CLEAN SHIPPING INDEX

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Methodology and Reporting Guidelines

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About the Clean Shipping Index

Clean Shipping Index is an independent reporting and labelling system of the environmental performance of ships and shipping companies.

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The process for registering vessels in Clean Shipping Index

The shipping company requests a login via the form under "registration & certification" on www.cleanshippingindex.com

CSI creates a user account and sends login details to the shipping company

The shipping company downloads the Methodology and Verification Guidelines and familiarizes with the publication, logs in to CSI and adds vessel(s) through answering the questionnaire ("self-assessment"). Finished questionnaire gives CSI Score and CSI Class

The shipping company asks accredited verification companies, listed under "registration & certification" on CSI's website, for quotes and e-mails info@cleanshippingindex.com when a verifier has been chosen

CSI gives the verifier access to the shipping company's vessels in the database

The verification company audits the vessel and verifies the answers in the questionnaire. When done, a digital certificate with three year validity is automatically generated and can be downloaded via the database

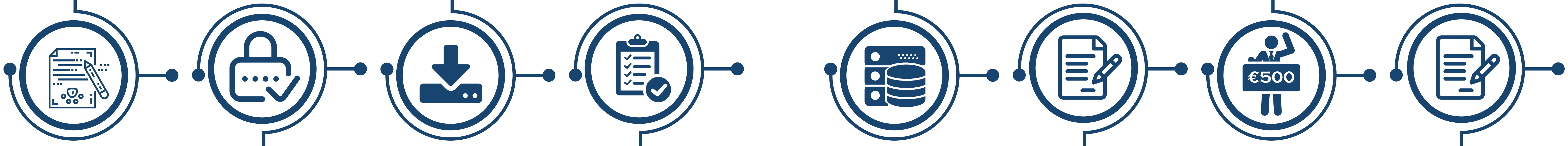
The shipping company reviews the result and any issues are to be solved between the shipping company and the verifier

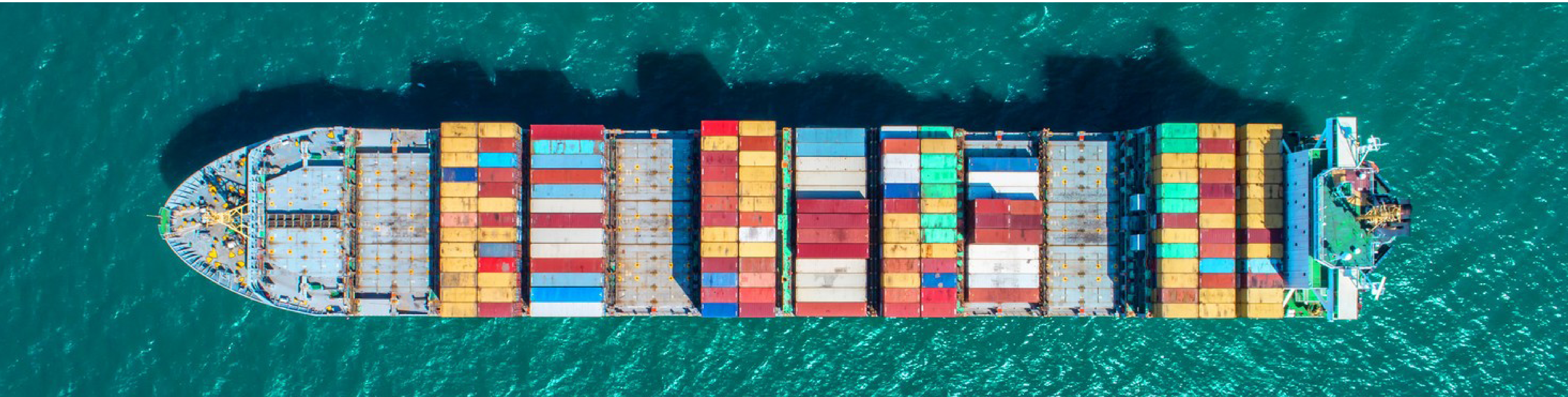
CSI charges an administrative fee of €500 for issuing the certificate. This is a fixed fee and will be invoiced via the verification company

Shipping companies can at any time login to CSI and edit the answers on the questionnaire. It is recommended to have the self-assessment aligned with the verified questionnaire

Verifiers can at any time update the certificate, which does not change the validity period for the certificate.

Important: Emissions of CO_2, SO_X and Particulate Matter need to be verified annually





