

CLEAN SHIPPING INDEX

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CONTENTS

WHAT IS THE CLEAN SHIPPING INDEX	3.
THE REVISED INDEX DATABASE	4.
GUIDANCE FOR ENTERING DATA	5.
VESSEL SCORING	17.
CLEAN SHIPPING RECOMMENDATIONS	20.
REFERENCES	21.

WHAT IS THE CLEAN SHIPPING INDEX?

Shipping is basically an environmentally sound way of transporting goods and people. It is energy efficient and has comparatively low demands on infrastructure. The international character of shipping has, however, led to an exemption from a large portion of the environmental demands placed on land-based means of transport and enterprises.

Shipping today causes a number of health and environmental problems. For a large number of parameters for instance NO_x, SO_x, particulate matter (PM), carcinogenic oils, oily bilge water, cleaning chemicals etc., the handling on board and the emissions to air and sea are unacceptable. For some parameter there are changes in the “pipeline” for example through regulations by the International Maritime Organization (IMO), but generally these problems acutely need to be addressed.

Aside of rules and regulations there is another strong environmental development force for shipping yet rarely assessed. It is the power of market demands from purchasers of sea transport. If reasonable but significant environmental demands could be coordinated from large cargo owners like export/import industries and companies, a “win-win” situation could be created. This would be beneficial for quality shipping companies, subcontractors for clean technology and last but not least – the environment itself.

The Clean Shipping Project started 2007 with the ambition to enhance this process from a regional/national perspective. The commissioners were regional actors in Gothenburg and the west of Sweden – but also a number of large export- and import companies of Sweden. The regional actors were the Region of Västra Götaland, County Administration Board, the Gothenburg Region Association of Local Authorities, the Environment Administration in the City of Gothenburg and Port of Gothenburg. The supporting companies in the Clean Shipping Network may be found on our homepage (www.cleanshippingproject.se)

The Project developed a Clean Shipping Index consisting of a questionnaire of 20 basic, not so complicated questions on environmental performance. They all go beyond existing rules and regulations and covers existing ships of ten different types. The Index is focused on the vessels’ operational impact on the environment and scoring is obtained in five different areas: SO_x and PM emissions, NO_x emissions, CO₂ emissions, Chemicals, Water and waste control. The information should be filled in on a “ship to ship” basis but the scoring is added to a total carrier score. A ranking is done based on the scoring.

The information is collected in the Clean Shipping Index Database. To this database the members of the Clean Shipping Network have access. To be a member for the moment you have to be a Swedish cargo owner accepted by the Project. The membership will involve a small administrative fee and you have to sign a Letter of Intent and a Confidentiality Agreement to get access to the database. However the Project has the ambition to open the database for more general use in the long run.

The Clean Shipping Project has developed a verification protocol for classification societies to get accredited to and carry out verification to the Clean Shipping Index.

From 2012 the Clean Shipping Index is been taken over and run by the Clean Shipping Network which is a non-profit organization mainly consisting of cargo owners. More on this new platform for Clean Shipping Index can be found on our homepage www.cleanshippingproject.se

THE 2012 REVISED INDEX DATABASE

The Clean Shipping Index was introduced in June 2008. From 2010 the Index became completely web-based. Some adjustments have been made on the way and for the 2012 version we would like to introduce some small changes that, however, might make a significant difference.

When doing changes we are very strict altering only what really is needed. Otherwise the actuality of the already submitted data may be endangered. However when regulation is catching up or there are new factors for example calculations of CO₂, we have to adopt this. In some cases we have done adjustments which do not affect the scoring.

1. Maybe the most important change is in the **ranking system for verified vessels and carriers**. When a shipping company/carrier is verified as a company it is automatically ranked in a top group competing by total score only by other verified carriers. If a carrier has verified one or more vessels but not the fleet, it is automatically ranked in a second top group competing with scores of other carriers in that group. Below these groups are all unverified carriers and vessels ranked as before by total weighed score.
2. On the carrier home page we have included a question on **scrapping policy** on vessels. This is a yes/no question yielding no scores and is explained further down in this document.
3. On demand of many cargo owners we have introduced two parameters as voluntary and again give no scores, namely emissions of **NO_x in grams/ tonne km** and **SO₂ in grams/ tonne-km**. In this context an exact figure of the **total yearly average of sulphur fuel** is needed. Simplified ways of calculating this from the presented CO₂ emission values are demonstrated.
4. When it comes to fuel quality in ECAs we have acknowledged the regulation of max 1%S after 1 July 2010, and adjusted our scoring according to that. We are giving scores just below 1.0% S in ECAs due to the lack of verification data for this with many carriers. We have also introduced a **Harbour bonus** which can be achieved by using 0.1% S in both main and auxiliary engines and boilers in harbour areas. This is explained further down in this document.
5. CO₂ calculation of EEOI values have changed considerably. IMO has adjusted the EEDI curves showing CO₂ emissions as a function of dwt significantly. Also new load factors are presented as well as adjustment of pay load factors in some cases. This leads to **new calculations of the EEOI_{ref} values**. Additionally the scoring has been adjusted considerably to mirror the real situations. As there is low validity to EEDI curves especially in low dwts, a **more generous scoring** is necessary. All this is entered into the database and calculated automatically as before.
6. CO₂ calculation according to CCWG for container vessels is updated with **new empirical reference values or CO₂ averages for the different trade lanes**. This is entered in the database and calculated automatically as before.
7. Finally the **demands for scoring in each subgroup under Chemicals and Water&Waste for reaching Good Performance are taken away**. In the current situation this proved to be too tough in order to get any Good Performance vessel.

GUIDANCE FOR CARRIERS

When you logged in with your username and password you will come to the **Welcome page**. Please read through this so all circumstances are clear!

