



Miljøministeriet  
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# Environmental classifications

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Må citeres med kildeangivelse.

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# Abbreviations and glossary

ABS	American Bureau of Shipping
ADEC	Alaska Department of Environmental Conservation
AFS	International Convention on the Control of Harmful Anti-fouling Systems on
Ballast water	Water carried for stability of the ship
Bilge water	Water that collects in the bottom of the ship often contaminated with oil
Black water	Wastewater from toilets and medical facilities
BSR	Business for social responsibility
BWMC	Ballast Water Management Convention
CCS	China Classification Society
CCWG	Clean Cargo Working Group
CEEMP	Company Energy Efficiency Plan
CSI	Clean Shipping Index
DNV	Det Norske Veritas
ECA	Emission Control Area
EEDI	Energy Efficiency Design Index
EEOI	Energy Efficiency Operation Index
EPS	Environmental Performance Survey
ESI	Environmental Ship Index
ESPIC	Environmental Ship Performance Indices and Concepts
GHGs	Greenhouse gases
GL	Germanischer Lloyd
Grey water	Wastewater from showers, sink, galleys, laundry facilities etc.
GTL	Gas to liquids
GWP	Global Warming Potential
HCFCs	Hydro chlorofluorocarbon
HFO	Heavy Fuel Oil
HKC	Hong Kong Convention
HNS	Hazardous and Noxious Substances
IHM	Inventory of Hazardous Materials
IMO	International Maritime Organization
LNG	Liquefied Natural Gas
LPG	Liquid Petroleum Gas
LR	Lloyd's Register
MARPOL 73/78	Maritime Pollution convention from 1973 with protocol in 1978.
NO <sub>x</sub>	Nitrogen oxide
ODP	Ozone depleting potential
ODS	Ozone depleting substances
OPRC	International Convention on Oil Pollution Preparedness, Response and Co-
PM	Particulate matter
RINA	Registro Italiano Navale (Classification society)
SCR	Selective Catalytic reduction
SEEMP	Shipping Energy Efficiency Management Plan
SO <sub>x</sub>	Sulphur oxides
TBT	Tributyltin
TMSA	Tanker Management Self Assessment

# Dansk resumé

Der eksisterer en række standarder til at klassificere skibe med hensyn til deres miljø- og klimamæssige præstationer. Dette notat vurderer deres anvendelighed og giver et forslag til et sæt kriterier, som også kan være relevante globalt.

I det seneste årti, og især i de seneste år, er en lang række miljø- og klima resultatvurdering standarder for skibe kommet frem. Nogle er meget omfattende, mens andre er begrænset til en udvalgt gruppe af skibe, fokuserer på bestemte områder eller emissioner. De fleste standarder er frivillige og drives af virksomheder eller organisationer. Nogle få er i hænderne på statslige myndigheder, og nogle af dem er obligatoriske, f.eks. den norske NOx-afgift, eller frivillige som Singapores Green Port program om SOx-emissioner.

En række indekser for miljø som Clean Shipping Index (CSI) eller Environmental Ship Index (ESI) er udviklet, og de fleste klassifikationsselskaber tilbyder også deres kunder mulighed for at opnå forskellige "grønne standarder", f.eks. Lloyds Register (LR), American Bureau of Standards (ABS), China Classification Society (CCS), Germanischer Lloyd (GL), Det Norske Veritas (DNV). De miljømæssige krav, der går ud over de eksisterende konventioner og regler er ofte ikke angivet med et kvantitativt kriterium. Kravet er typisk rettet mod eksistensen af en bestemt procedure eller udstyr.

Et system, der skal kunne fungere som en global standard, skal naturligvis være egnet til skibe, der opererer i et emissionskontrolområde, og dermed allerede opfylder strenge foranstaltninger vedrørende svovl, og formentlig indenfor en overskuelig fremtid også nitrogenoxider. I dette projekt er det valgt at gå ud over de eksisterende regelsæt ved f.eks. at kræve at eksisterende skibe overholder reglerne for nye skibe og gennemføre grænser for emissioner tidligere end hvad der er blevet vedtaget.

Den foreslåede standard består af et simpelt rangordningssystem på tre niveauer, som i vid udstrækning er baseret på informationer der er let tilgængelige, og for de fleste verificerbare i skibets certifikater. Der kan være to forskellige måder at bruge dette system: 1) at kræve at alle indikatorer skal overholde et vist niveau, før fartøjet kan godkendes til dette niveau, eller 2) at bedømme skibenes klima og miljøpræstationer ved at etablere en rangordning baseret på point. Det første giver skarpe adskillelser mellem niveauer og det andet en flydende overgang.

# Summary in English

An overview is provided of the existing mechanisms to classify ships with respect to their environmental and climate performance. This note assesses the applicability and discusses a proposal for a set of criteria, which may also be applicable globally.

Over the last decade and in particular during the most recent years a great number of environmental and climate performance assessment standards have emerged for ships. Some are all encompassing, whilst others are limited to a select group of vessels or focusing on specific areas or performance parameters. The majority of the standards are voluntary and operated by companies or organisations. A few are in the hands of governmental authorities and some of those are mandatory, such as the Norwegian NO<sub>x</sub> tax, or voluntary, such as Singapore's Green Port Programme on SO<sub>x</sub> emissions.

A number of environmental performance indices such as Clean Shipping Index (CSI) and the Environmental Ship Index (ESI) have been developed and most classification societies offer their clients the opportunity to obtain various "green standards", e.g. Lloyds Register (LR), American Bureau of Standards (ABS), China Classification Society (CCS), Germanischer Lloyd (GL), Det Norske Veritas (DNV). The environmental requirements that go beyond the existing conventions and regulations do often not specify a quantitative criteria, but the requirement is directed at the existence of a certain procedure or equipment.

A performance system, which may be applied as a global standard must obviously be suited for ships operating in an ECA and thus already complying with stringent measures on sulphur, and presumably nitrogen oxides as well, in a foreseeable future. In this project the way to go beyond the existing regulation has been to demand that existing ships comply with the rules for new ships and to implement limits of emissions earlier than what has been enacted.

The proposed standard consists of a simple three level ranking system largely based on information readily available, and for the most part verifiable in the ship's certificates. Two different ways of using this system are possible: 1) One way is to claim that all indicators have to comply with a certain level in order for the vessel to be certified for that level; 2) Another way to rate the vessels' climate and environmental performance under the same system is by a ranking score. The first option gives very stringent classes, and the second a more flexible transition between levels.

# 1. Introduction

This note provides an overview of the existing systems of classification of ships with respect to their environmental and climate performance. An assessment of their applicability is given and a proposal is advanced for a suitable set of criteria, which will also be applicable globally.

Over the last decade and in particular during the most recent years a great number of environmental and climate performance assessment standards have emerged for ships (for the purpose of this note termed Environmental Ship Performance Indices and Concepts (ESPICs)). Some are ubiquitous and quite comprehensive, while others are limited to a selected group of vessels or focusing on specific areas or performance parameters. The majority of the standards are voluntary and operated by companies or organisations. A few are in the hands of governmental authorities where some of those are mandatory, such as the Norwegian NO<sub>x</sub> tax, or voluntary, such as Singapore's Green Port Programme on SO<sub>x</sub> emissions. This study has its focus on environmental requirements that go beyond the existing conventions. However, it should be noted that many of the additional requirements in the available standards do not specify a quantitative value to aim for, but instead the approach can be procedural, e.g. relating to the existence of a garbage management plan, or the requirement can be "to do" or "not to do", e.g. no garbage overboard. It is emphasized that this note does not claim to be an exhaustive assessment of all available systems; the aim is to identify standards with general applicability regarding type of vessel, geographical area, and the range of pollutants included. Based on the assessed classification systems a proposal for a suitable Danish standard is given. This standard is created in such a way that it will also be applicable globally on the long run.

