

DISCUSSION PAPER

INCENTIVE SCHEMES FOR PROMOTING GREEN SHIPPING

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The original paper can be downloaded at: <http://nrdc.cn/information/informationinfo?id=174>.

About NRDC

The Natural Resources Defense Council (NRDC) is an international nonprofit environmental organization with more than 2 million members and online supporters. Since 1970, our lawyers, scientists, and other environmental specialists have worked to protect the world's natural resources, public health, and the environment. NRDC works in countries and regions including the United States, China, India, Canada, Mexico, Chile, Costa Rica, and the European Union. Visit us at www.nrdc.cn.

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Glossary

BDN	Bunker Delivery Notes
CSI	Clean Shipping Index
DECA	Domestic Emission Control Area
DWT	Dead Weight Tonnage
ECA	Emission Control Area
EEDI	Energy Efficiency Design Indexⁱ
EEOI	Energy Efficiency Operational Indicator
ESI	Environmental Ship Index
EVDI	Existing Vessel Design Index
GPP	Green Port Program
GSP	Green Ship Program
GT	Gross Tonnage
GTP	Green Technology Program
IAPH	International Association of Ports and Harbors
IMO	International Maritime Organisation
ISM	International Safety Management code
LNG	Liquefied Natural Gas
MARPOL	International Convention for the Prevention of Pollution from Ships
MDO	Marine Diesel Oil
MGO	Marine Gas oil
NO_x	Nitrogen Oxides
OGV	Ocean Going Vessel
OPS	On-shore Power System
SCR	Selective Catalytic Reduction
PM	Particulate Matter
SO_x	Sulfur Oxides
TEU	Twenty-foot Equivalent Unit (container)
WPCI	World Ports Climate Initiative

i. The Energy Efficiency Design Index (EEDI) is a mandatory regulation introduced by the IMO that applies to all OGVs of 400 gross tonnage or above constructed after 2013 that operate in international waters. EEDI relates to the design efficiency of a vessel and is a performance-based mechanism that does not prescribe specific technologies or marine fuels. The EEDI aims to reduce black carbon (BC) and CO₂ emissions from new vessels by 20 percent by 2020, and by 30 percent by 2025, compared to a baseline comprised of the average efficiency of OGVs built between 2000 and 2010. Increasingly the currently still voluntary Energy Efficiency Operational Indicator (EEOI) is applied in order to measure the operational in-use fuel efficiency performance of a vessel.

Introduction

In various countries and cities around the world, ports have in recent years introduced their own incentive programs to encourage ships calling at their ports to use cleaner marine fuels or in other ways reduce air emissions while in the port area. With the introduction of and gradual tightening of emission limits for so-called Emission Control Areas (ECA), which regulate sulfur oxide (SO_x) and/or nitrogen oxide (NO_x) emissions in the Baltic Sea, North Sea, North America and the US Caribbean - while China is currently introducing three Domestic ECAs - such emissions have become less of a concern for ports located in an SO_x and/or NO_x ECA. Nonetheless, many ports still have incentive programs in place, to encourage enhanced performance from vessels calling at their ports beyond the ECA mandated permissible emission levels, as well as for air emissions not effectively covered by the ECA, such as CO₂ and NO_x from ships in operation as the ECA NO_x requirements only apply to new ships.



This paper aims to provide greater insight on how the Chinese government, ports, and industry could potentially benefit from participating in the industry-initiated incentive programs, and/or adopt similar country-led incentive programs.

An incentive program initiated by one port city, however, offers limited financial benefits for shipowners and operators, as they can only receive incentives at one particular port for implementing (sometimes costly) emission reduction measures. For shipowners/operators this also puts an extra time and administrative burden on them, as each port will have different qualification criteria and different rules and processes to follow for demonstrating eligibility and subsequently obtaining the discounts. On the port side, extra administration costs and efforts may be incurred as well, as each port has to develop and manage its own scheme rather than taking a joint approach through a scheme recognized and implemented by multiple ports.

