM – Following the competing port of Antwerp, The Rotterdam harbour is rewarding more "clean" vessels with a discount on port fees.

Photo: NU.nl/Marga Plomp

For this and next year it will be at least 25 vessels, Port Authority announced Monday. These are ships that score better than the legal standard regarding emissions of harmful substances. They are included in the so-called Environmental Ship Index (ESI), an initiative of a group of European ports. This list now includes 375 ships.

Only the best
The Rotterdam port authorities had initially chosen only to reward the very best ships, that get a score of 31 points. There are only six of those ships, of which so far only one has arrived at the port of Rotterdam. The Antwerp Port Authority introduced for this year and the next a more flexible standard and Rotterdam now follows this. This means that ships having more than 20 score points, can count on a discount. Which can amount to 15,000 euro.

(source: several news items summarised by Sterk Consulting)

5.3 Perspective for economic instruments and incentives

The analysis of economic instruments was done jointly with the various stakeholders (from both industry and environmental organisations). They were asked to share their thoughts on possibilities for economic instruments and incentives to protect the marine environment.

Before the interview the stakeholders were informed with a short overview of possible economic instruments and incentives.

Econmic instruments and incentives
Economic instruments stimulate voluntary behavior that has financial consequences
Tariffs
Levy - tax
Subsidies
Quota
Tradable rights
Fines
Rewards (payment for services)
Depositsystems

Figure 14: illustrative overview of economic instruments and incentives (Source: Sterk Consulting, 2011)

A number of options was listed. Obviously, the industry may favour other options than the environmental organizations do. The options are not specific for marine litter but for the general protection of the marine environment.

Tariffs and -differentiation

- **Rewarding system for clean ships**: the essence of this instrument is that clean ships according to the Clean Shipping Index (CSI) receive a discount on the port charges of up to 15.000 euro. Litter is one of the issues of CSI so this instrument may also prove useful in reducing marine litter. This recent initiative, initiated by Port of Rotterdam, is a good example of tariff differentiation. The system could be supported and expanded.
- **Clean harbour**: similar to the Clean Shipping Index (CSI) a label for 'clean harbours' could be initiated. Ships could then use a database to choose the harbours that score best on certain environmental criteria. This would be an economic incentive for harbours to work on their environmental performance. This could possibly qualify as a PES (the practice of offering incentives to parties in exchange for some sort of ecological service).
- **Good sand winning techniques or zones:** it can be considered to reward sand winning techniques that cause little damage to the marine environment or reward winning sand in zones that are less environmentally harmful. This could be financed by differentiating the tariffs for the winning per m^3. Another option for financing this is to allow sand winners to finish sand winning jobs with a rugged profile instead of a straight profile. This may be better for the environment and saves costs at the same time.

Taxes

- **Clean ships:** it can be considered to reward ships with a good environmental performance with a tax cut. The height of the shipping tonnage tax could be related to the environmental performance of ships (CSI, so this is a combination with labelling). This is comparable with tax measures in the Dutch car industry that favour cars that have a better environmental performance. In the Dutch car industry this is a very successful instrument.

Subsidies for research

- Both the industry and the environmental organizations feel that there is still a lack of knowledge on several main themes in the MSFD domain. For example, the origin of and the damage done by litter (e.g. micro plastics) is only partly understood. Instruments meant to reach good environmental status for litter can only be effective when the actual problem is well understood. Also in terms of solutions there is a strong need for knowledge. For example the use of biodegradable materials for nets and balloons is often presented as a solution but at the same time still holds many questions on its feasibility. Also research on techniques that enable the functioning of a mass balance for ships could prove very useful. With this mass balance the disposal of waste by ships could be better controlled.

Rewarding systems

- **Fishing for litter:** similar to farmers that provide environmental or water services such as storage of water on their land or creating and maintain environmentally friendly shores, it could be considered to pay fisherman to fish for litter. Now their only incentive is that they can hand in the waste for free. An extra step would be to reward the fishermen financially (or any other way) for this activity. Then fishing for litter would qualify as a PES
- **Beach club reward**: similar to the rewarding system for clean ships in harbours, a reward could be considered for beach clubs that keep their beach clean. A possibility to reward them is to lower the cost of their tenancy contract. Coastal towns could finance a discount on the tenancy contract with the possible savings on beach cleaning. Although not explicitly examined, it

is expected that most beach clubs have a tenancy contract. Another option would be to pay for these services as for a PES.

- **Good fishing techniques or fishing in zones**: it can be considered to reward fishermen for fishing or not fishing in certain zones of with certain techniques. Fishing with certain techniques or at certain specific times could possibly also qualify as a PES.

Financing the initiatives.

Not all of the options mentioned above automatically have a financing source. The most applicable source of financing and the size of it also depend on the exact way the instrument is implemented. Some possibilities for additional financing are:

- **Levy on the use of the North Sea**: one option is imposing a levy on the users of the North Sea. Similar to the use of roads or the water management for farmers, a tax for the use of the North Sea could be considered. How to implement this would be a matter for further research
- **Voluntary fund**: another option could be to initiate a voluntarily fund. This fund could then be used for the instruments mentioned, comparable to the landscape fund on land where money is used to a clear sight guarantee (Jantzen 2007).
- **Fund based on platform decommissioning**: it is useful to start a discussion on the cost effectiveness of decommissioning platforms in the North sea. 'Small fields policy "(in short: first use oil and gas from small fields then use the big gas field) results in the depletion of a lot of gas fields in the coming decades. After that the platforms will be decommissioned. The estimated costs are huge (up to 100 billion euro). A discussion could be initiated on whether or not a different approach to decommissioning the platforms could be more cost effective for the marine environment. If for example 10% of the money needed for the platforms could be put into a marine environmental protection fund, this fund could pay for a step forward in the North Sea environment. With this type of funding the financing of instruments that were mentioned above would come within reach. But even more extreme instruments such as sector buy outs, could become feasible. The oil and gas exploration sector however is very cautious when it comes to conducting this very sensitive discussion. From an economic perspective this is an interesting idea. From a legal perspective it may prove difficult.

5.4 Assessment of (new) (litter related) economic incentives

This pargaraph assesses various options for new economic instruments, that could be introduced to reduce the amount of litter in the marine environment (see Table 20 for the results of this assessment):

- **Tariff and tariff differentiation**: the effectiveness of these incentives will largely depend on the height of the economic incentive and the elasticity of the behaviour to this incentive. The incentive holds a package of environmental issues. Litter is one of them; the incentive may be effective on any of these incentives. It can be an efficient system as it builds on market principles and as activities are integrated within the sector. Ships or harbours that stand out on their environmental performance may profit if that is what the market demands. The instruments are in line with PPP and CRP and it seems fair to reward the best performers. A boundary condition for these instruments to work is by the credibility of the labelling systems and organisations that provide the required labels;
- **Changes in tax systems:** a change in the tax system can also provide an incentive for the protection of the environment. Its success will also largely

depend on the height of the economic incentive and the presence of a good labelling system. Here too the incentive may hold a package of environmental issues and litter is one of them. It can be an efficient system as it builds on a market principle that parties will look for ways to cut costs. This instrument is also in line with PPP and CRP and it is fair to reward best performers by lowering their tax. This system holds no means to finance it and can be costly.