# 2. The baseline of existing regulations

## 2.1 MARPOL 73/78

The member states of the International Maritime Organization (IMO) have over the years agreed to articles, protocols, annexes and unified interpretations of the International Convention for the Prevention of Pollution from Ships (MARPOL), originally from 1973 and modified by the Protocol of 1978, in short form MARPOL 73/78. The six Annexes cover following areas:

Annex I: Regulations for the prevention of pollution by oil.

Annex II: Regulations for the control of pollution by noxious liquid substances in bulk.

Annex III: Regulations for the prevention of pollution by harmful substances carried by sea in packaged form.

Annex IV: Regulations for the prevention of pollution by sewage from ships.

Annex V: Regulations for the prevention of pollution by garbage from ships.

Annex VI: Regulations for the prevention of air pollution from ships.

There are a significant number of specific provisions relating to the area of applicability (e.g. within or outside of 12 nm offshore, in special areas, in ports etc.) and to the timing of the implementation as governed e.g. by the ship's year of built and size class.

## 2.2 Other relevant IMO conventions

There are other important conventions governing environmental issues including the International Convention on the Control of Harmful Anti-fouling Systems on Ships (AFS), the IMO Ballast Water management Convention (BWMC), the Hong Kong Convention for the Safe and Environmentally Sound Recycling of Ships (HKC) and the International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC) including its Protocol on hazardous and noxious substances (HNS). These conventions are in general applicable to all ships above a certain tonnage except for the BWMC, which has a somewhat complicated schedule of implementation related to the vessel's year of construction and ballast water capacity. Neither the BWMC nor the HKC has entered into force as of June 2013.

# 3. Environmental Ship Performance Indices and Concepts

It is the maritime authorities or the classification societies on their behalf that survey and certify that the ships meet the above-mentioned regulations. It is also the classification societies and in some cases other third parties, which certify that ships meet the Environmental Ship Performance Indices and Concepts (ESPIC), also where the standards go further than the current regulation with even stricter requirements. Many of the systems are operated by the classification societies and are applicable to ships across types or categories. Other standards e.g. the "Award or the Business for Social Responsibility (BSR) were developed only to tankers and container vessels, respectively, and yet others are delimited by pollutant or geographical area of applicability. Another widespread industry standard with a limited applicability is the Tanker Management Self Assessment (TMSA) scheme used in the crude oil trade. Most members of the International Association of Classification Societies (IACS) have developed "green notations", of which the most comprehensive ones are presented here. The classification societies Registro Italiano Navale (RINA), China Classification Society (CCS), Det Norske Veritas (DNV), American Bureau of Shipping (ABS) and Lloyd's Register EMEA (LR) have integrated the performance system with additional climate and environmental requirements for obtaining a "green" certificate. Table 1 provides an overview of some of the existing standards. The term "all inclusive standards" covers all vessels, all geographical areas and a broad range of pollutants while "delimited standards" concerns certain types of vessels, specific geographical areas or a limited range of pollutants. The requirements of some of the ESPICs that go beyond the MARPOL 73/78 and other environmental conventions are specified in details in Appendix 1.

TABLE 1: OVERVIEW OF ESPICs AND THEIR DELIMITATIONS.

All inclusive ESPICs		Delimited requirements	
All vessels, pollutants, areas	Vessel type	Pollutants	Area
LR, DNV, GL, RINA, ABS etc. all have "green" notations	BSR Green Award	EEDI* NOx tax	ECAs** Antarctica Treaty
CSI ESI	TMSA	Ports standards (typically SOx)	Ports standards

\*Energy Efficiency Design Index

\*\*Emission Control Areas

Going beyond the regulatory requirements and voluntarily invoke more stringent standards may be due to one or both of the following two reasons:

1. The shipping company has a "first mover" policy on additional stricter regulations in preparation of future demands.
2. The shipping company and its ships with a "green" certificate can gain access to transport buyers (shippers) that require the carrier to take environmental issues into account. Furthermore economic incentives such as reduced port fees may exist as well.

Different environmental performance indices such as Clean Shipping Index (CSI) and the Environmental Ship Index (ESI) have been developed, making it possible for ships to obtain a “green” ranking. In principle, this makes it transparent for transport buyers when comparing vessels and chose one according to environmental performance although the requirement of continuous improvement does present challenges for the ranking and comparison of ships. The mentioned indices are based on calculations concerning reductions of CO<sub>2</sub>, NO<sub>x</sub> and SO<sub>x</sub>, and how water and chemicals are managed. Water in this context includes black water (sewage), grey water (bilge water) and ballast water, and chemicals refer to antifouling paints, cleaning agents, stern tube oils, etc. Table 2 provides an overview of what pollution parameters the different ESPICs touch upon.

Other notable standards:

- The Energy Efficiency Design Index (EEDI), mandatory for new ships
- Shipping Energy Efficiency Management Plan (SEEMP), mandatory for existing ships

IMO has developed the Energy Efficiency Design Index (EEDI) as a technical measure to successively improve a ship’s efficiency and thereby a reduction in CO<sub>2</sub> emission. The index indicates the specific CO<sub>2</sub> emission per cargo capacity and distance sailed. The SEEMP and its company counterpart the Company Energy Efficiency Plan (CEEMP) are meant to act as guides for developing ship specific initiatives to improve energy efficiency with one of the potential measures, e.g. the Energy Efficiency Operation Index (EEOI). There are five major components of both SEEMP and CEEMP, which are: 1. Planning 2. Implementation 3. Monitoring 4. Self-evaluation 5. Improvement. The CEEMP is a broader management plan than SEEMP, incorporating all environmental measures of energy efficiency through the supply chain, including onshore and offshore suppliers plus subcontractors.

**TABLE 2: OVERVIEW OF MAIN SUPPLIERS OF ESPIC AND THE POLLUTION PARAMETERS INCLUDED.**

Pollution parameter	Organisation							
	RINA Green Plus	CSI	LR	ABS	CCS	GL	BSR CCWG	DNV
<b>Air pollution</b>								
CO <sub>2</sub>	+	+	+	+	+	+	+	+
SO <sub>x</sub>	+	+	+	+	+	+	+	+
NO <sub>x</sub>	+	+	+	+	+	+	+	+
Particulate Matter	+	+			+			
VOC			+	+	+	+		+
ODS	+		+	+		+		+
GWP substances	+		+	+		+		+
Cold Ironing	+			+				
Incinerators				+			+	+