2. CLEAN SHIPPING INDEX: HOW DOES IT WORK?

2.1 General overview and environmental parameters

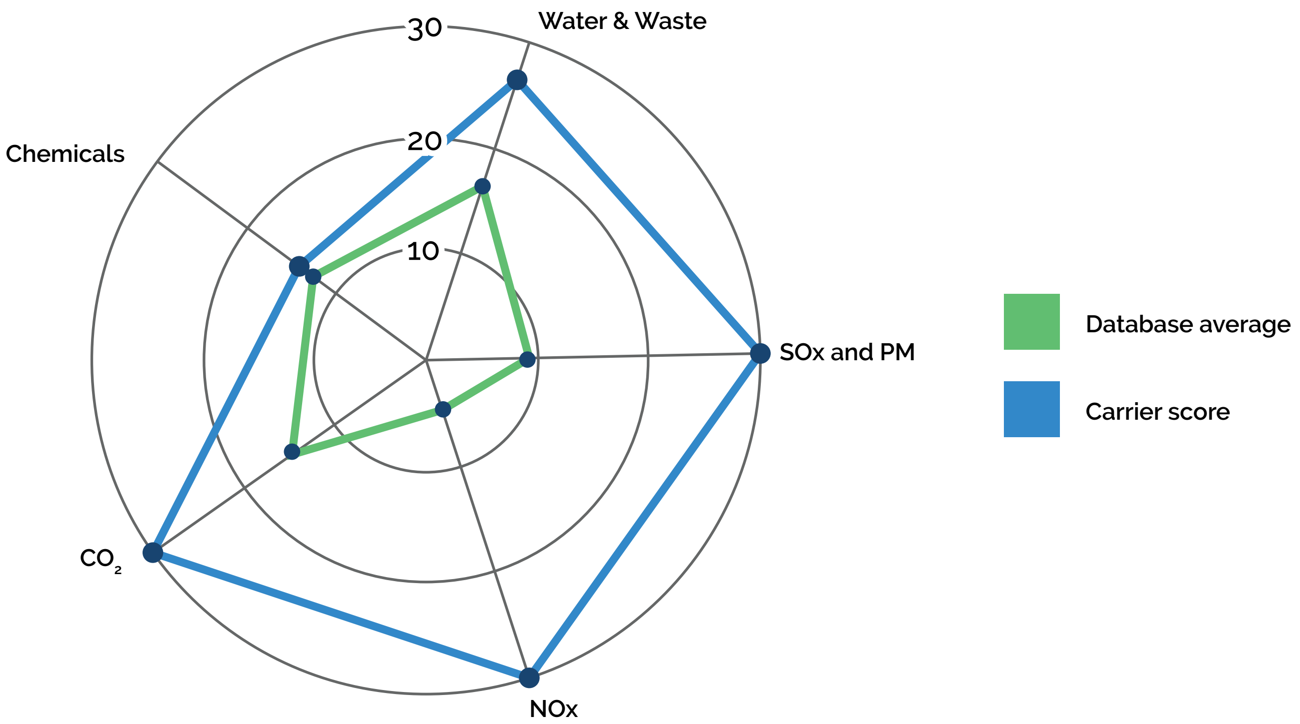
This section provides an overview of how the Clean Shipping Index works. For detailed guidance on the methodology please read chapter 3.

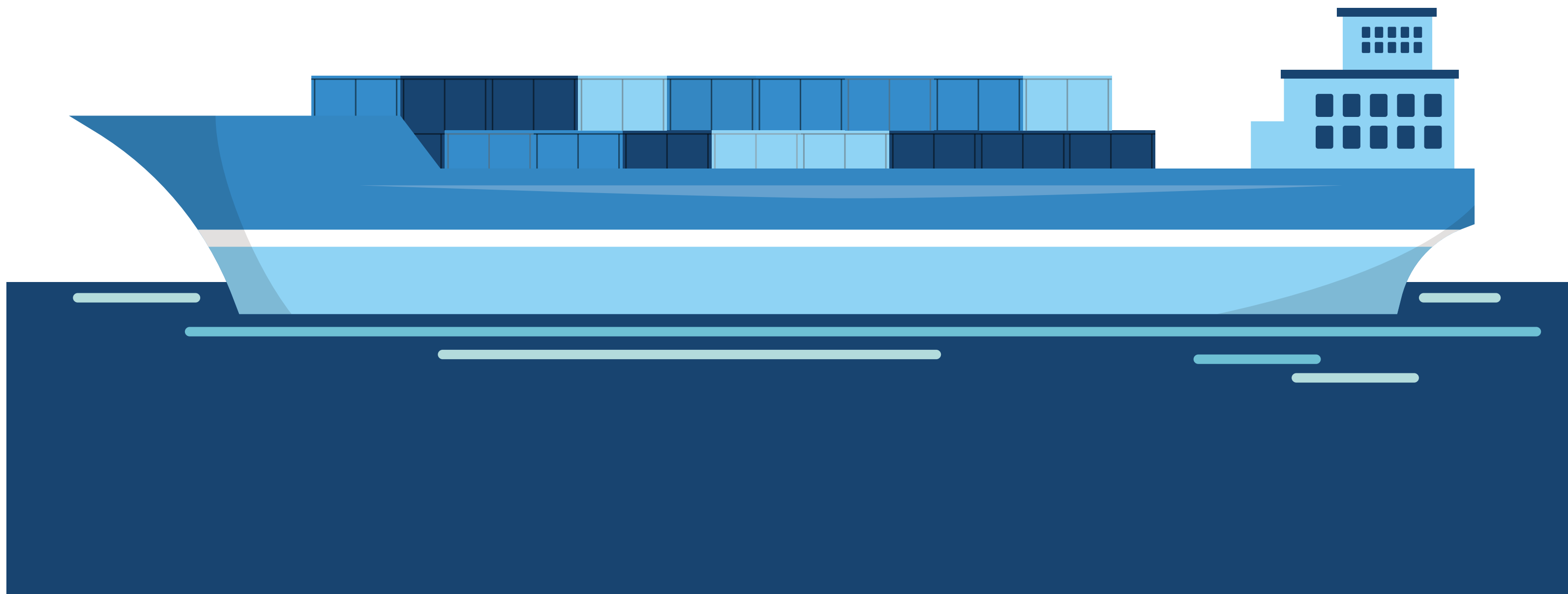
The Clean Shipping Index tool consists of a questionnaire of 25 basic questions on environmental performance of ships. They all go beyond existing rules and regulations and cover existing ships of different types.

Clean Shipping Index environmental parameters	*Environmental and health effects*
CO_2 emissions	Major greenhouse gas leading to climate change
Nitrogen oxides (NO_x) emissions	Smog formation and the formation of tropospheric ozone are harmful for the human respiratory system. Acidic precipitation affects growth of vegetation and has adverse effects on freshwater bodies. NO_x deposition also contributes to eutrophication.
Sulphur oxides (SO_x) emissions	Harmful for the human respiratory system. SO_x reacts with other compounds contributing to particulate matter (PM) pollution. Acidic precipitation affects growth of vegetation and has adverse effects on freshwater bodies.
Particulate matter emissions	Causing smog, harmful for the human respiratory system and the heart. Fine particles penetrate the lungs deeply when inhaled. Ultra fine particles can enter the bloodstream and may cause damage to the cardiovascular system.
Use of chemicals	Many chemicals used onboard are toxic for the environment, affect reproduction, are persistent and/or bioaccumulate in the marine environment. This also leads to pollution of the food chain.
Water and waste management	Discharges of waste water and waste pollute the oceans. Microplastics bind metals and pollute the food chain.