You are best off by start to enter the **Carrier/ Home** page in the left column. You enter **edit information** on the top of the page. If this is the first time you enter the database you should fill in the fields showing. If there already is information here, you just check that it is correct and fill in what is missing.

Note: The maximum time you may be logged in *and* inactive is 3 hours. After that you automatically will be logged out and all new information that is not submitted or updated will be lost.

The following information is needed on carrier level:

CARRIER INFORMATION

Carrier

Shipping line: The shipping line which owns, manages or operates the reported vessels.

Website: The website address to the shipping line.

Contact

Responsible person: The contact person who is the main contact with the carrier and responsible for all the information presented.

Phone number: International telephone to the responsible person.

E-mail address: The direct email address to the responsible person.

Vessel count

Operated vessels: The total operated vessels by the carrier.

Owned/ managed vessels: The total owned or managed vessels by the carrier.

CO₂

Does your company have a CO₂ reduction goal? Yes or no.

Target (%): The target figure in %, if there is a goal.

Target year: The year when the target shall be reached.

Baseline year: The year from which the target is set.

Reduction type: Is the target absolute or per transported unit?

Scrapping policy

Does your company have a policy for safe and environmentally sound recycling of vessels? Yes or no.

Answering yes comprises all of the following:

1. We do not use ship breaking facilities that are located on an intertidal coastal zone.
2. We carry an updated inventory of hazardous materials on board our vessels.
3. We sign a Covenant with the new owner when we sell our ship.

Update: When you have filled in the questions above you just click on the update button and the information will be submitted into the database. You will then automatically enter the home page again and find your information both on carrier level and on vessel level (when you have added vessel information). The full information showed on the carrier home page will be described later in this document.

VESSEL INFORMATION

Add Vessel/ Edit Vessel

When you are going to add a new vessel to the database you enter **Carrier/ Add vessel** in the left column of the home page. If you want to complete or change information on a vessel already in the database you enter **list of vessels** in the top of the home page and click on the IMO number of the concerned vessel in the vessel ranking list. You will then come to Vessel information where you enter **edit vessel** on the top of the page. From here the questionnaire looks the same for both Add vessel and Edit vessel. We will now guide you through this.

IMO number: The three letters IMO directly followed by the unique and permanent seven digit number (ex. IMO1234567). The database will not accept two vessels with the same IMO number. The database does neither accept a space between the O and the first number.

Name of vessel: The current name of the ship.

Prepared by: The person responsible for submitting the information on this specific ship.

Year (new built/ major conversion): The year the vessel was built or had a major conversion.

Maximum payload: The weight of carried cargo in tonnes or TEUs when the vessel is downloaded to the Plimsoll mark.

Deadweight tonnage (dwt): The total weight of a ship in tonnes when downloaded to the Plimsoll mark.

Type of vessel: Select from the drop down menu. In the choice of oil tanker there will appear two options "*light*" products referring to predominantly (>50%) products with low specific weight like gasoline, jet fuel, diesel, LNG/LPG etc. and "*heavy*" products referring to predominantly (>50%) heavy products like HFO, crude oil, asphalt etc.

Owned/ chartered vessels: Select from drop down menu. Note that time-chartered refers to vessels chartered for use for a period of 6 months or more and spot-chartered for periods less than 6 months.

Index verified by: Select from drop down menu. The verifier has to be a member of the International Association of Classification Societies (IACS) but also accredited according to ISO/IEC Guide 65 (EN 45011) or under ISO 14065:2007 for a verification service. The verifier should also be approved by the Clean Shipping Network.

Environmental Management System: Select from drop down menu which certification of the vessel that is conducted.

Calculated CO₂ emissions in grams/tonne-nm (nautical mile): Calculated according to IMO's Energy Efficiency Operational Indicator (3). The calculation should cover a period over one calendar year.

Calculated CO₂ emissions in grams/TEU-km: Calculated according to Clean Cargo Working Group CO₂ calculation formula (4) (26). This only applies to container ships. The calculation should cover a period of one calendar year.

NO_x emissions from main/auxiliary engines: For engines larger than 130 kW, NO_x emission data in g/kWh, along with engine rpm, should be presented. A number of options for finding this data are at hand, which is in accordance with the Norwegian Maritime Directorates guidelines on NO_x taxation (5).

Year: This should reflect the applicable NO_x certification date for a particular engine as defined by Revised MARPOL ANNEX VI (6), taking into account the relevant requirements related to "major conversions".

Total power: This should be the total installed power of all main or all auxiliary engines.

NO_x emissions (g/kWh): If the engine is installed on a ship constructed on or after 1 January 2000, the data will be found in the EIAPP certificate (6).

In cases where a NO_x reducing device is fitted but not part of an engine's NO_x

certification, such systems are to be covered by verification procedures required by the NOx Technical Code 2008, demonstrating that the claimed application cycle value is being achieved (6).

The same applies when performance of a pre-2000 engine is claimed having the appropriate application cycle weighted value within either the Tier I or Tier II limit.

Measurements of NOx emissions according to the regulations by the Swedish Maritime Administration for reduction of fairway dues, are also acceptable (7).

If SCR (Selective Catalytic Reduction) is installed as a post-combustion reduction technique there must not be an ammonia-slip (NH₃) above 20 ppm, according to the Swedish Maritime Administration (7).