Pollution parameter	Organisation							
	RINA Green Plus	CSI	LR	ABS	CCS	GL	BSR CCWG	DNV
<b>Sea pollution</b>								
Black water	+	+	+	+	+		+	+
Grey water	+				+			
Bilge water	+	+	+	+			+	+
Ballast water	+	+	+	+	+	+	+	+
Sea discharge: NLS <sup>1</sup>			+	+	+	+		
Harmful substances in packed form	+				+			
Operational pollution by oil			+	+	+			
Accidental oil pollution					+			
Sludge oil handling		+						
Garbage	+	+	+	+	+		+	+
Non-toxic anti-fouling paints	+		+	+	+		+	+
<b>Other measures</b>								
Scrapping policy	+	+	+	+	+		+	
Crew awareness		+					+	
Ship design/construction				+	+	+		
Fuel oil changeover <sup>2</sup>					+			
Noise and vibration	+				+			
SEEMP			+	+	+			
CEEMP				+			+	
Env. manager on board to prevent poll.	+			+				
EMS <sup>3</sup>							+	

<sup>1</sup> NLS: Noxious Liquid Substances

<sup>2</sup> Fuel changeover to Low Sulphur Fuel

<sup>3</sup> EMS: Environmental Management System

### **3.1 Ports and ship-owners focusing on environmental performance and differentiated fees in ports**

#### **3.1.1 The toolbox**

One way of speeding up the environmental performance of ships could be by introducing differentiated fees in ports. Ships with high environmental standards could foresee reduced ports fees, whereas ships with low environmental standards could foresee increased fees.

The fees would have to be based on a number of accessible parameters. And always on average values for the specific vessels, not on actual performance. Models like the Environmental Ship Index (ESI) or Clean Shipping Index (CSI) could be used by a number of foreign ports (and are in fact already in some ports).<sup>4</sup> In these models, environmental and climate performance are displayed in an easy accessible way.

Thereby the ports can decide whether the vessels is performing above or under a certain standard, and adjust the fees in accordance with this.

#### **3.1.2 The ship-owners' perspective**

A crucial element would be whether the ship-owners as such will be interested in taking part in such a system/classification. Based on findings regarding the earlier mentioned toolboxes, it seems that a number of lo/lo operators are currently taking part in this.

We have contacted the Danish Ship-owners Association and a large operator regarding this classification concept. They do see a number of possibilities, but on the other hand, they express some reluctance with respect to introducing such measures. A high degree of transparency regarding the performance of the system is requested, in order to keep the competitive balance between partners.

On the other hand, the ship-owners find themselves in a rather critical position due to the introduction of Sulphur Emission Control Areas (SECAs) in a number of waters from 1 January 2015. The requirements of using low sulphur fuels or alternatively the introduction of technologies<sup>5</sup> which can offset the negative impact connected with the use of high sulphur fuel on the environment, will play an important role in the in the next 15 months or so.

Initiatives carried out at sea and in ports reducing emissions but possibly also reducing costs at sea and in ports will surely be in focus. Based on the findings in the report from Trafikanalys<sup>6</sup>, the majority of ships in the Baltic SECA area will switch to low sulphur fuel in 2015.

This will result in an increase in actual cost with up to 64%.<sup>7</sup> We expect an increase of this size to lead to initiatives switching to other fuel types or installation of scrubbers. Such changes will have a positive impact on the emissions, both at sea and in ports.

In addition, regulation of port fees based on emission standards should therefore reflect these possible changes.

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A. <sup>4</sup> [www.cleanshippingindex.com](http://www.cleanshippingindex.com), <http://esi.wpci.nl>

B. <sup>5</sup> Scrubbers as the most likely alternative.

C. <sup>6</sup> Trafikanalys: Konsekvenserna av skärpta krav för svavelhalten i maritimt bränsle- delredovisng , Juli 2013.

D. <sup>7</sup> Trafikanalys p 42.

### 3.1.3 The perspective of ports

The Danish ports have different opinions of a differentiation of port fees.

The ports and their organization see opportunities in introducing such a system. However, they differ with respect to whether it should be compulsory for all ports (coordinated by the EU or IMO) and in which way it is to be controlled.

In contrast to this, Sweden has introduced a compulsory system as a part of their navigational concept (Färledsavgift). The system is controlled and managed by the Swedish Authorities (<http://www.sjofartsverket.se/sv/Om-oss/Ekonomi>).<sup>8</sup> The system brings around the necessary information concerning each vessel, based on information from classification societies. Onsite inspections are therefore not part of the concept.

In Denmark such a central system containing emission data for vessels does not exist, making it somewhat more difficult to introduce such systems here, without carrying out onsite inspections onboard the vessels.

As part of the Clean Baltic Sea Shipping concept<sup>9</sup>, initiatives applying schemes for environmentally differentiated port fees have been investigated. Based on the findings from a number of Swedish ports, systems with respect to how to differentiate the fees have been displayed. In general emissions of NOx, PM, noise and chemicals will be part of the system. Emissions of SOx are supposed to be regulated by SECA.

On the average, the reduction of port fees in Swedish ports are based on reduced emissions of NOx and SOx. The rebate is given based on the installation of e.g. scrubbers or SCR catalyst converters. Ships using LNG will also obtain a discount.

As an example to this, one can look into the discounts given by Port of Stockholm.<sup>10</sup> The sulphur rebate is up to 0,20 SEK/GT, when the sulphur content is less than 0,2. The nitric oxide rebate is 0,30 SEK/GT, when the content is less than 1 g/kWh.

These values are listed in the official records<sup>11</sup> and are therefore directly applicable to the ship when it calls at the port. No additional control is necessary.

Port of Gothenburg has introduced an even more comprehensive system. The system is based on an additional fee for ships using bunker with a sulphur content exceeding 0,5% in combination with a reduction for vessels using bunker with a sulphur content less than 0,1%.

On an annual basis, this shifts around 1 mio. EUR between the two categories of vessels, and it has reduced the emissions of SOx with app. 100 tons in the Gothenburg area.<sup>12</sup> When SECA is implemented in 2015, this system will be redundant, and new measures will have to be introduced.

### 3.1.4 Additional economic incentives

When looking at more incentives to reduce the emissions from ships, one could point to the use of power supply from land, soot particulate filters and similar measures.

Finally, the treatment of ballast water is an issue here as well. The EU funded project "Clean Air in Ports"<sup>13</sup>, focus on a broad diversity of possibilities focusing on cleaning the air in the commercial ports. The working paper "Clean Air in Ports"<sup>14</sup> lists even more opportunities.

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<sup>8</sup> It should be noted, that this system only have focus on emissions to air.

E. <sup>9</sup> Cleanship Task 4.6.

F. <sup>10</sup> [www.stockholmshamn.se](http://www.stockholmshamn.se).

G. <sup>11</sup> Färledsavgiften.

H. <sup>12</sup> Göteborgs hamn: Stöd till miljöansvarande rederier. 2013.

I. <sup>13</sup> NABU: Clean Air in Ports. 2012 and ongoing.

However, even though numerous projects take place in the ports, it seems that most ports are awaiting the effects of the SECA as well as the reactions from the ship-owners.

Therefore, additional economic incentives has to be in line with the ship-owners reactions. If it proves to be correct, that the operational costs will encounter substantial increases; economic incentives should help in keeping and even developing a competitive edge towards other transport modes.

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J. <sup>14</sup> NABU: Clean Air in Ports, Hamburg 2013.

# 4. Applicability of ESPICs

The classification systems available regarding ship's opportunities for environmental improvements beyond the regulations are often not directed at incremental improvements, but frequently utilize yes/no answers to assess the improved performance. This may include the existence of a company policy on a certain area with no actual assessment of a measurable performance indicator. In the following, focus is directed towards the incremental and quantitative indicators.