For the scoring of CO_2, the vessel efficiency is compared to a reference vessel of the same type and size, calculated mainly using data published by the International Maritime Organization (IMO). For all the other parameters, points are in principle given for exceeding legal compliance of environmental performance. For NO_x, the level of NO_x emissions defined by the Tier levels set by the IMO serve as the reference for scoring. The basis for scoring in SO_x and PM is how much sulphur is present in the fuel, or whether the exhaust gases are treated. In the chemicals section, shipping companies are asked to fill in questions about the chemical used in antifouling paint, the type of stern tube oil, hydraulic fluids and gear oils used, the type of boiling cooling water treatment system installed, the chemicals present in cleaning agents used and the type of refrigerants applied. Environmentally adapted solutions give a score. The waste water section covers the treatment of sewage and grey water, management of solid waste, sludge oil handling and bilge water treatment. The weighting is based on the input data for the questions about environmental parameters in the questionnaire. Data is entered on a vessel by vessel basis. All vessels in a carrier's fleet add up to a total carrier score. The total carrier score is the average score of all owned vessels. For owned, but unreported vessels a null score is given. The scoring of a vessel on each of the environmental parameters can be viewed in comparison to the database average for that type of vessel and compared to the carriers average scores, as shown in the spider chart in Figure 1.

Figure 1. Representation of environmental scores on each of the different environmental parameters.

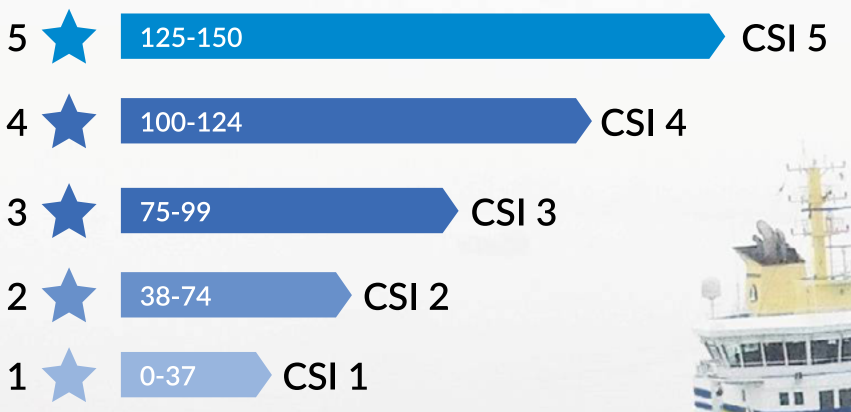




METHODOLOGY

2.2 Classification and verification

Figure 2. Graphical representation of the points in the CSI scheme.



2.3 The Clean Shipping Index Label

As a shipowner you can view the scores of your vessels, also in comparison to vessels of other shipping companies. You may thus compare the performance to other vessels of the same type and identify areas for improvement. Contact the Clean Shipping Index secretariat for possibilities of receiving a feedback report with an analysis of the environmental performance of the vessels entered in the database. Members who have access to the database all sign a confidentiality agreement. The data can be viewed by the members who wish to provide economic incentives for clean shipping: cargo owners, forwarders, ports, authorities and providers of clean technology. Banks and investors may use the Clean Shipping Index as guidance when investing in new ships. By submitting the data into the database, shipowners approve of sharing the data with the Clean Shipping Index.

3.1 Calculating and reporting CO_2 emissions

3.1.1 Options for calculating and reporting CO_2 emissions

Information needed is cargo carried, the distance travelled and the fuel consumption covering a 12-month period.

EEOI OR MRV

Calculated CO_2 emissions in grams per tonne-nautical mile (tonne-nm). The efficiency must be calculated according to IMO's Energy Efficiency Operational Indicator (EEOI) (3).

An MRV figure expressed in CO_2/TonneNm (or TEUkm) is accepted, provided it represents 50% or more of the total (global) distance travelled during the period (i.e. the MRV reporting period).

CRUISE & PASSENGER VESSELS

For Cruise and Passenger ships, the EEOI is calculated as grams CO_2 per passenger-nautical mile (passenger-nm).

ROPAX

*Factors for RoPax; total CO_2 emissions and the combined transport work of freight (in tonne-Nm) and passengers (in passenger-Nm), for the 12-month period is concerned. The EEOI is automatically calculated by the database as follows: EEOI = gCO_2 per year / (transport work of freight + 0.7 * transport work of passengers)*

CONTAINER VESSELS

Calculated CO_2 emissions in grams per TEU-kilometer for container vessels, calculated according to CCWG CO_2 calculation formula (4) (26). This only applies to container ships.

NEW VESSELS

The scoring is based on how the vessel's EEDI relates to the EEDI requirement/regulatory limit, yet the figure is reported as an EEOI figure in CSI by following calculation (example): A vessel's EEDI is 20 gram CO_2/DwtNm (or any other unit). The regulatory limit is set to 40 gram CO_2/DwtNm. This gives a factor of 0,5 (20/40). Assuming CSI's EEOI reference line is set to 50 gram CO_2/TonneNm, then your EEOI figure to report in CSI will be 25 gram CO_2/TonneNm (0,5 x 50). To view CSI's EEOI reference line you'll need to enter all ship specifications required and enter a temporary fictive value for CO_2/TonneNm. (The full method is also applicable for CO_2/TEUkm).

PLUG-IN BATTERY POWERED VESSELS

These vessels are considered to have zero CO_2 emissions. When a 12 month period has passed, the actual fuel consumption should be considered, if any bunker has been consumed.

The reported CO_2 emissions are compared against a reference value of vessels of the same type and size. The better the vessel performs compared to the reference value, the higher the score.