A harmonized approach, in which multiple ports on major shipping routes collaborate, instead creates benefits for both ports and ships owners. It allows ports to develop a more consistent approach to rewarding ships' emissions / environmental performance and gives ports the opportunity to exchange insights and experiences, and jointly improve the system. It also makes it more attractive for ships to partake in these schemes if they call at multiple participating ports on a shipping route, as the extra costs of implementing the emission reduction measures could be covered by incentives given at each of the participating ports.

This paper therefore provides an overview of four major globalⁱⁱ and three country-wide incentive or rating programs for encouraging shipowners / operators to reduce air

pollution from their ships while in and/or near ports. These programs include:

1. Industry-initiated programs: Environmental Ship Index, Clean Shipping Index, GHG Emission Ratingⁱⁱⁱ, and Green Award
2. Government-led programs: Norway's Business Sector NO_x Fund, Sweden's Differentiated Fairway Dues, and Maritime Singapore Green Initiative

ii. The Green Marine program has not been included in this paper, as it focuses on North-America only.

iii. The GHG Emission Rating is in essence a rating program, which however has been adopted by various ports as an incentive program.



The four major industry-initiated incentive or rating programs discussed allow qualified ships to receive incentives from all participating ports as well as other incentive providers participating in these programs.

These four major industry-initiated incentive or rating programs allow qualified ships to receive incentives from all participating ports as well as sometimes other incentive providers participating in these programs. Hence, they offer the potential of much higher and continued rewards for ships that are considering to adopt green shipping practices and technologies to go beyond existing regulatory requirements, while higher participation in these programs will also lead to greater environmental and health benefits for port cities. Several ports run these schemes on a cost-neutral basis by slightly increasing the port dues for non-qualifying ships which pays for the discounts provided to

qualifying ships. Whether this is a possibility depends also on a port's ownership structure.

The three government-led incentive programs offer examples of programs that have been introduced for all ports in a country, and have been designed to address each country's own green shipping goals, such as reducing air pollution from ships, or providing funding to local equipment makers and shipowners to incentivize the research, development, and adoption of green shipping technologies.

In addition, this paper also provides some insight in port-specific incentive programs, where ports have adopted several or all of the mentioned industry-initiated programs, in order to increase the pool of vessels calling at their port that could be eligible for discounts.

This paper therewith aims to provide greater insight in how both ports, and industry could potentially benefit from participating in the industry-initiated incentive programs covered in this paper, and/or adopt similar country-led incentive programs. The paper also discusses what it may take on the side of ports and shipowners / operators to participate in these programs.

Industry-initiated Green Shipping Incentive Schemes

ENVIRONMENTAL SHIP INDEX

PURPOSE OF THE SCHEME

The Environmental Ship Index (ESI) was introduced in 2010, and was designed by the ports of Le Havre, Bremen, Hamburg, Antwerp, Amsterdam, and Rotterdam to reduce air pollution in port areas. The ESI provides a reduction in port dues or tonnage charges for registered ocean-going vessels (OGVs) with below-average SO_x, NO_x, and/or CO₂ emissions, compared to the current emission standards of the IMO. Shipowners who wish to receive discounts must self-register their ship's emissions performance through the website of the ESI program. The program is entirely voluntary.¹

The index can be used by ports to reward ships that have better environmental performance beyond regulatory requirements (and participate in the ESI), but can also be used by shippers and others in the shipping sector as a promotional instrument.²

BENEFITS OF PARTICIPATING IN THE SCHEME

Ports participating in the ESI scheme send a signal to ship operators that they value lower emissions.

Because of the monetary reward, ships who regularly call at participating ports are more likely to use cleaner fuel or to retrofit their vessels in order to reduce emissions as the extra costs of doing so can be partially or fully paid back for by the reduction in port dues.

Participation has seen a considerable increase in eligible ship calls at port over the course of the past few years, showing a clear interest from ship operators. The increase is potentially driven by peer pressure and/or increasing requirements for lower emissions on the side of shippers commissioning loads. In the past 2 years, the scheme has also seen more than a fourfold increase in the number of ESI registered ships that have an ESI score of 50 or higher.