- **Rewarding systems:** a rewarding system such as PES for fishermen or beach clubs may prove successful. The height of the payment/reward is a boundary condition for the instrument to work. It may be very efficient as the parties that deal with the activities can combine these environmental activities with their regular activities. Litter surely is one of the most vital issues for fishermen and beach clubs so this instrument will influence their behaviour on this topic. The instruments do not conflict with PPP and CRP and it seems fair to reward parties for their effort to clean up litter. Critical points are the incomplete financing of these systems (for beach cleaning part of it could be financed with savings on beach cleaning) and the possibly high transaction costs (many organizations with different and specific contracts);
- **Subsidy research:** research will play a crucial role to achieve efficient protection of the marine environment. With this research one can enlarge the chances that the right measures will be taken for the problems. For each measure the risk of failure of the measure should be assessed;

Table 20: initial assessment of new economic instruments and incentives to reduce marine litter

Criteria **Incentives**	**Effectiveness (change of behaviour)**	**Effectiveness (change of GES litter)**	**Efficiency**	**CRP and PPP**	**Fairness**	**Other**
Tariff						
Port charge clean ships	+ (if strong enough)	± (litter one of the issues)	+ (limited costs exp.)	+	+ (effort pays)	labelingsystem
Clean harbour	+ (if strong enough)	± (litter one of the issues)	?	+	+ (effort pays)	labelingsystem
Taxes						
Tonnage tax clean ships	+ (if strong enough)	± (litter one of the issues)	± (sign. costs expected)	+	+ (effort pays)	labeling system
Rewarding system PES						
Fishing for litter	+ (if strong enough)	+ (litter the main issue)	++ (costs rel. small)	Na	+ (effort pays)	funding tr costs.
Beach club reward	+ (if strong enough)	± (litter the main issue)	++ (costs rel. small)	Na	+ (effort pays)	funding tr costs.
Subsidy research						
Origin and effect of litter	Not Applicable	+	+ (will help avoid wrong measures, WFD)	+	+ (helps to address true parties	

Possibilities of biodegr. materials	Not Applicable	+	+ (will help avoid wrong measures)	+	na	
Possibilities of mass balance ships	Not Applicable	+	?	+	+ (helps to address true parties	

Source: Sterk Consulting, 2011

Financing the options

Some of the possibilities mentioned have their own financing system, such as tariff differentiation or change in taxes by the government. For other options such as the subsidy for research or the PES options no financial means are in place yet. The three options for financing them are now assessed:

- Levy on the use of the North Sea: in advance it can be expected that a North sea tax will be very complex. This option assumes that both the user and the entity that will be taxed can be defined. It also assumes that transaction costs are in balance with the yield of the tax. In advance this possibility is not a very promising one as both finding an entity and keeping transaction costs reasonable may prove difficult.
- Voluntary fund: another option could be to initiate a voluntarily fund. This fund could then be used for the instruments mentioned. With a voluntary fund the problems mentioned for a tax will largely be resolved. The downside however is that industry and environmental organizations must have the willingness and means to finance this fund. It's feasibility is therefore doubtful.
- Fund platform decommissioning: the third option is an interesting option. It requires a large degree of ´out of the box thinking´ to imagine this work. In terms of legislation significant changes would have to be implemented to make a different decommissioning of platform possible. In terms of financial possibilities this option is interesting as there is a lot of money involved in the decommissioning of platforms. (Sums up to 100 billion euro are mentioned). A first step could be to initiate a commission to further investigate this option. This should be a commission in which authorities, industry and environmental organizations are represented.

6 Social analysis and stakeholder involvement

The Dutch have not performed a separate social analysis for the initial assessment. 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. This includes economic as well as social aspects, and may include consideration of the distribution of these impacts across stakeholders. In light of this definition, an explicit distinction between 'economic' and 'social' analysis is not necessary' (European Commission, 2010). In other words; the employment data of the use of the marine environment, together with the distribution of the likely impact of the (programmes of) measures cover the social aspects of the analysis of the use of the marine waters (Arcadis, 2010).

Although a separate social analysis is not strictly necessary, the Dutch have carried out a number of studies to get information on the social importance of the North Sea. One of those studies is a called 'Experiencing the North sea: a quantitative consultation under Dutch citizens on the North Sea' (TNS NIPO, 2011) in which a representative survey was conducted among 600 citizens in which their knowledge of and affinity with the North Sea was examined. Paragraph 6.1 describes the main outcomes of this study.

Not only various studies have been carried out, also stakeholders have been actively involved in the process towards the final program of measures, right from the start. Especially with regard to the active involvement of the stakeholders in the entire process, the Netherlands (seems to) have a fairly unique approach. Also in the realization of the measures for the WFD stakeholders were actively involved throughout the entire process. This worked very well back then, and led to a broad-based programme of measures. For the MSFD, stakeholders were asked for their involvement and comments on various moments, for example for their and views on the measures and instruments examined so far for the MSFD. The results are discussed in Section 6.2. In addition, Section 6.3 provides a description of the stakeholder meeting Litter at sea involving a large number of stakeholders who were invited to think of practical, feasible measures that can count on broad acceptance.

6.1 The public opinion

Activities on and along the North Sea represent not only an important economic value but also an important social value. In the study Perception of the North Sea: A quantitative consultation among Dutch citizens on the North by TNS-NIPO (2011) a random survey was held among six hundred Dutch citizens, in which their knowledge of and affinity with the North Sea were analysed. They were also asked to prioritise different possible solutions (with given consequences) for a number presented (potential) environmental problems.

When people think of the North Sea, then four tenths (40%) of them mainly think of the good things of the North Sea. The beach, the sun, the dunes and the coast are especially mentioned. A third (34%) mentions fishing (fishing, commercial fishing). A slightly smaller percentage (26%) mentions the sea and / or the (salt) water. Other associations that people mention are: leisure opportunities, having a drink in a cafe, a sense of enjoying, or they mention animals, for example, the seal or the herring. These positive associations relate to the activities that people undertake at the beach. A majority of the citizens (65%) goes to the beach for a walk. A third (30%) goes to the beach for swimming and / or sunbathing.

A large majority of the Dutch population (85%) does go to the beach occasionally. Four out of ten citizens (40%) do this once or twice a year, and nearly a quarter (23%) three to five times a year. On average, the Dutch citizen goes to the beach 6.2 times per year. This relatively high average is due to a small percentage of citizens that goes to the beach almost every day (for example because they work on the beach). For citizens living in the coastal areas, this average is much higher, at 22.5 times per year.

Citizens do not associate the North Sea with environmental problems that the North Sea is facing. When left to themselves, citizens merely mention positive associations but no problems. When Dutch citizens are asked what priority they give to the environmental problems at the North Sea, it appears that they do not see the problems of the North Sea to be urgent. Almost a third (30%) indicates that first there must be a solution to climate change. A quarter (22%) mentions air related problems first. Less than one fifth of the Dutch population (18%) mentions first that a solution should come for the pollution and depletion of the North Sea.

As could be expected, people in coastal areas find it more important to address the problems in the North Sea than people in the rest of the Netherlands. In the coastal areas 25% of the citizens mention that attention to the preservation of the North Sea should be first, compared to 18% in the rest of the Netherlands. This is a significant deviation with from the total population. This is illustrated in the following table (Table 23).

Table 21: Ranking of environmental problems (n = 600)

	Environmental problem	**Dutch citizens**	**Citizens in coastal areas**
1	Combating climate change	30%	24%
2	Improving air quality	22%	24%
3	**Tackling pollution and depletion North Sea**	**18%**	**25%**
4	Improving water quality	16%	16%

5	Protecting forest and heath	14%	11%

Source: TNS-NIPO, 2011

When comparing 'environmental problems' with other social themes such as 'health' and 'employment', it appears that Dutch citizens attach less importance to environmental themes. When citizens are asked to rank social issues in order of importance, only 5% of them list environmental themes first. Social issues that citizens attach more importance to are healthcare (34% mention this theme first), employment (14% mention this theme first) and income (14% mention this theme first).

The following table (Table 22) summarizes the situation around the perception of the social themes and the specific environmental problem of pollution and depletion of the North Sea. This puts the subject of environmental problems in perspective relative to other issues displayed. After that, the focus is narrowed down to various environmental issues and the place that pollution of the North Sea takes in relation to other environmental issues. This overview places the various issues related to the North Sea in a broader perspective.