The implementation of pollution reduction is often governed by restrictions, which become effective at a certain date and in some cases for certain areas (ports, ECAs etc.). Going beyond existing regulation may thus be done by constructing incremental improvements where the implementation dates are pushed forward and the rules only concerning specific areas are made effective in other areas. An incremental system makes it possible for all ships to make a difference even though their current stage of environmental performance is poor. An advantage is that for many of the pollution parameters the "values" or indicator levels, which may be used for an incremental standard, are already agreed amongst IMO members. In general, the ESPICs offered from classification societies rate or rank the vessel in a quantitative manner. A tool as CSI is developed to all vessel types, but it should be noticed that the vessel score should not be compared across vessel types. The CSI system seems to be a reasonable tool to distinguish between vessels both for rewarding taxes and as a help to transport buyers to choose company. BSR CCWG also provides a score but is only developed for containers, while CSI concerns all ship types. The use of a multi-indicator system for more than one matrix (air, water and chemicals), such as the CSI and ESI, does represent a complication with respect to the "value" associated with each indicator, as opposed to systems known from other sectors with relatively few indicators solely related to emissions to air. The indicators and their susceptibility to quantification will be assessed, since the use of an ESPIC should be surveyed and certifiable.

It should be mentioned that several classification societies and other third parties are working on concepts for zero emission vessels. An example is the classification society Germanischer Lloyd (GL), which is currently working on a zero emission technology based on hydrogen fuel cells. This means that no CO<sub>2</sub>, NO<sub>x</sub>, SO<sub>x</sub> and very limited noise emissions will take place. This technology has been used since 2008 by a passenger ship "FCS Alsterwasser" in the river Alster in Hamburg's city in Germany (GL Group, 2008). However, the energy requirement of larger ferries, tugboats and port authority vessels is still too high and the use of fuel cells in marine navigation is mainly limited to auxiliary functions. The development of zero emission vessels may challenge the technologies and bring forward innovative solutions but are not included in the ESPIC in this study. The technologies developed for the zero emission vessels will prevent air pollution, but still the environmental impacts from scrapping together with sea pollution from ballast water, sewage, garbage and chemicals should be managed.

## 4.1 Measures beyond mandatory requirements

As already mentioned, this study has its focus on environmental requirements that go beyond the existing conventions. In the following additional measures regarding prevention of air pollution and sea pollution will be described together with technical methods that may be used to achieve the targets.

#### 4.1.1 Measures for prevention of air pollution

For prevention of air pollution, the selected EPCAS suggest different mechanisms or technologies to reduce the emissions and they set a quantitative goal for obtaining a “green” notification or certification. In general, the quantitative targets are as follows:

1. SO<sub>x</sub> emissions should not exceed 0.5% and in SECAs not more than 0.1%
2. NO<sub>x</sub> emissions should be in compliance with Tier II or III depending on vessel age
3. Refrigerant substances should have a GWP < 1650 and an Ozone depleting potential (ODP) equal to zero. The monthly leakage should be under 3%.
4. Substances used for fire fighting should have a GWP<1650 and ODP=0
5. Hydro chlorofluorocarbon (CFCs and HCFCs) are prohibited

The technical methods listed here are included in the ESPICs and may be used to meet the listed quantitative targets:

1. Gas to liquids (GTL) providing higher energy content than diesel
2. Blending fossil fuel with second-generation bio-fuels reducing CO<sub>2</sub> footprint
3. Dual-fuel engines running with LNG
4. Fossil fuel pre-treatment (e.g. water emulsions)
5. Modification in prime movers
6. Use of non-fossil fuels (e.g. sails, fuel cells, etc.)

GTL is a fuel type where natural gas has been converted to a liquid using a hydrocracking catalyst. It has higher energy content than diesel and therefore reduces the CO<sub>2</sub> emissions. Furthermore it reduces SO<sub>x</sub>, NO<sub>x</sub> and PM emissions. By blending fossil fuel with second-generation bio-fuels, the SO<sub>x</sub> emission will be reduced. Another aspect is the CO<sub>2</sub> reduction potential, which will depend on the bio-fuel source, since not all biofuels necessarily have a net CO<sub>2</sub> benefit. The dual-fuel engines running with LNG and a small amount of fuel oil allow the ship to select the best option to meet local requirements regarding CO<sub>2</sub>-, SO<sub>x</sub>-, NO<sub>x</sub>- and PM emissions. Pre-engine or In-engine treatment with water to comply with Tier II requirements will reduce the NO<sub>x</sub> emissions and the PM formation. To further reduce PM emissions, e.g. engine modifications and the common rail technology are in play. Other measures that will impact the air emissions are the restrictions in the use of GWP substances, shore based electricity, and supporting tools to assist the captain in keeping the most efficient sailing draft and trim. It should be emphasised that the chosen technology should not cause a significant rise in emissions of other pollutants or GHGs..

#### 4.1.2 Measures for prevention of sea pollution

For prevention of sea pollution no quantitative targets have been set, which complicates the actual improvements for the ships when a measure is taken into force. However, the measures should not be undervalued. In the following, items contributing to sea pollution are listed and the technologies and suggestions to prevent the pollution are mentioned. Following measures for prevention of sea pollution are included in several of the EPCAS and are suggested for a common standard:

1. Black water:
  - a. Advanced treatment plant on board as per ADEC Title XIV (33 CFR Part 159 Subpart E)<sup>15</sup>
  - b. Holding tank, high level alarms located at manned positions and sewage discharge recording book
2. Grey water:
  - a. Advanced treatment plant on board as per ADEC Title XIV (33 CFR Part 159 Subpart E)
  - b. Holding tank and grey water record book
3. Bilge water:
  - a. Bilge holding tank with facilities for delivery ashore
  - b. High level alarms located at manned positions and automatic stopping device when oil content exceeds 5ppm

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<sup>15</sup> This US regulation sets discharge standards for sewage and grey water from large cruise ships operating in the Alaska waters.

- c. Labels/colour codes in order to identify the different piping systems
- d. Biodegradable and low aquatic toxicity lube oil
- 4. Ballast water:
  - a. BWM system in accordance with resolution MEPC.174(58)
  - b. Ballast water exchange in mid-ocean
- 5. Garbage:
  - a. Management Plan for hazardous wastes: lamp bulbs, batteries, printer cartridges etc.
  - b. Separation into following categories: recyclables, non-recyclables, food waste, hazardous waste.
  - c. Recycling of plastic, aluminium, glass, paper-cardboard
- 6. Antifouling:
  - a. The hull antifouling paint should be without organotin compounds, i.e. existing TBT containing paint not just coated.

It should be noticed that in cases where the selected five classifications societies have different restrictions for the same item, the strictest measure has been recorded in the list above.

#### **4.1.3 Other indicators of pollution prevention**

Scrapping of vessels is another issue raised in the ESPIC and is linked to the policies on the identification, labelling and removal of hazardous materials on board during operation or on the final voyage. The actual environmental benefit is difficult to assess during the operational phase of the vessel, but this issue is typically included in the ESPIC. In some cases, awareness training and other programs to engage the crew in the environmental and climate performance are also awarded points or benefits in the “green” notations.

In order to develop a suitable Danish standard, a shortlist of measures beyond existing regulation is presented in Table 3 including the most important performance indicators regarding prevention of air – and sea pollution together with scrapping and awareness.