PRIMARY USERS

The primary users of the ESI are ports and carriers. The total number of ships with a valid ESI score in late 2017 was almost 7,130, representing approximately 8% of the world's commercial fleet of OGVs, which was achieved over a period of approximately 7 years with the ESI scheme being introduced in 2010.³ The total number of ports participating in the scheme^{iv} in late 2017 stood at 47, the majority of which are based in North-Western Europe, as the ESI scheme was started by collaborating major ports in Western Europe.⁵

TABLE I: PARTICIPATING PORTS IN ESI BY REGION⁵

EUROPE	ASIA	LATIN AMERICA	USA & CANADA	MIDDLE EAST	OCEANIA
35 For example, Rotterdam, Hamburg, Antwerp	4 Busan, Ulsan, Tokyo, Yokohama	1 Panama Canal	4 Los Angeles, New York & New Jersey, Vancouver, Prince Rupert	2 Ashdod in Israel, Sohar in Oman	1 Nelson in New Zealand

iv. List of ports that joined the ESI scheme can be found at: <http://www.environmentalshipindex.org/Public/PortIPs>

HOW DOES IT WORK FOR PORTS?

The ESI scheme provides a reduction in port dues to qualifying vessels registered with the ESI once they call at a participating port. Ports provide a reduction based on a vessel's total ESI score, with the score comprising a SO_x, NO_x and/or CO₂ emission component and providing an additional bonus for the presence of an on-shore power system (OPS). The ESI score ranges from 0 for a ship that meets the standard environmental performance regulations currently in force, to 100 for a ship that emits no SO_x and no NO_x and reports (or monitors) its energy efficiency. Participating ports decide individually the minimum number of points that qualifies vessels for a discount, how high the discount will be, as well as what value they attach to the different air emission components of the ESI rating.

The maximum ESI score is set at 100, and many participating ports set the bar at 21 points for ships to be eligible for a reduction in port dues. The calculation of the ESI score is provided in the last section on 'What data are required?'. In many cases, ports have a tiered ESI discounts system in place, with 2 to 3 different levels of increasingly high discounts available pending a ship's emissions performance. This incentivizes ships to go beyond the minimum performance required to qualify, and appropriately recognizes the efforts put in by frontrunners.

As an example, at the Port of Rotterdam in the Netherlands, vessels that score a minimum of 31 points qualify for a 10% reduction on gross tonnage fees. Rotterdam attaches particular value to NO_x emission reductions, with vessels receiving a higher discount if their individual score for NO_x also amounts to 31 points or more. This is because NO_x non-attainment is a major concern in Rotterdam. The port of Antwerp instead focuses more on PM emissions associated with SO_x.

At Port of Rotterdam, if vessels qualify for a reduction under the ESI scheme, the port pays out the reduction in port dues (basically rebating part of the fee) to the shipping agents^v, who redistribute it to the ship operators they represent. Port of Rotterdam randomly audits some of the registered vessels. If data are found to be incorrect or non-compliant, the port will request the rebate on port fees to be returned to them. The following table provides an overview of the ESI incentives provided by a select number of ports.⁴

TABLE 2: OVERVIEW OF ESI INCENTIVES PROVIDED BY A SELECT NUMBER OF MAJOR PORTS

PORT	COUNTRY	ESI INCENTIVES
Port of Rotterdam	Netherlands	Ocean going vessels that score 31 points or more on the Environmental Ship Index (ESI) receive a 10% discount on the gross tonnage part of their port dues in Rotterdam. At the end of each quarter, the Port of Rotterdam Authority will determine which vessels are eligible for the ESI discount, based on two conditions: (1) at the actual time of arrival (ATA), the vessel must have an ESI score of 31 points or more, and (2) the ship called at the port of Rotterdam in the quarter concerned. The discount applies to each call in the quarter concerned, with a maximum of 20 calls per single ship per quarter. The discount is doubled if the ship also has an individual ESI-NO _x sub-score of 31 or more.
Hamburg Port Authority	Germany	Ocean going vessels are granted a discount on port dues of up to 10%, with the staggered discount scheme starting at an ESI score of 20 points. The following discounts are provided: ESI score 20 up to < 25 = 0.5% discount, up to a maximum of € 250 ESI score 25 up to < 35 = 1% discount, maximum of € 500 ESI score 35 up to < 50 = 5% discount, maximum of € 1,000 ESI score ≥ 50 = 10% discount, maximum of € 1,500
Port of Antwerp	Belgium	Ocean going ships with a score of 31 to 50 are granted a discount of 5% on the tonnage dues; 10% discount for a score between 50.1 and 70; and 15% for a score between 70.1 and 100. As PM associated with SO _x is a focus of the port, ships using closed-loop scrubbers or liquefied natural gas (LNG) can receive an additional discount of 10% and 5% respectively in 2017.
Port of Los Angeles	United States	Each vessel is eligible for an incentive grant on a per call basis as per the following scheme: 50 points or greater: US\$2,500 per call 40-49 points: US\$750 per call