Table 22: Social issues in order of importance and zoomed in to environmental problems (% respondents that mention the theme to be most important)

Social theme		**Environmental problem**	
Health care	34%		
Employment	14%		
Income	14%		
Economic growth	11%	Combating climate change	30%
Education	9%	Improving air quality	22%
Environmental	**5%**	**Tackling pollution and depletion North Sea**	**18%**
Criminality	5%	Improving water quality	16%
Old-age provision	4%	Protecting forest and heath	14%
Terrorism	2%		
Development	1%		
Foreign policy	0%		

Source: TNS-NIPO, 2011

The North Sea is facing several problems. In the survey, five problems were presented to the Dutch citizen in more detail, together with a description of possible solutions and the potential consequences these solutions might have for the citizens. This puts the seriousness of the issues in a broader perspective. In the survey it was clearly stated that the list of solutions presented only some ideas and was not meant to be exhaustive.

Oil pollution from spills or leakages gets the most attention of citizens. More than four in ten citizens (41%) refer to this as the most important issue. Also prevention of the extinction of fish and other species are important: more than a third (35%) refers to this as the most important issue. Plastic pollution, as an example of marine litter, is mentioned the most important issue by 15% of the people (see Table 23).

Table 23: Ranking of the five presented problems in the North Sea

	Five problems at the North Sea	**Dutch citizens**

1	Oil pollution by discharges or leakagess	41%
2	Extinction of fish and other marine species	35%
3	Plastic pollution at sea	15%
4	Algae problem due to manure	5%
5	Damage to seabed	3%

Source: TNS-NIPO, 2011

Despite the fact that problems related to plastic pollution are ranked on average 'only' as third problem, almost all (94%) say it is an important issue. A slight majority (51%) believes the problem is even very important (Figure 15). This is more than the problem 'extinction of fish and other species. Citizens apparently do bother about plastic pollution very much, but at the same time, they think that the problem 'extinction of fish and other species' should be solved first. One possible explanation for this is that the question about ranking the problems was asked at the end of the questionnaire, after completing the questions about how important citizens find the various problems and being confronted with the consequences of the various possible solutions and related measures. It is possible that this information is taken into account when ranking of problems. So it may be that citizen's think something really is a problem, but because the consequences may have a more important impact on their lives, they rank another problem higher (strategic behaviour).

Waste at sea exists of a wide variety of slowly degradable objects. There is not much known about it, but it is assumed that the main land based sources are tourism and sanitation, and the main sources at sea are shipping and fisheries, including abandoned and lost fishing gear. Waste at sea is a threat to many marine organisms, such as seabirds, marine mammals and turtles, by ingestion or entanglement, and also has an economic impact for local authorities and for different sectors such as aquaculture, tourism, fisheries, shipping, etc. 65% of the objects found on beaches contain plastic. Plastic degrades very slowly over hundreds of years and often do not disappear at all, but break into smaller and smaller pieces.

Different measures are possible to reduce the plastic pollution, for example setting up projects to collect plastic at sea (fishing for litter), have companies produce products that are biodegradable, improve the collection of waste from ships and on beaches, and more controls on the disposal of plastic waste.

These potential measures can have multiple consequences for citizens:
- More tax money should be used for additional checks and cleaning programs;
- Products containing plastic can become more expensive;
- No longer plastic bags and other bags available for free in the stores.

The figure below (Figure **16**: Acceptance of consequences of solutions to plastic pollution (TNS NIPO, 2011)Figure 16) shows that especially the acceptance for not getting bags in stores is significant. More than three quarters (76%) indicates to accept this (fully or partially). One in ten (10%) people does not accept this. This measure has relatively little impact on citizens and is therefore easier to ac-

cept.

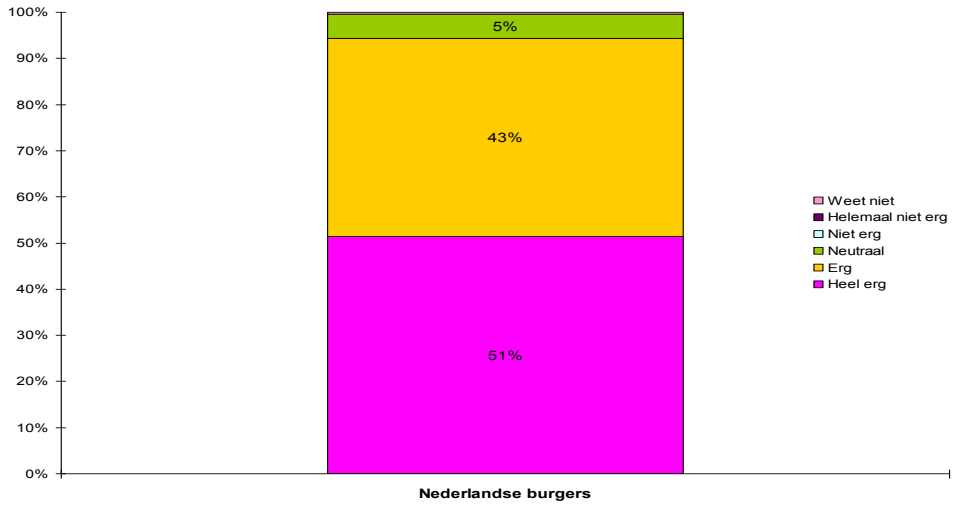


Figure 15: How important is plastic pollution in the North Sea? (TNS NIPO, 2011)

About the other possible consequences of actions the Dutch population is more divided and less pronounced than the measure with respect to the plastic bags in shops. E.g. more than four in ten (44%) accept (fully or partially) that products containing plastic may become more expensive. One-third (32%) is neutral and a quarter (23%) is not happy about it. This also applies to the use of more tax money for additional checks and cleaning programs. This result is accepted by 39%, but more than a quarter (26%) is against it, and one third (32%) is neutral.

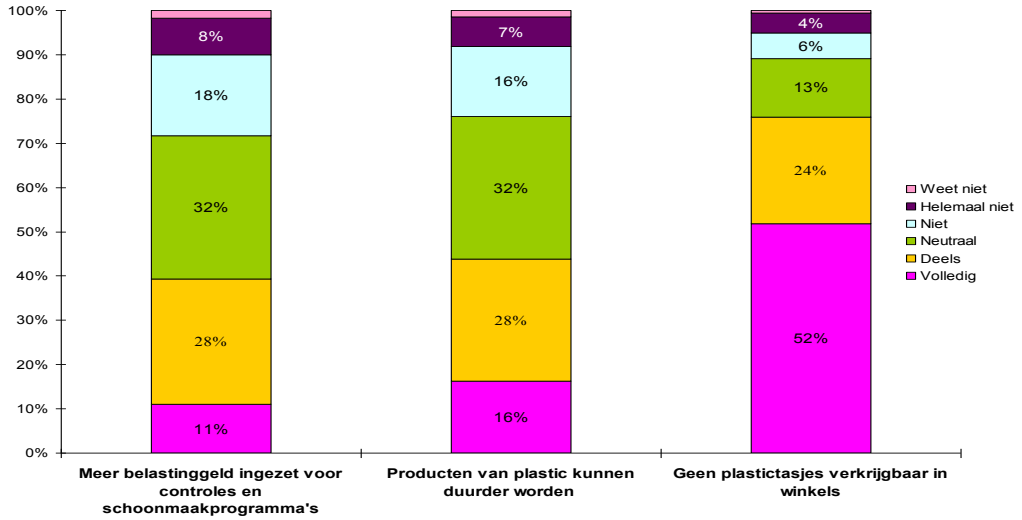


Figure 16: Acceptance of consequences of solutions to plastic pollution (TNS NIPO, 2011)

This survey illustrates that when it comes to taking responsibility for existing problems, citizens say they are prepared to contribute (a little). This should especially be done in ways that do not cost money, as is illustrated by the example of no longer having plastic bags available in stores. There is much more support for this type of measures than tax increases or increases in prices of products that contain plastic.

Slightly more than half of the citizens (57%) agree to pay a little bit more. Half of them (51%) would do so for intrinsic reasons; they think that it is a duty for mankind to protect the environment. Almost a third (30%) thinks of the future and believes it is important that one can continue to enjoy a beautiful nature. One in ten citizens (11%) specifically mention the beaches and the healthy fish they want to be able to also enjoy in the future and for this, they are willing to pay more.