Note: Clean Shipping Index applies a carbon factor of zero (0) for renewable fuels when calculating CO_2 emissions per TonneNm (EEOI) or TEUkm (CCWG).

3.1.2 CO_2 calculation of the reference value following the EEOI

See appendix 5 for description of CSI's reference value calculations, which are automatically performed and the basis for scoring.

3.2 NO_x emissions

The NO_x emission levels Clean Shipping Index uses as reference for scoring are the same levels as defined in the Tier I, II and III in MARPOL Annex VI, with one exception.

Between Tier II and III there are two levels included to reward different NO_x reduction techniques. From 2021-01-01 Tier III levels will apply for new ships in the NECAs in the North- and Baltic Sea. The scoring will therefore change from this date and only relate to the Tier III level. During a transition period older Tier III ships will receive points for NO_x and ships with emissions lower than Tier III will receive more points.

Data should be presented for both the main engine as well as the auxiliary engines. For ships without auxiliary engines, the scoring for the main engines is increased to get the same possible points. In case shore-side electricity is installed and used in all applicable harbours, the maximum score for auxiliary engines applies.

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 NO_x Technical Code 2008, demonstrating that the claimed application cycle value is being achieved (6).

Measurements performed in accordance with the NO_x Technical Code 2008 that show low NO_x emissions also score (75% load factor on ME and 50% load factor on AE). This might be the case for LNG-powered vessels with Tier II certificated engines. Measurements done by accredited institutions are also accepted.

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

Measurements of NO_x emissions according to the regulations by the Swedish Maritime Administration are also accepted (7). Note: last certificates were issued 2017-11-14.

If Selective Catalytic Reduction (SCR) is installed as a post-combustion reduction technique there must not be an ammonia-slip (NH_3) above 20 ppm, following the Swedish Maritime Administration regulations (7).

If none of these options are at hand, NOx data should be calculated by default factors found in Section 3-19-9 in the Tax on emissions of NO_x in Norway (8). See also Table 1, 2 and 3 of appendix 4: NO_x factors and emission conversion factors for main and auxiliary engines.

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 g/kWh * y kW = xy;

Engine 2: z g/kWh * a kW = za

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

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

When plug-in battery power is clamed, its required utilization must be 90% of the operational time at minimum, or non-utilization must have been caused by external factors that can be proven. A 12-months rolling period is considered with an exemption for new ships and retrofits.

3.3 SO_x and PM emissions

The basis for scoring in SO_x and PM is how much sulphur is used in the fuel, or whether the exhaust gases are treated. Total average of sulphur in all fuel used on board as percentage by weight, over a 12-month rolling period, are considered. Main engines and auxiliary engines are scored. A distinction in the scoring is made between the sulphur emitted in and outside Emission Control Areas (ECAs). For new vessels, the calculation is based on any fuel order basis.

Sulphur testing procedures should follow the Revised MARPOL Annex VI (6).

Highest points are given for operation with 'minimum sulphur fuels' with a weighted average of < 50 ppm. Minimum sulphur fuels refer to fuels such as LNG and methanol.

The use of abatement technology is accepted (for SO_x but not for PM) when compliant with MARPOL Annex VI. I.e. the corresponding total emission weight of sulphur dioxides should not exceed 6.0g SO_x/kWh when a fuel sulphur content of 1.5% is claimed or required. Additionally 4.0g SO_x/kWh corresponds to 1% Sulphur and 2.0g SO_x/kWh to 0.5% Sulphur etc (see Marpol Annex VI) .

Since the amount of sulphur emissions and particulate matter emissions correlate, the basis for scoring in the PM section is the average sulphur content in fuels for main and auxiliary engines used during 12-month rolling period.

In addition, measured PM emissions are also accepted. Points are given for low PM emissions if the emission factors for the engines are measured using ISO 8178 and the weighted average of the engines is calculated.

When shore-side electricity or plug-in battery power is claimed, the same requirements as for NO_x apply.

3.4 Chemicals

In the Chemicals section, Clean Shipping Index rewards points to environmentally adapted solutions used. The criteria Clean Shipping Index applies are from an environmental point of view. The functional features are the producers´ responsibility.

3.4.1 Antifouling

The basis for scoring relies on what type of biocide and what type of binder is included in the antifouling coating. A low-leaching but effective binder, as for example hydrolysing SPC (self-polishing coating) together with acceptable biocides, gets scores. A more traditional controlled depletion polymer (CDP) 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 inhibits fouling. Only biocides accepted according to the EU Biocide Directive 98/8/EG Annex 1 (10) are allowed in the binders in order to get a CSI score. See Table 6 below.

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

Table 6. Antifouling biocides included in Annex 1 to the EU Biocide Directive.

Name	CAS nr
Tolylfluanid	731-27-1
Copper thiocyanate	1111-67-7
Dicopper oxide	1317-39-1
Copper	7440-50-8
Zineb	12122-67-7
Bis(1-hydroxy-1H-pyridine-2-thionato-O,S)copper	14915-37-8
4,5-dichloro-2-octyl-2H-isothiazol-3-one	64359-81-5
Tralopyril	122454-29-9
Medetomidine	86347-14-0
Dichlofluanid	1085-98-9

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

3.4.2 Stern tube oils

Traditionally, engine oils or gear oils based on mineral oil containing additives are used. Operational spillage occurs due to over-pressure of lubricants in the stern tube.

Alternatives such as lubricants based on biodegradable oil, water lubrication, or systems with technically advanced sealing systems ('air seal') have less impact on the marine environment and score in Clean Shipping Index.

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 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 dependent on azimuth thrusters only.

3.4.3 External hydraulic fluids

In general, hydraulic fluids based on mineral oil are used. In external applications leakages may occur. There are several options for minimizing the risk for leakage. Biodegradable hydraulic fluids, the use of electrical power instead of hydraulic power or external hydraulic systems capped so that leakages will not reach the sea. These solutions score in the Clean Shipping Index. The definition of a biodegradable hydraulic fluid is the same as for stern tube oils as described above.