v. A shipping agent is the trusted representative of a shipowner or charterer who deals with the transactions of a ship in every port that the ship visits or docks. One of the shipping agent's responsibilities is to ensure all dues are paid or discharged.

HOW DOES IT WORK FOR SHIPOWNERS AND SHIPPING COMPANIES?

Shipowners and shipping companies can have their ships rated according to the ESI scheme on a voluntary basis, which is free of charge. To do so, they have to self-report the relevant data via the www.environmentalshipindex.org website. On the basis of these data and their subsequent score, ships receive a certificate, which serves as the basis for the discount on port dues and tonnage charges payable. Once ESI-registered vessels call at a participating port, port due discounts are offered based on the ESI-score published on the public part of the official ESI-website, valid at the time and date of arrival at the first berth situated within that port.⁴

WHO OPERATES THE SCHEME?

The ESI is one of the projects developed under the World Ports Climate Initiative (WPCI) initiative. This administration of the scheme is carried out by the ESI bureau of the International Association of Ports and Harbors (IAPH), which also hosts the WPCI. The scheme's fair operation and promotion is overseen by the Port of Rotterdam in collaboration with other ports. During regular member meetings, key ports discuss and re-evaluate the working and impact of the scheme.⁴

WHO PAYS FOR THE SCHEME?

ESI distinguishes between two types of financial funds required to maintain the ESI database: (1) fees for administrative support, maintenance, subscription, licensing fees, computer rental etc., and (2) costs connected with set up, changes, additions, renewals, improvements, extensions, editing, etc. of the ESI website.⁵

The finances required for item 1, which are of a recurring nature, are supplied by the IAPH, which is funded by its members including more than 180 ports. ESI incentive providers are expected to contribute to the costs for any changes to the ESI website (item 2), which are invoiced in advance to allow for budgets to be assigned, although the actual costs associated with the website are in practice relatively low.

The financial contribution requested from a particular incentive provider, such as a port, is based on "tonnage handled" converted into financial contribution points. The "tonnage handled" is calculated as the annual cargo tonnage, in metric tons, passing through the port as arriving or departing cargo transported by sea (only), two years before the invoicing year. That means the tonnage used to calculate the 2017 contribution is the tonnage handled by the port over the year 2015. If no cargo is handled the contribution point is set at 1.

TABLE 3: CONTRIBUTION POINTS TO CALCULATE THE FINANCIAL CONTRIBUTION OF AN ESI INCENTIVE PROVIDER, BASED ON TONNAGE HANDLED (TONS X 10⁶) IN THE YEAR OF INVOICING MINUS TWO⁵

CARGO TONNAGE HANDLED (METRIC TONS)	FINANCIAL CONTRIBUTION POINT(S)
Less than 10 tons x 10 ⁶	1
10 or more but less than 25 tons x 10 ⁶	2
25 or more but less than 50 tons x 10 ⁶	4
50 or more but less than 75 tons x 10 ⁶	6
75 or more but less than 100 tons x 10 ⁶	8
100 or more tons x 10 ⁶	10

After determining the financial contribution points, the total amount of funding required is divided by the sum of contribution points of all participating ports to calculate the amount due for each 1 contribution point.⁵

Any additional costs that a port or other incentive provider may incur for running the scheme, as well as the discounts on port dues provided to qualifying OGVs are borne by that incentive provider. With incentive providers setting the minimum number of points required for a vessel to qualify for a discount, as well as the percentage discount given, they remain in control of the costs incurred in running the scheme.