Still 22% of citizens say they are not willing to pay more in order to contribute to the solutions of the problems in the North Sea. This group of people has several reasons for this. Almost a third (32%) wonders why they should pay, since they believe that the cause of the problem - the polluter - must pay. Another reason why people are not willing to pay more, is that these people already have enough problems making ends meet: despite the fact that they think the environment is important, their budget does not allow for a financial contribution. This applies to 26% of the citizens. An almost equally large group of citizens (24%) feel that they already pay enough taxes and that the protection of the North Sea should be financed by cutting back on other items.

21 % of the Dutch citizens is neutral when it comes to making a financial contribution. These people have not decided yet or do not dare to express their views. In the willingness to pay of the Dutch there seems to be a discrepancy between socially desirable answers and actual behaviour. This is evidenced by the fact that half of the respondents indicate to be willing to pay money to do something against the environmental problems. However, when given the choice between different measures, they nevertheless tend to choose measures that do not result in additional costs for them. For example, in order to reduce the amount of plastic waste at sea, a price increase for products containing plastic is less accepted than no longer being able to get plastic bags from the supermarket. This type of behaviour seems to be an indication that people are most sensitive to measures that ultimately cost money.

6.2 Stakeholders' view on the cost-effectiveness of measures

The list of measures, as part of the cost-effectiveness analysis, discussed in chapter 3 is also discussed with Dutch stakeholders in face to face interviews. This has led to the following general findings. The stakeholders view on specific measures is incorporated in chapter 3.

- Most stakeholders think that current policy alone will solve most, but not all, problems related to the marine environment. Organisations for the protection of the environment do not agree with the choice of litter to be the only descriptor with an expected gap between the current situation and the targeted situation in 2020;
- In general, the stakeholders find the list quite limited. In view of the point above this is not strange. However, some stakeholders do not like that present policy is left out of the CEA as this means that the current work done is obscured from view. In particular, most stakeholders (including the fishing industry itself) feel that the common fishing policy should be part of the CEA. In this way all measures for all sectors can be assessed on a similar basis.
- Many stakeholders feel that more research is needed to find out what exactly causes the (mainly litter) problems. Little is known about sources, routes and effects. The stakeholders representing the industry feel in general that

the precautionary principle should not be followed, first more emphasis should be given to research.

Table 24: summarizes the stakeholders' opinions on the selected measures

	Measure	Stakeholder view
3	Different packaging standards of plastic pellets	Unknown, find solution for pollution caused in the past
4	Alternative for bundles of nylon wires used to protect fishing gear	Positive, further research measure
5	Biodegradable nets	Unknown, biodegradable plastic undesirable
6	Higher fines for littering	Negative, no effect expected
23	Silent construction methods	Positive, research measure
9	Ban on use of plastic bags in supermarkets	Positive, but not for marine alone
10	Do it yourself beaches	Positive, to be further promoted
11	Biodegradable user plastics at beaches	Unknown, biodegradable plastic undesirable
12	Biodegradable balloons, balloon valves and ribbons	Unknown, biodegradable plastic undesirable
13	Stricter enforcement on the use of port reception facilities to collect waste	Positive, specifically harmonisation across harbours
14	Fishing for litter	Positive, to be further promoted
15	Adding individually recognisable ID-markers to fishing nets and wires	Negative, no effect is expected
16	Additional Beach cleaning	Positive, to be further promoted
17	Deposits on all plastics	Positive, but not for marine alone

Source: Sterk Consulting, 2011

Conclusions

The following conclusions can be drawn from the stakeholder consultations described above:

- Most stakeholders (especially those from the industry) share the feeling of the ministry that current policy will bridge most gaps for meeting the GES.
- The stakeholders feel that the current list of measures (which will be submitted to a CBA next year) is too limited. This requires further explanation to the stakeholders or alternatively, changing the list to include a wider array of measures.
- Maintaining/reaching uniformity (level playing field) is a major concern for stakeholders. This applies to the different sectors involved ('Why are CFP measures not included in CBA') and different countries that carry out the directive (different standards/rules in every harbour). Stakeholders feel that the fact that this is a European directive should be an important driver for this.
- More research into cause-effect relations and (pollution) routes is needed. A number of stakeholders has its own research programmes that cover some of the knowledge gaps. The stakeholders from the industry use this as an argument to postpone certain measures until it becomes clear that they indeed have an effect on the problem.
- For some of the measures, e.g. different packaging standards of plastic pellets, the various measures that promote biodegradable materials, the stake-

holders do not recognize the problem (pellets) or find that the solutions (biodegradable plastics) are still too uncertain or undesirable.
- For some measures, stakeholders are / will be actively involved in the implementation. E.g. fishing for litter is carried out by the fishing industry.
- The MSFD in relatively unknown to the users of the North Sea. More, and more accurate, publicity is required.

6.3 Stakeholder meeting Litter in Sea

Since May 2010, a core group MSFD exists, containing of interested parties who want to think and talk into more detail about realizing the initial assessment, good environmental status, environmental targets and indicators. This core group has met seven times between May 2010 and the completion of the Marine Strategy Part 1 to discuss the progress, the products and the policy of the Marine Strategy. This process focused on joint fact-finding for the different components of the Marine Strategy Part I. All relevant stakeholders were involved in this process: fishery sector, shipping sector, nature and environment representatives, hydraulic engineers, offshore industry and the recreation sector.

In 2010, three workshops with a brainstorm component have been held with experts to discuss about the initial assessment and the good environmental status. In addition, where necessary, bilateral consultation with individual stakeholders were held. Even after the completion of the Marine Strategy Part I this stakeholder group had regular meetings (approximately 1 time every six weeks) to discuss about the program of measures. In addition, specific theme workshops including a workshop in November 2012 on the theme of marine litter has been organised.

On 11 October 2012, the Ministry of Infrastructure and the Environment organised in cooperation with the North Sea Foundation a stakeholder meeting on the issue of marine litter at sea. For this stakeholder meeting 'Litter in Sea' a large number of stakeholders were invited to think about practical and achievable steps to reduce the amount of marine litter in the sea. The purpose is to come to effective measures that help to reduce the amount of litter in the marine environment, and measures that might give the Netherlands a lead in the sustainability of the European economy, with the ultimate goal: Litter does not belong in the sea.

During this workshop, representatives from different organizations and sectors presented a number of examples of best practices, such as a cosmetics producer that would like to replace micro plastics in scrubs, a foundation that organizes a beautiful beach election which stimulates beach visitors and pavilions to clean beaches at relatively low cost and raises awareness, and a cruise company that is working actively on their own waste management plan.

During the meeting also possible additional measures for marine litter were discussed. Stakeholders were divided into groups to come to a broadening of the range of instruments / measures to reduce the amount of marine litter in the sea, which were then scored on feasibility and effectiveness. On this basis a top 3 of effective and feasible measures, and a 4th effective but non-feasible measure were identified. Then the four above measures were elaborated on the basis of a number of questions (What is the result? Which parties play a role (source & solution)? What steps should be taken? Obstacles? Benefits? What can stakeholders already do tomorrow?). Finally, the various sub-groups exchanged and elaborated their ideas with each other.

Some of the measures referred to in this exhibit overlap with the measures that were analyzed by LEI (2011) in the provisional cost-effectiveness and cost-benefit analysis for the MSFD (see Chapter 3). However, also new measures were mentioned. This has given rise to undertake additional research. The following list of measures were mentioned by the stakeholders as feasible and effective:

- Improve enforcement of litter from ships
- Improvement of ship litter intake system
- Raising awareness: make litter compulsory part of the curriculum and the learning record
- Raising awareness on ships by personal approach during visits and inspections by government and port
- Uniformity of tariffs and procedures for handing in litter in ports
- Improving port enforcement by cooperation of the Port Authority
- Facilitate and maintain
- Seduce the public
- Ecodesign
- Raising awareness
- Close the loop (plastic recycling)
- River Litter

The stakeholder meeting showed that many initiatives already exist, but that also many additional measures are possible. Many of these measures are within the private sector. It is therefore important to involve the different sector in the remainder of the process. For the implementation, there are several parties needed, so cooperation and dialogue is crucial. Although there are still many gaps in knowledge, that does not impede action. One concrete outcome of this meeting was the establishment of a permanent stakeholder group that meets every three months to continue to talk about the steps that should be taken in order to come to a program of measures.

