



norden

Nordic Council of Ministers

Method for economic assessment of the common marine policies

A toolkit for assessment of national consequences of the EU Commissions' Thematic Strategy on the Protection and Conservation of Marine Environment, and the proposed Marine Strategy Directive (MSD)

Content

Summary	1	
1. Introduction		5
1.1 Background and purpose of the methodological study		5
1.2 Economic assessment of community policies - purpose and approach		6
2. Overall framework		7
2.1 Basic understanding of the proposed strategy		7
2.2 Identifying sectors/drivers affecting the marine environment		11
2.3 Overall framework of the methodology		16
2.4 Scenario analysis		17
3. How to build a baseline scenario		23
3.1 Purpose of identifying environmental pressures		23
3.2 Identifying environmental pressures		25
3.3 Forecasting environmental pressures		34
3.4 Checklist		40
4. How to build the alternative scenario		41
4.1 Purpose and content of alternative scenario definition		41
4.2 Defining the likely national need for action to reach target environmental status	42	
4.3 Identifying relevant remedial measures for the Nordic Countries		45
4.4 Checklist		55
5. How to assess the extra cost of the alternative scenario		57
5.1 General methodology for calculation		57
5.2 Assessing the costs of the remedial measures		60
5.3 Assessing the benefits of the remedial measures		62
5.4 Assessing the total net cost of the proposed policy		65
5.5 Interpreting and presenting the results		66
5.6 Checklist		68
6. Recommendations for further development of methods and tools		71
References		73
Appendix 1: Examples of estimation of unit-cost in selected sectors		75

Summary

Purpose and aim of study

The overall purpose of this project is to develop a toolkit of methodology for economic analyses of the national consequences of the EU Commission's Thematic Strategy on the Protection and Conservation of Marine Environment, and the proposed Marine Strategy Directive (MSD).¹ The study has the aim of presenting guidance for analyses to be made in the individual Nordic countries and autonomous territories. The methodology presented will also accommodate the possible use for analyses in the Baltic countries. The envisioned recipients of the report are advisers to policy makers and policy makers themselves, - economists and non-economists alike.

This "toolkit" has been developed as a guide to performing economic assessments that will serve as inputs to the individual countries' political deliberations and planning activities, and possibly to the formulation of a position in connection with the coming negotiations under the auspices of the EU. In other words, it is not a mandatory guideline for the member countries of the Nordic Council, but a common reference framework which can facilitate the exchange of views on and considerations of the cost and benefits of the proposed and present common marine policies.

Overall framework of the proposed strategy

Following an introduction and background chapter, the report first presents the overall framework for the proposed MSD. This is done by mapping the environmental pressures on the marine environment and the sectors that act as drivers for these pressures. Secondly, a number of issues of actual or potential relevance to the Nordic countries are selected. Thirdly, a regulatory assessment is given of areas in which the proposed MSD may involve a need for action extending beyond the present international and regional agreements. The mapping exercise will result in an overview of the target area of the economic assessment of the proposed MSD. The overview is presented in Table 0.1 below.

¹ This package will be referred to as "the proposed strategy" or simply the MSD.

Table 0.1 Overview of probable impact on sectors from the proposed MSD, in the Nordic Countries

Sectors/Drivers	Fisheries and aquaculture	Maritime transport	Offshore activity (Oil and gas)	Dredging, sand and gravel	Tourism, coastal activities	Land-based activities
Environmental pressures						
Over-fishing		n.a.	n.a.	n.a.		n.a.
Hazardous substances	n.a.				n.a.	
Oil spill and discharges				n.a.	n.a.	
Eutrophication	n.a.			n.a.	n.a.	
Litter pollution			n.a.	n.a.		
Microbiological pollution	n.a.	n.a.	n.a.	n.a.		
Non-native species			n.a.	n.a.	n.a.	
Coastal habitats			n.a.			
Radionuclide discharges	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

n.a.	Not applicable - No significant pressure from this sector
	Issue of limited or no relevance in the present context
	Issue of potential relevance in connection with implementation of the MSD
	Issue of main relevance in connection with implementation of the MSD
	Covered by other binding international agreements

Method for economic assessment

The overall process of making an economic assessment of a proposed policy involves three steps:

First, the so-called baseline scenario needs to be established. This will serve as the basis against which the consequences of the proposed policy can be assessed. It is essential to go through this preliminary step in order to obtain a clearly defined interpretation of the total cost estimate involving in adopting the policy. The second step will be to define the national implications of the proposed transnational policy, should a country choose to accept it. This step is very much a question of scenario building, since the proposed policy in the case of the MSD is unspecific when it comes to the type and dosage of action that should be taken. The final and third step is the economic assessment of the extra cost of the proposed policy – i.e. of the alternative scenario compared to the baseline scenario. At the end of each Chapter there is a checklist of tasks involved in the particular step of the analysis. Table 0.2 provides an overview of the three steps and a summary of the checklists.

Table 0.2 Steps in an economic assessment of a proposed marine strategy

Step 1	Establishing the business-as-usual situation - the Baseline Scenario	Chapter 3
	- Assess the present environmental pressures - Identify the main origin of these pressures - Forecast the environmental pressures and the environmental states in the business-as-usual situation	Chapter 3.2 Chapter 3.3 Chapter 3.4
Checklist for Step 1	✓ The links between drivers, pressures, state and impact of the marine environment using a framework like the DISP are established ✓ Other relevant and overlapping domestically accepted strategies and international agreements have been identified and the regulatory differences have been interpreted. ✓ Information is gathered and consensus reached on a number of indicators to describe the current environmental state of the domestic marine environment ✓ The best available expertise or models have been used to forecast the environmental states in the "business-as-usual" situation where other already agreed policies are e.g. assumed to meet their goals.	
Step 2	Defining the national implications of the proposed policy - the Alternative Scenario	Chapter 4
	- Determine the likely need for action to reach target environmental status - Identify and "dose" relevant remedial measures	Chapter 4.1 Chapter 4.2
Checklist for Step 2	✓ The strategy that is the subject of the assessment has been formulated and delimited. This entails discussing and reaching an assumption of "new issues" in the proposed strategy that will entail incremental measures. ✓ Consensus has been reached or assumptions made on the interpretation of the goal of the proposed strategy ("good ecological status"). ✓ Relevant remedial measures have been identified and the most cost-effective solutions have been selected. ✓ The need for action - or "implementation gap" - has been established using of indicators of the environmental state and the dose-effect of the measures. Alternatively a pragmatic approach is used. ✓ One or more scenarios describing the potential national implementation of the proposed strategy is presented.	
Step 3	Economic assessment of the extra cost of proposed policy	Chapter 5
	- General calculation method - Assessment of the cost of the remedial measures - Assessment of the benefits of the remedial measures to various sectors and the economy as a whole - Assessment of total net cost of alternative scenario compared to baseline scenario - Interpretation of results	Chapter 5.1 Chapter 5.2 Chapter 5.3 Chapter 5.4 Chapter 5.5
Checklist for Step 3	✓ The general calculation method has been defined and clearly stated. ✓ The cost of the individual measures in the alternative scenarios has been calculated using unit-prices for partial effects and economic modelling estimates for measures with significant potential effects for the national economy. ✓ The benefits of the remedial measures to various sectors and the economy as a whole have been assessed. If possible, benefits are quantified and valued. If the incremental approach to scenario analysis was chosen in step 2, only the incremental benefits are isolated, so as to not count benefits reaped from other strategies. ✓ The total cost of the alternative scenario(s) has been estimated and compared to the total benefit assessment. ✓ The cost and benefits have been assessed for a number of politically relevant sectors and groups in the economy. ✓ Sensitivity analyses have been made, so that it is clear to the reader which assumptions that are uncertain and how critical they are to the result. ✓ The results have been presented in overview tables with all relevant assumptions and uncertainties alongside. A clear verbal conclusion has been made on the potential cost and benefits to the national/local economy of the proposed strategy.	

1. Introduction

The thematic marine strategy issued by the Commission sets out the overall goals for the protection and conservation of the marine environment. A draft Marine Strategy Directive has now been issued stipulating how the goals should be achieved. Negotiations of the draft directive are due for the second half of 2006.

1.1 Background and purpose of the methodological study

The overall purpose of this project is to develop a toolkit of methodology for economic analyses of the national consequences of the EU Commission's Thematic Strategy on the Protection and Conservation of Marine Environment, and the proposed Marine Strategy Directive (MSD). In the following; this package will be referred to as "the proposed strategy" or simply the MSD. The methodological study is aimed at presenting valuable guidance for national analyses that will be made in the Nordic countries². The methodology will also accommodate the possible use for national analyses in the Baltic countries. The envisioned recipients of the output from the study are advisers to policy makers, - economists and non-economists alike.

This "toolkit" has been developed as a guide to making economic assessments that will serve as input to the individual countries' political debate, and to the formulation of a position of the member states in the coming negotiations under the auspices of the EU. In other words, it is not a mandatory guideline for the member countries of the Nordic Council, but a common reference framework that will hopefully facilitate the exchange of considerations and views on the cost and benefits of the proposed and present common marine policies.

This toolkit is also relevant to both the EFTA/EØS countries, Greenland and the Faeroe Islands. A welfare-economic assessment of a policy proposal is relevant to all parties that will be significantly affected by the implementation of the policy. The EFTA/EØS countries have a natural interest in the proposed marine strategy given their association with the EU. With regard to Greenland and the Faeroe Islands, the concern is somewhat different. It is more and more often the case that economic analyses of a given policy or strategy are made at transnational, national and local levels. At the local level, a new policy may have sig-

² including both EU member states, EFTA countries and non-member states in the Danish national community

nificant positive or negative effects on local welfare and economy that differ from the national, aggregate result of the assessment. In terms of both liability and planning it is essential to ensure that all parties gain good understanding of the cost and benefits of any large investment, particularly when publicly funded. However, it should be noted that the proportion of economic assessments can and should vary depending on the relevance and potential impact of a given policy.³

It is common to all members of the Nordic Council that the economic assessment method will “force” decision-makers to consider the practicalities at an early stage thus facilitating the options of incorporating a certain flexibility in the wording of a directive or regulation that will agree with existing national or Nordic mechanisms, and reduce the costs of implementation for both the public and private sectors.⁴

1.2 Economic assessment of community policies - purpose and approach

Sustainability in the EU interpretation means paying attention to the environmental, social, and economic effects of any policy. This corresponds well to most other interpretations of sustainability, and modern decision-making often aims at taking all these issues into account. Not least in order to obtain results that harness the synergy effects of these factors, rather than being stifled by them.

The overall purpose of an economic assessment of community policies is to assess and compare all impacts that may affect the welfare of society following the proposed initiative, covering the three aspects of sustainability. An economic assessment thus includes the financial impacts on certain agents following the regulation as well as the non-financial costs, such as the environmental impacts or effects on people's scope of action and thereby their "well-being". The basic principles of the economic assessment methodology are to include the direct impacts on society as well as a number of more indirect or derived impacts to the extent that these can be said to significantly impact the welfare of society.⁵

The outcome of the economic assessment can be viewed as a supporting input to the policy formulation and implementation process, which gives a picture of the pros and cons related to a certain initiative, including their relative magnitude at societal level.

³ For a discussion of this issues see the new report Nielsen, U., Lerche, D.B., Kjellingbo, P.M., Jeppesen, L.M. (2006)

⁴ See Cabinet Office (2005) among others.

⁵ See chapter 5.2 for definitions of direct and indirect costs.

2. Overall framework

This chapter introduces the methodology by explaining the overall framework of the analysis to be made. This includes providing a basic understanding of the Directive to be assessed and the areas of focus in relation to implementation of the Directive. Further, the chapter provides an overview of the method for making the economic assessment of the MSD within the Nordic Countries, which will also serve as an introduction to the structure of the next chapters.

2.1 Basic understanding of the proposed strategy

As an introduction to the methodology, a brief description of the proposed strategy and Directive in terms of its aim and scope is provided.

2.1.1 Aim

In the 2002 Communication⁶ of the EU, reference is made to the 6th Environment Action Programme⁷ detailing the development of a thematic strategy for the protection and conservation of the marine environment with the overall aim *"to promote sustainable use of the seas and conserve marine ecosystems"*.

In the proposal for a Marine Strategy Directive (MSD) the objective is to:

"achieve good environmental status in the marine environment [by the year 2021 at the latest], and to ensure the continued protection and preservation of that environment and the prevention of deterioration"

The objective is thus defined in very general terms leaving a wide scope for interpretation. An important part of defining and evaluating implementation strategies of the Directive will be to translate the Directive into operational objectives. In this report, it is thus assumed that *"good environmental status in the marine environment"* has to be inter-

⁶ COMMUNICATION FROM THE COMMISSION TO THE COUNCIL AND THE EUROPEAN PARLIAMENT: Towards a strategy to protect and conserve the marine environment COM(2002) 539 final

⁷ The 6th Environment Action Programme of the European Community 2002-2012 requires the European Commission to prepare seven thematic strategies, one of them being the Marine Strategy

interpreted as being part of the assessment of the potential national consequences of the proposed Directive.

It is well established that the marine environment is subject to a variety of threats, including loss or degradation of biodiversity and changes in its structure, loss of habitats, contamination by dangerous substances and nutrients and impacts of climate change.

The principal threats to the marine environment are identified in the proposed MSD. These are⁸:

- Fisheries;
- Hazardous substances;
- Oil spills and discharges;
- Eutrophication;
- Litter pollution;
- Microbiological pollution;
- Introduction of non-native species;
- Pressures on coastal habitats;
- Seabed disturbance;
- Radionuclide discharges;
- Climate change;
- Marine noise pollution.

Based on the Directive's identification of principal threats and pressures to the marine environment, we have identified the following nine issues, termed *environmental pressures*, that need to be considered in order to achieve good environmental status in the Nordic marine environment:

- 1) Over-fishing;
- 2) Eutrophication;
- 3) Hazardous substances;
- 4) Oil spills and discharges;
- 5) Litter pollution;
- 6) Microbiological pollution;
- 7) Introduction of non-native species;
- 8) Pressures on coastal habitats;
- 9) Radionuclide discharges.

We will turn to these topics in Chapter 3. This list differs from the Directive's identification on three issues. Please note that pressures on coastal habitats and seabed disturbance have been merged into one category that also includes the pressures on fish spawning and nursery areas.

⁸ It should be noted that these pressures are not clearly listed in this way, but have been inferred from the text. The pressures correspond to those mentioned in the text of the 2002 Communication on the Thematic Strategy, par noise pollution.

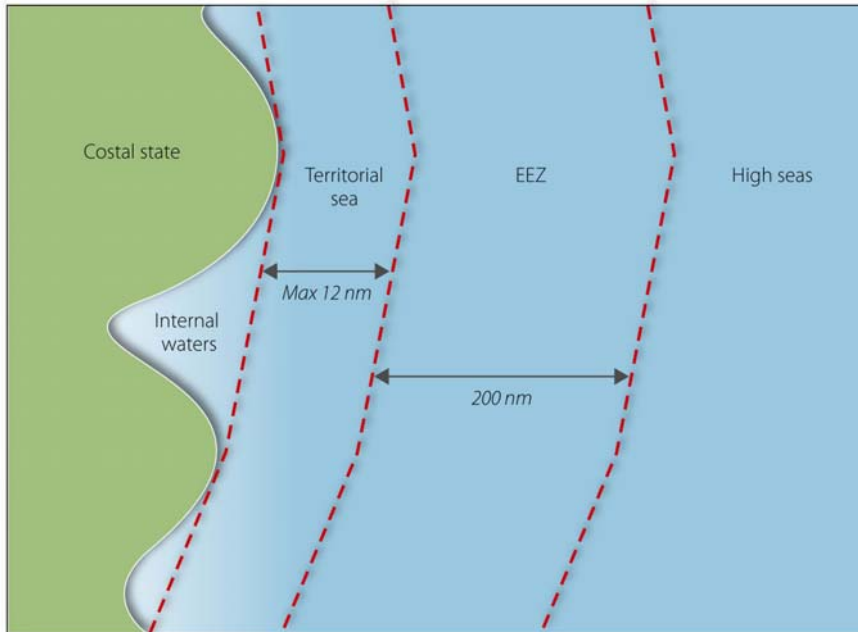
Secondly, climate change is left out, since the main cause of this pressure is not marine activities. On the other hand, marine activities will be affected by climate change, but climate change is regulated by the Kyoto Protocol. Finally, noise pollution is not expected to be an environmental pressure of main focus in connection with the further formulation and later implementation of the MSD, and it is therefore not considered in the present study.

2.1.2 Scope

The geographical coverage of the proposed Directive is extended to the territorial seas of the member states - up to 12 nautical miles from the land baseline. Furthermore, the geographical coverage of the proposed Directive is also meant to include the coastal state jurisdiction in the exclusive economic zone (EEZ), however, this latter area is only included in the scope of the proposed Directive to the extent that member states with coast lines have claimed the existence of an exclusive economic zone. The EEZ is the area that extends up to 200 nautical miles from the territorial sea baseline.

The basic difference between the preconditions and consequences of regulating in the two areas mentioned (the territorial sea and the EEZ) is that the regulatory competences conferred to the coastal state - as seen in international law - differ profoundly from area to area. In the territorial sea, the coastal state is allowed to apply national legislation for purposes that are deemed relevant by the coastal state, such as regulations governing environmental protection, safety and the acquisition of natural resources. In the EEZ, these regulatory competences are only conferred on coastal states for particular and limited regulatory purposes, such as environmental protection, safety at sea, navigation purposes and a possible exclusive right to the acquisition of natural resources in the EEZ.

Following the adoption of the proposed Directive, the Community will, to some extent, pre-empt the regulatory powers of the member states. However, there still remains a national regulatory competence within the geographical areas covered by the proposed Directive, in the sense that the approach taken in the Directive rests upon the adoption of national strategies as the basic tool to achieve the purposes of the proposed Directive.

Figure 2.1 Judicial zones at sea

In the sense that the purpose of the proposed Marine Strategy Directive is meant to require member states, i.e. coastal states, to adopt a national marine strategy for each of the designated marine regions mentioned in Section 3 of the proposed Directive, the scope of the proposed Directive seems to be in harmony with the jurisdiction accorded to coastal states in the EEZ. The main purpose is to improve the environmental protection. Such national strategies are endorsed and supported by international law and practice as applicable law. However, one should not disregard the fact that there are quite strict limits as to which legal areas that may be regulated in the EEZ by the coastal states

In existing international law, free navigation rights are accorded to vessels in the EEZ as long as they are not prejudicial to peace, good order, and safety. To some extent, coastal states are accorded the right to regulate navigation in the EEZ, but these rights are quite defensively formulated in law and practice.

The proposed Marine Strategy Directive extends the geographical scope of the Community's regulation of water in the sense that it supplements the regulatory instruments provided for in the Water Framework Directive (2000/60/EC) in the following manner:

- it extends the regulatory regime on water beyond the 1 nautical limit (calculated from the baseline) in relation to the ecological parameters by which a water body is characterised;
- it extends the regulatory regime on water beyond the outer limit of the territorial sea (12 nautical mile zone from the baseline) and

into the EEZ in relation to the chemical parameters by which a water body is characterised.