Generally, ports which join the scheme make some initial estimates of the number of ESI registered vessels they expect to call at their ports, in order to inform their decisions on the points and discounts level to apply. Where needed, they can adjust these on an annual basis. Many ports run the ESI (or any other discount) scheme on a cost-neutral basis, slightly increasing the port dues for non-qualifying ships which pays for the discounts provided to qualifying ships.

In addition, ports have to invest some initial effort in incorporating the discounts on port dues in the (automated) tariff and invoicing system, such that the discount is automatically applied to invoices for qualifying ships. Ports can also submit a request to other ports to share their experience with running the scheme, including setting points and discount levels, while the ESI administrator (at IAPH) is also available to support ports with questions they may have.

WHAT DATA ARE REQUIRED?

The ESI approach relies on self-declaration by shipowners. In practice, whenever high scores are observed, the data are scrutinized by the ESI bureau. In the event that the scores seem questionable, the data provider/ship operator would be invited to provide proof to the ESI Administrator. In addition, several ports (including the Port of Rotterdam, Amsterdam, Antwerp and Hamburg), which are incentive providers and employ professional ship inspectors, are authorized to perform audits on ESI's behalf. In addition, auditors of the Green Award scheme (discussed in a subsequent section) are also authorized to perform ESI audits.⁵

Many ports run the ESI (or any other discount) scheme on a cost-neutral basis, slightly increasing the port dues for non-qualifying ships which pays for the discounts provided to qualifying ships.

From 2015 to mid-2016, the combined number of ESI audits performed worldwide amounted to 48, of which 12.5% of vessels were found to be non-compliant. Reasons of non-compliance included not having all engines entered into the ESI system, bunker delivery notes (BDN) entry mistakes, BDNs missing, and a reported OPS not being present.⁶ This points to the possibility of ships using ESI self-registration to receive discounts without actually having made the effort to reduce emissions. This is a weak point in the ESI scheme that countries or ports interested in joining ESI may want

to consider how to address. For example, ports with professional ship inspectors on staff may request to be authorized for conducting ESI audits. The ESI bureau is also considering raising the fraction of ships being audited to improve compliance. improve compliance.

The overall ESI formula is built up of different parts for NO_x, SO_x and CO₂, with an additional bonus for the presence of an OPS. The ESI score ranges from 0 for a ship that meets the standard environmental performance regulations currently in force, to 100 for a ship that emits no SO_x and no NO_x and reports (or monitors) its energy efficiency. A vessel's ESI score is determined every 6 months, based on a vessel's performance in the two preceding quarters.

The formula for the ESI Score is as follows and with the maximum score capped at 100 points:

$$\frac{2 \times \text{ESI NO}_x + \text{ESI SO}_x + \text{ESI CO}_2 + \text{OPS}}{3.1}$$

whereby:

- ESI NO_x represents the sub-points for NO_x and ranges from 0 to 100 sub-points
- ESI SO_x represents the sub-points for SO_x and ranges from 0 to 100 sub-points
- ESI CO₂ is a 5-sub-point bonus for reporting data on total fuel used and distance traveled over a period of 3 years, plus a score ranging from 0 to 10 sub-points representing improvement in energy efficiency over the baseline period.
- OPS is the bonus for the presence of an OPS on board irrespective of its use and is fixed at 35 sub-points

An example of an ESI calculation for a vessel, as provided by the ESI website, is included below. The ship in this example has one main engine and three auxiliary engines, and uses three types of fuels as categorized by the ESI scheme based on fuel sulfur content: ⁵

TABLE 4: FUEL OIL CATEGORIES AS DISTINGUISHED BY THE ESI FOR PURPOSE OF CALCULATING THE SO_x SCORE

FUEL OIL CATEGORY	FUEL TYPE AND SULFUR CONTENT
HIGH	Heavy Fuel Oil, with a sulfur content greater than 0.50 % but not exceeding 3.50 %
MID	Medium-sulfur Marine Diesel Oil (MDO)/Marine Gas Oil (MGO), with a sulfur content equal to or less than 0.50 % but greater than 0.10 %
LOW	Low sulfur MDO, with a sulfur content equal to or less than 0.10 %