6.4 Distribution of costs and effects of measures on stakeholders (incl. employment)

In compiling the program of measures the distribution of the costs and expenses of the measures will be taken into account. Because the final package of measures is not yet known, the distribution of the burden can not (yet) be given.

7 International cooperation

7.1 Introduction

The protection of the marine environment is a typical case for international cooperation. Therefore, throughout the process of the realization of the socio-economic analyses for the program of measures, a lot of international exchange of background studies and information has taken place. In order to stimulate this exchange, it was decided from the beginning to write the background reports as much as possible in English and put them on the internet as soon as possible. Also, once the reports were published on the internet an email was sent to everybody who might be interested in these documents to inform them about the availability of these reports and information and where they can find these documents. In various working groups, the Netherlands have regularly given presentations, presenting not only the progress of the analyses, but also extensively discussing the lessons learned from the things that went well, or not so well.

Also in the process of compiling the program of measures, it was tried to work together international level as much as possible. This was mainly done by means of consultations in the regional sea convention, OSPAR.

7.2 Cooperation within EU

The Marine Strategy is not an isolated policy. Implemented on its own, it could never successfully achieve good environmental status. As with the implementation of existing and initiated policy, effective collaboration with other countries is of vital importance. The Netherlands has advocated optimal coordination of and consistency between the Member States' individual marine strategies, particularly within the OSPAR framework, but also in the working parties and expert groups established by the European Commission.

EU cooperation on preparing the program of measures
On European level, EU Member States are facing different challenges in preparing their programs of measures to achieve or maintain good environmental status of their marine environments (ecological situation but also considering their economic, social and regulatory situation). Hence, the European Commission (DG ENV) has contracted the consultant Arcadis in 2010 to prepare a study on the Economic assessment of policy measures for the implementation of the MSFD.

The objective of this study is to prepare the ground for the step of the MSFD consisting of preparing a program of measures to achieve or maintain good environmental status. The study of Arcadis includes building elements for Member States to facilitate the process of choosing a package of measures to achieve the targets set for their marine environment, or more specifically in terms of MSFD, to prepare a program of measures.

The guidance consists of an inventory of possible measures, their assessment according to a set of criteria (e.g. cost, effectiveness, benefits, feasibility) and the identification of key success / limiting factors for each measure or group of measures. The collected evidence in the toolkit could support Member States to select the set of measures suited for their own implementation of the MSFD. The outcome of the study should also help streamlining discussions between Member

States of the same region and between MS and the Commission on what direction to take in developing such a program of measures (by 2015).

7.2.1 EU cooperation on international harmonization of port reception facilities

In the LEI study of 2011 it is stated that international harmonisation of the fees of port reception facilities and controlling the amount of garbage handed in, is a potentially cost-effective measure to reduce litter from ships. In addition, awareness raising is mentioned as an important and cost effective measures.

One of the most important policy recommendations of the LEI study is international cooperation regarding marine litter with OSPAR member states. The Dutch government could initiate an international management plan for marine litter, in which all kinds of arrangements could be made about standards, priorities and metrics for measuring progress possible. A level playing field with respect to port reception facilities may prevent illegal dumping of waste at sea, while on the other hand competitive distortions between ports regarding the reception of waste will be reduced.

One of the points where differences exist between ports is the financing of waste collection in ports. There are already liabilities to pay for the provision of waste in ports, regardless of whether they offer waste ('indirect financing"). The obligation to pay for the provision of waste can be seen as an incentive to offer waste to the port reception facility (because the ship has already paid for it). However, there are major differences between ports in relation to the amount of waste that can be issues for free. For instance, in Sweden a system of 100% indirect funding (all waste that is offered is free) is in place, while in other ports this is less. Also the waste categories and the parameters for determining how much waste can be issued for free (the funding basis) vary by port (calculation per m3 or per kg).

The Ministry of Infrastructure and Environment has asked Oranjewoud to give substance to the advices and recommendations of previous studies by drafting a protocol that can be used in international discussions with other Member States, ports and shipping sector regarding how to deal with waste collection in ports and explore opportunities together with the stakeholders to do something with economic incentives for waste collection in ports, clean ships and clean ports. The results of the study of Oranjewoud are discussed in Chapter 3

7.3 Cooperation in OSPAR

At the OSPAR level different countries are working together to develop a regional approach to marine litter. On 7 and 8 November 2012, about 20 participants gathered at the tip of Brittany to discuss marine debris and plastic soup, at the tenth meeting of the OSPAR working group on marine litter (Regional approach to marine litter: challenging task at intersection of science and policy). OSPAR is a regional sea convention to protect the marine environment of the North-East Atlantic. Member States include Germany, Belgium, the Netherlands, United Kingdom, France, but also Sweden, Spain and Portugal.

During this meeting, the following topics have been discussed: data collection and monitoring (beach) waste, the development of guidelines, resource provision, indicators, research and a Regional Action Plan with possible measures. These topics has been discussed for the benefit of regional coordination in the framework of the European Marine Framework Directive, which states that in 2020 a good environmental status of the marine environment should be achieved.

One of the challenging discussion was about the measures that have to be taken in order to realize a reduction of marine litter in the marine environment. In determining the type of measure, it is important to know which sources of litter should be addressed (e.g. fisheries, shipping or tourism). The origin of the litter is not always easy to determine. In addition it is important to assess the effectiveness of the measures discusses. This is done on the basis of consistent monitoring of litter on fifty OSPAR beaches since the year 2000.

During the meeting, also the results of the stakeholder meeting 'Litter at Sea' of 11 October 2012 in the Netherlands have been explained. In 2015, all European countries must have program of measures, in consultation with the region. Germany has taken the initiative with the Netherlands to further sharpen the OSPAR Regional Action Plan OSPAR by including (regional) measures. This is a challenging task at the intersection of science and policy.

8 Knowledge Gaps Marine Litter

The expectation is that the quantity of litter from the key sources, i.e. shipping, fisheries, leisure activities and rivers, will not decrease in the coming years, despite prevailing and initiated policy. Although little is known about the environmental effects of micro plastics in the sea, there are indications of potentially major risks for food webs. The target for 2020 is a decrease in the quantity of litter on the beach and a downward trend in the quantity of litter in marine organisms.

Knowledge assignments: due to a lack of knowledge on the full scope and effects of litter on the ecosystem, it is not possible to make any predictions on the achievement of good environmental status. The aim is to accumulate more knowledge of the presence and effects of marine litter, particularly micro plastics. In the rest of this paragraph the knowledge gaps regarding marine litter will be elaborated.

8.1 Knowledge gaps

In the field of marine litter many knowledge gaps still exist. Due to a lack of knowledge and reliable research methods, it is difficult to get a complete picture of the trends and consequences of litter in the marine environment. That also makes it difficult to establish good environmental status with no damage to the marine environment. The recommendation of the EU Technical Subgroup Marine Litter provides examples of possible research and monitoring methods to which every Member State can join up. The main knowledge gaps are:

- There is no research protocol and data series for litter in the water column.
- There is no research protocol and data series for litter on the seabed. The expectation is that the existing International
- Bottom Trawl Survey (IBTS) can be extended to enable research into litter on the seabed.
- There is no research protocol and data series for microplastics in the marine environment.
- There is a lack of knowledge about the consequences of litter and plastics for marine organisms and ecosystems.
- There is insufficient knowledge for identification and standardization of sources of litter.

As a result, not enough quantitative information is available to provide clarity on how measures can contribute to achieving good environmental status. It is possible, however, to indicate which indicators are affected by the measures. In 2011, a cost-effectiveness analysis was performed based on expert knowledge. This led to a first possible ranking of potential measures. The results from these analyses can be used to elaborate the supplementary policy assignment into measures. When developing knowledge and drafting the monitoring programme, the Netherlands will work with other Member States in the European Technical Subgroup Marine Litter.