TABLE 3: SHORTLISTED MEASURES BEYOND EXISTING REGULATION.

<b>Air pollution</b>	
<b>CO<sub>2</sub></b>	EEDI: Phase 1, 2 and 3 reduction factors
<b>NO<sub>x</sub></b>	Tier II and Tier III for existing vessels (depending on vessel age)
<b>SO<sub>x</sub></b>	<0.5% and in SECA <0.1% S
<b>ODS</b>	Not allowed (also HCFCs)
<b>GWP</b>	GWP<1650 and have a leakage under 3% per year.
<b>VOC/PM</b>	Only for tankers: Vapour control systems
<b>GHG</b>	No further specific regulation, follows EEDI and SEEMP (EEOI) for CO <sub>2</sub>
<b>Shipboard incineration</b>	
	Not allowed
Sea pollution	
<b>Black water</b>	
	No discharge in certain areas and sewage treatment plant on board
<b>Grey water</b>	
	Advanced treatment plant installed
<b>Bilge water</b>	
	Biodegradable and low aquatic toxicity lube oil
<b>Ballast water</b>	
	Mid-ocean exchange, BWM system installed
<b>Garbage</b>	
	Management Plan for hazardous materials and recycling wastes
<b>Antifouling</b>	
	Paint without biocidal compounds, such as organotin
Other	
<b>Scrapping policy</b>	
	Inventory of hazardous materials onboard; policy on scrapping at approved non-beaching facilities
<b>Crew awareness</b>	
	Documented education in environmental policy, targets and procedures.

#### 4.2 Principles for a possible global standard

Based on the assessed ESPIC, a proposal for a possible future global standard, which is also applicable in Denmark, is developed (Table 4). A performance system applicable in Denmark must obviously be suited for ships operating in an ECA and thus already complying with stringent measures on sulphur, and presumably nitrogen oxides as well, in a foreseeable future. A way to go beyond the existing regulation is to demand that existing ships comply with the rules for new ships and to implement limits of emissions earlier than what has been enacted. The proposed standard consists of a simple three level ranking system largely based on information readily available, and for the most part verifiable in the ship's certificates (Table 4). Two different ways of using this system are possible:

One way is to claim that all indicators have to comply with a certain level in order for the vessel to be certified for that level. If all indicators meet the requirements for e.g. level 3, except from one indicator only complying with level 2, the ship can only be certified for level 2. Hence, a modern vessel that meets all air emission and water management indicators but not yet has an inventory of hazardous materials (IHM) will not benefit from lower port fees or relaxation of other levies, since it only complies with level 1. In order to comply with level 3 the ship has to achieve zero emission or discharge, except from CO<sub>2</sub>. The disadvantage of this way of ranking is that the ship owners will not be encouraged to bring up few parameters to level 3, if the rest are only complying with level 2.

Another way to rate the vessels' climate and environmental performance is by a ranking score. A system that does allow for a more continuous rating like this is the CSI. In this study all indicators at each level are treated equally and the ship obtains a total score by adding the points obtained. All parameters complying with level 1 are given 1 point, parameters complying with level 2 are given 3 points, and parameters complying level 3 are given 5 points. This system is not as sensitive to one specific pollutant parameter not complying with a certain level as it provides a total ranking score for the vessel. If ship owners find it easier to reduce some pollutants rather than others, this way of ranking will ensure that they do their best to achieve most points for all parameters. It will still be beneficial for the ship owner to improve the reduction of one pollutant in order to comply with level 3, even though all other parameters only comply with level 2.

**TABLE 4: PROPOSAL FOR AN APPLICABLE DANISH STANDARD.**

Pollutant parameter	Level 1 (1 point)	Level 2 (3 points)	Level 3 (5 points)	Certifiable
<b>CO2 New ships/ Existing ships</b>	Reduction 20% / Reduction 10%	Reduction 30% / Reduction 20%	Reduction >30% / Reduction 30%	Yes MARPOL Annex VI
<b>SOx</b>	0.5% outside ECA	0.1% outside ECA	No emission	Yes MARPOL Annex VI
<b>NOx<sup>1</sup> New ships/ Existing ships</b>	>Tier II*/Tier II	Tier III/Tier III	No emission	Yes MARPOL Annex VI
<b>ODS/ODP</b>	No use /ODP = 0	No use /ODP = 0	No use /ODP = 0	Yes MARPOL Annex VI
<b>PM<sup>2</sup></b>	0.4 g/kWh	0.15 g/kWh	0.1 g/kWh	Currently not
<b>Refrigerants GWP<sup>3</sup></b>	<3500	<2500	<1890	Yes MARPOL Annex VI
<b>Black water</b>	Advanced treatment	Holding tank	No discharge	Yes MARPOL Annex IV
<b>Grey water</b>	Advanced treatment	Holding tank	No discharge	Yes MARPOL Annex IV
<b>Bilge water</b>	< 5ppm	Holding tank	No discharge	Yes MARPOL Annex IV
<b>Ballast water</b>	Comply with D-1,	Comply with D-2	D-2 No chemicals system	Yes Ballast Water Convention
<b>Garbage</b>	Shore delivery	Waste separation	Recycling	Yes MARPOL Annex V
<b>Hazardous waste</b>	Separation	Reduction policy	No emission	Yes Policy
<b>Antifouling</b>	No TBT on hull	Non toxic paint	Biocide free paint	Yes Antifouling Convention
<b>Scrapping</b>	IHM onboard	No beaching	Certified facility	Yes Policy based on Hong Kong

<sup>1</sup> 20%-80% reduction

<sup>2</sup> No standard for PM emissions is given in the assessed ESPICs. ISO 8178-1 is often used in shipping..

<sup>3</sup> GWP is a measure of how much heat a greenhouse gas traps in the atmosphere relative to the effect of CO<sub>2</sub>; in this case over a time interval of 100 years. No chlorofluorocarbons are allowed at any level.

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# 6. Appendix: Selected Classification Societies and Environmental Performance Indices

This appendix provides information on the assessment standards for environmental and climate performance. The different issues have been divided into following topics: Air pollution, sea pollution and other measures. Each organisation's system has been screened for their environmental- and climate classification rules and marked in the cells with a plus sign. Four of the classification societies (Lloyd's Register, RINA, CCS and DNV) and two environmental performance indexes (CSI and BSR CCWG) have been selected for detailed listing and their environmental requirements have been specified in the following tables. Mandatory legislations according to MARPOL 73/78 have been excluded in this study, but the measures beyond MARPOL 73/78 and other regulations have been recorded. Furthermore, it should be noticed that generally CSI is built in a way so that the carriers that fulfil all international regulations do not get any points in the CSI system, and only additional "green" measures will count. Another ship performance tool has been developed by BSR Clean Cargo Working Group (CCWG), with the intention to have a transparent system for the transport buyers.

## 6.1 RINA

Ships can obtain two different Green passports according to RINA's classification rules. One called RINA GREEN PLUS, which comply with MARPOL 73/78, while RINA GREEN STAR contains additional measures, which are weighted in their environmental index. If each point is complied the ship gets the Green Passport Plus/Star.

For each measure the score is higher in the environmental index. Examples of measures:

1. Gas to liquid fuels
2. Water injection into combustion chamber
3. Running with LNG
4. Exhaust gas treatment
5. NOx monitoring and recording

The specifications for RINA GREEN STAR can be found in Table 5.