3.4.4 Gear oils for thrusters and/or controllable pitch propellers

The use of biodegradable gear oils score in the Clean Shipping Index. The definition of biodegradable gear oil is the same as for stern tube oils (see above). The option 'Not applicable' also scores and should be selected when no thrusters and no CP propellers are installed.

3.4.5 Boiler-/ cooling water treatment

The basis for scoring is the avoidance of 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 (DSD) (14). Additionally, the use of chemical products classified as sensitizing, toxic or dangerous for the environment according to the DSD directive should be avoided, with the exclusion of nitrite. Nitrite is toxic, but is not bioaccumulating or persistent.

Information on the features mentioned above are stated in the Material Safety Data Sheets (MSDS) for the chemical products in question.

3.4.6 Cleaning agents

As with boiler cooling water treatment, the basis for scoring on the use of cleaning agents is the avoidance of 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 (DSD) (14). Additionally, 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) should be avoided. Organic solvents classified and with risk phrases on health and environmental danger according to DSD directive, should also be avoided. The above information can be found in the Material Safety Data Sheets (MSDS) 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.

3.4.7 Refrigerants

Clean Shipping Index considers the type of refrigerants that are used in cargo refrigerant plants, centralised air-conditioning and refrigeration systems installed on board. A score is given when all refrigerants applied comply with the Clean Shipping Index standard. 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).

For scoring, the refrigerants should be natural (NH_3, CO_2) 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 Material Safety Data Sheet (MSDS) and Technical Data Sheet (TDS) for the refrigerants in question.

Table 7. Particularly Sensitive Sea Areas. The year of the designation as PSSA is given in parenthesis

The Great Barrier Reef, Australia (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)

3.5 Water and waste control

The waste water section covers the treatment of sewage and grey water, management of solid waste, sludge oil handling and bilge water treatment.

3.5.1 Sewage

The options that score are either 1) 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, or 2) that no sewage discharge in Particularly Sensitive Sea Areas (PSSAs) can be shown through operation manuals. In Table 7 below the PSSAs are listed.

3.5.2 Grey water

The options that score are either treating the grey water with the black water in 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 grey water discharge in PSSAs can be shown through operation manuals.

3.5.3 Garbage handling

For a score in CSI, 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 discharge. 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).

3.5.4 Sludge oil handling

As with garbage, there should be no incinerator on board or documentation of no incineration of sludge oil for a CSI score. 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.

3.5.5 Bilge water treatment

The basis for scoring is how the bilge water is treated on board or whether it is discharged to an onshore facility. The complexity of bilge water mixtures today often results in stable oil/water emulsions, hard to be broken down 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 ensures that no oily water discharge occurs and will continuously register position and time.

3.5.6 Crew awareness

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

3.6 Other issues

The environmental paramaters described in section 3.1 to 3.5 are used to calculate a total CSI score. The parameters all concern operational emissions and leakages that occur during the normal use of a vessel. Apart from the operational questions, Clean Shipping Index also requires shipping companies to report about end-of-life vessel handling on a company policy level. The European Shiprecycling Regulation serves as the reference. It is not included in the CSI scores.

The Clean Shipping Index is a dynamic index. When regulations change, or when new techniques or solutions enter the shipping market, the criteria may need to change or be removed. During 2017, the question on ballast water management was removed from the CSI questionnaire due to the implementation of the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention).

The parameters are reviewed annually by a technical committee with experts on air emissions, ecotoxicology, ship construction, environmental policy and -science.

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APPENDIX 1. CALCULATIONS FOR RORO VESSELS

Following MEPC 64/4/14 and MEPC 64/4/4, fj_{RoRo} is calculated as follows:

$$F_{JRORO} = \frac{1}{Fn_L^{\alpha} \times \left(\frac{Lpp}{Bs}\right)^{\beta} \times \left(\frac{Bs}{Ds}\right)^{\gamma} \times \left(\frac{Lpp}{\frac{1}{\Delta 3}}\right)^{8}};$$

where FnL is the Froude's number:

$$Fn_L = \frac{0.5144 \times V_{ref}}{\sqrt{L_{pp} \times G}};$$

G is the gravitational acceleration;

L_{pp} is the Length between perpendiculars in m;

v_{ref} is the ship's reference Speed in knots;

B_s is the Breadth in m;

d_s is the Draught (at summer load) in m;

Δ is the Volumetric displacement in m^3 (multiply by 1.025 to get Δ in tonnes).

The exponents α, β, γ and δ are 2.00, 0.50, 0.75 and 1.00, respectively, for RoRo ships; and 2.50, 0.75, 0.75 and 1.00, respectively, for RoPax ships.

APPENDIX 2. ICE-CLASS CORRECTION FACTORS

f_i values for ice-classed ships adopted by the IMO. Note that the minimum value is 1.

Ship type	f_i	Limits depending on the ice class			
		IA Super	IA	IB	IC
Tanker	$\frac{0.00138L_{pp}^{3.331}}{capacity}$	max $2.10L_{pp}^{-0.11}$, min 1.0	max $1.71L_{pp}^{-0.08}$, min 1.0	max $1.47L_{pp}^{-0.06}$, min 1.0	max $1.27L_{pp}^{-0.04}$, min 1.0
Bulk carrier	$\frac{0.00403L_{pp}^{3.123}}{capacity}$	max $2.10L_{pp}^{-0.11}$, min 1.0	max $1.80L_{pp}^{-0.09}$, min 1.0	max $1.54L_{pp}^{-0.07}$, min 1.0	max $1.31L_{pp}^{-0.05}$, min 1.0
General cargo ship	$\frac{0.0377L_{pp}^{2.625}}{capacity}$	max $2.18L_{pp}^{-0.11}$, min 1.0	max $1.77L_{pp}^{-0.08}$, min 1.0	max $1.51L_{pp}^{-0.06}$, min 1.0	max $1.28L_{pp}^{-0.04}$, min 1.0
Containership	$\frac{0.1033L_{pp}^{2.329}}{capacity}$	max $2.10L_{pp}^{-0.11}$, min 1.0	max $1.71L_{pp}^{-0.08}$, min 1.0	max $1.47L_{pp}^{-0.06}$, min 1.0	max $1.27L_{pp}^{-0.04}$, min 1.0
Gas carrier	$\frac{0.0474L_{pp}^{2.590}}{capacity}$	max 1.25, min 1.0	max $2.10L_{pp}^{-0.12}$, min 1.0	max $1.60L_{pp}^{-0.08}$, min 1.0	max $1.25L_{pp}^{-0.04}$, min 1.0