8.1.1 Knowledge gaps regarding method

The cost-effectiveness analysis method is based on currently available information and input from experts. For the cost-effectiveness analysis quantitative descriptions are needed for both the Business as Usual scenario and for the MSFD targets. This

information is currently not sufficiently available for a full quantitatively cost-effectiveness analysis. Thus the amount of measures to be taken cannot be estimated. The physical effects of potential measures can be identified, but not quantified. The pressures that are being addressed by a measure can easily be identified, but how much these measures (per unit) contribute to achieving GES is not yet known.

Furthermore, most of the possible measures assessed in this study are relatively new. Therefore, information about their effect is not yet available. In these cases, expert opinion is the only available source of information. On the basis of this study potential cost-effective measures can be selected and elaborated before the phase of implementation of MSFD. The methodology applied is suitable in circumstances with limited data availability.

For the cost-benefit analysis the problems with quantification of potential effects of measures and consequent impacts on the marine environment prevents a proper estimate of the potential benefits in monetary terms. Based on some very arbitrary assumptions, at least some indication of the most important beneficiaries and an order of magnitude might be given.

8.1.2 Knowledge gaps waste streams

Marine litter originates from numerous different sources with approximately 80% of litter entering the marine environment from land-based sources (world-wide) and the remaining 20% originating from sea-based sources, although this varies between areas. According to monitoring data the proportion of sea-based litter on Dutch beaches is relatively high. In the 2005-2010 period 44% of the litter found on beaches originates from shipping and fisheries, 30% of litter stems from land and from 26% of litter the origin is unknown.

Although the amount of litter at the Dutch beaches is currently monitored, no quantitative information is available on the quantity of litter in the sea, nor about the quantity emitted yearly by the distinguished sources, nor on the effects on the marine ecosystem. Therefore, a litter flow-model should be developed based on the currently available information on marine litter, in order to get more grip on the sources entering litter in the sea. This model should describe the litter circle and reveal missing information links that might be solved by extra monitoring or research.

The amount of litter in the North Sea stemming from rivers is largely unknown. Although the share of riverine litter in North Sea is probably smaller than the average global amount of 80%, it still can be a significant source of litter. Therefore a more solid assessment is needed of the amount of litter in rivers so measures to reduce this source of marine litter can be developed.

8.1.3 Knowledge gaps regarding number of beach visitors

Ecorys (2012) has developed a simple cost function to estimate the cost of cleaning up litter on Dutch beaches. This equation describes the total cost of waste disposal from the beach (y) as a function of the number of beach visitors (x) on an annual basis (as an explanatory factor). The fact that the number of beach visitors is a good proxy for the costs involved, can also be explained intuitively, since, as more visitors come to the beach, in general more facilities will be available, that have to be cleaned more often (outside regular working hours) in order to be able to provide

visitors clean beaches. At the same time, more visitors are likely to result in more waste. This means that the variable 'number of visitors' implicitly takes into account many of the determinants of the costs.

However the reliability of the number of visitors per municipality is a concern. In the Netherlands, there is no systematic research on the number of beach visitors per municipality. That means, that for the estimation of the number of visitors per municipality incidental counts and/or information from other studies has been used.
This uncertainty regarding the number of visitors is also included in the key figure for the annual cost per 1,000 visitors. Hence, the cost estimate can be improved by more 'reliable' information about beach visitors per municipality. Furthermore, the basic data would be ideally gathered for the other beach municipalities that has not been included in this study. However, it is not expected that this impact the cost estimate significantly.

8.1.4 Other knowledge gaps regarding identified measures

In this study many possible measures are mentioned and investigated. Many of these measures are relatively new, and hence knowledge gaps still exist. For instant, the source and age of resin pellets is hard to identify. Hence, the relative contribution of separate industries and transporters is unknown, which makes it difficult to determine effective source based measures. Furthermore, based on current knowledge the amount of netting discarded and lost by fishermen is unknown, as are the impacts. The impact of the measure biodegradable nets on fishermen behaviour is difficult to estimate. Also, the total amount of plastic packaging sold annually by beach pavilions in the Netherlands is unknown. Furthermore, the amount of litter can be reduced cost-effectively by awareness raising activities and campaigns. However, it is unclear how effective these information campaigns are.

8.2 Research Needs as identified by the Technical Sub Group on Marine Litter

8.2.1 The socio economic impact

Anthropogenic inputs may have changed and sources are maybe shifting between tourism fishing, shipping and marine industry. More research towards a clear evidence base is necessary to ensure efficient policy decisions. It is essential that common methodologies are developed to collect both social and economic data. This must be addressed to develop comparable datasets for evaluation at the EU level. The evaluation of direct costs and loss of income to industry and local authorities should be evaluated on a yearly basis and using harmonized protocols with overall responsibility for marine litter, as part of a national marine litter strategy in each MS. In relation to the economic costs of marine litter, further research needs then to be undertaken in order to:

- Evaluate the potential loss of income to due to beach litter in relation to tourism.
- Evaluate the potential loss of fish stocks due to abandoned and lost fishing gear.
- Evaluate direct costs to industry, local authorities and governments, to ecosystems goods and services.
- Assess socially acceptable levels of marine litter to the public and industry.
- Improve tools such as GIS, socio-economic models etc. enabling evaluations of sources of litter, social impact and contributing to management efforts.

- Establish the impact of marine litter on human health.
- Develop an indicator for the aesthetic impact of litter.
- Understand the effectiveness of measures intended to reduce the amount of marine litter.

8.2.2 Recommendations for research priorities

The implementation of the Marine Strategy Framework Directive is a long term process to reach the good environmental status by 2020. This include different steps and research will have to be engaged quickly to support the start of monitoring by 2014, such as short term research is needed and includes the following priorities:

1. Behaviour (floatability, density, effects of wind, fouling, degradation rates) and factors affecting the fate of litter (weather, sea altitude, temperature driven variations, slopes, canyons, bays, etc.) affecting transport must be evaluated.
2. Comprehensive models should define source and destination regions of litter (especially accumulation areas, permanent gyres, deep sea zones), estimated residence times, average drift times and must consider transborder transportation, from/to MSFD region/sub regions.
3. Evaluate rates of degradation of different types of litter, quantify degradation products (to nanoparticles) and evaluate environmental consequences of litter related chemicals (Phthalates, bisphenol A, etc.) in marine organisms.
4. Identify sources for direct inputs of industrial microlitter particles.
5. Establish the environmental consequences of microlitter to establish potential physical and chemical impacts on wildlife, marine living resources and the food chain.
6. Evaluate effects (on metabolism, physiology, on survival, reproductive performance and ultimately affect populations or communities).
7. Evaluate the risk for transportation of invasive species.
8. Study dose/ response relationships in relation with types and quantities of marine litter to enable science-based definition of threshold levels.
9. Evaluate direct costs to industry, fishing industry, local authorities and governments to ecosystems goods and services.
10. Develop automated monitoring systems (ship-based cameras, microlitter quantification etc.) and impact indicators (aesthetic impact, effects on human health, and harm to environment).
11. Rationalization of monitoring (standards/baselines; data management/quality insurance; extend monitoring protocols to all MSFD sub regions)

Amongst these priorities, point 10 and 11 are critical for monitoring.