If none of these options are at hand NOx data should be calculated by table factors found in Section 3-19-9 in the Tax on emissions of NOx (8):

Engines

<i>Rpm less than 200:</i>	<i>100 kg NOx per tonne of fuel</i>
<i>200 rpm to 1,000 rpm:</i>	<i>70 kg NOx per tonne of fuel</i>
<i>1,000 rpm to 1,500 rpm</i>	<i>60 kg NOx per tonne of fuel</i>
<i>1,500 rpm upwards</i>	<i>55 kg NOx per tonne of fuel</i>

For converting the emission factors 1 kg NOx/tonne bunkers into specific NOx emissions in g/kWh, table 7 and 8 in MEPC 58/INF. 6 (9) should be applied:

Main engine specific fuel consumption values (g/kWh)

<i>Engine age</i>	<i>Above 15000kW</i>	<i>15000-5000 kW</i>	<i>Below 5000 kW</i>
<i><1983</i>	<i>205</i>	<i>215</i>	<i>225</i>
<i>1984-2000</i>	<i>185</i>	<i>195</i>	<i>205</i>
<i>2001-present</i>	<i>175</i>	<i>185</i>	<i>195</i>

Auxiliary engine fuel consumption values (g/kWh)

<i>Engine age</i>	<i>Above 800 kW</i>	<i>Below 800 kW</i>
<i>Any</i>	<i>220</i>	<i>230</i>

NOx averages: If there is more than one main engine or more than one auxiliary engine installed, the power weighted emission value should be presented. The principal calculation of this will be:

Engine 1: $x \text{ g/kWh} * y \text{ kW} = xy$;

Engine 2: $z \text{ g/kWh} * a \text{ kW} = za$

Power weighted average: $xy+za/(y+a)$;

where x and z are the NOx emission values ; y and a are the engine powers.

Shore-side electricity: In case of shore-side electricity installed and used in all applicable harbours, Tier III values or 0 may be filled in under NOx auxiliary engines.

:

Rpm: Rated engine speed in revolutions per minute.

Calculated NOx emissions in grams/tonne-km: This is voluntary information. However some cargo owners have an interest in these figures. A way of calculating this emission by using the CO₂ emission data is the following:

If you divide with the factor giving the emitted mass of CO₂ per mass of fuel consumed (3.114 for HFO and 3.206 for diesel/gasoil) you will get the fuel consumption per transport work (in gram fuel/tonne-km).

With the knowledge of your engines' age and power you will find the specific fuel consumption (g fuel per kWh engine work) values both for main engines and auxiliary engines in the tables above.

By dividing the fuel consumption per transport work (in gfuel/tonne-km) with the specific fuel consumption value you will get the engine work needed per transport work which will

have the unit kWh/tonne-km. By multiplying this with the NOx emission factor (in g/kWh) for your engine you will have get the emission of NOX per transport work in grams/tonne-km. The values for auxiliary engines should be calculated in a similar way and added.

Calculated NOx emissions in grams/ TEU-km: This is voluntary information just as above. The calculation may be done accordingly with the exception of transforming between nautical miles and kilometres.

Sulphur in fuel: Total yearly average (calendar year) of sulphur in all fuel used on board as percentage by weight.

Calculated SO2 emissions in grams/ tonne-km: This is voluntary information. However some cargo owners have an interest in these figures. A way of calculating by using the CO2 emission data is the following:

By dividing the CO2 emission in g/tonne-nm with 1.852 you will get the CO2 emission g/tonne-km.

If you know the ratio of different fuel types you run on board you can calculate the fuel consumption per transport work (in gram fuel/tonne-km) by dividing with the factor giving the emitted mass of CO2 per mass of fuel consumed (3.114 for HFO and 3.206 for diesel/gasoil))

To get the emission of SO2 the fuel consumption should be multiplied with the average sulphur content in the fuel and then multiplied by 2. (The factor 2 comes from the conversion from S (atomic mass 32) in the fuel to SO2 (molecular mass 64) in the exhaust.

Calculated SO2 emissions in grams/ TEU-km: This is voluntary information just as above. The calculation may be done accordingly with the exception of transforming between nautical miles and kilometres.

Trade lanes/ Routes: Trade lanes are limited to a number of 25 predetermined options. The declared route should be that of 31st December the reporting year. If the ship operates on more than one route during the year, you may just mark the other ones also. For container vessels the marking of trade lanes gives a basis for CO2 scoring below if values are presented according to the Clean Cargo Working Group calculation formula (4).

VESSEL PERFORMANCE

SOx and Particulate Matter (PM)

SOx/PM main engines/auxiliary engines: The basis for scoring is the average sulphur content in fuels for main and auxiliary engines used during a calendar year. The averages should reflect the tonnage weighted sulphur content. The reason for including PM in the scoring is the close link between SOx emissions and PM emissions (27).

Just complying with global standards does not score. Sulphur testing procedures should follow the Revised MARPOL Annex VI (6). Sulphur analysis protocols should be found on board.

Under this parameter it is possible to fill in four fields: *Operations in non-ECAs and ECAs (total yearly average)*, which means the yearly average of sulphur in fuel for the total consumption in main engines. *Operations in ECAs (yearly average)*, which means the yearly average of sulphur in fuel exclusively used in ECAs for main engines. *Harbour bonus* which is an extra 3p you can score if you use $\leq 0.1\%$ S fuel in main engines/auxiliary engines/boilers when you navigate in all harbour or port areas. These are defined as the point from where you have to take or leave pilot. *Auxiliary engines*, means the yearly average of sulphur used in fuel for auxiliary engines. However if you report Fuel quality $\geq 2.5\%$ S as total yearly average in the first field, the possibility to fill in and get scores under Operations in ECAs, disappears.

Note that if you *only* operate inside ECAs alternatively *only* outside ECAs and fill in one of these options, the scoring will double from what you get in ECAs alternatively in non-ECAs/ECAs.

The use of abatement technology is acceptable as long as the demands in Annex VI of MARPOL are fulfilled. The corresponding total emission weight of sulphur dioxides should not exceed 6.0 g SO_x/kWh when a fuel sulphur content of 1.5% is claimed or required. Additionally 4.0 g SO_x/kWh corresponds to 1% S and 2.0 g SO_x/kWh to 0.5% S. The use of the term ECAs (emission control areas) in the questionnaire refers to *both* SECAs and ECAs.