## 6.2 Lloyd's Register

Lloyd's Register has Environmental classification rules for ships. If a ship fulfils additional requirements beyond the MARPOL 73/78 it can obtain an ECO notation. Requirements for obtaining the ECO notation can be found in Table 6. Furthermore, Lloyd's environmental classification rules are built up with supplementary characters to the ECO notation (Lloyd's, 2013), which can also be found in Table 6. This makes it easy for transport buyers to figure out in which pollution areas the ships make a "green" performance, but for the uninformed it can be problematic to know how the items are weighted and therefore problematic to compare the vessels' environmental performance.

### **6.3 CCS**

The CCS divides the ships into three environmental classes: Green Ship I, Green Ship II and Green Ship III. The Green Ship I is the lowest class and applies to ships that fulfil the mandatory legislation and have a basic Shipping Energy Efficiency Management Plan (called SEEMP I). The criteria can be found in Table 7. The Green Ship II contains additional requirements to Green Ship I including an expanded SEEMP, while Green Ship III comprises additional items to Green Ship II and a further expanded SEEMP (CCS, 2013).

The CSS's requirements to the different levels of SEEMP:

**SEEMP I notation:** The ship is to have a Ship Energy Efficiency Management Plan (SEEMP) developed in accordance with the relevant IMO guidelines.

**SEEMP II notation:** In addition to compliance of the ship with the requirement of SEEMP I, a ship energy efficiency management system is to be established by the company or the operator of the ship and certified by CCS.

**SEEMP III notation:** In addition to compliance of the ship with the requirement of SEEMP II, the ship is to have software for real time monitoring of e.g. route optimization and hull bio fouling so as to monitor relevant parameters affecting ship energy efficiency and/or adjust energy efficiency measures at any time.

### **6.4 DNV**

According to DNV's environmental classification rules, ships that comply with mandatory requirements set by MARPOL 73/78 get the certification CLEAN, while CLEAN DESIGN indicates that the ship comply with additional measures. The additional measures are shown in Table 8.

### **6.5 BSR CLEAN CARGO WORKING GROUP**

BSR Clean Cargo Working Group has developed a Performance Metrics Tool, which should make it easy for transport buyers to distinguish between the vessels' "green" performances. This scoring system consist of a comprehensive question list which covers air pollution, sea pollution and additional environmental issues as scrapping policy, the environmental impact through the supply chain in the company, etc. For instance, the scoring system requests additional descriptions of the environmental Management Program, the percentage of fleet covered by Green Passport for ship recycling, the strategy and practice to achieve targets, indicators used to evaluate environmental performance, etc. Furthermore the CO<sub>2</sub>, NO<sub>x</sub> and SO<sub>x</sub> emissions according to supply-chain are evaluated (BSR, 2013). Answering the questions gives a score calculated by the Metric Tool, which is based on a program in excel. Some of the questions require a simple "yes" or "no", other questions require a description, while some items require a calculation. How the description issues are weighted in the system is not clarified but the final score makes it transparent for transport buyers to differentiate between the vessels environmental performance. In Table 9 the most relevant items used in the CCWG tool are shown.

### **6.6 Clean Shipping Index**

The CSI is built up to give a vessel score when additional measures beyond the mandatory convention are performed. The pollution elements weighted and used in the CSI can be found in Table 10. Here the quantitative measures are listed:

For CO<sub>2</sub> improvement the EEOI is calculated for existing ships and should be more than 40% lower than for the reference ship. For container ships the CO<sub>2</sub> emissions are calculated according to the CCWG. NO<sub>x</sub> emission reduction can give a score if the vessel complies with Tier III requirements. SO<sub>x</sub> emission reduction gives a score if fuel quality is under 0.1% S. Use of LNG or biogas will give a

zero emission scenario, and thus the highest score. Furthermore, the change from diesel/HFO to LPG, LNG or biogas will also reduce the PM formation. It is required for container and cargo vessels that the use of refrigerants substances may *not* have an ozone depleting potential (i.e. ODP=0) and the use of substances like HFCs, which have a global warming potential (GWP) should not exceed 3500. The score will be even higher when the used substances have a GWP<1850. Regarding bilge water a score is obtained when there is an active treatment and the oil in outgoing water is under 5ppm with an emission control box in place. Ballast water exchange is not optimal for the environment and thus provides a reduction in the CSI scoring system. To obtain a full score a Ballast Water Management system that has received Type Approval Certification following Final Approval by IMO should be implemented (CSI, 2013).

A number of other classification societies, organisations and public indices are briefly described below but not into further details.

### **6.7 ABS**

American Bureau of Shipping (ABS) has an environmental classification standard that distinguishes between ENVIRO and ENVIRO+ notation (ABS, 2013). ENVIRO notation is based on compliance with the international conventions, while ENVIRO+ notation includes additional criteria for environmental protection related to design characteristics, management and support systems, sea discharges and air emissions. The specifications are not significantly different from other class systems and are not described into further details in this report.

### **6.8 Environmental Ship Index**

The Environmental Ship Index (ESI) identifies seagoing ships that perform better in reducing air emissions than required by the current emission standards of the IMO. The ESI evaluates the amount of NO<sub>x</sub> and SO<sub>x</sub> that is released by a ship and includes a reporting scheme on the greenhouse gas emission of the ship. The ESI is an indication of the environmental performance of ocean going vessels and assist in identifying cleaner ships in a general way. ESI provides a total score or a score based on each of its constituent parts separately. ESI is an adaptable index where the weighting of the scores between the different constituents of the formula might change and the evaluation of the performance can be adjusted to be more in line with constituents as they are added and existing ones deleted. Deletions will be made if a measure has proven to be effective and the behavioural change has become widespread. Disadvantage: Due to the adaptability and adjustment of the index, the total score will *not* be comparable for the same ship from year to year, since improvement calculations is not possible. Therefore, ESI is only comparable between ships within the same year.

### **6.9 IMO's Energy Efficiency Design Index**

IMO has developed the Energy Efficiency Design Index (EEDI) as a technical measure to successively improve a ship's efficiency. The index indicates the specific CO<sub>2</sub> emission per cargo capacity and distance sailed. This tool has been created for improvement in CO<sub>2</sub> reduction. The amendments to MARPOL Annex VI Regulations for the prevention of air pollution from ships, scheduled to enter into force on 1 January 2013, add a new chapter to Annex VI, where the Energy Efficiency Design Index (EEDI) is made mandatory for new ships. The EEDI expresses the impact on the environment from shipping versus the benefit to society from shipping;  $EEDI = \text{Impact to environment} / \text{Benefit to society}$ . EEDI, which is measured in g CO<sub>2</sub> per ton-miles, requires step-wise improvements to the energy efficiency of new build ships, starting at 10% reduction in CO<sub>2</sub> per tonne-mile from 2015, increasing to 20% and 30% in 2020 and 2025, respectively.