9 References

- Arcadis (2009). Eindrapport Ecologische Kennisleemtes voor kostenbaten analyses ten behoeve van de Kaderrichtlijn Mariene Strategie. Arcadis, 2009
- Ashton, K., L. Holmes and A. Turner, 'Association of metals with plastic production pellets in the marine environment.' In: Marine Pollution Bulletin 60 (2010), pp. 2050-2055.
- Ayalon O., T. Goldratha, G. Rosenthalc and M. Grossmanc, 'Reduction of plastic carrier bag use: An analysis of alternatives in Israel.' In: Waste Management 29 (2009) 7; pp. 2025-2032.
- Aviation News, 2011. www.luchtvaartnieuws.nl
- Bathing Water Directive (76/160/EEC and 2006/7/EC)
- Blue Flag, http://www.blueflag.org/):
- Brown J., Macfadyen G., Huntington T., Magnus J., Tumilty J., 2005. Ghost Fishing by Lost Fishing Gear. Final Report to DG Fisheries and Maritime Affairs of the European Commission. Fish/2004/20.
- Bureau Waardenburg (2011).Evaluating biodiversity of the North Sea using Eco-points: Testing the applicability for MSFD assessments. Bureau Waardenburg, 2011
- Bureau Waardenburg (2012). Zwerfafval en KRM. Bureau Waardenburg, 2012
- Carpenter, A., 'The Bonn agreement aerial surveillance programme: Trends in North Sea oil pollution 1986-2004.' In: Marine Pollution Bulletin 54 (2007), pp. 149-163. Agentschap NL 2010, Nederland is schoner dan u denkt. November 2011.
- Creagh, S., 'Plastic bag levy failing email.' In: The Sydney Morning Herald, January 8, 2007.
- Convery, F., S. McDonnell en S. Ferreira, 'The most popular tax in Europe? Lessons from the Irish plastic bags levy.' In: Environmental Resource Economics 38 (2007): pp. 1-11.
- Deltares, IMARES, *Initial Assessment, Implementation of the Marine Strategy Framework Directive for the Dutch part of the North Sea Background document, page 137* (Delft, 2011)
- Deltares IVM, *Microplastics Litter in the Dutch Marine Environment* (Delft, Amsterdam, 2011) 4.
- DHV (2010). Measures for the Marine Strategy Framework Directive; First overview of potential measures, related costs and effects of implementing the Marine strategy. DHV, 2010
- Directive on Packaging and Packaging waste (2004/12/EC)
- Dworak, T., Gorlitz, S., Interwies, E., Rehdanz, K., Bertram, C., Hiebenthal, C. (2011): Methodische Grundlagen fur sozio-okonomische Analysen sowie Folgenabschatzungen von Masnahmen einschlieslich Kosten-Nutzen Analysen nach EG-Meeresstrategie-Rahmenrichtlinie (MSRL). Project Report.
- Ecorys (2012a). Bepaling van schade door afval in netten en schroeven. Ecorys, 2012
- Ecorys (2012b). Kostenkentallen voor opruimen zwerfafval langs de Nederlandse stranden. Ecorys, 2012
- EFTEC (2012). Recreational benefits of reductions of litter in the marine environment. EFTEC, 2012
- E.M. Foekema, C. de Gruijter, M.T. Mergia, C. Kwadijk, M. Kotterman, C. Klok, J.A. van Franeker,A.J. Murk & A.A. Koelmans (2011), Inventory of the presence of plastics in the digestive tract of North Sea fishes http://documents.plant.wur.nl/imares/afval/vissen/plastics-fish-2011.pdf
- Environmental Liability Directive (2004/35/EC)

- European Commission, Commission Staff Working Document, Overview of EU policies, legislation and initiatives related to marine litter, SWD(2012) 365 final, Brussels, 31.10.2012
- European Commission (2011) Plastic waste in the environment – Final Report. DG Environment.
- European Commission, Plastic Waste in the Environment. Specific contract 07.0307/2009/545281/ETU/G2 under Framework contract ENV.G.4/FRA/2008/0112. Revised final report. DG Environment, Brussels, 2011.
- EU Directive on port reception facilities for ship-generated waste and cargo residues (2000/59/EC)
- *EU Marine Strategy Framework Directive (2008/56/EC)*
- European Parliament and Council, Directive 94/62/EC of 20 December . 1994.
- *EU, Richtlijn 2000/59/EG van het Europees Parlement en de Raad van 27 november 2000betreffende havenontvangstvoorzieningen voor scheepsafval en ladingresiduen* (Brussel, 2000).
- Franeker J.A., oktober 2011. Plastic soep komt op ons bord. Milieudossier nummer 6, oktober 2011.
- Franeker, J.A. van., C. Blaize, J. Danielsen, K. Fairclough, J. Gollan, N. Guse, P.-L. Hansen, M. Heubeck, J.-K. Jensen, G. Le Guillou, B. Olsen, K.-O. Olsen, J. Pedersen, E.W.M. Stienen and D.M. Turner, 'Monitoring plastic ingestion by the northern fulmar Fulmarus glacialis in the North Sea.' In: Environmental Pollution 159 (2011) 10: pp. 2609-2615. http://nl.wikipedia.org/wiki/touw
- Franeker, J.A. van and the SNS fulmar study group, Fulmar litter EcoQO monitoring along Dutch and North Sea coast in relation to EU Directive 2000/59/EC on Port Reception Facilities: results to 2009. Report nr. CO37/11. IMARES, part of Wageningen UR, Texel, 2011.
- Galgani, F., D. Fleet, J. van Franeker, S. Katsanevakis, T. Maes, J. Mouat, L. Oosterbaan, I. Poitou, G. Hanke, R. Thompson, E. Amato, A. Birkun and C. Janssen, Marine Strategy Framework Directive Task Group 10 Report Marine litter. Prepared under the administrative arrangement between JRC and DG ENV (no 31210 – 2009/2010), the Memorandum of Understanding between the European Commission and ICES. 2010.
- Gregory M., R., 2009. Environmental implications of plastic debris in marine settings – entanglement, ingestion, smothering, hangers-on, hitchhiking and alien invasions. Philosophical transactions of the Royal Society, biological sciences (2009) 364, 2013-2025.
- Hall, K., Impacts of marine debris and oil; economic and social costs tot coastal communities. KIMO. Shetland, Scotland, 2000.
- Hogg, D., D. Fletcher and T. Elliott, Have we got the bottle? Implementing a deposit refund scheme in the UK. A report for the Campaign to protect Rural England. Eunomia Research & Consulting, Bristol, UK, 2010.
- IMO, *International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978* (MARPOL 73/78).
- IMO, Resolution MEPC.207(62) (IMO, 2011) '2011 Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species', which was adopted on 15 July 2011, the Marine Environment Protection Committee (MEPC) of the International Maritime Organisation (IMO)
  www.imo.org/About/Conventions/StatusOfConventions/Pages/Default.aspx
- International Convention for the Prevention of Marine Pollution from Ships (1973) as modified by the Protocol of 1978 relating thereto (MARPOL 73/78)
- J.A. van Franeker, *Fulmar Litter EcoQO Monitoring in the Netherlands 1979-2008 in relation to EU Directive 2000/59/EC on Port Reception Facilities,* Report C027/10, IMARES (Wageningen, 2010) 12.