Note: containership capacity is defined as 70% of the DWT.

APPENDIX 3. THE CLEAN SHIPPING INDEX QUESTIONNAIRE

A total of 150 points can be obtained, 30 points in each of the different environmental areas. This means 30 points for good performance on CO_2 emissions, 30 on low NO_x emissions etc. Points are granted only for exceeding legal compliance performance on SO_x, PM, NO_x, chemicals and Water and waste management. For CO_2 emissions there are no binding regulations yet for the existing fleet.

CO_2 therefore scores for good performance compared to a calculated reference vessel of the same type and size. The number of points that can be earned are set by the Clean Shipping Index secretariat and the Technical Committee.

The overall score indicates how well a vessel is performing compared to legislative requirements and compared to other vessels of the same type and size.

SOx		
Main engines Operations in non-ECAs (yearly average)	No data/compliance	0
	Operation only in ECAs*	0
	Fuel quality < 0.1% S	3
	'Minimum Sulphur fuels' (<50 ppm)	5
	Plug-in battery power, fuel cell, wind power or similar	5
**When answering Operation only in ECAs, the score doubles for the questions on operation in ECAs. Otherwise the vessel cannot reach the same score as vessels operating in- and outside ECAs.*		
Main engines Operations in ECAs (yearly average)	No data/compliance	0
	Operation only in non-ECAs*	0
	<500 ppm S	2
	'Minimum Sulphur fuels' (<50 ppm)	5
	Plug-in battery power, fuel cell, wind power or similar	5
**When answering Operation only in non-ECAs, the score doubles for the questions on operation in non-ECAs. Otherwise the vessel cannot reach the same score as vessels operating in- and outside ECAs.*		

Aux. engines (yearly average)	No auxiliary engines*	0
	No data/compliance	0
	Shore-side electricity	5
	'Minimum Sulphur fuels' (<50 ppm)	5
	Plug-in battery power, fuel cell, wind power or similar	5
**If no Auxiliary engine, report the fuel quality used in main engine when in non-propulsion mode.*		
PM		
Main engines Operations in non-ECAs (yearly average)	No data	0
	Operation only in ECAs *(ECA scoring doubles)*	0
	Fuel quality < 0.1% S	3
	PM < 0.2 g/kWh	3
	PM < 0.1 g/kWh	5
	'Minimum Sulphur fuels' (<50 ppm)	5
	Plug-in battery power, fuel cell, wind power or similar	5
Main engines Operations in ECAs (yearly average)	No data/compliance	0
	Operation only in non-ECAs *(non-ECA scoring doubles)*	0
	<500 ppm S	1
	PM < 0.2 g/kWh	3
	PM < 0.1 g/kWh	5
	'Minimum Sulphur fuels' (<50 ppm)	5
	Plug-in battery power, fuel cell, wind power or similar	5

PM Aux. engines (yearly average)	No auxiliary engines*	0
	No data/compliance	0
	PM < 0.2 g/kWh	3
	PM < 0.1 g/kWh	5
	Shore-side electricity	5
	'Minimum Sulphur fuels' (<50 ppm)	5
	Plug-in battery power, fuel cell, wind power or similar	5
**If no Auxiliary engine, report the fuel quality used (or specific PM emission value) in main engine when in non-propulsion mode.*		
NO_x		
Main engines	No data	0
	Engines 2000-2011, above or within Tier I levels	0
	Engines prior year 2000, Tier I levels	6
	Engines prior year 2011, Tier II levels	9
	30% below Tier I levels	12
	40% below Tier I levels	15
	Tier III levels	21
	Plug-in battery power	21
Aux. engines	No auxiliary engines*	0
	No data	0
	Engines 2000-2011, above or within Tier I levels	0
	Engines prior year 2000, Tier I levels	2
	Engines prior year 2011, Tier II levels	3
	30% below Tier I levels	4
	40% below Tier I levels	6
	Tier III levels or when shore-side electricity is installed and used	9
	Plug-in battery power	9
**If no Auxiliary engine, report the fuel quality used in main engine when in non-propulsion mode.*		

CO_2		
Emission performance EEOI	No data	0
	20% above reference or more	0
	<20% above reference	3
	<15% above reference	6
	<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
	>25% below reference	30
Emission performance according to CCWG	No data	0
	Reference value or above	0
	< 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
	> 45% below reference	30

Chemicals		
Antifouling	No data	0
	Other	0
	Controlled depletion polymer (CDP)	0
	Self-polishing coating (SPC), only accept. Biocides)	5
	Non-toxic	7
Stern tube oil	No data	0
	Mineral oil based	0
	Based on biodegradable oil	5
	Air seal	7
	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 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		
Grey water	No data	0
	No treatment	0
	No discharge in sensitive areas (PSSA) or treatment in sewage plant onboard	4
Sewage / black water	No data	0
	No treatment	0
	No discharge in sensitive areas (PSSA) or sewage treatment plant onboard	4
Garbage handling	No data	0
	Incinerator used on board	0
	No incinerator onboard or documented no incineration of garbage and separate garbage handling for reuse, recycling and disposal	6
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	5
Bilge water treatment	No data	0
	Gravimetric separation	0
	Active treatment installed and < 15ppm oil in outgoing water	4
	Active treatment installed and < 5ppm oil in outgoing water	6
	Active treatment installed and < 5 ppm oil in outgoing water **and** emission control box in place	8
	Discharge to onshore facility	8
Crew awareness	No data	0
	Education of personnel on environmental awareness, health risks and adequate protective equipment	3