Basically, the regulatory instruments provided for in the proposed Marine Strategy Directive correspond to the regulatory instruments provided for in the Water Framework Directive (2000/60/EC).

2.1.3 The interface of the MSD and other strategies

In order to assess the economic consequences of the proposed strategy, it is essential to start by deciding on a basis for comparison. Different bases can be chosen, depending on the purpose of the assessment in the individual countries. If the purpose of the assessment is to estimate the incremental costs and benefits of adopting this particular regulation as compared to no action, the basis for assessing the Directive is current regulation. The key term here is increment, since it ensures that only the costs and benefits of the Directive are weighted. Alternatively, one may wish to look at the total, including historical, costs and benefits of e.g. achieving an environmental goal. In this case, the cost of all regulations and strategies that have and will have an effect must be included in the analysis in addition to the Directive.

In this report, we recommend the incremental approach. This ensures that it is then assessment of the strategy that is being negotiated and not other historical or future decisions. Other approaches may be viewed more appropriate in some of the Nordic countries. It is, however, pivotal to economic assessment that the approach is well thought through and clearly stated in the reporting of the results.

2.2 Identifying sectors/drivers affecting the marine environment

The types of environmental pressures listed above, which in combination affect the marine environment, are caused by various activities in a number of sectors. The sectors in focus are the following:

- Fisheries and aquaculture;
- Maritime transport;
- Offshore oil and gas activities;
- Dredging, sand and gravel;
- Tourism and coastal activities;
- Land-based activities.

Below, each sector is described briefly from a Nordic country perspective, the focus being on how the individual sectors acts as the driver

of some of the environmental pressures on how the sectors may be affected by the proposed MSD.

Fisheries and aquaculture

Today, fishing is regulated by a patchwork of international and regional agreements. However, over-fishing is still deemed to be one of the most significant environmental pressures, in the Baltic Sea in particular. HELCOM assesses that commercial fishing causes environmental pressures in several ways. First of all, directly by the reduction of target and by-catch species with the risk of leading to their extinction or local extirpation. Moreover, in direct and indirect ways by bottom trawling and through sediments thus modifying the physical environment and threatening the diversity of habitats. By damaging habitats these activities may, in turn, have an effect on their potential to host both commercial and non-commercial species. Waste from aquacultural installations can cause similar damage, but is deemed not to have a significant relevance to the Nordic Seas. If the proposed Directive's goal of restoring good environmental status is to be achieved, measures directed at the pressures from commercial fishing must be taken.

Maritime transport

Maritime transport exerts environmental pressure on the marine environment mainly in the form of the risk of oil spills and illegal discharges, plus pollution with hazardous substances. Further, the littering and illegal emptying of ballast water and the inherent risk of introducing non-native species are noted as problems. As mentioned in the description of the scope of the Directive, this sector is regulated by the free navigation rights. The proposed MSD could imply additional regulations governing maritime transport in the zone covered by the Directive, even though the sector is fairly well regulated today with regard to environmental impacts.

Oil and gas

The offshore sector in the Nordic countries exerts pressures on the marine environment in various ways. The main problems are emission of produced and displacement water containing heavy metals and chemicals, and accidental spillages of oil from platforms. Today, the sector is subject to environmental regulation, but in some countries this regulation differs somewhat from onshore practice. The proposed Directive may well lead to stricter regulation of the sector in terms of reducing the risk of unwanted environmental pressures.

Dredging, stone/sand and gravel

This sector is relatively small compared to some of the other sectors affected by the proposed Directive. It is, however, the driver of some of the environmental pressures. Dredging on the ocean floor can cause the

relocation of depositions of hazardous substances. More significant is, however, the potential physical pressure on coastal habitats caused by dredging activity and removal of stone reefs. It is assessed that the Directive might influence the concession rights in the sector.

Tourism and coastal activities

Particularly, tourism and coastal activities have an effect on the pressure on coastal habitats. This can be in the form of construction works, such as the construction of ports, or wind/wave power plants in the marine environment. The proposed Directive may put a damper such activities in the future, but since these types of construction works are quite well regulated in terms of environmental effects, this is not assessed to be a main impact of the proposed Directive. In addition, the littering from tourist and recreational activities in the coastal area may be trigger action towards stricter regulation of the sector. Again, this is not assessed to be a major effect of the proposed Directive.

Land-based activities

Land-based activities affect the marine environment through airborne and waterborne pollution from activities caused by agricultural, wastewater and industrial processes. A major environmental pressure from such activities is eutrophication caused by nitrate and phosphorous. Such activities will to a great extent be regulated by the Water Framework Directive, which aims to restore good ecological status in rivers, lakes and coastal waters. The Water Framework Directive includes very ambiguous targets for reduction of land-based water borne nutrients, and following this, these sources are not expected to be of main focus in the EU Marine Strategy.

Airborne emissions also cause nutrient loads in the marine environment. In the Baltic Sea, it is estimated that 25 % of nutrient load stems from airborne deposition. One of the main contributors is the transport sector from which significant amounts of NO_x are emitted. The Ambient Air Quality Framework Directive (96/62/EC) and Directive 99/30/EC (the first Air Quality Daughter Directive) set ambient air limit values for nitrogen dioxide and oxides of nitrogen, sulphur dioxide, lead and particulate matter. A number of other national and transnational agreements also target this problem. It is hard to say whether the MSD would imply a need for action beyond the obligations set forth in the above Directives, but within the scope of this study is assumed that it will not be the case.

Based on the above description, Table 2.1 below indicates sectors of main importance in relation implementation of the MSD in the Nordic Countries and the main environmental pressures arising from the activities which will be affected by the MSD.

Table 2.1 Overview of probable impact on sectors from the proposed MSD, in the Nordic Countries

Sectors/Drivers	Fisheries and aquaculture	Maritime transport	Offshore activity (Oil and gas)	Dredging, sand and gravel	Tourism, coastal activities	Land-based activities
Environmental pressures						
Over-fishing		n.a.	n.a.	n.a.		n.a.
Hazardous substances	n.a.				n.a.	
Oil spill and discharges				n.a.	n.a.	
Eutrophication	n.a.			n.a.	n.a.	
Litter pollution			n.a.	n.a.		
Microbiological pollution	n.a.	n.a.	n.a.	n.a.		
Non-native species			n.a.	n.a.	n.a.	n.a.
Coastal habitats			n.a.			
Radionuclide discharges	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

n.a.	Not applicable - No significant pressure from this sector
	Issue of limited or no relevance in the present context
	Issue of potential relevance in connection with implementation of the MSD
	Issue of main relevance in connection with implementation of the MSD

Finally, Table 2.2 below provides an overview of the main activities and environmental pressure in each of the identified sectors affected by the implementation of the MSD. Some issues are governed by other Directives already in force or by binding international agreements. The focus in this handbook will be on providing guidance for assessing the implementation of measures affecting the activities marked in red, as these are the issues of main relevance to the implementation of the proposed MSD.

n.a.	Not applicable - No significant pressure from this sector
	Issue of limited or no relevance in the present context
	Issue of potential relevance in connection with implementation of the MSD
	Issue of main relevance in connection with implementation of the MSD
	Covered by other binding international agreements

Table 2.2 Environmental pressures and links to sectors/drivers, in the Nordic Countries

SEC-TORS/DRIVERS ENVIRON-MENTAL PRES-SURES	Fisheries, aquaculture and fish processing	Maritime transport	Offshore activity (Oil and gas)	Dredg-ing, sand and gravel	Tourism, coastal activi-ties	Land-based activities (indus-try, agriculture, traffic, munici-pality waste handling)
Over-fishing	- over-fishing leading to the reduction of target and by-catch species - bottom trawling causing modification of the physical environment and habitats	n.a.	n.a.	n.a.	n.a.	n.a.
Hazardous sub-stances	n.a.	- anti-fouling agents/paints from ships - Cadmium losses to water from sacrificial zinc anodes for corro-sion protection	- chemicals used and dis-charged offshore - Cadmium losses to water from sacrificial zinc anodes for corro-sion protection	- re-suspen-sion of heavy metal deposi-tions	n.a.	- industrial waste (chemicals, heavy metals) - municipal waste water (chemicals) - incineration of waste, air-borne (heavy metals) covered by the Water Frame-work Directive and proposed daughter directive
Oil spills and discharges	n.a.	- collisions/groundings causing oil spills - illegal discharges from ships (oil, waste water)	- produced water (chemicals) - use and discharge of drilling fluids and cuttings - accidental spillages (oil)	n.a.	n.a.	- refineries, industrial waste water, municipal waste water
Eutrophication	n.a.	- emissions of NOx stemming from ships	- minor emissions of NOx caused by flaring	n.a.	n.a.	- waterborne emissions of N and P covered by the Water Framework Directive - airborne emissions of NOx regulated under the Ambient Air Quality Framework Direc-tive
Litter pollution	- litter pollution in open seas and ports	- pollution by ship-generated waste			- littering by tourists- and recreational activities	- littering by tourists- and recrea-tional activities
Microbiological pollution	n.a.	n.a.	n.a.	n.a.	n.a.	- urban/municipal waste water covered by the Bathing Water Directive
Non-native spe-cies	- outbreaks from aquacul-ture installations	- ballast water from ships	n.a.	n.a.	n.a.	n.a.
Pressures on coastal habitats	- bottom trawling causing modification of the physical environment and habitats	n.a.	n.a.	- dredg-ing activ-ity	- Construction of ports, wind mill parks, wave power, bridges, tunnels, cables, etc cause destruc-tion/reduction of spawning and nursery areas	n.a.
Radionuclide discharges	n.a.					

2.3 Overall framework of the methodology

The overall process of making an economic assessment of a proposed policy involves three steps:

First, the so-called baseline scenario needs to be built. This will serve as the basis against which the consequences of the proposed policy can be assessed. It is essential to go through this preliminary step to obtain an unambiguous interpretation of the total cost of adopting the policy. Building the baseline also entails assessing the present environmental pressures and the main origin of these pressures. This knowledge is used to forecast the likely environmental state in the business-as-usual ("in-action") baseline scenario.

The second step is to define the national implications of the proposed transnational policy, should a country choose to adopt it. This step is very much a question of scenario building, since the proposed policy in the case of the MSD is unspecific when it comes to the type and dosage of action to be taken. The ultimate goal is known, but it is up to the member states to plot the course. Defining the "alternative scenario" which is the situation in which the proposed MSD is adopted therefore entails an assessment of the scope of the need for action at the national level. Further, this has to be broken down into specific remedial measures, such as mandatory replacement of a specific type of fishing gear with a more environmentally friendly type. The result of this step is thus a fairly detailed list of measures to be carried out at a certain dosage.

Table 2.3 Steps in a national economic assessment of a proposed marine policy

Step 1	Establishing the business-as usual situation - the Baseline Scenario	Chapter 3
	- Assessment of present environmental pressures - Identification of the main origin of these pressures - Forecast of the environmental pressures and the environmental status in the business as usual situation	Chapter 3.2 Chapter 3.3 Chapter 3.4
Step 2	Defining the national implications of the proposed policy - the Alternative Scenario	Chapter 4
	- Determination of likely need for action to reach target environmental status - Identification and "dosage" of relevant remedial measures	Chapter 4.1 Chapter 4.2
Step 3	Economic assessment of the extra cost of proposed policy	Chapter 5
	- General calculation method defined and stated - Assessment of the cost of the remedial measures - Assessment of the benefits of the remedial measures to various sectors - Assessment of total net cost of alternative scenario compared to baseline scenario - Interpretation of results	Chapter 5.1 Chapter 5.2 Chapter 5.3 Chapter 5.4 Chapter 5.5

The final and third step is the economic assessment of the extra cost of the proposed policy - i.e. of the alternative scenario compared to the baseline scenario. First, the general calculation method should be chosen and stated. For readers' information, a number of calculations supporting assumptions, such as the discount rate, have to be defined. Then, the actual cost assessment begins. The more detailed the list of measures are, the better the basis for the cost estimation. In some cases, the need for action

is uncertain or the potential remedial measures are unknown that it prevents the identification of cost data. In those cases, a quantitative or descriptive assessment of the magnitude of the potential cost can be made. For each measure, the benefits of the measure should be assessed. Again, this may not take the form of an actual calculation, but rather be some form of description and assessment of significant benefits. When the cost of the components (the measures) of the scenario has been assessed, the total national net cost of the proposed policy can be assessed. The net cost is the cost minus the benefits. If the value of benefits is larger than the cost, the net cost will, in fact, not be a cost but a net benefit to society. A net cost may, on the other hand, not necessarily imply a net loss to society as it may not have been possible to map and value all benefits. The final task in the third step is thus the interpretation of the results.

Each chapter is concluded by a checklist of tasks involved in the particular step of the analysis.

2.4 Scenario analysis

The purpose of building a scenario is to clarify *the basis for comparison* of the development of costs and benefits over time.

The basis for comparison depends on the type of question to which an answer is needed. Such a question might be What are the incremental costs and benefits of applying this specific regulation as compared to no action? or What are the total, including historical, costs and benefits of taking action to observe a certain regulation?

In order to assess the incremental costs and benefits of a specific action, it is necessary to discuss and assess which *situation* would prevail if the action was not taken. In economic jargon this means all other things being equal. This is a critical and very important step in the analysis. The no-action situation comprises overall societal developments, such as economic growth as well as more sector-specific developments, such as in this context the development of the environmental pressures.

It is essential that the costs and benefits assessed refer to the same physical and regulatory development over time, and that the timeframe is the same for the costs and benefits assessed.

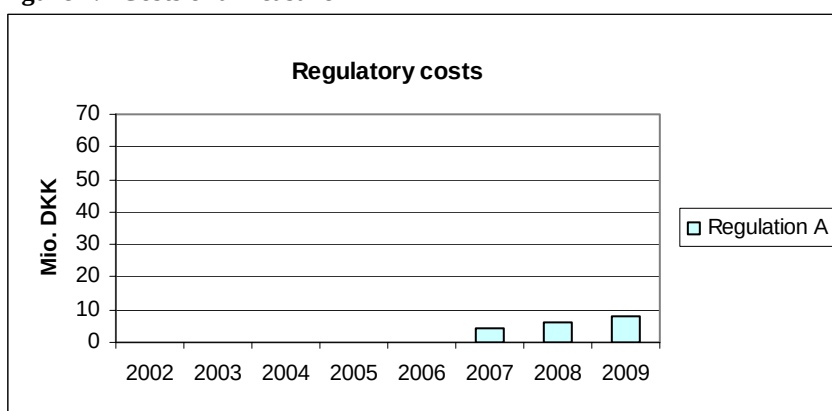
2.4.1 Economic assessment of a new political measure

The economic assessment of the introduction of a political measure should normally take as its point of departure the *situation* at the time of the decision on the measure. Thus, the prevailing environmental state should be used as the point of departure, and the projection of the expected future environmental state should be assessed based on this point of departure.

Next, the costs associated with the implementation of the political measure should be assessed along with the benefits in terms of an improved environmental state. The benefits are calculated as the reduced negative environmental impact (reduced damage costs), consequential of the political measure.

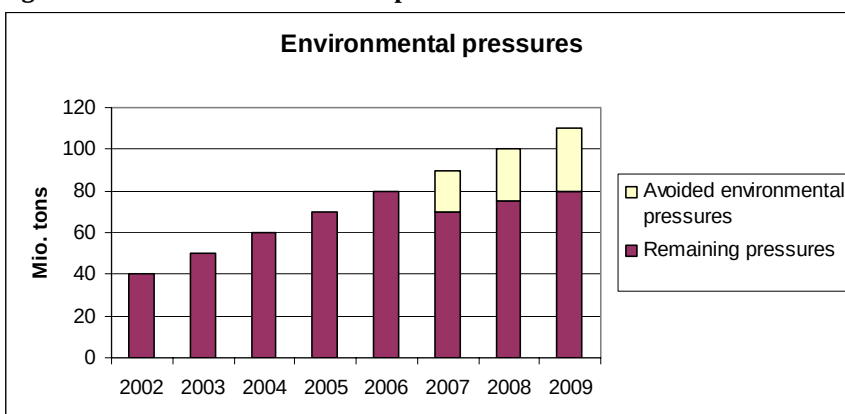
In the two figures below this approach is illustrated with imaginary figures for the implementation of a measure A. The costs of the measure are indicated in the first figure and the benefits in terms of reduced environmental pressures are shown in the second figure.

Figure 2.2 Costs of a measure



For illustrative purposes, it is assumed that the measure is initiated in 2007, and that the associated costs are defrayed from 2007 to 2009.

Figure 2.3 Avoided environmental pressures



In the second figure, it is assumed that from the outset there are emissions of a certain magnitude (measured in tonnes) caused by human activity, and that the political measure leads to a reduction in the said emission during the same years (avoided environmental pressure).

Next, the reduction of emissions should - to the extent possible - be valued in monetary terms, and the result of the analysis could then be

calculated as the difference between the costs and the benefits of the measure.

2.4.2 Economic assessment of existing measures

The introduction of a measure may impact costs and the environmental state for several years, sometimes for many years. If a measure requires restoration of a certain environmental quality, the costs of meeting this standard will depend on the development in a number of exogenous factors, such as industrial behaviour and marine activities for years to come. Costs may increase even though more drastic measures are not taken but as a result of increasing environmental pressures. Similarly, the benefits of the measure should be measured as the changes to the environmental state which have been brought about *due* to the measure.

Sometimes, there is political interest in assessing the costs and benefits of previous political measures. If there is a wish to look into the past and to investigate the costs and benefits of previous measures, it is imperative to make sure that the timeframe, the costs and the benefits all refer to the same measure. Further, distinction should be made between costs and benefits which have accrued in earlier years, and the costs and benefits which are expected in the future due to the measure.

The costs defrayed in previous years can be regarded as *sunk costs* - i.e. costs which cannot be retrieved, even though new decisions may be taken. Thus, if a measure has incurred a cost in the past, the cost is termed sunk costs whereas future costs caused by the measure are termed incremental costs. In principle, such costs could be avoided, although in practice legal and political issues may stand in the way because legislation is already in force and has to be amended if the measure is to be abandoned. Both sunk incremental costs should, however, in this case be assigned to the measure in question.

The figures below illustrate the costs and benefits associated with a total of four measures:

Measures A and B: Two measures which are to be decided on, and for which costs and benefits only accrue in the future (from 2007 to 2009 in the example).

Measures C and D: Two measures which were implemented some years ago (in 2002 in the example), and for which costs still accrue and benefits still can be reaped. In this example *sunk costs* and already harvested benefits relate to the years 2002 to 2006 whereas future costs and benefits caused by measures C and D concern the years 2007 to 2009. Such costs could at least theoretically be avoided by a political decision not to meet obligations of previous measures.

Figure 2.4 Overview of sunk costs and incremental costs, new and previous measures.