NO_x

NO_x main engines/auxiliary engines: The basis for scoring is how the NO_x emissions from main/auxiliary engines relate to the standards set in the Revised MARPOL Annex VI (6). Actual figures should be declared under the NO_x field above. If several engines are installed a mean value should be presented. For calculation see **NO_x averages** above.

Just complying with global standards does not score. The emission levels mentioned are tied to the same levels as defined in the Tier I, II and III in the Annex VI, with one exception. Between Tier II and III there is a level included to reward different pre-combustion NO_x reduction techniques. Note that the timetable or special areas tied to the different Tiers are not included in the scoring.

The tier I level or “IMO-curve” is defined as the following emissions of total weighed NO₂:

- 17.0 g/kWh when the rated engine speed (n) is less than 130 rpm (revolutions per minute);
- $45 * n^{(-0.2)}$ g/kWh when n is 130 or more but less than 2,000 rpm;
- 9.8 g/kWh when n is 2,000 rpm or more.

The tier II level is defined as the following emissions of total weighed NO₂:

- 14.4 g/kWh when n is less 130 rpm;
- $44 * n^{(-0.23)}$ g/kWh when n is 130 or more but less than 2,000 rpm;
- 7.7 g/kWh when n is 2,000rpm or more.

The tier III level is defined as the following emissions of total weighed NO₂:

- 3.4 g/kWh when n is less than 130 rpm;
- $9 * n^{(-0.2)}$ g/kWh when n is 130 or more but less than 2,000 rpm;
- 2.0 g/kWh when n is 2,000 rpm or more;

Database scoring

The database will calculate the scoring you will get, according to the above formulas and the data you presented about the actual NO_x emissions earlier. Just click on the **Compute** button. Note that if you change or edit some NO_x information you have to click the Compute button again.

CO₂

CO₂ emission information: The basis for scoring is reporting annual CO₂ emission data for a calendar year. Calculation references are given under CO₂ field above. Actual figures should also be declared under the CO₂ field above. Two options are accepted. Either data according to MEPCs Energy Efficiency Operational Indicator EEOI (3) or for container vessels there is an additional option to report data according to the Clean Cargo Working Group (BSR) calculation formula (26)(appendix). Basic information for carrying out these calculations is *the cargo carried, the distance travelled and the fuel consumption*.

CO₂ emission performance/ EEOI: The basis for scoring is how well a vessel is performing compared to a reference ship. To get scores the vessel must have an emission in certain relation to this reference.

The Energy Efficiency Operational Indicator (EEOI) for the reference ship is obtained in two steps. First the Energy Efficiency Design Index (EEDI) is calculated. This is done based on the methods outlined by the Greenhouse Gas Working Group of IMO (24). In a recent MEPC resolution baselines are defined for the most common ship types of the world, expressing ideal technical circumstances but not including operational features. The baselines are presented as functions between deadweight (dwt) and emitted grams CO₂ per tonne-nm.(28).

The EEDI thus gives an average fuel consumption for a specific ship (type and size) that carries a cargo corresponding to the dwt. The EEDI are in the IMO documents presented as function of dwt for six different categories of ships (see below).

General cargo	$EEDI = 107.48dwt^{-0.216}$
Reefer (gen. cargo)	$EEDI = 227.01dwt^{-0.244}$
Bulk	$EEDI = 961.79dwt^{-0.477}$
Tanker	$EEDI = 1218.8dwt^{-0.488}$
Gas carrier	$EEDI = 1120 dwt^{-0.456}$
Container	$EEDI = 174.22dwt^{-0.201}$
RoRo	$EEDI = 4092dwt^{-0.5197}$
Car carrier (RoRo)	$EEDI = 11554dwt^{-0.6565}$

where dwt is the deadweight in tonnes and EEDI the average design index value in grams CO₂/ tonne nautical mile. The values for RoRo and Vehicle carriers have not been adopted by the IMO but are from a working paper (29).

In the second step operational factors are accounted for. This means that estimated average load factors and estimated payload factors are taken into account.

The load factors (ratio of actual load to maximum load on mass basis) assumed for the reference ships are taken according to the Second IMO GHG study (25)

General cargo		0.6
Reefer		0.5
Bulk	dwt < 100000	0.5
	dwt 10000-100000	0.55
	dwt 0-10000	0.6
Product tanker	dwt < 20000	0.55
	dwt 10000-20000	0.50
	dwt 0-10000	0.45
LPG tanker		0.48
Oil tanker		0.48
Chemical tanker		0.64
Container		0.7
RoRo		0.7
Car carrier		0.7

For some types of vessels the payload ratio (ratio of maximum weight commercial cargo to the deadweight) is an important factor when calculating the EEOI for the reference ships. General payload ratios are given for some type of ships below. The values used here are based on information from ship constructors and ship operators. For the same type of vessel different payload ratio may occur depending on the large differences in the specific weight of the cargo predominantly carried.

General cargo	0.9
Reefer	0.9
Bulk	0.9
Tanker predominantly (>50%) heavy products, asphalt, HFO, crude oil	0.95
Tanker predominantly (>50%) light products, gasoline, diesel, jetfuel	0.8
Container	0.8
RoRo	0.5
Car carrier	0.25

Gas carriers are assumed to have the same payload ratio as tankers with light products.

There are data implying that a factor considering fuel consumption as a function of load should be included in the calculation of $EEOI_{ref}$ (29). However lack of sufficient basic data for calculating this factor, leaves this for further index revisions.