APPENDIX 4. NO_X FACTORS AND EMISSION CONVERSION FACTORS FOR MAIN AND AUXILIARY ENGINES

Table 1. NO_x factors for ship engines, derived from the Norwegian Tax on NO_x emissions (8)

Engines	kg NO_x per tonne of fuel
Rpm less than 200	100
200 rpm to 1,000 rpm	53 (54 for engines constructed prior 2000)
1,000 rpm to 1,500 rpm	50
1,500 rpm upwards	44 (45 for engines constructed prior 2000)

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

Table 2. NO_x emission conversion factors for main engines (9)

Main engine specific fuel consumption values (g/kWh) for different engine ages and different maximum rated power			
Engine age	**Above 15,000kW**	**15,000 – 5,000 kW**	**Below 5,000 kW**
<1983	205	215	225
1984-2000	185	195	205
2001-present	175	185	195

Table 3. NO_x emission conversion factors for auxiliary engines (9)

Auxiliary engine fuel consumption values (g/kWh) for different maximum rated power		
Engine age	**Above 800 kW**	**Below 800 kW**
any	220	230

APPENDIX 5. CO2 calculation of the reference value following the EEOI

The actual reported CO_2 emissions of the vessel are compared to a reference vessel of the same type and size. This section describes how Clean Shipping Index calculates the value for the reference vessel. The calculations use the EEDI reference lines from the IMO as a starting point. The following is relevant for options 1-3 mentioned under section 3.1.1.

The Energy Efficiency Operational Indicator ($EEOI_{ref}$) for the reference ship is obtained in two steps. First the Energy Efficiency Design Index reference value ($EEDI_{ref}$) is calculated. This is done using methods outlined by the Greenhouse Gas Working Group of the IMO (24). In an MEPC resolution baselines are defined for the most common ship types, expressing ideal technical circumstances but not including operational parameters. The baselines are for most ship types presented as functions between deadweight (dwt) and emitted grams CO_2 per tonne-nm (28).

The $EEDI_{ref}$ gives a typical fuel consumption for a specific ship of a certain type and size. The $EEDI_{ref}$ can be calculated as a function of dwt for different categories of ships, as shown in Table 3 below. Clean Shipping Index automatically calculates the $EEDI_{ref}$ to be able to compare the efficiency of the reported CO_2 emissions to the reference.

Table 3. $EEDI_{ref}$ formula per ship type derived from the IMO MEPC74 (28)

Type of vessel	Size, dwt (GT for Cruise/Passenger)	Reference EEDI from 2020-01-01
General cargo	0-3000	$EEDI_{ref} = 107.48dwt^{-0.2t16}$
	3000-15000	$EEDI_{ref} = (111.51-0.0013435dwt)\ dwt^{-0.216}$
	15000-	$EEDI_{ref} = 91.358dwt^{-0.216}$
Reefer (gen. Cargo)	0-3000	$EEDI_{ref} = 227.01dwt^{-0.244}$
	3000-5000	$EEDI_{ref} = (278.0873-0.0170258dwt)dwt^{-0.244}$
	5000-	$EEDI_{ref} = 192.9585dwt^{-0.244}$
Bulk	0-10000	$EEDI_{ref} = 961.79dwt^{-0.477}$
	10000-20000	$EEDI_{ref} = (1154.147-0.0192358dwt)dwt^{-0.477}$
	20000-	$EEDI_{ref} = 961.79dwt^{-0.477}$
Tanker	0-4000	$EEDI_{ref} = 1218.8dwt^{-0.488}$
	4000-20000	$EEDI_{ref} = (1279.74-0.0152350dwt)dwt^{-0.488}$
	20000-	$EEDI_{ref} = 975.04dwt^{-0.488}$
Gas carrier	0-2000	$EEDI_{ref} = 1120\ dwt^{-0.456}$
	2000-10000	$EEDI_{ref} = (1176-0.0280dwt)dwt^{-0.456}$
	10000-	$EEDI_{ref} = 896\ dwt^{-0.456}$
Container	0-10000	$EEDI_{ref} = 174.22dwt^{-0.201}$
	10000-15000	$EEDI_{ref} = (243.908-0.0069688dwt)dwt^{-0.201}$
	15000-	$EEDI_{ref} = 139.376dwt^{-0.201}$
RoRo	0-1000	$EEDI'_{ref} = 1405.15dwt^{-0.498}$
	1000-2000	$EEDI'_{ref} = (1686.18-0.28103dwt')dwt^{-0.498}$
	2000-	$EEDI'_{ref} = 1124.12dwt^{-0.498}$
RoPax	0-250	$EEDI'_{ref} = 752.16dwt'^{-0.381}$
	250-1000	$EEDI'_{ref} = (802.304-0.200576dwt')dwt'^{-0.381}$
	1000-	$EEDI'_{ref} = 601.728dwt'^{-0.381}$
Car carrier (RoRo)	0-10000	$EEDI_{ref} = 11554dwt^{-0.6565}$
	10000-	$EEDI_{ref} = 9820.9dwt^{-0.6565}$
Cruise/Passenger	0-25000	$EEDI_{ref} = 2279.7PC^{-0.209}$
	25000-85000	$EEDI_{ref} = (2469.9-0.00760GT)PC^{-0.209}$
	85000-	$EEDI_{ref} = 1823.9PC^{-0.209}$

Dwt is the deadweight in tonnes and $EEDI_{ref}$ is the design index value in grams CO2/ dwt nautical mile. For Car carriers, the IMO uses a correction factor that is not applied here. For RoRo and RoPax ships, the $EEDI'_{ref}$ value should be divided by f_{jRoRo} for each ship to obtain the $EEDI_{ref}$. The calculation of f_{jRoRo} is described in appendix 1. For RoPax ships, the $EEDI'_{ref}$ value is calculated using the parameter $dwt'=f_{cRoPax}$ * dwt, where f_{cRoPax} = 1 for ships with dwt/GT >0.25 and f_{cRoPax} = ((dwt/GT)/0.25)-0.8 for ships with dwt/GT <0.25.