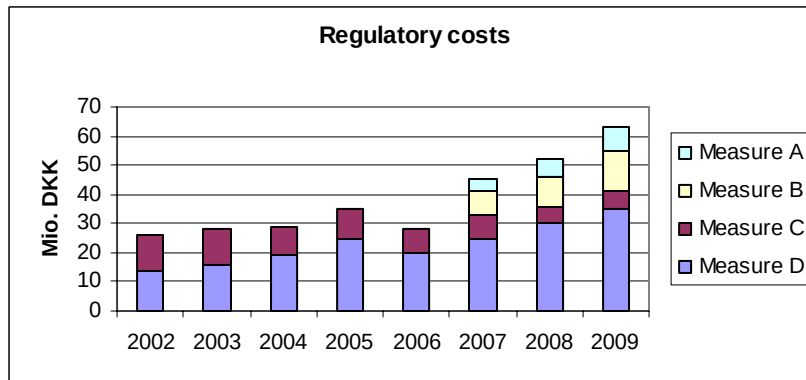
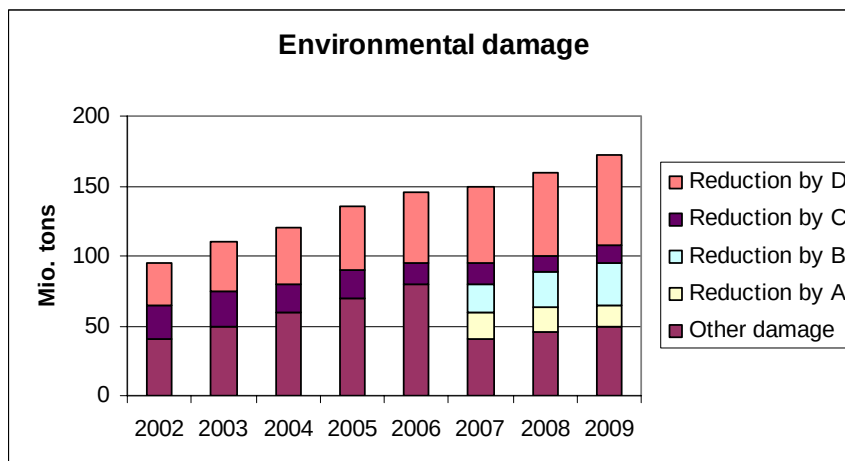


Figure 2.5 Overview of already harvested avoided pressures and expected new avoided pressures, new and previous measures.



It is a prerequisite for making an economic assessment of environmental measure that a line is drawn in time. This means that at some point in time a baseline scenario is defined describing the state of the environment, the prevailing measures in the sector, the general exogenous factors, etc. Otherwise, the analytical task will be endless.

A number of practical, specific issues will need elaboration when building a baseline scenario, but it is important to keep these basic choices in mind.

2.4.3 "Costs of in-action"

If a decision is made not to take steps to reduce some specific environmental pressures, it will impose costs on society, which may sometimes be referred to as "the costs of inaction". This term is used in the proposed strategy. Such costs would correspond to the avoided environ-

mental pressures obtained by measure A, in Figure 2. Since the pressures would not be reduced, the environmental pressures would remain at the higher level and the environmental costs would be higher.

On the other hand, society would also avoid the costs of measure A as illustrated in Figure 1.

The *net* costs of in-action would depend on the relationship between the avoided costs and the benefits not obtained (the cost-benefit ratio).

3. How to build a baseline scenario

This chapter gives instructions on how to build the baseline scenario, which is to be used as the reference for the assessment of the cost of the proposed Directive. The baseline scenario describes a reference situation of business as usual in the situation without the Directive.

There are three main parts in building and defining the baseline scenario: First, the present environmental pressures have to be identified (chapter 3.1). The EU Commission has already outlined them, but they must be evaluated against the particular situation for the national point of view. Secondly (chapter 3.2), the origin of these pressures must be identified: What sectors cause the pressures? How much is due to national sources?. Finally, this information must be put together to forecast the environmental pressures and the environmental status in the business-as-usual situation, which is the baseline scenario (chapter 3.3).

3.1 Purpose of identifying environmental pressures

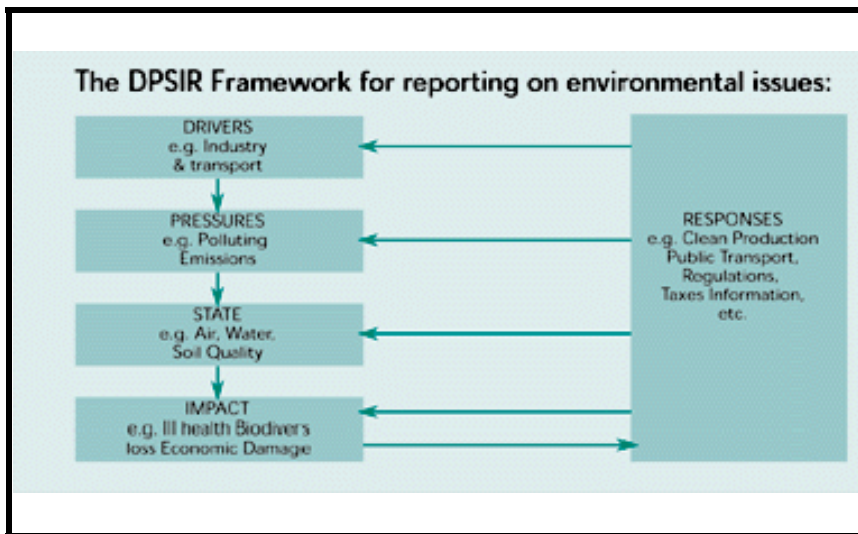
The programme of measures that will eventually be executed by member states in honour of the MSD will be effective only if they are devised based on a sound knowledge of the state of the marine environment. The proposed Directive suggests that, as a first step in that preparation, member states across the marine region should undertake analyses of the characteristics of their marine waters, thus identifying the predominant pressures and impacts on those waters, as well as the cost of degradation of the marine environment. It will be on the basis of such analyses that member states should determine for the European waters a set of characteristics for good environmental status. In the Commission's eyes, this entails the provision of "generic qualitative descriptors", "detailed criteria" and "standards" - all of which is to be developed in the near future by the Commission with the involvement of all interested parties.

3.1.1 The DPSIR framework

According to Marine Research on Eutrophication (MARE), one of the main impediments to the successful management of the Baltic Sea is the insufficient understanding of how different systems - marine physical transports and nutrient cycles - are interlinked. Since the eutrophication

effects, to take an example, result from nutrient transports and transformations in all of these systems, management without understanding these links is likely to result in more costly mitigation programmes than necessary. Besides understanding the links in the ecosystems, and thus knowing how to intervene, another crucial issue is the monitoring of the environmental state. To this end, we will use the DPSIR framework.

Figure 3.1 The DPSIR framework



Source: EEA

The DPSIR framework approach for descriptive indicators is applied by the European Environmental Agency (EEA 1999) and many other national and international bodies. According to this systems analysis view, social and economic developments exert **Pressure** on the environment and, as a consequence, the **State** of the environment changes, such as the provision of adequate conditions for health, resources availability and biodiversity. Finally, this leads to **Impacts** on human health, ecosystems and materials that may elicit a societal **Response** that feeds back into the **Drivers**, or on the state of impacts directly, through adaptation or curative action. Obviously, the real world is far more complex than can be expressed in simple causal relations in systems analysis. There is arbitrariness in the distinction between the environmental system and the human system. And, moreover, many of the relationships between the human system and the environmental system are not sufficiently understood or are difficult to capture in a simple framework. Nevertheless, from the policy point of view, there is a need for clear and specific information on:

- Driving forces
- The resulting environmental pressures
- The state of the environment

- Impacts resulting from changes in environmental quality
- The societal response to these changes in the environment

3.2 Identifying environmental pressures

The following sections will elaborate on each of the topics by focusing, where possible, on *pressure*, *drivers causing the pressure*, *main conventions* covering the issue, and one or several potential *indicators* - all with the purpose of assessing environmental status against a particular pressure. We will do this for the nine pressures outlined in Chapter 2:

- 1) Over-fishing
- 2) Eutrophication
- 3) Hazardous substances
- 4) Oil spills and discharges
- 5) Litter pollution
- 6) Microbiological pollution
- 7) Introduction of non-native species
- 8) Pressures on coastal habitats
- 9) Radionuclide discharges

Out of the nine mentioned topics, the first four will be dealt with in more depth due to their high relevance to the seas of the Nordic region.

In many ways, biodiversity is under threat from all the environmental pressures combined. The Convention on Biodiversity⁹ defines biodiversity in the following way:

"Biological diversity" means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems."

In the Convention's strategic plan outlining its 2010 biodiversity target, reference is made to reducing the rate of loss of the components of biodiversity, including: (i) biomes, habitats and ecosystems; (ii) species and populations; and (iii) genetic diversity. Furthermore, the plan refers to addressing the major threats to biodiversity, including those arising from invasive alien species, climate change, pollution, and habitat change.

HELCOM through the BSAP is currently developing a conceptual model on biodiversity for the marine environment. The facts below are mainly from the work of the Convention on Biodiversity and the BSAP.

⁹ www.biodiv.org

Table 3.1 Facts on environmental pressure on biodiversity

Impact	Reduction of: biomes, habitats, ecosystems, species, populations, genetic diversity
Drivers	Numerous incl. invasive alien species, climate change, pollution, and habitat change
Main conventions	Convention on Biodiversity OSPAR IMO
Examples of indicators	• Conservation status of species using the population growth curve with defined safe biological level (top predators: seals, white-tailed eagle, salmon, harbour porpoises) Trends in abundance and distribution of selected species/commercial fish selected by ICES • Change in status of threatened species (Natura2000, Red List indicator under development) • Coverage of protected areas: Protection of endangered and declining species habitats/biotopes (bladder wrack, eelgrass, phytoplankton blooms, changes in zoobenthos) • Trends in genetic diversity of fish species of major socio-economic importance (smolt/salmon) • Numbers and cost of alien invasions • Marine trophic index • Water quality in aquatic ecosystems (Sources: CBD and HELCOM/BSAP)

These indicators can be used as general indicators of loss of biodiversity, which is an indirect or direct impact of many (or all) of the pressures dealt with in the following.

No. 1: Over-fishing

Sustainable commercial fishing is a complex topic requiring an understanding of several factors such as spawning biomass, fishing mortality, and their associated underlying drivers as well as an understanding of the migration patterns of various stocks. An important element in promoting sustainable commercial fishing practices is the use of a framework establishing the lower boundaries (B_{lim} ; the biomass limit reference point), beyond which fish stocks are likely to enter a phase of serious decline, and a fishing mortality rate that should not be higher than an upper limit (F_{lim}), which, if maintained, will drive the stock to the biomass limit. However, spawning biomass and fishing mortality can only be estimated with uncertainty. Consequently, in the 2005 advice of the International Council for the Exploration of the Seas (ICES 2005) on fishery management and the marine environment, ICES is using a "precautionary approach" in defining what the reference points should be for these boundaries. One of the key features of the precautionary approach is the notion of acting in a precautionary way by using safe benchmarks and thus setting a higher spawning biomass reference point (B_{pa} ; the biomass precautionary approach reference point). Similarly, a safe fishing mortality rate should be set below the upper limit for fishing mortality (F_{pa}). The EU fishing quotas are taking these considerations into account, but obviously EU fishing policies are also influenced by political decision-making having to deal with the objective of ensuring employment and incomes for a

great number of people across EU countries. Commercial fishing in the EU is thus also determined by political forces and the resulting consensus-building among different countries.

Commercial fishing causes environmental pressure in several ways. This occurs directly by the reduction of target and by-catch species with the risk of leading to their extinction or local extirpation and in direct and indirect ways by bottom trawling. By damaging habitats this may, in turn, have an effect on their potential to host both commercial and non-commercial species.

Commercial fishing in the Baltic Sea mainly focuses on cod, herring and sprat. According to HELCOM, cod is the overall most important species for commercial fisheries in the Baltic Sea, and populations have collapsed due to environmental conditions and simultaneous fishing pressures (HELCOM 2006a). Both the Eastern cod population, which constitute 90 % of the total population, and the Western population are considered to be outside safe biological limits. The actual spawning stock of Baltic cod is below the critical limit (B_{lim}). The actual fishing pressure has long exceeded the precautionary value (F_{pa}) and at times the critical limit (F_{lim}) value as well. Herring and sprat are the main target species of commercial fishing enterprises as well as the most important prey of Baltic cod. Herring has been over-fished - at least in the Baltic Proper and the Gulf of Finland. In the 1980s and 1990s, fishing pressure exceeded safe biological limits, and the spawning stock fell radically. For most parts the total allowable catches were well above those recommended by ICES. As a result of a decrease in catches, the population began to gradually recover in 2002, and currently the level of fishing mortality is well below the precautionary value (F_{pa}). In the Bothnian Sea, the stocks have remained well within safe biological limits. Sprat has benefited greatly from the decline in cod populations with its stocks increasing between 1989 and 1996.

Table 3.2 Facts on over-fishing as an environmental pressure

Impact	Directly by reduction of target and by-catch species, possibly leading to their extinction or local extirpation. Also directly and indirectly by bottom trawling and through sediments thus modifying the physical environment and threatening the diversity of habitats, which may, in turn, have an effect on their potential to host both commercial and non-commercial species.
Drivers	Fishing, over-fishing, bottom trawling
Main conventions/policies	EU Common Fisheries Policy (2003) FAO Code of Conduct for Responsible Fisheries (1995)
Examples of indicators	• Trends in abundance and distribution of selected species (e.g. cod and hake) • Change in status of threatened species (Natura2000, Red List indicator under development) • Coverage of protected areas • Trends in genetic diversity of [...] fish species of major socio-economic importance • Marine trophic index

(Sources: CBD, EU)

No. 2: Hazardous Substances

Various hazardous substances reach the marine environment following their discharge, emission and loss from a number of industrial processes and commercial and domestic uses. Given their intrinsic properties of toxicity, persistence, and liability to bioaccumulate, there is evidence that a diverse range of natural and man-made substances have the potential to impair biological processes in aquatic organisms. Pollution by hazardous substances has been a well-known problem in, for example, the Baltic Sea since the 1960s when the detrimental effects of heavy metals and organochlorines on biota, especially many fish-feeding species, were observed. Although monitoring indicates that the loads of some hazardous substances have been reduced considerably over the past 20-30 years, problems still persist. Pollution caused by hazardous substances refers to a massive number of different anthropogenic substances ending up in the marine environment. According to HELCOM, substances that do not occur naturally in the environment include PCBs, DDTs, dioxins, organotin compounds, NP/NPE, SCCP, PBDEs certain PFOS and certain nitro-musks. Furthermore, substances occurring at concentrations exceeding natural levels include heavy metals (lead, copper, cadmium, mercury).

Table 3.3 Facts on hazardous substances as an environmental pressure

Impact	Hazardous substances cause detrimental effects on the ecosystem, such as: impaired general health status of animals; impaired reproduction of animals, esp. top predators; and increased pollutant levels in fish for human food. Effects generally complex and not well understood.
Drivers	Pollution sources are numerous, both waterborne and airborne. Includes industrial and municipal wastewater and atmospheric deposition - in part from the incineration of waste. Also contaminants originating from shipping including anti-fouling agents used in paints.
Main conventions/policies	OSPAR IMO Convention on Harmful Anti-foulants Stockholm Convention on POPs
Examples of indicators	• Levels of mercury, lead, cadmium, zinc, lindane, • PCB, dioxins, PBDE, PFOS, PAH • Possibly selected species for contamination control (herring, cod, blue mussel and others) Source: BSAP paper on hazardous substances HELCOM Baltic Sea Action Plan (2006): Hazardous Substances in the Baltic Sea; Draft Thematic Assessment in 2006

No. 3: Oil spills and Discharges

According to HELCOM, intense shipping traffic puts pressure on the environment of the Baltic Sea. The most obvious of these are accidental pollution (accidents and groundings) and pollution by ship-generated waste (a third issue, transportation of non-native organisms via ballast water, is dealt with later). Regarding offshore activities, oil and gas installations are sources of pollution in relation to discharges of oil (from produced water, displacement water and accidental spillage) and chemicals.

Maritime Transport

Accidental pollution is related to groundings and accidents involving ships, and causes local impacts to the environment (by polluting the shoreline in a certain area) but can also have wider effects via affecting components of the ecosystem (habitats, wintering birds, spawning grounds, etc.) which are significant for the whole region. The statistics shows no decrease in the number of groundings in recent years and a rise in the number of collisions where especially the Danish Straits and the Gulf of Finland are affected (HELCOM 2006e). Intense shipping traffic is one of the reasons for this trend.

Despite the strict legal regime of the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) almost 600 illegal discharges were observed in the Baltic Sea from 2003 to 2004 - as stated in the HELCOM report on maritime transport. The real number of discharges is considered to be even higher. Most of the observed illegal discharges are smaller than 1 m³, but around 8 % are bigger and sometimes exceeding 100 m³. The illegally discharged oil has a number of negative effects, including the killing of seabirds and pollution of shores and beaches. However, the implementation of the Baltic Strategy is positive results. Despite the rapidly growing density of shipping, increased frequency of surveillance flights and improved usage of remote sensing equipment have lead to a gradual decrease in the number of observed illegal oil discharges.

Offshore oil and gas activities

With regard to the offshore oil and gas production activities in the North Sea, reports and data seem limited to a few sources. However, since 1978 OSPAR (and formerly PARCOM) has regularly monitored the discharges and waste handling from offshore oil and gas installations. In the most recent OSPAR assessment of oil and gas activities (2003), the situation is summarised focusing on a few key issues. The facts presented in this section are based on that particular assessment (OSPAR 2005). To begin with, it is reported that the production of hydrocarbons in the OSPAR maritime area (North-East Atlantic) increased by 4 % between 1999 and 2001, but decreased by 1.5 % both in 2002 and in 2003. The total quantity of dispersed oil (aliphatic oil) discharged to the sea (from produced water, displacement of water and accidental spillage) continued to decrease, and was 9,209 tonnes in 2002 and 8,998 tonnes in 2003, compared to 9,782 tonnes in 2001. As in previous years, produced water and displacement of water are the main contributors to the oil discharges from offshore oil and gas activities, representing 97.6 % of the total amount of oil discharged into the sea in 2002, but only 90.8 % in 2003 due to exceptional accidental spillage. Flaring is a minor source of oil discharges. The total amount of produced water and displacement water discharged daily shows a slight increase over the past years. The quality

of the water discharged (expressed as content of dispersed oil in the water discharged) has remained more or less stable over recent years. The annual average dispersed oil content in produced water in 2003 was 19.1 mg/l, well below the current performance standard for dispersed oil of 40 mg/l for produced water discharged into the sea. The number of installations, which exceeded the 40 mg/l performance standard for dispersed oil in produced water, remained stable in 2001 to 2003 (23 in 2001, 20 in 2002, 22 in 2003). Despite the efforts made to reduce the number of installations which have poor records, there are still every year new installations which do not meet performance standards. Since 2001 the use and discharge of chemicals have been regulated by the OSPAR Convention. The first reporting year for which all major contributors provided data was 2003. The total quantity of chemicals used offshore in 2003 was 768,000 tonnes, out of which less than 0.04 % is on the OSPAR List of Chemicals for Priority Action (LCPA). The total quantity of chemicals discharged into the sea was roughly 275,000 tonnes, almost 89 % of this are chemicals on the OSPAR list of substances/preparations used and discharged offshore which are considered to pose little or no risk to the environment (PLONOR). Discharge into the sea of chemicals on the LCPA list was 0.75 tonne, and discharge of chemicals of "equivalent concern" reached 16.6 tonnes.