CALCULATION OF ESI NO_x SUB-SCORE

The ESI NO_x score is defined as follows:

$$ESI\ NO_x = \frac{100}{\text{Sum of Rated Power of all engines}} \times \left(\sum \text{of all engines} \frac{(\text{NO}_x \text{ limit value} - \text{NO}_x \text{ rating}) \times \text{Rated Power of engine}_i}{\text{NO}_x \text{ limit value of engine}_i} \right)$$

The ESI NO_x score is calculated by comparing the NO_x rating of every engine on board with the NO_x standard (i.e., emission limits) at the time the engine was built. And for the ship in the example, it is assumed that the engine NO_x emission standard level and rating are as follows:

TABLE 5: EXAMPLE OF NO_x EMISSION LEVEL AND RATING FOR PURPOSE OF CALCULATING THE NO_x SCORE

	MAIN ENGINE(S)	AUXILIARY ENGINE(S)
NO _x standard level (g/kWh)*	17	11.5
NO _x emission rating of engines on board (g/kWh)	15	11
Difference in emission (g/kWh)	2	0.5
Rated power (kW)	9,480	970
Number of engines	1	3

* The NO_x points are calculated with reference to the NO_x standard level when the engines were built, not the current level for new built engines.

Calculation:

$$\{100/(9480 + 970 \times 3)\} \times \{(17 - 15) \times 9480/17 + (11.5 - 11) \times 970 \times 3/11.5\} = 1241 \times 0.008 = 10.0$$

CALCULATION OF ESI SO_x SUB-SCORE

The ESI SO_x score reflects the reduction in the sulfur content of fuels below the sulfur limits set by the IMO and regional governments. ESI categorizes fuels into three types: fuels typically used at high seas (heavy fuel oil - HIGH), fuels previously typically used in ECAs (medium sulfur MDO/MGO - MID), and fuels typically used in ECA zones (low sulfur MDO/MGO - LOW) (see Table 4). The baseline sulfur level of each of the three types of fuels defined by the ESI, and the actual sulfur level of fuels purchased by the ship in the example are listed below.

TABLE 6: EXAMPLE OF BASELINE SULFUR LEVELS APPLIED BY ESI AND ACTUAL SULFUR LEVELS OF FUEL PURCHASED

FUEL OIL CATEGORY	FUEL TYPE	ACTUAL SULFUR LEVEL OF FUEL PURCHASED, % S (M/M)	ESI BASELINE SULFUR LEVEL, % S (M/M)
HIGH	Heavy Fuel Oil	2.00	3.50
MID	Medium sulfur MDO/MGO	0.40	0.50
LOW	Low sulfur MDO/MGO	0.05	0.10

The ESI SO_x score is calculated as follows:

$$\text{ESI SO}_x = x \times 30 + y \times 35 + z \times 35$$

whereby:

- x = the relative reduction of the average SO_x content of heavy fuel oil (HIGH)
- y = the relative reduction of the average SO_x content of medium sulfur MDO / MGO (MID)
- z = the relative reduction of the average SO_x content of low sulfur MDO/MGO (LOW)

For each type of fuel, the relative improvement of the sulfur content of the fuel purchased compared to the baseline sulfur level of that fuel is calculated, which is then divided by the improvement in sulfur if shifted to using the next tier of cleaner fuel (e.g., from HIGH fuel to MID fuel) to obtain the relative reduction. The following example uses the sample values provided in the table above to explain the calculation method.