### **6.10 IMO's Ship Energy Efficiency Management Plan and Energy Efficiency Operational Indicator**

The Ship Energy Efficiency Management Plan (SEEMP) is an operational measure that establishes a mechanism to improve the energy efficiency of a ship in a cost-effective manner. The SEEMP also

provides an approach for shipping companies to manage ship and fleet efficiency performance over time using, for example, the Energy Efficiency Operational Indicator (EEOI) as a monitoring tool. The guidance on the development of the SEEMP for new and existing ships incorporates best practices for fuel-efficient ship operation, as well as guidelines for voluntary use of the EEOI for new and existing ships (MEPC.1/Circ.684). The EEOI enables operators to measure the fuel efficiency of a ship in operation and to gauge the effect of any changes in operation, e.g. improved voyage planning or more frequent propeller cleaning, or introduction of technical measures such as waste heat recovery systems or a new propeller. The SEEMP urges the ship owner and operator at each stage of the plan to consider new technologies and practices when seeking to optimise the performance of the ship (IMO, 2013). SEEMP is mandatory for ships over 400 GT from the 1st of January 2013 (Lloyd's, 2013).

**TABLE 5: ENVIRONMENTAL CLASSIFICATION RULES FROM RINA BEYOND MANDATORY REQUIREMENTS.**

<b>Pollution area</b>	<b>Additional measures which have impact on the Environmental Index in RINA</b>
<b>Air pollution</b>	
<b>CO<sub>2</sub></b>	Gas to liquids (GTL), Blending fossil fuel with second-generation bio-fuels, Dual-fuel engines running with LNG, CO <sub>2</sub> emissions monitoring and recording
<b>SO<sub>x</sub></b>	Gas to liquids (GTL), Blending fossil fuel with second-generation bio-fuels, Dual-fuel engines running with LNG, SO <sub>x</sub> emission monitoring and recording
<b>NO<sub>x</sub></b>	Gas to liquid (GTL), Fossil fuel pre-treatment, (e.g. water injection) Dual -fuel engines running with LNG, NO <sub>x</sub> emissions monitoring and recording
<b>PM</b>	Gas to liquids (GTL), Fuel pre-treatment, Lower PM emission achieved by modifications in prime movers that do not increase other pollutants and GHGs emissions, Dual-fuel engines running with LNG
<b>ODS</b>	Restrictions in the use of GWP (global warming pot.) substances
<b>GHG</b>	Non fossil fuels (e.g. Sails, fuel cells, etc.), Second generation of bio-fuels partially or totally used on board, Cold ironing, Tool to monitoring and recording fuel supplies and consumption, Computerized system to monitor fuel consumption, Supporting tool to assist the Master in keeping most efficient sailing draft and trim
<b>Sea pollution</b>	
<b>Black Water</b>	Advanced treatment plant as per ADEC Title XIV (33 CFR Part 159 Subpart E), High level alarm in manned position
<b>Grey Water</b>	Advanced treatment plant as per ADEC Title XIV (33 CFR Part 159 Subpart E), Grey water record book, Holding tank
<b>Bilge water</b>	High level alarm in manned position, Dry bilge concept, Magnetic coupling on oil pumps, Biodegradable and low aquatic toxicity lube oil, Retention on board, Bilge water treatment with alarm, automatic stop and recorder
<b>Ballast water</b>	Using Ballast water exchange
<b>Discharge of water</b>	Limitation of hot water discharge: such as not to increase by more than 2`C in mixing zone
<b>Garbage</b>	Management plan for hazardous wastes: lamp bulbs, batteries, printer cartridges etc., Recycling of plastic, aluminium, glass, paper-cardboard
<b>Other</b>	
<b>Ship recycling</b>	Res. MEPC.179(59) Res. A.962(23)

**TABLE 6: ENVIRONMENTAL CLASSIFICATION RULES FROM LLOYD'S REGISTER BEYOND MANDATORY REQUIREMENTS.**

Pollution area	ECO notation	Supplementary characters to the ECO notation
<b>Air pollution</b>		
<b>CO<sub>2</sub></b>		EEDI: submitted and approved by LR, EEOI: in acc. With IMO guidelines
<b>NO<sub>x</sub></b>	Comply with MARPOL Annex VI	NOx-1: <80% of Tier I NOx emission limits NOx-2: <80% of Tier II NOx emission limits NOx-3: meets the Tier III emission limits
<b>SO<sub>x</sub></b>	S content in Oil fuel < 3.0% m/m	DIST: SOx, fuel sulfur content less than 0.10% m/m
<b>CFC</b>	Prohibited	
<b>HCFCs</b>	In new prohibited, ODP=0, GWP<1950	
<b>Refrigerants</b>	Alarm system, and leakage <10-3%	R: Refrigeration systems, natural substances are to be used as the refrigerants in all main r. Systems (cargo systems, provision rooms and air conditioning)
<b>VOC</b>	VOC Management Plan	VECS: Vapor emission control systems in acc with IMO Standards for Vapor Emission Control Systems
<b>Sea pollution</b>		
<b>Black water</b>	Treatment system in accordance with MEPC Res. 159(55)	
<b>Bilge</b>	MARPOL, Annex I, <15 ppm alarm	OW: Oily Bilge water, discharge ashore
<b>Oil-in-water</b>	Content in water discharge 15 ppm	TC: Enhanced tank cleaning
<b>Ballast water</b>	Ballast water management plan In accordance with regulation B1 of the International Convention for the Control and Management of Ships' Ballast Water and Sediments.	BWT: if treatment system in acc. With MEPC 174(58)
<b>Garbage</b>	Management plan, IMO MEPC Res. 71(38)	
<b>TBT</b>	Prohibited	A: Anti-fouling system is to be non-biocidal
<b>Noxious liquid substances</b>		CRM: Cargo Residue minimization GW: Grey Water, treatment plant installed and/or tank for discharge ashore
<b>Other</b>		
<b>SEEMP</b>	SEEMP in accordance with the relevant IMO Guidelines	

**Scrapping Policy**

IHM: Inventory of hazardous materials, should be in compliance with Regulation 5 of the Hong Kong International Convention for the Safe and Environmentally sound Recycling of Ships

**TABLE 7: ENVIRONMENTAL CLASSIFICATION RULES FROM CCS BEYOND MANDATORY REQUIREMENTS.**

<b>Additional measures which have impact on the CSI Index</b>			
<b>Pollution area</b>	<b>Green Ship I</b>	<b>Green Ship II</b>	<b>Green Ship III</b>
<b>Air pollution</b>			
<b>SOx</b>	-	Not to exceed 3.0%	Not to exceed 0.5%
	-	In SECA not to exceed 1.0%	In SECA 0.1%
<b>NOx</b>	-	-	Tier III
<b>ODS</b>	-	-	HCFCs prohibited
<b>Sea pollution</b>			
<b>Black water</b>	Sewage Pollution Prevention Certificate	Effective operational procedure for sewage treatment	
		Sewage treatment system in acc. With res. MEPC.159(55)	
		Holding tank	
		Alarms	
		Sewage discharge recording book	
<b>Grey water</b>		Holding tank	Sewage treatment system
		Alarm	or discharged more than 12 nautical miles from land
<b>Bilge Water</b>		Alarm and auto stop when oil content exceeds 15ppm	Not to exceed 5ppm
			Bilge water treatment system, IMO MEPC.1/Circ.642
<b>Ballast water</b>	BWM convention	Requirments adopted by res. MEPC.149(55)	BWM system in acc. With res. MEPC.174(58)
	BWM Certificate	Res. MEPC.140(54)	
<b>Garbage</b>		Procedures for garbage documented	
<b>Antifouling</b>	AFS convention		without Organotin compounds

(act as biocides)