Table 3.4 Facts on oil spills and discharges as an environmental pressure

Impact	The accidental spill or discharge of oil has a number of negative effects ,including the killing of seabirds and pollution of shores and beaches. The oil spills can also have a wider impact by affecting components of the ecosystem (habitats, wintering birds, spawning grounds, etc.) which are significant for the whole region.
Drivers	Shipping: accidents, groundings, discharges, Offshore oil and gas production: produced water, displacement water, accidental spillages
Main conventions/policies	MARPOL IMO BW Convention OSPAR HELCOM several others
Examples of indicators	• Adequate response resources and arrangements are available in all sub-regions of the Baltic • Number of pollution accidents vs number of successful response operations • Number of illegal discharges • Number of oily birds • Beaches contaminated by oil (in km) • Abundance of marine litter • Amounts of wastes delivered to ports compared to general shipping activities • Number of polluters found/convicted • Number of new introductions • Number of established species • Number of vessels implementing ballast water management according to IMO BW Convention (Source: HELCOM/BSAP)

No. 4: Eutrophication

The EU mentions eutrophication as one of the pressures to the marine environment. According to HELCOM, excessive waterborne nitrogen and phosphorous loads coming from land-based sources are the main cause of the eutrophication of the Baltic Sea. However, about 25 % of the nitrogen load comes as atmospheric deposition, where one of the sources is thought to be NO_x stemming from traffic pollution. As part of the Baltic Sea Action Plan, HELCOM has elaborated much on the eutrophication issue - as far as to the level of identifying possible indicators for eutrophication, although the exact definition and fine-tuning of indicators is work in progress (HELCOM 2006d).

Table 3.5 Facts on eutrophication as an environmental pressure

Impact	Intense algal growth: excess of filamentous algae and phytoplankton blooms. Also, production of excess organic matter and increase in oxygen consumption, oxygen depletion with recurrent internal loading of nutrients and death of benthic organisms, including fish
Drivers	Excessive nitrogen and phosphorous loads coming from land-based sources are the main cause of the eutrophication of the Baltic Sea. About 75 % of the nitrogen load and at least 95 % of the phosphorous load enter the Baltic Sea through rivers or as direct waterborne discharges. About 25 % of the nitrogen load comes as a atmospheric deposition (HELCOM, 2006)
Main conventions/policies	EU Water Framework Directive EU Urban Wastewater Treatment Directive OSPAR HELCOM MARPOL
Examples of indicators	• water transparency (measured by Secchi depth) • natural levels of algal blooms (e.g. plankton spring blooms, late-summer cyanobacterial blooms, amount of harmful species) • natural oxygen concentrations (measured by levels of bottom water oxygen concentration) • natural levels of nutrients (dissolved nutrient concentrations during the winter time and N:P ratio) • distribution of plants and animals (community structure of zoo-benthos) (Sources: HELCOM/BSAP)

There are many relevant sources of information on the monitoring and abatement of eutrophication. One example already mentioned is the MARE research programme. It is important that the airborne sources are given specific attention if one wishes to assess the impact of the MSD on this pressure, and the NOVA monitoring programme is therefore another relevant reference.¹⁰

No. 5: Litter Pollution

According to the EU 2002 Communication, contamination with litter is believed to be a general problem in all European Seas. The main

¹⁰ See for example the following report for a status on the atmospheric deposition on Danish Seas: Ellermann, T., Hertel, O., Hovmand, M.F., Kemp, K. & Skjøth, C.A. (2001): Atmosfærisk deposition 2000. NOVA 2003. Danmarks Miljøundersøgelser. NERI report No.: 374. <http://faglige-rapporter.dmu.dk>

sources are shipping (fishing and commercial) and tourist and recreational activities. Impacts on marine life include the drowning of birds entangled in plastic sheeting, and the death of birds, turtles and cetaceans caused by ingested plastic objects. Litter has also been found to carry a variety of epiphytic organisms to sea areas that these organisms would not normally reach. As tourism, urban development and industrial pressure for development in the coastal zone increase, the problem of litter may also increase.

The magnitude of litter pollution as a pressure on the marine environment in the Nordic Seas is unknown, but is not deemed to be a major problem due to fairly low levels of littering resulting from well established systems of efficient waste handling. However, and not the least for aesthetic reasons, some attention on this topic is difficult to avoid.

No. 6: Microbiological Pollution

There are still a number of Community beaches where problems with microbiological pollution exist. These result from deficiencies in implementing the Urban Waste Water Directive and the EU Bathing Water Directive. However, microbiological pollution is not likely to cause a major pressure on the marine environment in the Nordic Seas. In Denmark, for example, only 14 out of 1,249 beaches are being banned for the 2006 season. The topic can thus be regarded as a minor issue.

No. 7: Introduction of Non-native Species

Increasing shipping activities and consequently the growing amount of ballast water transported to the Baltic increases the risk of introducing new species to the region. The non-indigenous species can induce considerable changes in the structure and dynamics of marine ecosystems. They may also hamper the economic use of the sea or even represent a risk to human health. About 100 non-native species have been recorded in the Baltic Sea, and almost 70 of them have been able to establish viably reproducing populations. Most of these invasive species originate from freshwater or brackish-water environments, particularly from North America or the Ponto-Caspian region. In some cases, alien species have been deliberately introduced for fishing or aquaculture, but most of them have been introduced accidentally by ships, which can rapidly transport marine animals, plants and algae across the world in their bilge and ballast waters.

An example of a particular problem in the Norwegian Waters is the introduction of the red king crab. Russian scientists introduced this species to the Kola Peninsula of the Barents Sea from the Russian northern Pacific. It has since spread in numbers and biomass through active migration of individuals. A good reference for the assessment of the issue of introduction of non-native species in the Nordic Countries is C.C.E. Hop-

kins (2001): Actual and potential effects of introduced marine organisms in Norwegian waters, including Svalbard.¹¹ For examples of specific remedial measures and their economic cost, look to the report "Review of Current Ballast Water Technologies and Comparative Indicative Costs of Practical Options".¹²

No. 8: Pressures on Coastal Habitats

The increasing intensity of human activities along the coasts (development of ports, coastal protection, land reclamation, tourism and sand and gravel extraction) has a severe impact on coastal habitats and associated ecological processes. More recent research has focused on the cumulative effects on human activity on estuaries and marine environment in general.¹³ These impacts may extend for a significant distance offshore. In addition to increasing levels of urbanisation and tourism, developments such as barrages and wind parks may also have an impact on habitats and sensitive species. Currently, this pressure is regarded as being less relevant in the Nordic context where these activities are regulated quite effectively regarding environmental impacts.

No. 9: Radionuclide discharges

In the EU 2002 Communication it is mentioned that there is a public concern with regard to discharges of radionuclides, particularly those arising from nuclear fuel reprocessing plants. Compared to many other areas of the world, some of Europe's regional seas have received significant discharges of nuclear material. However, there are few data concerning the impact on marine ecosystems. In the Baltic Sea, according to HELCOM¹⁴, radioactive pollution can persist for long periods due to the long residence time of the water. Levels of strontium-90 and cesium-137 are high in the Baltic compared with other seas. The artificial radionuclides in the Baltic originate from nuclear weapons testing, the 1986 Chernobyl accident, and European nuclear installations. Radionuclides have been closely monitored in the water, sediments, fish, aquatic plants and benthic animals of the Baltic Sea since 1984. A periodic assessment of radioactivity in the Baltic Sea covering 1999 to 2006 will be made by HELCOM. The assessment will include levels, inventories and trends for radioactivity in the Baltic Sea and the radiological impact on man.

The issue is not likely to be a major cause of concern in the Nordic context where enrichment is not taking place and where nuclear power plants must implement extremely strict safety measures.

¹¹ <http://www.dirnat.no/archive/attachments/01/26/Actua059.pdf>

¹² No reference for this report at this date (July 2006) - document forwarded by Nordic Council entitled "Ballast_Rapport13"

¹³ See: Lotze, H.K., Lenihan, H.S., Bourque B.J., Bradbury R.H., Cooke R.G., Kay M.C., Kidwell S.M., Kirby M.X., Peterson C.H., Jackson JBC (2006) for most recent publication of such results.

¹⁴ http://www.helcom.fi/projects/on_going/en_GB/mors/?u4.highlight=radionuclides

3.3 Forecasting environmental pressures

3.3.1 *The impact of other policies of relevance to the marine environment*

Other international policies will influence some of the environmental pressures that the MSD is aimed at relieving. The impact of these policies must be assessed in order to clarify any remaining action to be taken in relation to the MSD - that is in order to achieve the goals of the MSD. The evaluation of the European Commission Impact Assessment (RPA & ABPmer 2005b, pp. A-4) points out that at least three of the environmental pressures on the marine environment are already covered by other EU policies. Fishing is regulated by the Common Fisheries Policy; climate change is subject to the obligations under the Kyoto Protocol; and eutrophication will be influenced by the Water Framework Directive. Though the latter is not yet implemented, the policy has been adopted by the EU member states.

For both member and non-member states there are a number of international marine conventions and agreements that are intended to reduce some of the environmental pressures. In RPA & ABPmer 2005a the following long list is presented:

EU Legislation and International and Regional Conventions Relevant to the Marine Strategy

Biodiversity

EU Measures

- EU Strategy for Sustainable Development;
- Habitats Directive (92/43);
- Birds Directive (79/409);
- Water Framework Directive; (2000/60);
- Draft recommendation on Integrated Coastal Zone Management in Europe;
- Recreational Craft Regulations 2004 (as amended) (94/25/EC);

International and Regional Conventions

- Convention on Biological Diversity and, in particular, the Jakarta Mandate
 - OSPAR Convention;
 - Bergen Declaration;
 - Agreement on the conservation of Small Cetaceans of the Baltic and North Seas (ASCOBANS)
- under the Bonn Convention (the Convention on Migratory Species)
- IMO Convention.

Commercial Fisheries

EU Measures

- Common Fisheries Policy (3760/92) and Community Action Plan (COM (2002)186);
- Regulation laying down measures concerning incidental catches of cetaceans in fisheries.

International and Regional Conventions

- Williamsburg Resolution (under NASCO);
- FAO Code of Conduct for Responsible Fisheries 1995.

Hazardous Substances

EU Measures

- Water Framework Directive and Daughter Directives;
- Proposed EU Chemicals Policy (REACH);
- Pesticides Policy;
- Strategy in relation to Dioxins, Furans and PCBs;
- Integrated Pollution Prevention and Control Directive;
- SCALE Strategy for environment and health; and
- Endocrine Disruptors Program.

International and Regional Conventions

- OSPAR Strategy for Hazardous Substances;
- IMO Convention on Harmful Antifoulants; and
- Stockholm Convention on POPs.

Eutrophication

EU Measures

- Urban Wastewater Treatment Directive (UWWT)
- Bathing Water Directive (BWD)
- Nitrates Directive (ND)
- Water Framework Directive (WFD)
- Common Agricultural Policy (CAP) as reformed (May 2004)
- Integrated Pollution Prevention and Control Directive (IPPC)
- Large Combustion Plants Directive
- EU Air Quality Strategy
- EU Acidification Strategy
- Marine Fuel Sulphur Directive.

International and Regional Conventions

- MARPOL Convention (Annex IV and VI);
- OSPAR Strategy on Eutrophication; and
- HELCOM Convention.

Other Policies/Regulation in Progress

- Thematic Strategy on Air Pollution (COM (2005)446) provisional.
- Directive on Ambient Air Quality and Cleaner Air for Europe (the 'CAFÉ' Directive)
- Revision of Bathing Water Directive limits - Common Position agreed in December 2004. Conciliation in progress.

Litter

EU Measures

- Directive on port reception facilities for ship generated waste and cargo residues;
- Bathing Water Directive; and
- Urban Wastewater Treatment Directive.

International and Regional Conventions

- MARPOL Convention;
- London Convention; and
- OSPAR Convention.

Oil Spills and Discharges

EU Measures

Council Resolution of 26 June 1978;

- Commission Decision of 25 June 1980 (80/686/EEC) (as amended);
- Council Decision of 3 December 1981 (81/971/EEC);
- Council Decision of 6 March 1986 (86/85/EEC); and
- Decision 2850 of 20/12/2000.

International and Regional Conventions

- Barcelona Agreement for the Protection of the Mediterranean Sea Against Pollution;
- Bonn Agreement;
- Bucharest Convention;
- Copenhagen Agreement on Marine Pollution;
- HELCOM Convention;
- Espoo Convention on Environmental Impact Assessment in a Trans-boundary Context;
- International Conventions on Civil Liability for Oil Pollution Damage;
- International Conventions on the Establishment of an International Fund for Compensation for

Oil Pollution Damage;

- Lisbon Agreement (not yet in force);
- MARPOL Convention 73/78 on the Prevention of Pollution from Ships;
- OSPAR Convention;
- IMO Guidelines on Ship Recycling;
- 5th North Sea Conference – Bergen Declaration;
- Regulation on accelerated phase-in of double hull requirements; and
- Regulation setting up the European Maritime Safety Agency

Noise Pollution

No specific measures at present

Microbial Pollution

EU Measures

- Bathing Water Directive
- Council Directive 91/271/EEC amended by Directive 98/15/EC on Urban Wastewater
- Water Framework Directive (WFD)
- Freshwater Fish Directive (FFD)

- Council Directive 91/492/EEC on Shellfish Hygiene
 - Fish Hygiene Directive (FHD) (Council Directive 91/493/EEC)
 - Maximum Levels of Contaminants in Certain foodstuffs Regulation (Council Regulation 446/2001 amended by Council Regulation 2375/2001) and
 - Shellfish Waters Directive (SWD) (Council Directive 79/923/EEC)
- International and Regional Conventions*
- MARPOL Annex IV
 - Barcelona Convention;
 - Bucharest Agreement; and
 - HELCOM Convention

In general, there are a number of issues to be taken into consideration when determining how the need for action in case of adoption of the proposed Marine Strategy Directive compared to the baseline situation is affected by other policies. First, there is the relation between obligations formulated in international legal frameworks, especially the problem of non-performance of parties, vis-à-vis the obligation to transpose (legally and in practice) the obligations formulated in a future EU Directive.

Furthermore, the impact of the proposed Marine Strategy Directive must be viewed as a supplement to existing EU Directives that mainly adds to the existing Directives a widened geographical scope, notably the Water Framework Directive (2000/60/EC) and the Bathing Water Directive (2006/7/EC). However, some intrinsic co-ordination mechanisms have yet to be provided to ensure that member states fully implement and enforce the provisions of all three frameworks in order to ensure the required benefit to the environment.

The relation between international legal frameworks and a corresponding EU requirement is perhaps the most notable driver in providing for the alleged benefits to the marine environment, not only in terms of stricter implementation and enforcement regimes, but also in terms of an earlier delivery of the alleged results.

To some extent, obligations formulated in international legal frameworks, especially in the environment field, suffer from bad or incomplete implementation among the parties to the agreement. This is mainly because there is in general no independent enforcement forum apart from meetings of the parties to the agreement. International studies have revealed that even in cases of wilful disregard of obligations among one or several parties to an international agreement in the environment field such behaviour is seldom - if ever - addressed in a rigorous manner by the parties to the agreement.

The implementation deficit in international environmental agreements may to some extent be surmounted by the basic character of European Community Law. The European Community Law differs profoundly from international law in the way that community law builds on a stricter regime where the EC Court is the sole and sovereign interpreter of Community Law, and as such the superior enforcement body within EC Law.

Furthermore, a specific feature of EC Law that also will affect the implementation of the obligations as formulated in the proposed Marine Strategy Directive (and in prevailing International Environmental

Agreements) is the fact that the regulatory competences within the area falling under the proposed Directive - geographically and substantially - is pre-empted by the European Community. Pre-emption in this particular context means that the member states are now required to implement, apply, and enforce the obligations of the proposed Marine Strategy Directive, but also that member states are no longer allowed to uphold specific national legislation in the area (geographically and substantially) regulated by the proposed Directive - at least to the extent that such national legislation may be in conflict with the future Marine Strategy Directive.

European Community Law thus offers the opportunity to strengthen both the implementation and the enforcement of existing obligations in International Environmental Agreements by locating the regulatory initiative at Community level instead of in member states.

The extended geographical scope of regulating the Marine Environment is also likely to support the implementation of measures to combat the prevailing degradation of the marine environment. The Water Framework Directive (2000/60/EC), the Bathing Water Directive (2006/7/EC) are mutually supported by and support the implementation of obligations arising from the adoption of the future Marine Strategy Directive. There is thus a probable synergistic effect of having put into force all three Directives in the coming ten years.

3.3.2 Forecasting the impact of economic development

The general economic development of the countries around the North Sea and the Baltic Sea should be considered when forecasting the environmental pressures. If particular industrial sectors are projected to boom, and they have an impact on one or more of the pressures, this should be accounted for. As a rule of thumb, the past years' growth in environmental pressures can be assumed to continue at the same rate. This is a default assumption and others can be made, as long as it is done explicitly.

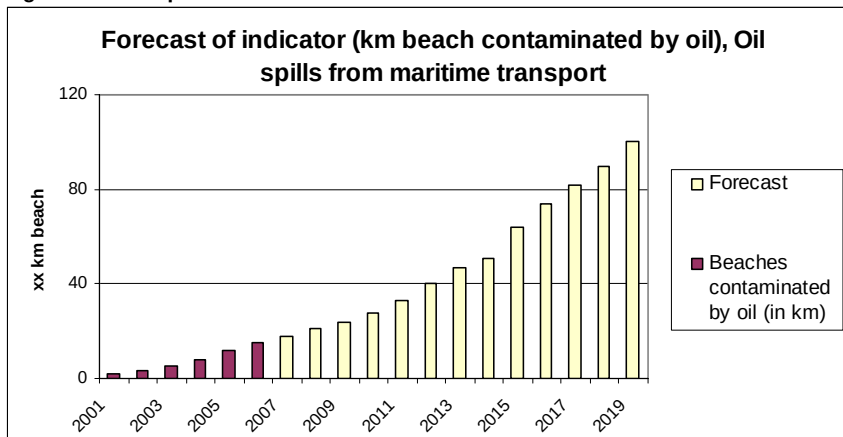
3.3.3 Forecasting the environmental state

The remaining task of building the baseline scenario is to use the knowledge of the current environmental pressures, drivers and impacts together with the assessment of the impact of already adopted policies and forecast the most likely projection of the environmental state from today till 2021. This is by no means an easy task, and some pragmatic shortcuts may have to be taken at this early stage of the policy formulation and planning of implementation strategies. Below a methodologically correct approach is sketched. Suggestions for alternative ways through this step of the assessments are also given, if data or details are lacking.