For RoPax ships, a parameter that describes the combined capacity for freight and passengers has been identified. This parameter, called L, is a linear function of the number of available lanemeters and the passenger capacity so that:

L =2(number of lanemeters) + 0.7*(passenger capacity).*

Analysis of RoPax ship data gives that L is proportional to dwt' for RoPax ships so that:

*L = 0.6*dwt'. Using the IMO EEDI function we then get*

RoPax $EEDI'_{ref} = 619.14L^{-0.381}$

An $EEDI_{ref}$ function was developed for Cruise ships using empirical data:

Cruise $EEDI_{ref} = 2279.7PC^{-0.209}$

where PC is the passenger capacity. This function is also used for Passenger ships.

In the second step of calculating the $EEOI_{ref}$ value for the reference ship, operational factors are accounted for. This means that estimated average load factors and estimated payload factors are considered.

The load factors, the 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).

Table 4. Load factors for different types of vessels according to the second IMO GHG study (25)

Type of vessel	Load factor
General cargo	0.6
Reefer	0.5
Bulk dwt > 100,000	0.5
Bulk dwt 10,000-100,000	0.55
Bulk dwt 0-10,000	0.6
Product tanker dwt > 20,000	0.55
Product tanker dwt 10,000-20,000	0.50
Product tanker dwt 0-10,000	0.45
Gas carrier	0.48
Oil tanker	0.48
Chemical tanker	0.64
Container	0.7
RoRo	0.7
Car carrier	0.7

For Cruise ships the following capacity utilisation is assumed:

Cruise 0.94 (this is a preliminary assumption, it may change after more data modelling)

For RoPax ships the capacity utilisation is a combination of passenger and lanemeter utilisation (i.e. "L-utilisation"):

RoPax 0.37 (this is a preliminary assumption, it may change after more data modelling)

For some types of vessels, the payload ratio (ratio of maximum weight commercial cargo to the deadweight) is an important factor when calculating the $EEOI_{ref}$ for the reference ships. General payload ratios are given for the main type of ships below. The values used here are based on information from ship constructors and ship operators. For tankers, different payload ratio may occur depending on the large differences in the specific weight of the cargo predominantly carried. Gas carriers are assumed to have the same payload ratio as tankers with light products.

Table 5. General payload ratios for main ship type

Type of vessel	Payload ratio
General cargo	0.9
Reefer	0.9
Bulk	0.9
LNG carrier	0.8
Container	0.8
RoRo	0.5
Car carrier	0.25

Ships carrying products with densities below 0.9 tonne/m^3 should use a payload factor of ρ/0.9 where ρ is the average density of the product carried over the year (calculating the average should reflect distance) while for ρ > 0.9 the payload ratio of 0.95 is used as before.

For RoPax ships, this ratio is accounted for when using the relationship between dwt' and L (see above).

Cruise ships use significant amounts of fuel while at berth. To account for this the EEDIref value is multiplied by a 'berth factor' of 1.09. Using the EEDI baseline functions and considering load factors and payload factors, the calculation for an operational reference value will generally look like this:

for cargo ships:

*$EEOI_{ref}$(dwt) = $EEDI_{ref}$(dwt) / (load factor * payload ratio);*

for RoPax vessels:

$EEOI_{ref}$(L) = $EEDI_{ref}$(L) / (L-utilisation factor);

for Cruise ships:

$EEOI_{ref}$(PC) = $EEDI_{ref}$(PC) * (berth factor) / (capacity utilisation factor).

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.

For ice-classed ships, the $EEOI_{ref}$ value is increased by multiplying with the factor fi as defined for the calculation of attained EEDI for ice-classed ships. fi is given in appendix 2.

3.1.3 CO_2 calculation of the reference value following the Clean Cargo Working Group methodology

Shipping companies with container vessels can report data according to both the method based on EEOI (Option 1 in 3.1.1) as described above and the Clean Cargo Working Group (CCWG) method (Option 4 in 3.1.1).

The CCWG method only applies to container vessels. The 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 the preceding year (26).

Standardized trade lane	CCWG Average (g CO_2/ TEUkm)
Asia – Africa	45,8
Asia – Mediterranean	38,4
Asia – Middle East/India	46,5
Asia – North America EC*	53,8
Asia – North America WC**	48,8
Asia – North Europe	33,7
Asia – Oceania	59,5
Asia – South America (EC/WC)	43,6
Europe (North& Med) – Africa	59
Europe (North& Med) – Middle East/ India	54,8
Europe (North& Med) – Oceania (via Suez/via Panama)	42,6
Europe (North& Med) – Latin America/ South America	54,2
Intra –Americas (Caribbean)	69,6
Intra – Asia	60
Intra – Europe	75,3
Mediterranean – North America EC (incl. Gulf)	52,1
Mediterranean – North America WC	58,8
North America EC – Middle East/ India	66,4
North America – Africa	74,2
North America – Oceania	57,2
North America –South America (EC/WC)	52,9
North Europe – North America EC (incl. Gulf)	60,1
North Europe – North America WC	60,7
South America (EC/WC) – Africa	42,3
Other	64,6

**EC = East Coast* **WC= West Coast*

The actual calculated CCWG data for the vessel is compared with the CCWG tradelane average (i.e. the reference) for the 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, a score is obtained.

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