Using the EEDI baseline functions and considering load factors and payload factors, the calculation for an operational reference value will generally look like this:

$$EEOI_{ref} = EEDI / (\text{load factor} * \text{payload ratio}).$$

The actual calculated EEOI for the vessel is compared with the calculated $EEOI_{ref}$ for the vessel. Depending if and how much above or below the reference the actual EEOI is, a scoring is obtained.

Database scoring

For CO₂ emission information you fill in the applicable field.

For CO₂ emission performance all data is already entered (if you have filled in correctly) including the reference value, and a click on the **Compute** button will give you your scores according to your data and the above formulas. Note that if you change or edit some CO₂ information you have to click the Compute button again.

CO₂ emission performance/ CCWG: This only applies to container vessels. The basis for scoring is how well a vessel is performing compared to a reference. To get scores the vessel must have an emission below this reference. The Clean Cargo Working Group (CCWG) references are obtained from calculated averages for standardized trade lanes. The use of reefers is not included. The averages are based on CCWG empirical data from preceding year (26).

Standardized trade lane	CCWG Average (g CO ₂ / TEUkm)
<i>Asia – Africa</i>	84.87
<i>Asia – Mediterranean</i>	67.52
<i>Asia – Middle East/India</i>	73.72
<i>Asia – North America EC*</i>	78.15
<i>Asia – North America WC**</i>	74.20
<i>Asia – North Europe</i>	67.26
<i>Asia – Oceania</i>	92.80
<i>Asia – South America (EC/WC)</i>	80.57
<i>Europe (North& Med) – Africa</i>	88.67
<i>Europe (North& Med) – Middle East/ India</i>	76.19
<i>Europe (North& Med) – Oceania (via Suez/via Panama)</i>	101.52
<i>Europe (North& Med) – Latin America/ South America</i>	87.33
<i>Intra –Americas (Caribbean)</i>	102.28
<i>Intra – Asia</i>	76.14
<i>Intra – Europe</i>	72.75
<i>Mediterranean – North America EC (incl. Gulf)</i>	80.03
<i>Mediterranean – North America WC</i>	59.69
<i>North America EC – Middle East/ India</i>	84.20
<i>North America – Africa</i>	97.37
<i>North America – Oceania</i>	100.48
<i>North America –South America (EC/WC)</i>	84.96
<i>North Europe – North America EC (incl. Gulf)</i>	85.41
<i>North Europe – North America WC</i>	79.81
<i>South America (EC/WC) – Africa</i>	77.81
<i>Other</i>	78.55
<i>*EC = East Coast</i>	
<i>*WC= West Coast</i>	

Database scoring

For CO₂ emissions you fill in the applicable field.

For CO₂ emission performance the actual calculated CCWG data for the vessel is compared with the CCWG average (i.e. the reference) for the actual trade lane the vessel is using. If

more than one trade lane is used per year the arithmetic average for the actual trade lanes is the reference value. Depending if and how much below the reference the calculated CCWG value is, the correct option is selected by the database by clicking on the **Compute** button. Note that if you change or edit any CO₂ information you have to click the Compute button again.

Chemicals

Antifouling: The basis for scoring relies on what type of binder and what type of biocide that is included in the antifouling coating. A low-leaching but effective binder as for example hydrolysing SPC (self-polishing coating), do get scores when a more traditional CPD (controlled depletion polymer) does not. A general definition of an SPC may be that it is a binder which chemically reacts in sea water by hydrolysis and which segregate components which inhibits fouling.

An approach that scores higher is using SPC on the sides of the hull where fouling is most frequent, and a non-toxic coating on the whole bottom of the hull.

Non-toxic coatings i.e. coatings without chemical or biological activity and exempted from approval according to the Biocide Directive, do get high scores.

Only biocides accepted according to the EU Biocide Directive 98/8/EG Annex 1 (10) are allowed in the binders that scores. See table 1 below.

The data on antifouling of the vessel is found in the AFS certificate supplemented by the coating manufacturers, in the MSDS (Materials Safety Data Sheet) and in TDS (Technical Data Sheet). In certain cases a direct contact with the producer is needed. Random sampling may be done through coating analysis.

Note that the demands above are from the environmental point of view. The functional features are totally the producers' responsibility. If a non-toxic product is chosen it is of utmost importance that it has a good function. Otherwise it may result in negative impacts in other environmental areas like an increased fuel consumption or/and increased transport of invasive species.

Table1. Antifouling biocides applied for inclusion in Annex 1 to the EU Biocide Directive. (The only ones in question within foreseeable time, but all of them might not pass)

Name	CAS nr	Rapporteur Member State
Tolyfluanid	731-27-1	FI
Dichlofluanid	1085-98-9	UK
Copper thiocyanate	1111-67-7	FR
Dicopper oxide	1317-39-1	FR
Copper	7440-50-8	FR
Zineb	12122-67-7	IE
Pyrithione zinc	13463-41-7	SE
Bis(1-hydroxy-1H-pyridine-2-thionato-O,S)copper N'-tert-butyl-N-cyclopropyl-6-(methylthio)-	14915-37-8	SE
1,3,5-triazine-2,4-diamine	28159-98-0	NL
4,5-dichloro-2-octyl-2H-isothiazol-3-one	64359-81-5	N
Tralopyril	122454-29-9	UK
Medetomidine	86347-14-0	UK

Stern tube oils: The basis for scoring relies on the type of lubrication applied in the stern tube. Generally engine oils or gear oils based on mineral oil containing large amounts of additives, are used. Considerable amounts are leaking out in the oceans every year just by

normal operations, due to over-pressure of lubricant in the stern tube. Alternatives do however exist like lubricants based on biodegradable oil, water lubrication, or systems with technically advanced sealing systems (“air seal”).