Example: Oils spills from Maritime Transport

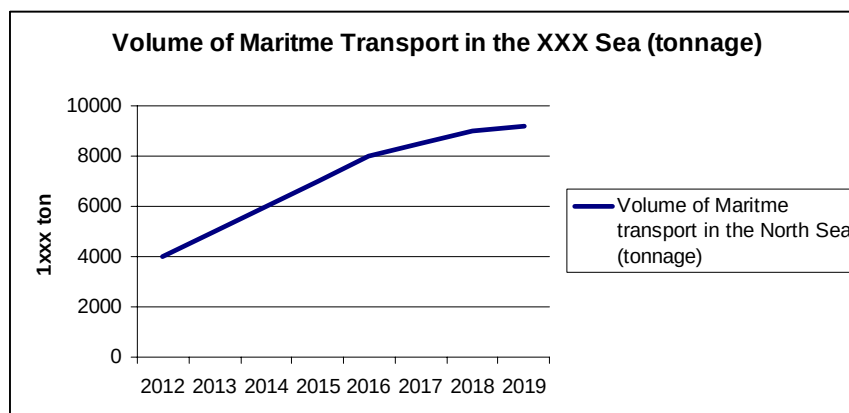
When forecasting the environmental pressures, one can use different approaches. The most straightforward is some form of forecasting based on historic data. Figure 3.2 illustrates a situation where there is historic data until 2006, from where the future development - in this case a continued increase - is projected.

Figure 3.2 Example of forecast of indicator



Such a projection, as illustrated in figure 3.2 can be qualified by various data on the drivers behind the pressure. In this example it could be knowledge on the projected growth in maritime transport in this area. If the development is as illustrated in figure 3.3 this would support the continued growth in the pressure. Relevant regulation coming into action, and the technological advancement in the intermediate years must however be taken into account. The relation between tonnage of maritime transport and km of beaches contaminated by oil may not be a constant.

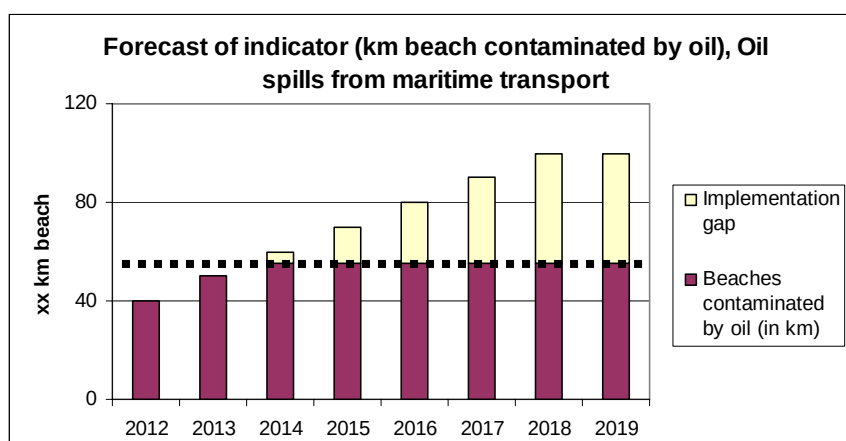
Figure 3.3 Example of forecast of development of driver



Finally, it is now possible to determine the implementation gap. This is the gap between the forecasted development in an indicator, and the level the strategy has as a target for this indicator. As mentioned earlier,

such specific targets are not set by the proposed MSD, so an interpretation of "good ecological status" (GES) must be made. Figure 3.4 illustrates this final step. The dotted line is the target for the indicator.

Figure 3.4 Example of determination of implementation gap



A more pragmatic approach is often needed, since the above-mentioned method puts significant demands on resources. This is probably not possible given the short timeframe before the start of negotiations. One may argue that this is the only proper way to establish demands that the proposal will put on sectors and member states, and there is, indeed, a risk that the more pragmatic approach will generate quite inaccurate answers. It is very important to keep in mind that the overall methodology of this toolkit is scenario analysis and that the results will not be the most likely consequences of the proposed MSD, but rather assessments of one or more assumed scenarios for implementation of the Directive.

The pragmatic approach can be to form a consensus among relevant practitioners, researchers and strategists on a best estimate of the need for e.g. further emission reduction (or other remedial measure). This consensus will be based on the available data on indicators and environmental state, but will only be a rough estimate. One example is saying that, based on past experience, there is a need for further reduction of 50 % of current levels of emission of a certain substance in order to restore good ecological status in the sea. Alternatively, one can set up an optimistic and a pessimistic best estimate scenario to the effect that there will be a need for reductions of between 30 % and 60 %. If the need for action is established in such a pragmatic way, it enhances the need for sensitivity analyses of these assumptions to see if the best estimates are critical to the results of the total cost estimate.

The projected environmental state constitutes the baseline scenario against which a national implementation of the proposed MSD can be assessed. The cost of the baseline scenario is set to zero as it represents decisions already taken, and any cost of compliance of other policies are

so-called "sunk cost". As discussed in the previous chapter on scenario analysis, this assumption can be changed if one wants to look at these costs in comparison with the proposed strategy. However, that would mean that the economic assessment is not only of the MSD, but of all marine policies.

3.4 Checklist

- ✓ The links between drivers, pressures, state and impact of the marine environment using a framework such as the DISP are established.
- ✓ Other relevant and overlapping domestically accepted strategies and international agreements have been identified, and the regulatory differences have been interpreted.
- ✓ Information is gathered, and consensus has been reached on a number of indicators describing the current environmental state of the domestic marine environment.
- ✓ The best available expertise or models have been used to forecast the environmental state in the "business as usual" situation where other already agreed policies are e.g. assumed to achieve their goals.

4. How to build the alternative scenario

4.1 Purpose and content of alternative scenario definition

The next step is to define the policy situation to be assessed. This situation is termed the "alternative scenario". The alternative scenario represents a situation of national implementation of the MSD. The Directive by implication leaves a considerable margin of discretion to Member States with regard to implementation. Thus, it expressly requires the national authorities to make their own provision in some respect. A decision needs to be taken on how a directive can be transposed into the national level of implementation when constructing scenarios for assessment of a proposal.

Due to the inherent uncertainty, scenario building is an indispensable tool in economic assessment. Multiple scenarios can be built and analysed, representing various interpretations and suggestions for implementation.

Establishment of the alternative scenario(s) will include the following steps:

- Defining the environmental state of compliance;
- Assessing the implementation gap based on the definition of the baseline scenario and the environmental state of compliance;
- Defining actions to close the gap.

Initially, the desired environmental state must be defined in terms of the environmental pressures described in Chapter 3, meaning the environmental state of compliance. Secondly, based on the baseline scenario and the state of compliance, the required action in terms of environmental improvement is identified, the so-called the implementation gap. Finally, the definition of the policy scenario must include identification and definition of the required actions in order to close the gap.

In practice, the three steps cannot be viewed separately. The interpretation of the term "environmental state of compliance" depends to some extent on the current status since the implementation gap should not be unrealistically high. In addition, the number, volume and related implications of remedial measures will affect the achievable level of environmental status.

As mentioned in the introduction of this report, the aim of this study is to develop a toolkit of methodology for economic analyses of the national consequences of the EU Commission's Thematic Strategy on the Protection and Conservation of Marine Environment, and the proposed Marine Strategy Directive in combination. Thus, the alternative scenario to be defined could illustrate an implementation of both the Thematic Strategy and the proposed MSD, or it could be defined to exemplify the implementation of the Thematic Strategy separately. In this way, the cost difference could be assessed by comparing these two alternative scenarios. As no specific actions are identified in the Strategy, it could be assumed that the actions set out in the 2002 Communication will be carried forward.¹⁵

In section 4.2 below, we will provide overall guidance for the process of establishing the alternative scenario(s). This section is followed by a section providing more details about how to identify specific remedial measures (section 4.3).

4.2 Defining the likely national need for action to reach target environmental status

The definition of need for action depends on the definition of the state of compliance, which is left rather open in the present formulation of the proposal for MSD. The general recommendation is to set up a limited number of alternatives, e.g. an ambitious and a moderate interpretation of the environmental state of compliance. In this connection, it should be noticed that the analysis result will depend closely on the particular level of environmental targets. Also, at unit level the result will depend on the defined level of environmental improvement. This is so because the marginal costs of the actions are not constant, but rather tend to increase with the level of environmental improvement.

The state of compliance and need for actions should be considered for each of the relevant environmental pressures. Preferably, it should be quantified, e.g. in terms of tonnes of N loads reductions or the need to reduce the risk of oil spills by x %. Overall guidance for the definition and quantification of the environmental need can be found below for the three environmental pressures, which were previously pointed out as the main relevant pressures in relation to implementation of the MSD in the

¹⁵ This illustrates the UK partial impact assessment of the EU Commission's Thematic Strategy on the Protection and Conservation of Marine Environment and the proposed Marine Strategy Directive (RPA and ABPmer 2005a).

Nordic countries, i.e. over-fishing, hazardous substances and oil spills and discharges.

4.2.1 Over-fishing

The Marine Strategy does not identify a specific objective for commercial fishing, it rather states that the oceans and seas should be safe, clean, healthy and productive. Good ecological status can be assumed to mean ensuring sustainable fisheries and a healthy ecosystem.¹⁶

The main EU measure regulating fisheries in the EU is the Common Fisheries Policy (CFP) and Community Action Plan. There is also a range of separate initiatives which seek to control fisheries by-catch.¹⁷ The reformed Common Fisheries Policy (CFP) provides for goals similar to those of the proposed strategy, but the mechanism for achieving the objectives may not go far enough.

In such cases, the implementation of the proposed strategy would mean taking measures that meet the characteristics of good environmental status for commercial fisheries. As these characteristics will not be defined until after the Directive enters into force, it is open to debate, at this point, what this will entail. It is, however, likely that the current commitments will not suffice, and the proposed strategy is envisioned to be an important push in right direction.

In an assessment of the need for action, both biological and other scientific data and studies are relevant. Studies that link the ecological state and economic effects are preferable, but scarce. In its CM 2003 Documents, ICES has gathered many overview articles on the regulation of fisheries. One example is the article on the invited plenary lecture by Caddy, J.M. and Agnew D.J: *Recovery plans for depleted fish stocks: an overview of global experience*.¹⁸ Also, the article on recovery trajectories from stock rebuilding programmes for North Atlantic and Baltic salmon stocks is an example of relevant literature to consider.¹⁹

4.2.2 Hazardous substances

Regarding hazardous substances, the objective defined in the Commission's 2002 Communication (Objective 4) is: "to progressively reduce discharges, emissions and losses of substances hazardous to the marine environment with the ultimate aim to reach concentrations of such substances in the marine environment near background values for naturally occurring substances and close to zero for manmade synthetic substances". The need for action regarding hazardous substances will gener-

¹⁶ As defined in the goal is also defined in the Commission's 2002 Communication on the Thematic Strategy.

¹⁷ (RPA and ABPmer 2005a, Annex B)

¹⁸ <http://www.ices.dk/products/CMdocs/2003/INVITED/INV2PAP.PDF>

¹⁹ <http://www.ices.dk/products/CMdocs/2003/U/U0903.PDF>

ally depend on the definition of “substances hazardous to the marine environment” and the interpretation of “near background values” and “close to zero”. If the interpretation of these terms goes beyond the requirements of the WFD, very significant additional costs could be incurred (RPA & ABPmer 2005a, Annex C).

The need for action in case of acceptance of the proposed MSD would probably be the following types of measures: further measures to ensure full implementation of the IMO Convention; and measures to address substances under the OSPAR Convention not covered by the WFD. There may also be a need for imposing stricter control of substances included in the WFD, depending on the definition of the above mentioned terms.

The OSPAR list of Chemicals for Priority Action includes the majority of the substances on the WFD List of Priority Substances. It does not, however, include many of the substances listed under the WFD.

Table 4.1 List of potential Priority Hazardous Substances. OSPAR List of Chemicals for Priority Action

4-tert-butyltoluene	4-(dimethylbutylamino)diphenylamin (6PPD)
cadmium	triphenyl phosphine
lead and organic lead compounds	hexamethyldisiloxane (HMDS)
mercury and organic mercury compounds	dicofol
organic tin compounds	endosulphan
neodecanoic acid, ethenyl ester	hexachlorocyclohexane isomers (HCH)
tetrabromobisphenol A (TBBP-A)	methoxychlor
hexachlorocyclopentadiene (HCCP)	pentachlorophenol (PCP)
1,2,3-trichlorobenzene	trifluralin
1,2,4-trichlorobenzene	clotrimazole
1,3,5-trichlorobenzene	2,4,6-tri-tert-butylphenol
brominated flame retardants	nonylphenol/ethoxylates (NP/NPEs) and related substances
polychlorinated biphenyls (PCBs)	octylphenol
polychlorinated dibenzodioxins (PCDDs)	certain phthalates: dibutylphthalate,
polychlorinated dibenzofurans (PCDFs)	diethylhexylphthalate
short chained chlorinated paraffins (SCCP)	polyaromatic hydrocarbons (PAHs)
	musk xylene

Source: RPA and ABPmer (2005a)

The specific measures available in order to reduce discharges, emissions and losses of hazardous substances are substitution of substances for not harmful substances; reduction in the use; or reduction in discharges. In case of illegal emission, stricter enforcement and control can be used as measures.

4.2.3 Oil spills and discharges

Accidental oil spills from maritime transport can be categorised as being the release of large amounts of oil in a fairly restricted area, causing considerable damage. In some cases, the long-term effects to the environment and to the local economy have been minimal²⁰ although the short-term effects of oil spills are very damaging.

²⁰ Unless pollutant levels are of such a magnitude as to interfere with the regenerative ability of the particular area.

An on-going problem is that of small oil spills from maritime transport where relatively small amounts of oil come ashore, potentially over a large area. Frequently tar balls, specks of oil or oiled debris come ashore on beaches and, although in low levels, are still capable of killing wildlife, causing long-term loss of salt marsh vegetation, and tarnishing the good environmental image of an area.²¹

Regarding legal discharges from offshore sector, the need for action is as complex to determine as in the case of hazardous substances. There is a possibility that the proposed strategy can be interpreted to mean that all emissions must be eliminated. This will call for very strict regulation and stringent measures on industry. The objective does not take account of whether discharges, if minimised and controlled, present a continuing risk to the environment (RPA and ABPmer 2005a). In that sense, it does not correspond to the OSPAR recommendation with respect to limitations for the ability to reduce discharge concentrations. Depending on the interpretation of the proposed strategy, the need for action - and the corresponding relevant measures - will either be along the lines of compliance with the OSPAR recommendations, or a more strict interpretation, involving elimination of virtually all spills and discharges.

4.3 Identifying relevant remedial measures for the Nordic Countries

In order to assess the extra cost of the scenarios representing the proposed strategy, it is necessary to identify how the implementation gap may be closed. This is done by looking at potential remedial measures that would have to be taken to achieve the envisioned goals.

The term "measure" consists of two elements:

- *Technical measure*, which is the technical solution to improve the environment;
- *Policy measure*, which is the instrument supporting the implementation of the technical measure, and which is defined by asking the question "which instrument may ensure that a given technical measure is implemented?"

Preferably, an assessment should include a specification of both the technical measure and the policy measure in order to assess the impact of the overall "package". Depending on the specific case, focus could be clearly identifying either the technical or the policy instrument whereas overall assumptions may be made for the other part if this is believed to have only modest impact on the cost assessment.

²¹ (Toft et al, 1994, in UK Marine SACs Project, 2004) in RPA and ABPmer 2005a

Five issues have been identified as being relevant to the need for action to meet the intentions of the proposed MSD. These five issues are defined by the influence of a sector on an environmental pressure. The five issues are listed in table 4.2 below.

Table 4.2 The five selected relevant issues in relation to the proposed MSD.

1	SECTOR: Fisheries ENVIRONMENTAL PRESSURES: Over-fishing
2	SECTOR: Maritime transport ENVIRONMENTAL PRESSURES: Hazardous substances
3	SECTOR: Offshore activity (Oil and Gas) ENVIRONMENTAL PRESSURES: Hazardous substances
4	SECTOR: Maritime transport ENVIRONMENTAL PRESSURES: Oil spills and discharges
5	SECTOR: Off-shore activity (Oil and Gas) ENVIRONMENTAL PRESSURES: Oil spills and discharges

For each of the above sectors, a number of specific problems were identified in Chapter 3. Now, relevant measures to alleviate problems need to be identified. Once done, the basis for making cost estimates of the need for action will become available. Below, each of the five issues and the specific problems will be assessed one by one in terms of possible remedial measures.

For some of the environmental impacts, it may well be the case that the potential measures are not well defined or involve new and/or untested administrative tools or technology. In these cases, it will be difficult to establish the required basis for an economic assessment of the cost. However, attempts should be made to be as specific as possible and to describe the relevant available options as objectively as possible. For each option, the effectiveness in achieving of the policy goals, including legal risks, should be described and assessed. Moreover, both the likelihood and the magnitude of any potential adverse effects should be assessed. It can also be of considerable value to consult external stakeholders at appropriate stages (Cabinet Office, 2005). The more specific and detailed the description of the measure is, the better the cost estimate can be made.

Table 4.3 Examples of relevant remedial measures, issue 1

SECTOR: Fisheries	
ENVIRONMENTAL PRESSURES: Over-fishing	
Specific problem	Remedial Measures
Over-fishing leading to the reduction of target and by-catch species	- Capacity limits and restricted licensing - Modification of gear types - Raising minimum landing sizes - Setting by-catch limits and discard bans - More stringent EIA for new gear and fisheries - Restrictions on the overall size of gear or volume of nets as the materials used in nets - Economic instruments, including reform of subsidies and green taxes - Education, consultation and/or co-management arrangements
Bottom trawling causing modification of the physical environment and habitats	- Establishment of no-take/no-trawling zones

Source: RPA & ABPmer (2005a), COWI, (IEEP 2000)

There is a host of potential technical and administrative measures available aimed at reducing the impacts of over-fishing. They range from management plans such as the use of property rights, restrictions on fishing capacity and effort; conditions on fishing, such as prohibitions on gear use or closed areas; setting of by-catch limits and the use of multi-species or basket quotas, in addition to single species quotas; economic instruments, including reform of subsidies and green taxes; positive financial and other incentives to support sensitive fishing practices; marketing provisions; education, consultation and/or co-management arrangements to improve fishing methods. Technical measures are also suggested such as substantially increasing minimum mesh sizes; requirements concerning the use of more selective gear, to protect target and/or non-target species; minimum standards such as BAT; restrictions on the overall size of gear or volume of nets as the materials used in nets; and restrictions on the use of certain gear types, particularly to protect sensitive species and habitats (IEEP 2000).