- J.A. van Franeker, 'Monitoring plastic ingestion by the northern fulmar Fulmarus glacialis in the North Sea', *Environmental Pollution,*nr. 159 (10) (2011) 2611/2614.
- JRC IES (eds.) (2011): Marine Litter - Technical Recommendations for the Implementation of MSFD Requirements. MSFD GES Technical Subgroup on Marine Litter.
- Lavee, D., 'A cost-benefit analysis of a deposit-refund program for beverage containers in Israel.' In: Waste management 1 (2010) 30: pp. 338-345.
- LEI (2010). The current cost of avoiding degradation of the Dutch North Sea Environment. LEI, 2010
- LEI (2011). How to achieve good environmental status in North Sea: Framework for cost effectiveness and cost-benefit analysis for the MSFD. LEI, 2011
- Leslie H.A., van der Meulen M.D., Kleissen F.M., Vethaak A.D., 2011. Microplastic litter in the Dutch Marine Environment. Providing facts and analysis for Dutch policymakers concerned with marine microplastic litter. Deltares project 1203772-000.
- Lewis, H., K. Verghese and L. Fitzpatrick, 'Evaluating the sustainability impacts of packaging: the plastic carry bag dilemma.' In: Packaging Technology and Science 23 (2010): pp.145-160.
- Macfadyen G., Huntington T., Cappell R., 2009. Abandoned, lost or otherwise discarded fishing gear. UNEP Regional Seas Reports and Studies, No. 185; FAO Fisheries and Aquaculture Technical Paper, No. 523. Rome, UNEP/FAO. 2009. 115p.
- Marine Conservation Society, Beachwatch 2005 - The 13th Annual Beach Litter Survey Report. Marine Conservation Society, Ross-on-Wye, United Kingdom, 2006.
- McIlgorm, A., Campbell H. F. and Rule M. J. (2008) Understanding the Economic Benefits and Costs of Controlling Marine Debris in the APEC Region, APEC Marine Resources Conservation Working Group.
- McIlgorm, A., H.F. Campbell and M.J. Rule, 'The economic cost and control of marine debris damage in the Asia-Pacific region.' In: Ocean and Coastal Management 54 (2011): pp. 643-651.
- Ministerie van Infrastructuur en Milieu, *Agenda duurzaamheid.*
- Min I&M (2012). Mariene Strategie voor het Nederlandse deel van de Noordzee 2012-2020, Deel I Ministerie Infrastructuur en Milieu en Ministerie Economische Zaken Landbouw en Innovatie, Den Haag, 2012
- Ministerie van Infrastructuur en Milieu, *Meer waarde uit afval. DP 2011048374. Brief aan de Tweede Kamer* (Den Haag, 25 Augustus 2011) 1-7.
- Ministerie van Infrastructuur en Milieu, *Meer waarde uit afval,* 51.
- Ministerie van Infrastructuur en Milieu, *Motie en Toezeggingen Scheepvaart. IenM/BSK-2011/118115. Brief aan de Tweede Kamer* (Den Haag, 26 september 2011).
- Ministerie van Infrastructuur en Milieu, *Motie en Toezeggingen Scheepvaart.*
- Ministerie van Infrastructuur en Milieu, *Onderzoek VI kunststof verpakkingsafval uit huishoudens* Brief aan de Tweede Kamer DP2011036919 (Den Haag, 2011).
- Ministeries VROM, LNV, SZW, WVC and bedrijfsleven, Convenant verpakkingen I, bijlage A.1. Den Haag, 2008.
- Monitor zwerfvuil, Monitoren zwerfvuil op de Nederlandse stranden 2005-2010. Draft 2011. Wageningen, 2011.
- Mouat, T., Lopez-Lozano, R. & Bateson, H. (2010) Economic impacts of Marine litter, pp. 117: KIMO (Kommunenes Internasjonale Miljøorganisasjon).
- Mouat, John, personal comment, 2012
- Mouat, J, Rebeca Lopez Lozano and Hannah Bateson (2010) Economic Impacts of marine Litter.

- NCEE, The United States Experience with Economic Incentives for Protecting the Environment. Report no. EPA-240-R-01-001. National Centre for Environmental Economics, Washington, USA, 2001.
- Nederland Schoon
- Nicolaus E. E. M. Benthic marine litter collection between 1992 and 2008: Towards an assessment of marine litter that might cause harm to the marine environment. Presentation. Cefas Lowestoft, UK.
- North Sea Foundation, 2011. www.noordzee.nl
- Ocean Studies Board, Tackling Marine Debris in the 21st century. The National Academies Press, Washington DC, 2009. www.nap.edu/catalog/12486.html
- OECD, Glossary of Statistical Terms Online. 2011 http://stats.oecd.org/glossary/detail.asp?ID=594
- Operation Clean Sweep, October 2010
- Oranjewoud (2012). Discussion document Managing undesirable ship generated waste discharges in Marine Environments. Oranjewoud, 2012
- OSPAR Commission, 2007: Monitoring of marine litter on beaches in the OSPAR region.
- OSPAR (2009). Marine litter in the North-East Atlantic Region: Assessment and priorities for response. London, United Kingdom, 127 pp.
- OSPAR Commission (2010): Guidelines for Monitoring Marine Litter on the Beaches in the OSPAR area.
- OSPAR (2012), *MSFD Advice document on Good environmental status - Descriptor 10: Marine Litter.*
- PBL, Natuurverkenning 2010-2040; visies op de ontwikkeling van natuur en landschap. PBL, Bilthoven, 2012.
- Perestrelo I.P.L. and H. Spínola, 'The influence of a voluntary fee in the consumption of plastic bags on supermarkets from Madeira Island (Portugal).'In: Journal of Environmental Planning and Management (2010) vol. 53, issue 7: pages 883-889. Machico, Portugal.
- personal communication with Renate De Backer, Wadden Sea Society, October 2011.
- personal communication with Renate de Backere, Waddenvereniging, October 2011
- Rijkswaterstaat online
- Rijkswaterstaat Noordzee, *Draft Monitoren zwerfvuil.*
- Ruigrok, E.C.M., Baten van de Kaderrichtlijn Mariene Strategie. Witteveen+Bos/Rijkswaterstaat RIKZ, Deventer, 2008.
- Singapore, 2011
- Singapore, 2010
- Staatsblad, p. 580. 2008.
- Sterk Consulting (2011). Assessment of economic instruments for the Marine Strategy Framework Directive. Sterk Consulting, 2011
- Taal, K., personal comment.
- Takehama, S. (1990) Estimation of damage to fishing vessels caused by marine debris, based on insurance statistics. In: Shomura, R.S., Godfrey, M.L. (Eds.), Proceedings of the Second International Conference on Marine Debris, Honolulu, Hawaii, 2-7 April 1989. US Department of Commerce, pp. 792–809.
- Thompson, R.C., B.E. La Belle, H. Bouwman & L. Neretin (2011), Marine debris: Defining a global environmental challenge.
- Tinch, D. and Hanley, N. (DRAFT) The value of changes to the bathing water directive in Northern Ireland. University of Stirling.
- TNS NIPO (2011). Beleving van de Noordzee: Een kwantitatieve consultatie onder Nederlandse burgers over de Noordzee (Amsterdam, 2011).
- United Nations Convention on the Law of the Sea (UNCLOS) and General Assembly (GA) Resolutions, especially UN Resolution A/RES/60/30 – Oceans and the Law of the Sea
- Urban Waste Water Treatment Directive (91/271/EEC and 98/15/EC)

- US EPA, Plastic pellets in the aquatic environment. Sources and Recommendations. United States Environmental Protection Agency, Cincinatti, USA, 1993.
- Van Franeker, pers. Comment
- Vereniging van Nederlandse Gemeenten, *Focusprogramma Zwerfafval, BAMM/U201000025 Lbr. 10/003,* Brief aan de leden t.a.v. het college en de raad (13 januari 2010).
- Washington State, Litter Fines. 2009.
- Waste Framework Directive (2008/98/EC)
- Wegner, A., E. Besseling, E.M. Foekema, P. Kamermans, A.A. Koelmans. 2012. Effects of Nanopolystyrene on the Feeding Behaviour of the Blue Mussel (Mytilus edulis L.). Environ. Toxicol. Chem.. http://www.wageningenur.nl/nl/ExpertisesDienstverlening/Onderzoeksinstituten/imares/show/Onzichtbare-plastic-deeltjes-in-zeewater-nadelig-voor-zeedieren.htm

  World Plastic Market Review and Plastics, Europe Market Research Group 2010, USA.
- Wurpel, G., Van den Akker, J., Pors, J. & Ten Wolde, A. (2011): Plastics do not belong in the ocean. Towards a roadmap for a clean North Sea. IMSA Amsterdam.
- www.bdpplastics.com
- http://blog.odintechnologies.com/bid/52341/What-do-RFID-Tags-Cost
- http://www.noordzee.nl/blog/consumenten-spoelen-massaal-plastic-milieu-in/);
- http://pubs.acs.org/cen/news/89/i39/8939scene1.html
- http://www.sciencepalooza.nl/2012/05/badeendjes-zwemmen-oceaan-over/ (30 oktober 2012).
- http://www.pelletwatch.org (31 oktober 2012).