The definition of a biodegradable oil is that each main component (>5% by weight) should have a biodegradation >60% within 28 days. Testing should be according to ISO 9439 (11) or ISO 10708 (12) but ISO 9408 (13) may be accepted if the theoretical oxygen demand (ThOD) and a time period of maximum 28 days are chosen in the method. The option “Not applicable” may be chosen if the vessel does not have a stern tube, for example if the propulsion is depending on azimuth thrusters only.

External hydraulic fluids: The basis for scoring relies on the type of external hydraulic system applied on board. Generally hydraulic fluids based on mineral oil are used, and in external application a leakage may lead to emission into the sea. There are several options for minimizing the risk for environmental damage. Namely the use of biodegradable fluids, the use of electrical power instead of hydraulic power or external hydraulic systems capped so that leakage will not reach the sea. The definition of a biodegradable hydraulic fluid is the same as for stern tube oils (see above).

Gear oils for thrusters and/or controllable pitch (CP) propellers: The basis for scoring is what type of gear oil that is used in thrusters and/or CP propellers. The option possible is using biodegradable gear oils in these applications. The definition of biodegradable gear oil is the same as for stern tube oils (see above). The option “Not applicable” may be chosen only when no thrusters **and** no CP propellers are installed.

Boiler-/ cooling water treatment: The basis for scoring is avoiding the use of chemical products, **or** components in the products, classified as carcinogenic, mutagenic or toxic to reproduction (CMR), according to the EU Dangerous Substance Directive (14). Additionally you should avoid the use of chemical products classified as sensitizing, toxic or dangerous for the environment according to the DSD directive, with the exclusion of nitrite. Nitrite is toxic but neither bioaccumulating nor persistent. Information on the features mentioned above should be found in the MSDS (Material Safety Data Sheets) for the chemical products in question.

Cleaning agents: The basis for scoring is avoiding the use of chemical products **or** components in the products, classified as carcinogenic, mutagenic or toxic to reproduction (CMR), according to the EU Dangerous Substance Directive (14). Additionally you should avoid the use of detergents classified as dangerous for the environment according to the DSD directive or with limitations in the EU Regulation on detergents (15). Organic solvents classified and with risk phrases on health and environmental danger according to DSD directive, should be avoided. The above information should be found in the MSDS (Material Safety Data Sheets) for the products in question. Detergents, surfactants or other components that disturb the installed bilge water treatment should be avoided. Information on approved surfactants is usually found on the website of the bilge water cleaning equipment manufacturer.

Refrigerants: The basis for scoring is what type of refrigerants that are used in cargo refrigerant plants, centralised air-conditioning and refrigeration systems installed on board. All these refrigerants have to comply with the demands. Reefer refrigerants are not included. The focus is put on ozone layer depletion potential (ODP) and global warming potential (GWP) as defined by the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer (16). The ODP number is correlated to the effect of R 11(CFC) and the GWP number is correlated to CO₂. For scoring the refrigerants should be natural (NH₃, CO₂) or HFC (Hydro Fluoro Carbon) with ODP number= 0 and the GWP number <3500. Additional points are achieved if the GWP is below 1850. The information should be found in the MSDS (Material Safety Data Sheet) and TDS (Technical Data Sheet) for the refrigerants in question.

Water and waste control

Ballast water treatment: The basis for scoring is how international vessels are treating their ballast water for to hinder transport of invasive species. For regional and coastal shipping the natural habitat borders should be respected but they are normally excluded and may fill in the option “Not applicable”. Ballast water exchange receives scoring but is not a final solution due to safety reasons, and fresh water could enhance growth of remaining organisms. Ballast water exchange should be conducted according to the proposed Ballast Water Convention (17) with corresponding guidelines (18). The Convention is still not fully ratified (June 2009). Information on ballast water exchange should be found in the Ballast Water Record Book or its equivalence.

Ballast water management systems which received Type Approval Certification following Final Approval by IMO (19) get full scoring.

Sewage/ black water: The basis for scoring is how sewage water is treated in PSSAs (Particularly Sensitive Sea Areas). The options are either an approved sewage treatment plant according to MEPC (20) – Certificate of Type Approval for Sewage Treatment Plant – and a control of its usage and function through a maintenance record. An alternative option is that no sewage discharge in PSSAs can be shown through operation manuals.

Table 2. Particularly Sensitive Sea Areas (see next page)

the Great Barrier Reef, Australia (designated a PSSA in 1990)

the Sabana-Camagüey Archipelago in Cuba (1997)

Malpelo Island, Colombia (2002)

the sea around the Florida Keys, United States (2002)

the Wadden Sea, Denmark, Germany, Netherlands (2002)

Paracas National Reserve, Peru (2003)

Western European Waters (2004)

Extension of the existing Great Barrier Reef PSSA to include the Torres Strait (proposed by Australia and Papua New Guinea) (2005)

Canary Islands, Spain (2005)

the Galapagos Archipelago, Ecuador (2005)

the Baltic Sea area, Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland and Sweden (2005)

the Papahānaumokuākea Marine National Monument, United States(2007)

Garbage handling: The basis for scoring is the garbage handling on board. There should be no incinerator on board or documentation of no incineration of garbage. Additionally there should be no waste overboard – food waste excluded – and separate garbage handling for reuse, recycling and disposal. This information should be found in the Garbage Record Book on board and the Garbage Management Plan according to Annex V in MARPOL 73/78 (21).

Sludge oil handling: The basis for scoring is the handling of sludge oil on board. There should be no incinerator on board or documentation of no incineration of sludge oil. Additionally there should be documented disposal of sludge oil to treatment facilities on shore. This information should partly be found in the IOPP (International Oil Pollution Prevention) Certificate according to MARPOL Annex I (22), or found in operating manuals on board.