The commonality of all these measures is, however, that they are aimed at impacting a significant reduction in fishing, and/or restoration of estuary nursery areas. The measures required to achieve the characteristics of good environmental status with regard to commercial fisheries could entail very considerable additional costs to the member states. The bulk of the cost would accrue to the fishing industry. There would also be indirect effects on the retail, food processing and livestock sectors.

Establishing the magnitude of these costs cannot be estimated using unit-prices and partial analyses. Primarily because a reduction the pro-

duction in an industry of maybe 50 % ²² is not a marginal change and the effect on the economy would be complex. Secondly, the effects on fish stocks are hard to predetermine, and therefore also the economic impact. In the short term, the amount of fish catches would decrease, but fisheries could also benefit significantly as it will be possible to reverse the decline in stocks and ensure sustainable fisheries and a healthy marine ecosystem. In sum, the cost estimation for the industry and the ecosystem that supports it of such large structural changes should be investigated in an economic macro model or a computable general equilibrium model using input from scientific predictions on fish stock recovery rates. In addition to the costs to industry, there may be social costs associated with reduced earnings in fishing and activities that depend upon it, such as increased unemployment in coastal zones for a period of time.

Table 4.4 Examples of relevant remedial measures, issue 2

SECTOR: Maritime transport	
ENVIRONMENTAL PRESSURES: Hazardous substances	
Specific problem	Remedial Measures
Anti-fouling agents/paints from ships (hazardous substance TBT)	- Further action may be required to fully implement the requirements of the IMO Convention, for example provisions for the prohibition of other anti-fouling substances in the future - Removal and deposition on land of contaminated sediments along shipping routes - Prohibition of marine disposal of dredged sediment
Cadmium losses to water from sacrificial zinc anodes for corrosion protection	- Substitution of cadmium with indium

Source: COWI (2006)

Anti-fouling agents/paints from ships

In 2001 the International Maritime Organisation (IMO) adopted the International Convention on the Control of Harmful Anti-fouling Systems on Ships. This convention prohibited application of TBT-containing anti-fouling paints on all boats from 2003 and prohibits navigation of ships with active TBT-containing paint on from 2008. The EC implemented the Convention through EC order 782/03 of 14 April 2003. The IMO Convention and the related EC Order has prohibited the application of new TBT-containing antifouling paints on all EC ships and ships from other countries, which have ratified the IMO Convention. From 2008 emission to the marine environment of TBT from antifouling paints should totally cease as a result of the regulation. It is assessed that some foreign ship

²² The British Partial Impact Assessment of the proposed MSD looks at a reduction in the production value of commercial fishing of 60% (RPA and ABPmer 2005a, Annex B)

owners could possibly try to avoid the prohibition and still apply TBT-containing antifouling paint for a few years, as the known alternatives are not as effective as the traditional TBT-containing products. The emission of TBT from ships will probably be minimal after 2008. However, further action may be required to fully implement the requirements of the IMO Convention, for example provisions for the prohibition of other anti-fouling substances in the future.

As a consequence of the previous very extensive use of TBT in anti-fouling paints for ships, many types of marine sediment are today highly contaminated with TBT. TBT has a long lifetime in sediments and can thus be a source for release of TBT to the water phase for a number of years. The highest TBT concentrations are found close to harbours and shipping routes.²³ As a consequence of the proposed MSD these sediments could be removed and deposited on land. This would, however, be a vast undertaking due to the extent of contaminated sediments. It is more likely that the Directive could entail the prohibition of marine disposal of dredged sediments. When sediments are removed in connection with marine constructions, the sediments can in other words not just be removed, but have to be deposited on land instead.

Substitution of cadmium in sacrificial zinc anodes

One of the most important sources of emission of cadmium to the Nordic water environment is the use of sacrificial anodes made of zinc for protection of steel structures in the water environment. Sacrificial anodes made of zinc are designed to be dissolved thereby protecting steel structures against corrosion. The structures in question include oil production platforms, harbour structures, steel boats etc. The zinc anodes contain about 0.05 % cadmium by weight, which will be dissolved together with the zinc. In 1996, the amount of cadmium released to the water environment in Denmark was estimated at 0.6 tonnes.²⁴ Sacrificial anodes have been assessed to be the most important single source for contamination of the water environment by cadmium in Denmark (mainly coastal/marine environment).²⁵

It is assessed that at least 50 %, and probably more, of the sacrificial zinc anodes are used for protection of ships and boats against corrosion. The content of cadmium in the anodes plays a technical role, which,

²³ In the proposed Daughter Directive to the WFD for priority substances and priority hazardous substances, TBT is classified as a priority hazardous substance, which implies that "discharges, emissions and losses" to the aquatic environment must have ceased within 20 years from the date of entry into force of the directive. If such release of TBT from sediments to the water phase within the internal waters and harbours is covered by the directive's requirement for *cessation of losses*, TBT-containing marine sediments would have to be dealt with under this Directive.

²⁴ Drivsholm, T.; J. Maag, E. Hansen and S. Havelund 2000. Substance flow analysis for cadmium. Environmental project no. 557, 2000. The Danish Environmental Protection Agency. (in Danish)

²⁵ COWI (2006): Assessment of a Draft EC Directive on Priority Substances under the Water Framework Directive, Draft report April 2006.

however, can also be achieved by use of indium as a substitute for cadmium.

Table 4.5 Examples of relevant remedial measures, issue 3

SECTOR: Offshore activity (Oil and Gas)	
ENVIRONMENTAL PRESSURES: Hazardous substances	
Specific problem	Remedial Measures
Chemicals used and discharged offshore	- A progressive reduction of discharges, emissions and losses of these substances (as in WFD). This would entail • substitution of hazardous substances • reduction in use of hazardous substances • reduction in discharges of hazardous substances • reduction in offshore activity
	- Enforcement of OSPAR Decision 2000/2 on a Harmonised Mandatory Control System for the Use and Reduction of the Discharge of Offshore Chemicals - Resources and responsibility identified and earmarked for handling of OSPAR Recommendation 2000/4 on a Harmonised Pre-Screening Scheme for Offshore Chemicals - Resources and responsibility identified and earmarked for handling] OSPAR Recommendation 2000/5 on a Harmonised Offshore Chemical Notification Format (HOCNF)

Source: OSPAR Report on Discharges, Spills and Emissions from Offshore Oil and Gas Installations in 2003 including assessment of data reported in 2002 and 2003

The hazardous substances used in the offshore sector are mainly heavy metals such as cadmium, chrome, copper, lead, zinc and mercury. Also, a number of chemicals are used such as stabilisers, retarders, well cleaners, viscosity regulators, and foam inhibitors.

As mentioned at the beginning of this chapter, the need for action on hazardous substances will usually depend on the definition of “substances hazardous to the marine environment” and the interpretation of “near background values” and “close to zero”. The interpretation can either be similar to provisions of the Water Framework Directive (WFD) or less strict along the lines of the OSPAR recommendations for offshore activities.

A progressive reduction of discharges, emissions and losses of these substances (as in the WFD)

It will probably be a considerable task and a potentially very costly one to achieve ‘close to zero’ or ‘near background’ levels for a range of substances that are historically or naturally present in the environment. This will also be the case for the Nordic countries, even when considering the present and historic attention to progressive reductions of many of the substances compared to other European Countries. Unfortunately, at pre-

sent, it was not possible to identify generally applicable data in this study that would allow for estimation of the cost of such a task. However, it seems almost evident that it will be impossible to reach 'close to zero' levels of at least some hazardous substances in the marine environment without imposing a high economic cost on industry in general and on offshore activities in particular. It will probably also involve considerable costs to monitor substances, depending on the number of additional substances on which restrictions or ban measures are imposed and the interpretation of 'close to zero' (RPA and ABPmer 2005a).

OSPAR strategies

Since 2001, the use and discharge of chemicals have been regulated by the OSPAR Convention. The provisions in both the OSPAR strategy and the WFD Article 16 are identical. They, can therefore be assumed to result in comparable controlling measures with similar implementation costs. The costs of implementing Article 16 of the WFD can be viewed as an indication of the cost of compliance with the OSPAR Strategy. Unlike the WFD Article 16, it is theoretically so that the same costs under the OSPAR Strategy could be attributed to the marine environment.

There is an overlap in substances between the OSPAR Strategy and Article 16 of the WFD. This may result in some duplication in the estimated costs of both measures. In addition, some of the discharges of substances under the OSPAR list are already being addressed under the EU and national chemicals strategies and other relevant policies, and the OSPAR Strategy may therefore not incur additional costs on these.

Table 4.6 Examples of relevant remedial measures, issue 4

SECTOR: Maritime transport	
ENVIRONMENTAL PRESSURES: Oil spills and discharges	
Specific problem	Remedial Measures
Shipping: Collisions/groundings causing oil spills	- Widening of shipping lanes in narrow straits - Deepening of shipping lanes - Traffic separation in shipping lanes - Vessel Traffic Service (VTS) on land - Floating Vessel Traffic Service (VTS) - Ban on fishing in separation zones - Synchronous flashing lights in shipping lanes - Moving lighthouses to better positions for current shipping lanes
Illegal discharges from ships (oil, waste water)	- Stricter enforcement of existing national laws and international agreements

Source: COWI (2002), Søfartsstyrelsen og Farvandsvæsenet: Risikovurdering af sejlandssikkerhed i de danske farvande (Risk assessment of maritime safety in the Danish waters)

Reducing the risk of accidental oil spills from maritime transports can be targeted in two different ways: Either, the target can be to reduce the risk of ship collisions and groundings, or it can be to reduce the damage,

if these events occur. Phasing out of single-hull ships is aimed at the latter, while most other measures are aimed at avoiding accidents.

A number of risk-reducing measures have already been taken in the Nordic countries, as well as in other parts of the world. The Automatic Identification System (AIS) has been made mandatory and is expected to be fully extended in 2008. Also, there is international agreement on the use of electronic charts (ECDIS), even though the implementation is voluntary (COWI 2002). Finally, it has been agreed that the ports in the Baltic Sea should not accept calls by ships that have had their licence for single-hull extended. This will mean a phasing out of single-hull ships by 2015. The deadline of these three measures could be brought forward, but this is not assumed to be relevant for the proposed MSD, which is subject to a deadline which is longer than that already in place.

Widening or deepening of shipping lanes

In narrow or shallow shipping lanes this option is quite cost-effective as it has a significant effect on reducing the risk of both groundings and collisions, and at the same time is not excessively expensive. There will be a certain investment cost, and the digging and removal activities proper will entail an environmental impact as well as hydrological effects.

Separation of traffic in shipping lanes

Separation of traffic in shipping lanes can be achieved by buoyage, and the investment cost is therefore limited. The effects will greatly depend on the already existing buoyage and on the width and depth of the shipping lane, and this measure should therefore be assessed in conjunction with the above.

Vessel Traffic Service (VTS)

Vessel Traffic Service can comprise a number of instruments, but commonly it entails the introduction or extension of surveillance and reporting of ships, and information (and counselling) to ships. If a vessel is assigned to the VTS, the cost is considerably higher, as is floating VTS. However, onshore VTS was found to be one of the most cost-effective measures in Danish waters (COWI 2002). Generally, the cost of the measure will vary greatly depending of the geographical area in question.

Synchronous flashing lights in shipping lanes and moving lighthouses to better positions for current shipping lanes

These measures can be particularly relevant where lights are a main factor in the shipping navigation. In a Danish study of cost-effectiveness of measures to reduce the risk of oil spills, these types of measures were, however, found to be relatively inadequate.

Stricter enforcement of existing national laws and international agreements on illegal spillage

It has not been possible in this study to identify other studies that investigate what specific measures to be taken to ensure stricter enforcement in cases of illegal spillage from maritime transports. Present control and surveillance measures could possibly be used as the basis for assessment of further action in this field.

Table 4.7 Examples of relevant remedial measures, issue 5

SECTOR: Offshore activity (Oil and Gas)	
ENVIRONMENTAL PRESSURES: Oil spills and discharges	
Specific problem	Remedial Measures
Produced water (discharges contaminated with oil)	- Full implementation of the OSPAR Recommendation 2001/1 for the Management of Produced Water from offshore Installations - Full implementation of the PARCOM Recommendation of a 40mg/l Emission Standard for Platforms, 1986 - Resources and responsibility identified and earmarked for handling OSPAR sampling and analysis procedure for the 40mg/l target standard (currently under review) - Capital investment in measures to recover hydrocarbons from offshore oil and gas waste and transport it for disposal
Use and discharge of drilling fluids and cuttings	- Take up action in relation to OSPAR Decision 2000/3 on the Use of Organic-phase Drilling Fluids (OPF) and the Discharge of OPF-contaminated Cuttings - Resources and responsibility identified and earmarked for handling Guidelines for the Consideration of the Best Environmental Option for the Management of OPF-Contaminated Cuttings Residue (reference number: 2002-8) - Capital investment in measures to recover hydrocarbons from offshore oil and gas waste and transport it for disposal

Source: OSPAR Report on Discharges, Spills and Emissions from Offshore Oil and Gas Installations in 2003 including assessment of data reported in 2002 and 2003

The total quantity of dispersed oil (aliphatic oil) discharged to the sea is the sum of discharges from produced water, displacement of water and accidental spillage. Produced water and displacement of water are the main contributors to the oil discharges from offshore oil and gas activities, representing above 90 % (OSPAR 2003). Accidental spillage is responsible for the rest.

OSPAR strategies on produced water

There is a 40 mg/l performance standard for dispersed oil in produced water, but some installations do not meet performance standards. In this study, we have not been able to identify why this is the case. According to the OSPAR Report on Discharges, Spills and Emissions from Offshore Oil and Gas Installations in 2003, it is recommended that full implementation of the already agreed performance standards is enforced, but it is not specified how. Further, it is recommended that resources and responsibility be identified and earmarked for handling an OSPAR sampling and analysis procedure, which is currently under review. Increases in the costs due to the requirement to treat production water and drilling mud will be negligible as treatment is already taking place whereby expensive drilling fluids and chemicals are recycled in conjunction with treatment of the wastewater from the production process. The costs of improving the systems will probably be relatively small compared to the other costs identified. However, as these costs will depend on the size and output of the platform and oil field, they cannot be valued accurately (APR and ABPmer 2005a). Monitoring costs will also be incurred by the oil industry, but these will probably be insignificant.

OSPAR strategies on the use and discharge of drilling fluids and cuttings

As to discharges with produced water, there are a number of OSPAR regulations in force covering the Nordic countries. The problem of non-compliance is not overwhelming, but stricter implementation and identification of resources and delegation of responsibilities for handling are recommended (OSPAR 2003). Since estimates of the compliance cost of the regulation have not been identified in this study, the additional cost of stricter enforcement is not possible to estimate. The cost will, however, probably not be very high.

Capital investment to recover hydrocarbons waste

For some countries, it may be deemed necessary to recover hydrocarbons from oil and gas installations in order to reach the target of ceasing discharges. In that case, the oil and gas production industry will need to invest heavily in injection equipment to remove hydrocarbon substances and drilling coolant liquids from oil cuttings and mud. Consultations with the industry in the UK have revealed that the costs of such new investment could be high (RPA and ABPmer 2005a). Especially platforms located in the central part of the North Sea are will probably be required to make investments in new technology and clean up facilities as the North Sea is relatively shallow. Shallow waters are characterised by strong currents requiring better treatment of cuttings. In the case of recovery of hydrocarbons, there are also additional costs associated with the transport and disposal of waste products onshore or offshore. This issue is also

relevant when it comes to the removal of obsolete platforms and pipelines containing hydrocarbon-based substances.

4.4 Checklist

- √ Formulation and delimitation of the strategy that is the basis of the assessment. This entails discussions and an assumption of what is "new" in the proposed strategy and thus requiring incremental measures.
- √ There is consensus on or an assumption of how to interpret the goal of the proposed strategy ("good ecological status").
- √ Identification of relevant remedial measures and selection of the most cost-effective solutions.
- √ Definition of the need for action - or "the implementation gap" - using of indicators of the environmental state and the dose effect of the measures. Alternatively a pragmatic approach is adopted.
- √ Presentation of one or more scenarios describing the potential national implementation of the proposed strategy.

5. How to assess the extra cost of the alternative scenario

5.1 General methodology for calculation

For each measure selected as being relevant for the scenarios to be assessed, the cost now has to be estimated. The costs of the measures are the building blocks of the overall assessment of the cost of each scenario.

The following overall steps must be taken in order to assess the cost of the measures:

1. General approach:
 - Time horizon and discount rate
 - Types of prices (market prices or factor prices)
 - Net tax factor (for domestic and internationally traded goods)
 - Marginal cost of public funds
 - Net Present Value, annual cost and time profile
2. Assessment of cost of measures
 - Sensitivity analysis

Delimitation

The basic approach most commonly used today in economic policy or project assessments is the welfare-economic approach. This approach is recommended in this context, and it means that a specific definition of economic cost is given by use of the welfare economic paradigm and that it can be compared across the analyses. Further, it is a premise that national cost assessments are made in the member states while the Commission carries out the EU-wide assessment.

Delimitation of the environmental effects is not a trivial issue, and it must be discussed in the report of the economic assessment. Given the national delimitation of the cost assessment, there is a strong argument for limiting the assessment of the environmental benefit to the national level as well. However, given the transboundary nature of the marine environment this will be difficult in practice. Further, there is general consensus that member states wish to improve the state of environment not just nationally, but rather regionally and even globally.

General assumptions

The general assumptions to be made relate to ensuring consistency in both internal and external cost estimates. This requires verification that the estimates can both be compared within the scope of the analysis and to welfare economic estimates of other analyses. The general assumptions also have implications on the interpretation of the results. The general assumptions include:

- Discount factor, which is to represent the time preference of the society;
- Time horizon of the analysis, which should depend on the concrete initiative as well as the purpose of the assessment;
- Choice of prices, which should reflect society's opportunity cost of the good. This means that impacts should be estimated in market prices, which are defined as factor prices incl. taxes;
- Distortion costs from public funding, taking into account that revenue raising for financing public projects through general income taxation tends to distort the supply of labour.

The general assumptions of discount rate and other key figures vary from country to country (and even between authorities within a country) as can be seen in table 5.1 below. This is not necessarily a problem, since it may be due to different conditions in countries and within different policy areas. However, it is important carefully to consider these assumptions and present them along with the analysis, since they may have a substantial influence on the result.

Table 5.1 General Assumptions in Denmark and European Commission as examples

Country	Welfare economic discount rate %	Tax adjustment factor	Average marginal cost of public funds
Denmark	6%*	17%	20%
Sweden		23%	30%
Norway	4%**	explicit factor not defined	20%
Finland	5%	n.a.	n.a.
EU	4% (New guidelines for Impact Assessment)	Marked	n.a.

* The Ministry of environment operates with a discount factor of 3 % combined with an alternative depreciation rate on capital of 6 %.

** 6 % for high-risk projects

Below the different types of general assumptions are briefly discussed. For more information about these general methodological issues in connection with economic assessment, we refer to the national general guidelines (e.g. Møller et. al. (2000); Finansministeriet (1999); Finansdepartementet (2005); SIK (2005)).