Anti-fouling Certificate

**Chemicals**

**Oil** Oil pollution Prevention Certificate

**Harmful substances carried by sea in packaged form** Certificate for Carriage of Noxious Liquid Substances Drainage system for Noxious liquid substances

**Refrigerating systems** Isolated Ozone depletion potential is to be 0  
GWP less than 2000

Liquid receiver

Annual refrigerant leakage rate is to be less than 10% of its total charge

Alarm system

**Other**

**SEEMP** SEEMP (I) SEEMP (II) SEEMP (III)

**Scrapping policy** Hong Kong Convention

**TABLE 8: ENVIRONMENTAL CLASSIFICATION RULES BY DNV BEYOND THE MARPOL 73/78.**

Pollution area	Additional measures to obtain CLEAN DESIGN
<b>Air</b>	
<b>SOx</b>	Max. 2.5% in fuel oil carried on board  As alternative: use of an electrical shore connection
<b>ODP/GWP</b>	GWP < 1890, and ODP=0. No chloroflourocarbons (CFCs and HCFCs) allowed.
<b>Incinerators</b>	Installed, unless enough capacity for 100% delivery to shore
<b>Sea pollution</b>	
<b>Bilge water</b>	Bilge holding tank with facilities for delivery ashore.  Labels/colour codes in order to identify the different piping systems  Alarm, set to 5ppm  Bilge water separator with automatic stopping device
<b>Garbage</b>	Vessel shall be equipped and arranged for sorting, collecting, minimizing and storing garbage prior to incineration or delivery to shore.  Separated into following categories: recyclable, non-recyclable waste, food waste, hazardous waste
<b>Only for tankers</b>	
<b>VOC (cargo evaporation)</b>	Vapor control systems CFR 46 Part 39

TABLE 9: SELECTED ELEMENTS FROM THE CCWG ENVIRONMENTAL PERFORMANCE SYSTEM.

Pollution Area	Measure
<b>Air pollution</b>	
<b>CO2</b>	Calculated, Vessel speed reduction, weather routing, hull and propeller polishing/hull resistance reduction, optimal rudder adjustment
	Optimal trim, optimized vessel utilization
	Optimized vessel load through freight consolidation
	Ballast water reduction measures for a better CO2 / TEU ratio
	Waste heat recovery systems
	Shaft generators
	Electronic engine controls
<b>NOx</b>	High pressure fuel injection systems
	Calculated
	Slide valve technologies
	Common rail technology
	Electronic engine controls
<b>SOx</b>	Water-based technologies
	After treatment technologies (e.g. SCR)
	Measured S content in fossil fuel
<b>Alternative energy: wind, solar, etc.</b>	Description of program to reduce SOx emissions
	Noticed
<b>Sea pollution</b>	
<b>Oily discharge</b>	Score depend on percentage.
<b>Ballast water</b>	Treatment, Minimization,
	Mid-ocean ballast water exchange when required by regulations
<b>Hull</b>	Which biocide used, Which coating used
<b>Waste</b>	"No-garbage-over-board" policy, No-incineration policy, Discharge food waste only at mid ocean, e.g. >25 nm off-shore, Waste disposal onboard ship/at ports
<b>Other</b>	
<b>Environmental policy</b>	Yes/no (if yes: Description)
<b>Annual environmental performance report</b>	Yes/no (if yes: Description)
<b>Environmental</b>	Yes/no (if yes, is it certified?) (e.g. ISO 14001)

<b>Management System</b>	
<b>All certificates</b>	Supplied, and each weighted
<b>Environmental short-term (annual) and long-term goals</b>	Description
<b>Monitoring of environmental performance</b>	Description
<b>Recycling policy</b>	Yes/no (if yes: Description)
<b>CEEMP</b>	Description
<b>Crew awareness</b>	In environmental policy, targets and procedures.
<b>Container management</b>	Operate reefers with low energy consumption potential
	Use of environmentally friendly technologies for application of paint
	Verification of legally and sustainable wood used for container floors.
<b>Monitored facilities</b>	Paper consumption
	Electricity consumption
	Water consumption

TABLE 10: MEASURES IN CSI THAT IMPACTS THE VESSEL SCORE.

Pollution area	Measures which have impact on the CSI Index
<b>Air pollution</b>	
<b>CO2</b>	EEOI compared with a similar reference ship: >40% below reference
	Reduction goal: CCWG: >40% below reference
	For container ships: CO2 emissions calc. acc. to Clean Cargo Working Group
<b>NOx</b>	Calculation of NOx emissions per transport work in grams/tonne-km.
	NOx emissions calculated in grams/TEU-km, Tier III (80% reduction)
<b>SOx</b>	Total yearly average of sulphur in all fuel used as percentage by weight: Quality up to < 0.1% S. SOx emissions in grams/TEU-km. Fuel S content < 2.5 % as total yearly average.
<b>PM</b>	Connected to the SOx emissions.
<b>Refrigerants</b>	Use of ODP substances should have ODP =0
	Use of GWP substances should have GWP <3500 or even <1850
<b>Sea pollution</b>	
<b>Black water</b>	Scoring based on how treatment is in Particularly Sensitive Sea Areas (PSSAs)
	No Sewage discharge in PSSAs
<b>Sludge oil handling</b>	No incinerator on board, Documented disposal of sludge oil to treatment on shore.
<b>Bilge water</b>	Active treatment equipment has to be installed, calibrated and documented emission of <5ppm oil in the disposed bilge water
	Installation of emission control box
<b>Ballast water</b>	Ballast water exchange (reduced score)
	BW Management systems which received Type Approval Certification following Final Approval by IMO (full score)
<b>Garbage handling</b>	No incinerator on board, no waste over board, separate garbage for handling for reuse, recycling and disposal.
<b>Antifouling</b>	Using SPC (self-polishing coating)
	Non-toxic coating, accepted according to EU Biocide Directive 98/8/EG Annex 1 (10)
<b>Chemicals</b>	
<b>Stern tube oils</b>	Biodegradable oil according to ISO 9439(11), ISO 10708 or ISO 9408 (13)
<b>External hydraulic fluids</b>	Biodegradable fluids, Electrical power instead of hydraulic power, External hydraulic power capped so leakage will not reach the sea

**Gear oil for thruster or propellers**

Biodegradable oil

**Boiler-  
/cooling  
water  
treatment**

Avoiding the use of chemicals classified as carcinogenic, mutagenic or toxic to reproduction, according to the EU Dangerous Substance Directive (14), Avoiding products classified as sensitizing, toxic or dangerous for the environment according to the DSD directive (exclusion of nitrit)

**Cleaning  
agents**

Avoiding the use of chemicals classified as carcinogenic, mutagenic or toxic to reproduction, according to the EU Dangerous Substance Directive (14). Avoiding detergents classified as dangerous for the environment according to the DSD directive. Detergents, surfactants that disturb the installed bilge water treatment should be avoided.

**Other**

**Scrapping  
policy**

Breaking facility may not be located on intertidal coastal zone. They have to carry an updated inventory of hazardous materials on board. They sign a Covenant with the new owner when selling the ship

**Crew  
awareness**

Documented education for all crew on board with special emphasis on engine room personnel and handling of heavy fuel oil



Miljøministeriet  
Miljøstyrelsen

Strandgade 29  
DK - 1401 København K  
Tlf.: (+45) 72 54 40 00

**[www.mst.dk](http://www.mst.dk)**