Bilge water treatment: The basis for scoring is how the bilge water is treated on board. The complexity of bilge water mixtures today often results in stabile oil/water emulsions, hard to be broken in traditional gravimetric separators. Scoring is received only if active treatment equipment is installed, calibrated and a documented emission of <5ppm oil in the

disposed bilge water. This information should partly be found in the IOPP Certificate according to MARPOL Annex I (22), or found in operating manuals on board. Additional scoring can be received if an emission control box is installed. The box reassures that no oily water discharge is occurring and will register position and time continuously.

Crew awareness: The basis for scoring is a documented education for all crew on board with special emphasis on engine room personnel and handling of heavy fuel oil.

Submit: Below the questionnaire you will find a button saying Submit. When clicking on this button, all the information above will add into the database. However if there is some important compulsory information missing, nothing will be submitted to the database and the errors will show on the top of the page. The information has to be completed and another Submit click has to be done to get the information into the database. Congratulations – you may now automatically see **Vessel information** on the vessel you just added.

VESSEL INFORMATION RESULTS

You may continue to add or edit other vessels. If you have vessels with identical performance data you may use the function **use as template** on the top of the page which only erases IMO number and ship name of the vessel showing. If you sell or anchor up your vessel for a long period you may also delete all info by enter **delete vessel**. This will erase the vessel from the database.

The vessel information page will present a spider diagram of the five different environmental areas and the scores for this specific ship. Putting the pointer on the different breaking points in the diagram will show the score percentage you have reached in these different areas for your ship.

The total score will be shown putting the pointer on the coloured performance field below. The performance levels are defined in the field but in more detail in the Clean Shipping Recommendations chapter below.

Under Routes at the bottom of the page you may enter **view in chart**. In the spider diagram an orange line now will show the mean values for all vessels of the same type in the database on that specific route. Your ship is not included in these mean values.

To see all the detailed information you have presented on your ship you may enter **view questionnaire** at the absolute bottom of the page.

CARRIER HOME RESULTS

When all your ships are added or edited you may view the result under **Carrier/ Home**. If you enter **list of vessels** on the top of the page you will see a ranking of all ships you have added. If you have different types of vessels in your fleet you may select only one type and rank them towards each other. A blue colouring is indicating how well you perform environmentally going from dark with low performance to very light with good performance. These colours are not connected with the Clean Shipping Recommendation colours but are used mainly for illustrative purposes.

If you want to rank your vessels according to some specific environmental field you may click on some of the orange headlines on the top of the table like **CO2** or **Chemicals**.

If you want to go back to Vessel Information for any of your ships you may click on the orange **IMO number** in the table.

If you want to change anything concerning carrier information you just click on **edit information** as described in the beginning of this document.

A chart is showing at the top of the page. This is presenting the **total weighed carrier ranking** in the database with your company designed as a red star. The weighed ranking means that the percentage of reported ships of the totally owned fleet is multiplied with the total score. By putting the pointer on the different (unnamed) carriers you will see their total weighed score.

If you go down the page to Ranking and enter the orange ranking figures by the type of ship, the top chart will update to show the weighed ranking for that type of carriers. This is probably the most adequate comparison as the same types of carriers are compared.

Under Vessel Count and reported vessels you may enter **view vessel ranking**. This is the same page as **list of vessels** mentioned above

Getting a vessel verified by a approved verifier (see Verification Guidelines on our homepage) will give the vessel and the carrier access to the top of the ranking table, passing all unverified vessels and carriers, competing only with scores of verified vessels and verified carriers. This will be shown by a star by the vessel or the carrier. The verification document will be found on the actual vessel or carrier page

STATISTICS

Under the **Statistics/ Search** function you may search the database for your own ships by adding constraints as routes, type of vessel, owned chartered, verified and environmental management systems.

Under the **Statistics/ Mean Comparison** function you can compare the mean values for all your vessels compared to all other vessels in the database of the same type and on the same route. Your vessel is in that case not included in the mean values of the database.

Under the **Statistics/ Vessel ranking** you enter the same page as **list of vessel** and **view vessel ranking** mentioned above.

VESSEL SCORING

The scoring system is divided into five areas with a maximum total score of 150 p. The five areas have maximum score of 30 p each, and they are all important to address. However it is difficult to scientifically compare different type of emissions with exact figures. The scoring system may be seen as a tool to estimate how well a vessel is performing in each area. The weighing together of the score gives a hint of the overall performance but must be judged with reason and used as a platform for more detailed discussions in for example a procurement situation.

The score selection is made so there is room for development. Ideally the scoring should not have to be changed over time so a comparison could be done for example between procurement intervals.

SOx and PM: 20% of 150p = Max 30p

SOx/PM main engines (if operating *only* outside or *only* inside ECAs, fill in that option and the value doubles)

Operations in non-ECAs and ECAs (total yearly average)	No data	0
	Operation <i>only</i> in ECAs (ECA scoring doubles)	0
	Fuel quality $\geq 2.5\%$ S	0
	Fuel quality $< 2.5\%$ S	1
	Fuel quality $< 2.3\%$ S	2
	Fuel quality $< 2.0\%$ S	3
	Fuel quality $< 1.5\%$ S	5
	Fuel quality $< 1.0\%$ S	7
	Fuel quality $< 0.5\%$ S	9
	LPG/LNG/Biogas	10
Operations in ECAs (yearly average)	No data	0
	Operation <i>only</i> in non-ECAs (scoring above doubles)	0
	Fuel quality $\geq 1.0\%$ S	0
	Fuel quality $< 1.0\%$ S	3
	Fuel quality $< 0.8\%$ S	5
	Fuel quality $< 0.5\%$ S or MDO $< 1\%$ S	7
	Fuel quality $< 0.1\%$ S	9
LPG/LNG/Biogas	10	
Harbour Bonus: main/aux engines, boilers	Fuel quality $> 0.1\%$ S in harbour areas	0
	Fuel quality $< 0.1\%$ S in harbour areas	3
SOx/PM aux. engines:	No data	0
	Fuel quality $> 0.1\%$ S	0
	Fuel quality $\leq 0.1\%$ S – included use in boilers	6
	Shore-side electricity – included use of $\leq 0.1\%$ S	7
	LPG/LNG/Biogas	7