Discount factor: This parameter is subject to frequent discussions between experts, and therefore, if possible, the estimation should be made so that sensitivity analyses of these parameters can be made relatively easy. Table 5.2 below illustrates the implication of alternative discount factors, by presenting the annualised costs of alternative discount rates and the lifetime of an investment of EUR 100,000.

Table 5.2 Annualised cost, in EUR, of an investment of EUR 100,000

Life time	10 years	50 years
Discount rate		
1% p.a.	10,558	2,551
3% p.a.	11,723	3,887
6% p.a.	13,587	6,344

Time horizon: The choice of time horizon depends on the timing of the costs and benefits of the project. In general, the time horizon should be set so that it captures the most substantial future effects. If the proposed time horizon for the implementation of the MSD is set at 2021, thus, the question still remains: How long after this date should costs and benefits accruing to the Directive be included? Depending on the discount factor, impacts lasting for more than 50 years generally only have marginal impact on the net present value of the initiative.

Regarding prices, the standard assumption in welfare economic analysis is to use market prices, including taxes. However, this should be stated clearly. In case the market prices are calculated based on factor prices²⁶, the tax adjustment factor assumed should be identified.

Tax distortion: In the Nordic countries, the welfare-economic cost will also include the marginal cost of public funds. This is an expression of the distortionary effects of all public expenditure as it constitutes redistribution of taxes revenues. The degree of distortion can/should be calculated for each specific measure depending on the envisioned financing strategy, but in practice a standard factor is often used for all publicly funded measures. In Denmark, the general guideline for welfare-economic assessments is a marginal cost of public funds of 20 % on top of the market price. If the cost of a measure is to be borne by an industrial sector, and no compensation is proposed, there will generally not be any marginal cost of public funds. The effect of a financing strategy for each measure will thus have some consequence for the cost assessment, not least in relative cost-effectiveness assessment of potential measures.

Finally, it must be decided whether to present the results as the net present value or as the annual cost (or both), and which time horizon. The net present value is the net value today of the future cost and benefits

²⁶ For example, if the price data is exclusive of VAT.

calculated using the discount rate. The average annual cost is another way of expressing the same result as the cost in this instance is annualised over the period using the discount rate.

5.2 Assessing the costs of the remedial measures

When the general assumptions are unambiguous, the cost data can be collected. Costs can be broadly categorised under two headings: direct costs and indirect costs, as illustrated in the box below.

Brief welfare economic cost assessment "check-list"

Direct cost

- Administrative cost
- Investment cost
- Operating and maintenance cost

Indirect cost

- Losses and gain of revenue in affected productive sectors
- Losses and gains to citizens welfare (value of environmental and social impacts)

Direct costs are those that accrue as a direct consequence of the measure introduced. In many cases, there will be some additional administrative costs associated with a measure. This is a direct cost. Another direct cost is the investment cost in case the measure entails the installation of new equipment. Direct costs may also be associated with operating and maintaining e.g. new equipment.

Indirect costs are costs relating to the impact of the measure. If the measure is some form of restriction on commercial fishing, there may be a loss of production. Similarly, if recreational fishing is restricted, it would entail a reduction in the perceived welfare of citizens who enjoy angling.

Table 5.3 Sectors that may endure welfare economic costs or reap benefits

Key sectors affected by the degradation or improvement of the of the marine environment	How they are affected negatively (costs)	How they are affected positively (benefits)
Public sector - State - Local Government	Increased administrative cost New investment cost New operating and maintenance cost	Less administrative cost Less operating and maintenance costs
Industry - Fisheries, aquaculture, fish processing - Port, shipping, ship-building - Oil and Gas production - Dredging - sand and gravel - Tourism and coastal development - other	increased administrative cost New investment cost New operating and maintenance cost Loss of revenue	Less administrative cost Less operating and maintenance costs Gain in revenue
Citizens - Nationals - In other countries	Reduction in welfare	Increase in welfare

Table 5.3 provides an overview of the types of cost to be included in a welfare-economic cost estimation. It is important to note the types of costs that are not included. These include the category of transfers, which is a term used for exchange of funds within the economy. Such transfers do not represent creation or loss of value in society, but are transference of wealth from one sector or group of people to another. Examples of transfers that should not be included in the welfare-economic cost assessments are taxes, subsidies, compensations etc. Subsidies from abroad, such as EU subsidies, must, however, be included, since there is a national delimitation of the assessment. Net transfers into the economy from abroad constitute a gain to society.

Another type of economic effects to be excluded are those termed macro-economic effects, such as the effect on the trade balance and effects on the labour market. If the measures needed to adhere to the proposed marine policy are considerable enough to bring about such effects, they must be investigated in a macro-economic analysis, preferably using a general equilibrium model.

Distributional effects

Net transfers among the different groups within the economy can be of major relevance to decision-makers. If a particular industry or region in a country has to pay for the bulk of the cost associated with a new regulation that has distributional consequences. Such consequences can best be investigated in a supplementary financial budgetary assessment where all cost and transfers are included to give the full picture of the distributional effects. Such an assessment requires good knowledge of how each measure will be financed, which is often not the case at the

stage of a proposed directive. Various scenarios for financing can naturally be used to illustrate possible distributional consequences, but this will increase the number of scenarios further and add to the already lengthy list of assumptions made in order to make a cost estimate.

As a pragmatic approach, it is recommended to make a (qualitative) assessment of the distributional effects within the welfare-economic assessment. This can be done in the form of a result table indicating who will pay what and who will benefit in a given scenario. See Chapter 6.3 on the presentation of results for an example of such a table.

5.3 Assessing the benefits of the remedial measures

In relation to the welfare-economic assessment of the proposed MSD, the number of specific benefits that should be valued and included in the analyses is potentially quite high. It is a relatively important part of the assessment to list and describe all the significant benefits that can be identified from the national implementation of the proposed strategy. It may not be possible to value them all, given the complex and overlapping nature of marine environment. It should be attempted to quantify or in other ways assess the importance to society of each benefit.

The time horizon for the benefits should also be considered. If the strategy that is being assessed will provide benefits that in the baseline scenario would probably occur at a later date, this is important. Simply put, benefits that occur sooner have a higher value to society than the same benefits occurring at a later stage. In relation to the proposed MSD, the main benefits could be said to be the setting of a deadline for a number of commitments already made under other transnational agreements, but formerly without specific deadline and sanctioning possibilities in case of non-compliance.

For each of the benefits identified, its magnitude should be assessed compared to the commitments under the baseline scenario. It is important not contribute with more than the "fair share" of the benefit to the share of the benefit actually brought about by the proposed strategy.

Table 5.4 Examples of Benefits from reducing environmental pressures on the marine environment

Environmental pressure	Improvement in indicator of environmental state	Benefits to society (Impact)
Over-fishing	- Trends in abundance and distribution of selected species/commercial fish selected by ICES - Change in status of threatened species (Natura2000, Red List indicator under development) - Coverage of protected areas: Protection of endangered and declining species habitats/biotopes	- Significant benefit for conservation and enhancement of biological diversity and sustainable use of biodiversity - Prevention of irreversible decline of fisheries - Improved possibilities for recreational fishing Fisheries could also benefit significantly from the impact of the measures for the sustainability of fishing (although there may be time lags between the costs being incurred and the benefits realised).
Oil spills and illegal discharges	- Adequate response resources and arrangements are available in all sub-regions of the Baltic - Number of pollution accidents vs number of successful response operations - Number of illegal discharges - Number of oily birds - Beaches contaminated by oil (in km) - Abundance of marine litter - Amounts of waste delivered to ports compared to general shipping activities - Number of polluters found/convicted - Number of new introductions - Number of established species - Number of vessels implementing ballast water management according to IMO BW Convention	The benefit of reducing the risk of oil spills and illegal discharges can be termed as probable avoided cost. In Denmark, the direct cost in case of oil spills (of 400 tonnes of oil) has been estimated to 50 million DKK. This is however only the direct cost of cleaning up and avoided cost to the shipping sector. The effects on other business sectors such as tourism and commercial fishing are not included in this estimate. - Potential, avoided clean-up cost - Potential, avoided cost to shipping sector: Loss of cargo (oil), repair or replacement cost of ships, loss of revenue in while in shipyard - Potential, avoided cost to affected sectors such as tourism, aquaculture and fishing The environmental benefit of avoiding both oil spills and illegal discharges are mainly: - Environmental benefits to the environment from reduced number of discharges in the open seas - potential aesthetic benefit from reduced damage to coasts Since large oil spills are very eye-catching and thus get relatively high media attention, it can be assumed the many citizens have a strong preference against these incidents. The damage of the affected wildlife and the aesthetic and physical effects at sea and particularly on coasts are generally highly unwanted by citizens. This may however, not correspond to the relative ecological damage.
Hazardous substances	- Mercury, lead, cadmium, zinc, lindane, - PCB, dioxins, PBDE, PFOs, PAH - Possibly selected species for contamination control (herring, cod, blue mussel and others)	The principle benefits from reduction or elimination of discharges of hazardous substance to the marine environment are - improved water quality - protection and enhancement of the marine ecosystems, and wildlife and their predators up the food chain Since the full risks of many of the hazardous substances are not known today, it is not possible to fully assess the benefits. Substances that are persistent, bioaccumulative and toxic may accumulate and travel long distances. They may affect the immune and reproduction systems of biota. These risk factors can be summed up to: - Reduction of risk to the environment - Precautionary approach Some substances (e.g. PAHs) generally occur with other substances and the reduction of the discharges of these will have the benefit that the emission of other substances are also abated. - Side-effect in reduction in other unidentified, potentially harmful substances Finally, the environmental regulation may lead to the development of safe substitutes that could have other uses.

Sources: Oil spills and illegal discharges: COWI (2002), Søfartsstyrelsen og Farvandsvæsenet, Risikovurdering af sejlandssikkerhed i de danske farvande (Risk assessment of maritime safety in the Danish waters) Hazardous substances: DEFRA (2002), Regulatory Impacts Assessment of a priority list of substances under the article 16 of the WFD.

Regarding fishing, it should be noted that the recovery of stocks may not be achievable in some areas. The Partial Impact Assessment from the UK points out that the restoration of marine ecosystems may not be feasible even with extensive further measures extending beyond the current measures (RPA and ABPmer 2005a, Annex B). This should be taken into consideration when assessing these types of benefits.

5.3.1 Valuation of non-priced benefits or losses

In table 5.3, the last row gives instructions for cost-estimation of the change in citizen's "welfare". As already mentioned, the basic principle is that this constitutes a gain or loss to society and that it should somehow be represented in the welfare-economic assessment. The yard-stick used to measure the welfare is money, as it represents value to society in the welfare-economic analysis. What citizens are willing to pay for a good is taken as an expression of what they are willing to sacrifice in order to obtain this improvement. The practice is termed valuation, and various techniques can be applied to extract the welfare-economic value of "non-marketed or non-priced goods". These goods can be improved health, aesthetic improvements, noise reduction, etc.

There are two basic approaches to valuation of benefits; the revealed preference approach and the stated preference approach. The revealed preference approach covers various techniques of estimating a value from goods that people are willing to pay for, - and where the goods to be valued are in some way related to each other. The stated preference approach entails asking people more directly about what they would pay in a hypothetical situation where the improvements are brought about. There are many technical questions that have to be taken into consideration in order to obtain valuation estimates that are concise and usable in an economic analysis. However, databases and scientifically published papers constitute a growing source of creditable estimates for various non-marketed goods.

Examples of relevant literature on valuation of benefits of the type that are in focus in the MSD are a number of published articles on the value of improved water quality in the Baltic Sea. These include Gren, I.-M., Söderqvist, T., Wulff, F. (1997), Markowska, A. & Zylicz, T. (1999); Söderqvist, T. (1996); Söderqvist, T. & Scharin, H. (2000); and Turner, R. K., Georgiou, S., Gren, I.-M., Wulff, F., Barrett, S., Söderqvist, T., Bateman, I. J., Folke, C., Langaas, S., Zylicz, T., Mäler, K.-G., Markowska, A. (1999).

A Danish literature study of benefit estimates for reduction of nutrient emissions to water is also a good reference point for assessment of this type of benefits: Pedersen, A. B. (2003).²⁷

²⁷ <http://www.mst.dk/udgiv/publikationer/2003/87-7972-726-3/pdf/87-7972-727-1.pdf>

5.4 Assessing the total net cost of the proposed policy

The identification, assessment and possible valuation of the main impacts on society following the alternative scenarios of MSD should result in an assessment of the total net costs.

In general, this may be done in terms of cost-effectiveness or a cost-benefit assessment.

5.4.1 Assessment of cost-effectiveness (CEA)

The cost-effectiveness of an initiative expresses the costs of achieving a certain (environmental) benefit. In the present case, it provides an assessment of the costs of achieving the environmental state of compliance with the MSD given the interpretations set up in the scenarios. In the case where the environmental benefit can be quantified in terms of a unique indicator expressing the environmental benefit, a cost-effectiveness ratio can be presented, expressing the costs per unit of environmental benefit. This method is often used in connection with CO₂-reducing initiatives where the initiatives are assessed in terms of their costs per tonne of CO₂ reduced (also termed the CO₂ shadow price).

In general, the cost-effectiveness approach is very suited for identifying the least cost option or package of options of complying with a certain environmental demand. It, however, lacks the ability of answering the question of whether a demand for a certain environmental improvement is beneficial seen from a total welfare-economic point of view. For this purpose a cost-benefit approach is needed.

Cost-effectiveness is a key concept in most of EU's environmental policies. In the Water Framework Directive, the focus in the economic analyses is very much on determining the "most cost-effective combination of measures". It is a sound principle that whenever possible, the most cost-effective packages of alternative measures should be chosen. It can be assumed that this economic precondition will be applicable with regard to the marine strategies.

5.4.2 Assessment of cost/benefit (CBA)

The basic principle of a cost/benefit assessment is weighing cost and benefits against each other to analyse whether and under what conditions the initiative or implementation strategy will provide society with net gain or loss in a welfare-economic sense.

The CBA may be seen as preferable since it includes a higher information level than the CEA. The drawback of the CBA approach is, however, that it requires substantial information on the environmental im-

pacts, since these are to be transformed into an impact on welfare that can somehow be compared with the financial impact and other impacts.

Whether to use a CEA approach or a CBA approach thus depends on the questions to be answered by the assessment. There may be a tendency towards employing the CEA approach to overcome the obstacle of welfare-economic assessment of the environmental benefits. But this is not a valid reason. Instead, a feasible way of assessing environmental benefits must be found, normally being of a rather qualitative character. This, however, creates need for very systematic comparisons of costs and benefits to conclude whether and under what conditions the initiative results in net gains or losses to society.

5.5 Interpreting and presenting the results

The presentation and interpretation of the results constitute the final step in the analysis within its own right.

First, ample consideration should be given to presenting the scenarios that have been analysed, and for which reason. This will form the basis for the interpretation of the results. Further, it is important to provide a relatively high degree of detail in the presentation, especially given the presence of uncertainty and thus the high number of assumptions made in the process of producing the cost estimates. Especially the benefit side is complex, and it is likely that it is not possible to quantify and value all benefits. They must therefore be described in qualitative terms. Another important issue to be on top of the agenda when presenting the results is the political interest in the distributional effects. Which sectors in the economy will bear the potential cost and who can be expected to reap which benefits from the proposed strategy? The cost should be attempted to be distributed on sectors, such as the public sector, the industrial sectors (or industries as a whole) and citizens. Other groups in society can be of political relevance. This could be regions such as coastal areas, small islands or a particular region with high unemployment rates. The effects on such societal groups must be assessed separately as there is always the risk of double-counting both costs and benefits as the groups may be overlapping.

It is suggested that a simple table of the total cost and benefits of the scenarios be supplemented by a table distribution the cost on sectors in the economy. Table 5.5 below is an example of such a table.

5.5 Examples of presentation of total annual cost of Alternative Scenario 1 (MSD) compared to the Baseline scenario (Business as usual), distributed on sectors

Key sectors affected by the degradation or improvement of the of the marine environment	Cost	Benefit	Net cost
Public sector - State - Local Government	<i>Medium administrative cost to state (XXX EURO) low cost to local, government</i>		
Industry - Fisheries - Oil and Gas extraction - Dredging - sand and gravel - Tourism and coastal development - other	<i>Potentially very high cost to fisheries (XXX X EURO)</i>	<i>Potentially high benefits to fisheries from sustainable fishing, but highly uncertain impact.</i>	<i>For fisheries the costs are assessed to exceed the benefits in the short run, but the benefits may exceed the cost in the long run (30 years +)</i>
Citizens* - Nationals - In other countries		<i>Improved marine water quality has recreational value, and existence value</i>	

Note: The "results" given in the table are only illustrative examples. *) There is a risk of double-counting cost to citizens and industry, if it is not clearly envisioned what cost could be passed on to consumers etc.

Another important part of the presentation of the result is an overview and discussion of the uncertainties inherent in the assessment. This should be done in such a way that the impact on the result of each of the separate assumptions can be understood. Key factors in the results should be brought forward and discussed in connection with the final results, and critical values should be tested for their relative impact on the assessment of the costs and benefits. A sensitivity table is a good way of giving an overview of the critical values and assumptions. Table 5.6 is an example of such a table.

Table 5.6 Example of result table for sensitivity analysis of the results

Critical factor	Scenario 1 (MSD) Change in total NPV (EURO)	Scenario 1 (MSD) Change in % of total cost
Technical assumptions: - Discount rate +/- 2% - Discount rate +/- 4% - Time horizon +XX years	+/- XXX EURO	+/- XX %
- Investment cost in off shore sector underestimated by XX % - Investment cost off shore sector overestimated by XX %	+/- XXX EURO	+/- XX %
- Cost to fisheries underestimated by XX % - Cost to fisheries overestimated by XX % - Benefits to fisheries underestimated by XX % - Benefits to fisheries overestimated by XX %	+/- XXX EURO	+/- XX %
etc.		

It should be noted as a final remark that all factors can be critical and/or uncertain and that both issues should be investigated separately. A final conclusion can then be drawn with the lessons learnt in the sensitivity analysis.

5.6 Checklist

- ✓ The general calculation method has been defined and clearly stated.
- ✓ The costs of the individual measures in the alternative scenarios have been calculated using unit prices for partial effects and economic modelling estimates for measures with significant potential effects for the national economy.
- ✓ The benefits of the remedial measures to various sectors and the economy as a whole have been assessed. If possible, the benefits are quantified and valued. If the incremental approach to scenario analysis was chosen in step 2, only the incremental benefits are isolated, so as to not count benefits achieved through other strategies.
- ✓ The total cost of the alternative scenario(s) has been estimated and compared to the total benefit assessment.

- √ The cost and benefits have been assessed for a number of politically relevant sectors and groups in the economy.
- √ Sensitivity analyses have been carried out, so that it is clear to the reader what assumptions are uncertain and how critical they are to the result.

The results have been presented in overview tables listing all relevant assumptions and uncertainties. A clear verbal conclusion has been given on the potential cost and benefits to the national/local economy of the proposed strategy.

6. Recommendations for further development of methods and tools

On developing these methods and tools, a number of issues have appeared, to which the Nordic Countries need to pay special attention when making an economic assessment. The following recommendations are particularly aimed at facilitating the process faced by the Nordic countries.

The research behind this report and the drawing up of the report itself were carried out over a relatively short time span in order for it to be ready in time for the negotiations on the proposed Marine Strategy Directive. In order to facilitate the process of making national economic assessments, the handbook contains an evaluation of the sectors and environmental pressures likely to be in focus. As an economic assessment at the stage of a proposed Directive should - and can - only be a preliminary estimation of potential cost, the proportion of the analyses must be accordingly. Judgment must be exercised to identify where the proposed strategy represents the most distinctive departure from the business-as-usual procedure. At the same time, such judgment will depend on an interpretation of the current legal practice and political commitment to conventions and transnational agreements already in place. The way in which the individual Nordic countries view the proposed MSD in terms of the ensuing need for action could be explored further outside the scope of this handbook. Central policy-makers and practitioners could be interviewed to obtain an indication how the MSD is most likely to be implemented in the Nordic countries and to receive stronger pointers on the likely costs of the Directive.

The interrelation with the Water Framework Directive, the Maritime Strategy and other overlapping legislation could also be investigated further to better guide the delimitation of the economic analyses.

Three sectors were selected for focus on examples of economic unit-cost of remedial measures in this handbook. It was only possible to give a few concrete examples of the costs of a limited number of unit prices within the scope of this study. Setting up a larger catalogue of unit prices of relevant measures could be very helpful in making the economic analysis in this area. Especially measures in the oil and gas sectors are not well-covered by economic cost data today. In the case of fisheries, it seems that unit costing is not the appropriate basis for economic analysis. The potential effects on this sector could very well be substantial, and a

partial analysis of this sector is therefore not appropriate. In addition, the ecological complexity of forecasting the impact of profoundly changing fisheries regulations is not easily understood and deserves separate scientific assessment.

Finally, the identification of the implementation gap - that is the need for action compared to the situation without the Directive - is pivotal to the economic assessment. In fact, it is a very informative, but difficult sub-result in the assessment as it interprets the Directive and sets up a likely scenario for national implementation. The proposed Directive is not specific in the definition of the target as is also the case with e.g. the Water Framework Directive. Further, the status of the marine environment cannot be measured on one scale, but only using a variety of ecological and other indicators. In sum, the implementation gap is not easily identified. In this handbook a number of indicators are presented with reference to the literature and institutions that have the expertise and knowledge in this field. The pragmatic recommendation at the stage of the proposal of the directive is to define a scenario of the implementation gap on a somewhat incomplete foundation with regard to specification of the environmental target. More detailed guidance for ecological and biological assessment of the need for action could be developed and would be instructive given the complexity of the marine environment.

References

- Berglann, Helge (2006), Non linear Taxes in Resource Management and Pollution Control. The degree doctorerum politicarum. University of Bergen, Norway. ISBN 82-308-0098-7
- Cabinet Office - Regulatory Impact Unit (2005), Transposition guide: how to implement European directives effectively, UK
- Caddy, J.M. and Agnew D.J (2003), Recovery plans for depleted fish stocks: an overview of global experience. ICES CM 2003 Documents, <http://www.ices.dk/products/CMdocs/2003/CM2003.PDF>
- Commission of the European Communities (2005), *Annex to the Communication from the Commission to the Council and the European Parliament. Thematic Strategy on the Protection and Conservation of the Marine Environment and Proposal for Marine Strategy Directive Impact Assessment.* {COM(2005) 504 + 505 final}
- COWI (2002), Søfartsstyrelsen og Farvandsvæsenet: Risikovurdering af sejlandssikkerhed I de danske farvande (Risk assessment of maritime safety in the Danish water)
- Ellermann, T., Hertel, O., Hovmand, M.F., Kemp, K. and Skjøth, C.A. (2001), Atmosfærisk deposition 2000. NOVA 2003. Danmarks Miljøundersøgelser. NERI report No.: 374
- European Environmental Agency (1999), Environmental indicators: Typology and overview, Technical report No 25, Edith Smeets and Rob Weterings, Copenhagen, 1999
- Finansdepartementet (Norway) (2005): Veileder i samfunnsøkonomiske analyser.
- Finansministeriet (Denmark) (1999): Vejledning i samfunnsøkonomiske konsekvensvurderinger.
- Fiskeriverket (2006), Effekterna av utflyttad trålgräns på fisk och bottenfauna. Analys av ökad användning av passiva redskap innanför trålgränsen samt de ekonomiska konsekvenserna för näringen.
- http://www.fiskeriverket.se/publikationer/ovr_publ/pdf/traalgraens_inkl_appendix060307.pdf
- Gezelius, S.S. (2002), Do Norms Count? State Regulation and Compliance in a Norwegian Fishing Community. *Acta Sociologica*, 45(4): 305-314.
- Gren, I.-M., Söderqvist, T., Wulff, F. (1997), Nutrient Reductions to the Baltic Sea: Ecology, Costs and Benefits. *Journal of Environmental Management* 51:123-43
- HELCOM (2006a) HELCOM Baltic Sea Action Plan (2006): Biodiversity and Nature Protection in the Baltic Sea; Draft Thematic Assessment in 2006
- HELCOM Baltic Sea Action Plan (2006b), HELCOM Ecological Objectives for an Ecosystem Approach
- HELCOM Baltic Sea Action Plan (2006c), HELCOM biodiversity thematic assessment
- HELCOM Baltic Sea Action Plan (2006d), HELCOM Eutrophication
- HELCOM Baltic Sea Action Plan (2006e), Marine Transport; Draft Thematic Assessment in 2006
- Hopkins, C.C.E. (2001) Actual and potential effects of introduced marine organisms in Norwegian waters, including Svalbard. Research report 2001-1, Directorate for Nature Management
- ICES Advice 2005 (2005): Report of the ICES Advisory Committee on Fishery Management, Advisory Committee on the Marine Environment and Advisory Committee on Ecosystems, 2005, Volume 1
- IEEP (2000), A Shadow Action Plan for Biodiversity in Fisheries. Institute for European Environmental Policy
- Jensen, C. L. and Aarset, B. (forthcoming), Explaining non-compliance in the Norwegian coastal cod fishery: an application of the multinomial logit. *Applied Economics*

- Lotze, H.K., Lenihan, H.S., Bourque B.J., Bradbury R.H., Cooke R.G., Kay M.C., Kidwell S.M., Kirby M.X., Peterson C.H., Jackson JBC (2006), Depletion, Degradation, and Recovery Potential of Estuaries and Coastal Seas. *Science* 312: 1806-1809
- Maoiléidigh N. Ó, Legault, C., Amiro, P., Erkinaro J., and Chaput G., Long and Short Term Recovery Trajectories from Stock Rebuilding Programmes for North Atlantic and Baltic Salmon Stocks. ICES CM 2003 Documents, <http://www.ices.dk/products/CMdocs/2003/CM2003.PDF>
- Markowska, A. & Zylicz, T. (1999), Costing an international public good: the case of the Baltic Sea. *Ecological Economics* 30(2):301-16
- Møller et al. (2000), Samfundsøkonomisk vurdering af miljøprojekter, Miljø- og Energiministeriet (Denmark)
- Nielsen, U., Lerche, D.B., Kjellingbo, P.M., Jeppesen, L.M. (2006), Getting Proportions Right - How far should EU impact assessments go?, IMV Institut for Miljøvurdering /Environmental Assessment Institute, Copenhagen.
- OSPAR Commission (2005), Discharges, Spills and Emissions from Offshore Installations in 2003
- Pedersen, A.B. (2003). Økonomisk værdisætning af spildevandsemissioner af nitrogen, fosfor og organisk stof. Et litteraturstudie. Miljøprojekt Nr. 821 2003, DMU (NERI)
- RPA & ABPmer (2005a), Regulatory Impact Assessment for the European Marine Thematic Strategy and the Proposed Marine Strategy Directive. Partial RIA, prepared for Defra, UK, November 2005.
- RPA & ABPmer (2005b), Regulatory Impact Assessment for the European Marine Thematic Strategy and the Proposed Marine Strategy Directive. Evaluation of the European Commission Impact Assessment, prepared for Defra, UK, October 2005.
- SIK, Kalkylvärlden och kalkylmetoder (ASEK), SIK PM, 2005:16.
- Söderqvist, T. (1996), Contingent Valuation of a Less Eutrophicated Baltic Sea. Beijer Discussion Paper 88. Beijer International Institute of Ecological Economics.
- Söderqvist, T. & Scharin, H. (2000), The Regional Willingness to Pay for a Reduced Eutrophication in the Stockholm Archipelago. Beijer Discussion Paper 128. Beijer International Institute of Ecological Economics.
- TemaNord 2006:540, Økonomien i de nordiske fiskerier - Fokus på resourcerenten (The Economics of the Nordic Fisheries - Focus on Resource Rent), ISBN 92-893-1347-1, <http://www.norden.org/webb/news/news.asp?lang=6&id=6254>
- Turner, R. K., Georgiou, S., Gren, I.-M., Wulff, F., Barrett, S., Söderqvist, T., Bateman, I. J., Folke, C., Langaas, S., Zylicz, T., Mäler, K.-G., Markowska, A. (1999), Managing nutrient fluxes and pollution in the Baltic: an interdisciplinary simulation study. *Ecological Economics* 30:333-52

Appendix 1: Examples of estimation of unit-cost in selected sectors

In this appendix a number of relevant unit prices/other economic parameters for selected sectors are presented: The sectors are; maritime transport, and fisheries. The cost are presented in a table, where the financial and welfare economic investment cost, operating and maintenance cost and administrative cost are shown. The investment cost can then be annualised using the technical lifetime and the chosen discount rate.

The total annual cost can be calculated as follows, if there is both an one-off investment cost, annual operating and maintenance cost and possibility net revenues (the sum of loss and gain in revenue), and environmental cost:

$$ATC = \frac{(IC \cdot r)}{(1 - (1 + r)^{-L})} + AOC + AMC - ANR + AEC$$

ATC: Annual Total Cost

IC: Investment Cost

r: interest rate (in number, not percentage)

L: Technical Lifetime of investment

AOC: Annual Operating Cost

AMC: Annual Maintenance Cost

ANR: Annual Net Revenue

AEC: Annual Environmental Cost

Maritime transport

Hazardous substances

Approximate unit-cost for measures regarding marine sediments containing TBT from anti-fouling paint on ships, financial cost (EURO)

Measure	Removal and deposition on land
Unit	m ³ sediment
Annual Total Cost (EUR/unit) minimum estimate	9
Annual Total Cost (EUR/unit) maximum estimate	64

Source: COWI, Note: DKK / EURO rate of 7.4 used

Measure: Removal and deposition on land

TBT is a hazardous substance, and the cost of prohibiting marine disposal of dredged TBT-contaminated sediments and instead depositing the sediments on land is given here.

The differences in the prices for marine disposal and disposal on land is around 9 - 64 EURO/m³ sediment depending on the marine disposal technique (controlled or uncontrolled) and the kind of disposal facility on land (disposal area ("spulefelt"), landfill etc.).²⁸ The cost estimates are unit costs that include both marginal investment cost and operation and maintenance cost, since the source does not specify the distribution on these categories.²⁹

This estimate have been used in calculation of the extra cost in connection with a Danish Strategy, and the cost will vary between the Nordic Countries according to the financial and welfare economic cost of disposal, an the nationally available disposal option. It is therefore hard to give a generic unit cost estimate for this measure.

²⁸ Klapping - konsekvenser af ændring af klappingsstrategi med indførelse af koncentrationsgrænse og øvre mængdegrænse. Note prepared by COWI for DEPA, November 2004. Document no.: 59129-A-1 rev. 01.

²⁹ This means that the scrap value are not included in the estimation.

Approximate unit-cost for substitution of cadmium in sacrificial zinc anodes, financial cost (EURO)

Measure	substitution of cadmium in sacrificial zinc anodes
Unit	kg
Administrative cost	-
Technical lifetime (years)	-
Investment cost (EUR/unit)	10% increase in cost compared to zinc anodes
Annual operating and maintenance cost (EUR/Unit)	0
Loss in production value	Functionality unchanged

Source: COWI, Note: DKK / EURO rate of 7.4 used

Measure: Substitution of cadmium in sacrificial zinc anodes

This can be achieved by substituting the zinc anodes with aluminium or indium-based anodes, which is technically possible and will mean little or no loss of quality or functionality of the anodes. In fact, the market for sacrificial anodes is already dominated by aluminium anodes.

The main use of anodes is on boats. On small boats and yachts the typical amount of anodes is 0.5 to 10 kg per boat. On larger ships and fishing vessels that typical amount is 50 to 2000 kg. For the remaining underwater uses such as floodgates, gutters at seawater intakes, and protection of steel constructions in brackish water and pipelines the amounts used are all quite small and very difficult to estimate.

There is an added financial cost of production of aluminium or indium anodes compared to zinc anodes. The additional cost of indium-based zinc anodes is roughly estimated at around 10 % if whole production facilities are rearranged to the use of this metal. It should, however, be noted that this is a highly uncertain preliminary estimate.

Oil spills and illegal discharges**Approximate cost for measures regarding widening or deepening of shipping lanes, financial cost (EURO, 2001-prices)**

Example of Measure	Investment cost	Life time years	Operating and maintenance cost
Wider shipping lane - Drogden (Denmark)	47	50	0.04
Deeper shipping lane - Hatter skrårate (Denmark)	34	50	0

Source: COWI (2002) Note: DKK / EURO rate of 7.4 used.

Approximate unit-cost per m3 of excavated material, widening or deepening of shipping lanes, financial cost (EURO, 2001-prices)

Types of material	Cost of excavation and depositing Cost / m ³
Silting	2.0 - 2.7
Sand	2.4 - 3.4
Clay and pebble	6.1 - 7.4

Source: COWI (2002), Note: DKK / EURO rate of 7.4 used.

Measure: Widening or deepening of shipping lanes

Above are given two examples from a Danish study from 2002 on the most cost-effective measures to reduce the risk of accidental oil spills from ships in the Danish straits. Widening and deepening of shipping lanes was selected as some of the most cost effective measures, particularly the two examples Drogden and Hatter skråroute. The investments cost are substantial, but there is a long life time and low/none O&M cost.

The investment cost is made up of the cost of excavating the seabed and depositing the material. The second table above give the unit prices for three different types of material; silting, sand, and clay and pebbles. Note that the cost estimates are based on an assumption that the material can be deposited within a moderate distance (15 nautical miles).

Approximate cost for measures regarding VTS, financial cost (Million EURO, 2001-prices)

Example of Measure	Investment cost	Life time years	Operating and maintenance cost
VTS Drogden (Denmark)	0.9	10	1.1
VTS Hatter (Denmark)	1.1	10	1.2
VTS Sundet Nord (Sweden/Denmark)	2.7	10	1.4

Source: COWI (2002) Note: DKK / EURO rate of 7.4 used.

Approximate unit-cost of components for VTS, financial cost (Million EURO, 2001-prices)

Types of material	full time staff required	Investment cost
Diameter (45-50 km)	17	1.0 - 1.1
Two radars	12	0.6
Three radars	16	2.8
Route (Type of VTS)	13	6.1

Source: VTS World 97 in COWI (2002), Note: DKK / EURO rate of 7.4 used.

Measure: Vessel Traffic Service (VTS)

Vessel Traffic Service can be comprised of a number of instruments, but commonly in entails the introduction or extension of surveillance and reporting of ships, and information (and counselling) to ships. The VTS centre can be with or without a vessel, and can be on land or floating.

Generally the cost of the measure will vary greatly depending of the geographical area in question. This will determine the technical need of the centre. Costs that should be considerate are:

Investment cost	• Number and type of radars, cameras, direction finders, aerisals • Software (degree of integration) • Buildings • Terrain • Change of buoyage, charts
Operating and maintenance cost	• Staff (number of consoles times 6) • Maintenance • Future development of software etc. • Rent, utility charges

The three examples of VTS centres are based partly on the unit-cost from the international study (VTS World 97) shown in the second table above, and partly on past, regional experience. A VTS centre at Drodgen is assessed to need two radars, a TV/IR camera, a direction finder, and a staff of 13 (twelve for operating the consoles plus one manager). The radius is close to 45 km. A VTS centre at Hatter would be similar, but new building would have to be built and the projecting would be more extensive. A VTS at Sundet Nord would be join Swedish and Danish measure. This would probably mean extra cost to trans-national coordination. The technical specifications are: 2-3 radars, land based centre, direction finder and TV/IR cameras, and microlink for transmission of signals.

VTS on land has been evaluated as one of the most cost-effective measures in Danish waters (COWI 2002).

Fisheries

Over-fishing

Unit-costing is not the appropriate basis for economic analysis of the cost of the measures in fishing. The potential effects on this sector could well be substantial and partial analysis of this sector is therefore not appropriate.

A new report from July 2006 about the economics and resources of the Nordic fisheries industry "The Economics of the Nordic Fisheries - Focus on Resource Rent" spotlights the macroeconomics of specially selected parts of the industry in the Region.³⁰ This report can be used as a reference for both methodology and examples of economic cost-estimates. The methodology used in the analysis is centred on the concept of resource rent. The report defines resource rent as "the profit remaining after capital and labour costs equivalent to those paid in other industries".

³⁰ TemaNord 2006:540, ISBN 92-893-1347-1
<http://www.norden.org/webb/news/news.asp?lang=6&id=6254>

The report concentrates on regulations designed to guarantee greater and more sustainable economic benefits, including who gains financially and how the benefits are divided up between the industry itself and the public sector.

The case studies in the report are: 1) Icelandic trawlers, which are regulated by means of individually transferable quotas, 2) Norwegian coastal fishing, which is regulated by means of individual non-transferable quotas, 3) Faroese trawling in pairs, which is regulated by means of days at sea, 4) Swedish shoal fishing, which is regulated by means of rations, and 5) Danish mussel fishing, which is regulated by means of licenses.

Regarding cost and effect estimation of economic remedial measures such as taxes, relevant work includes Norwegian research at NILF (Norwegian Agricultural Economics Research Institute / Norsk institutt for landbruksøkonomisk forskning) and University of Bergen.³¹ Another relevant reference is to recent research into explaining non-compliance in the fishery.³²

Also in Norway, a recent study from Fiskeriverket looks at extending the boundaries for trawling in order to reduce over-fishing and the damage to bottom fauna. The report "Effekterna av utflyttad trålgräns på fisk och bottenfauna. Analys av ökad användning av passiva redskap innanför trålgränsen samt de ekonomiska konsekvenserna för näringen" gives the results of analyses of both the environmental effect and the potential economic effect on the fishing sector.³³

³¹ See for example Gezelius, S.S.(2002) or Berglann, Helge (2006)

³² See for example Jensen, C. L. and Aarset, B. (forthcoming)

³³ http://www.fiskeriverket.se/publikationer/ovr_publ/pdf/traalgraens_inkl_appendix060307.pdf