NOx: 20% of 150p = Max 30p

NOx main engines:	No data	0
	Engines 2000-2011, above or within Tier 1 levels	0
	Engines prior year 2000, Tier I levels	6
	Engines prior year 2011, Tier II levels	9
	$\geq 40\%$ below Tier I levels Tier III levels	15 21
NOx aux. engines:	No data	0
	Engines 2000-2011, above or within Tier 1 levels	0
	Engines prior year 2000, Tier I levels	2
	Engines prior year 2011, Tier II levels	3

≥ 40% below Tier I levels	6
Tier III levels or when shore-side electricity is installed and used	9

CO₂: 20% of 150p = Max 30p

CO ₂ emission information:	No data	0
	CO ₂ per TEU-km according to CCWG	3
	CO ₂ per tonne-nm according to MEPC (EEOI)	3
CO ₂ emission performance EEOI	No data	0
	20% above reference or more	0
	<20% above reference	3
	<15% above reference	6
Ref value.....	<10% above reference	9
	<5% above reference	12
	Reference value or below	15
	>5% below reference	18
	>10% below reference	21
	>15% below reference	24
	>20% below reference	27

CO ₂ emission performance CCWG	No data	0
	Reference value or above	0
Ref value.....	< Reference value	3
	> 5% below reference	6
	> 10% below reference	9
	> 15% below reference	12
	> 20% below reference	15
	> 25% below reference	18
	> 30% below reference	21
	> 35% below reference	24
> 40% below reference	27	

Chemicals: 20% of 150p = Max 30p

Antifouling:	No data	0
	Other	0
	Controlled depletion polymer (CDP)	0
	Self-polishing coating (SPC), only accept. Biocides)	3
	SPC on sides (only acceptable biocides) and non-toxic bottom	5
	Non-toxic	7
Stern tube oil:	No data	0
	Mineral oil based	0
	Air seal	3
	Based on biodegradable oil	5
	Water lubrication	7
	Not applicable	7
External hydraulic fluids:	No data	0
	Mineral oil based	0
	External hydraulics exchanged to electrical power	3
	Based on biodegradable oil	3
	External hydraulic system capped	3
Gear oils for thrusters and controllable pitch(CP) propellers:	No data	0
	Mineral oil based	0
	Based on biodegradable oil	5
	Not applicable	5
Boiler/ cooling water treatment:	No data	0

	Classified as CMR, toxic, sensitizing or dangerous to the environment	0
	Not classified as above (nitrite exclusive)	2
Cleaning agents:	No data	0
	Classified as CMR, dangerous to the environment or toxic	0
	Not classified as above	3
Refrigerants:	No data	0
	Non-natural (excluding the HFCs below)	0
	HFCs complying with GWP < 3500 and ODI = 0	1
	Natural (NH ₃ , CO ₂) or HFCs complying with GWP < 1850 and ODI = 0	3
Water and waste control: 20% of 150p = Max 30p		
Ballast water treatment	No data	0
	No treatment	0
	Ballast water mid-ocean exchange	3
	IMO final approval	10
	Not applicable	10
Sewage/ black water	No data	0
	No treatment	0
	No discharge in sensitive areas (PSSA) or sewage treatment plant onboard	3
Garbage handling	No data	0
	Incinerator used on board	0
	Waste overboard	0
	No incinerator onboard or documented no incineration of garbage and no waste overboard and separate garbage handling for reuse, recycling and disposal	3
Sludge handling	No data	0
	Incinerator used onboard	0
	No incinerator onboard or documentation of no incineration of sludge and disposal of sludge to treatment on shore	4
Bilge water treatment	No data	0
	Gravimetric separation	0
	Active treatment installed and < 5ppm oil in outgoing water	5
	Active treatment installed and < 5ppm oil in outgoing water and emission control box in place	7
Crew awareness	No data	0
	Documented education of personnel on environmental awareness, health risks and adequate protective equipment	3

CLEAN SHIPPING RECOMMENDATIONS

Using this database as a tool for selecting environmentally enhanced vessels and carriers, it is up to the cargo owner to set the criteria on how the selection shall be performed.

However the Clean Shipping Project would like to give some recommendations defining three levels of environmental performance in the colours of red (“low performance”), yellow (“medium performance”) and green (“good performance”).

In the database the colours are showed both on carrier basis and on vessel basis. They could exist separately so for example a “green” carrier does not have to have only “green” vessels. The green or good performance would refer to carriers with at least 90% of the vessels reported, the carrier verified and the total weighed scoring 40% or above. The yellow carriers with medium performance are those with at least 10% in total weighed score and reporting at least 20% of their owned/managed fleet. The red or low performance are those with total weighed score less than 10% or reporting less than 20% of their owned/managed fleet.

Transferring the recommendation colours to vessels, the green would refer to vessels with verified information and scoring at least 50% in total, at least 35% in all five major fields and scoring in all subgroups under Chemicals and Waste & Water. The yellow would refer to vessels scoring at least 20% total score and the red would refer to vessels scoring below 20%.

This could be summarized in a table:

	Carriers	Vessels
GREEN	≥90 % vessels reported, the carrier verified, ≥ 40% weighed total score	The vessel verified, total score ≥ 50%, ≥ 35% score in all five fields
YELLOW	≥ 20% vessels reported ≥ 10% weighed total score	Total score ≥ 20%
RED	< 20% vessels reported or, < 10% weighed total score	Total score < 20%

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