Calculation:

$$x \times 30 + y \times 35 + z \times 35 =$$

$$\begin{aligned} & (\text{Baseline HIGH} - \text{Actual HIGH}) / (\text{Baseline HIGH} - \text{Baseline MID}) \times 30 + \\ & (\text{Baseline MID} - \text{Actual MID}) / (\text{Baseline MID} - \text{Baseline LOW}) \times 35 + \\ & (\text{Baseline LOW} - \text{Actual LOW}) / (\text{Baseline LOW} - 0\% \text{ SO}_x) \times 35 = \end{aligned}$$

$$(3.50 - 2.00) / (3.5 - 0.5) \times 30 + (0.50 - 0.40) / (0.5 - 0.1) \times 35 + (0.10 - 0.05) / (0.1 - 0.0) \times 35 = 15.0 + 8.75 + 17.5 = 41.25$$

The average SO_x content of the different fuels is extracted from the bunker delivery notes. The average for the respective fuels is the weighted average over all bunker fuels used. The SO_x score is updated every 6 months based on the bunker delivery notes of the previous two quarters. For example, if the ESI Score would need to be calculated on January 1st 2017, the shipowner would need to enter the BDN fuel data of the 2nd and 3rd quarter of 2016 before December 31st, 2016.

Alternatively, where scrubbers are used, the equivalent sulfur percentage established in accordance with IMO procedures may be used to replace the actual sulfur value.

ESI CO₂ SUB-SCORE (EEOI)

An extra 5 bonus points can be obtained by the vessel if reporting on two sets of input data needed for calculating EEOI, namely fuel consumption and distance sailed over a period of three years (baseline period). The shipowners do not have to report on their vessels' load.^{vi,4} If vessel fuel efficiency of any year in the next three-year period (reporting period) shows improvement over the baseline period, additional ESI CO₂ sub-score (0-10 points) is given based on the percent increase in efficiency, with total ESI CO₂ sub-score capped at 15 points. These CO₂ sub-score points were introduced in early 2016, and are aimed to allow the ESI to focus on continuous improvement of vessel performance. In the future, this may be expanded to bonus points to be gained if a vessel can prove that its EEOI improves year-on-year.

ON-SHORE POWER SYSTEM (OPS) BONUS

An extra 35 bonus points can be obtained if the vessel has an OPS installed on board. Incorrect reporting of an OPS, where it turns out that the installation is not capable of providing the power for all ship operations that may have to be carried out in port, can lead to the exclusion of the ship from the ESI database for a period of six months.

TOTAL ESI SCORE

The above calculation would lead to an overall ESI Score of 34.3 points, calculated as follows:⁵

$$(2 \times 10.0 + 41.25 + 10.0 + 35.0) / 3.1 = 34.3$$

More detailed information on how to calculate the ESI scores can be found in the ESI Fundamentals factsheet (<http://esi.wpci.nl/Content/Documents/ESI-Fundamentals.pdf>)

CLEAN SHIPPING INDEX

PURPOSE OF THE SCHEME

The Clean Shipping Index (CSI) was introduced in 2007 by regional shipping industry stakeholders in Gothenburg and the west of Sweden, as well as a number of large Swedish export & import companies. CSI is an online tool that provides a rating to each registered ship based on a range of environmental criteria and is now being used by ships and shippers from around the world, although the majority are based in Europe.

The CSI is often used by shippers, i.e., cargo owners and forwarders purchasing capacity on a vessel, who can therewith compare the environmental performance of different ships (including the full range of OGVs and short-sea vessels) when procuring services. Shipping companies affiliated with the index may also decide to publicly disclose the CSI of their ships, thereby promoting enhanced environmental performance. Shippers can also see how the different ships in their fleet perform in relation to each other.

As noted above, the CSI gives each registered ship a rating between 1 and 5 stars, based on the number of points achieved. In total 150 points can be obtained, 30 points in 5 different performance categories. The index is designed in such a way that a ship will be awarded points only for performance that goes beyond legal requirements.⁷

BENEFITS OF PARTICIPATING IN THE SCHEME

Shippers, i.e. cargo owners and forwarders, procuring capacity on, in particular although not exclusively, container and ro-ro vessels use the CSI to select more fuel-efficient vessels, while they can also use it for vetting and risk mitigation purposes with their current carriers. Shipping companies, i.e. the carriers of the goods, can through the CSI not only get recognition for their environmental performance, but also increase their economic performance as CSI rated ships are more likely to be selected by shippers in their procurement processes if selecting for fuel-efficiency. For the shipping industry as a whole, schemes like CSI help raise the bar on environmental performance in shipping and reduce the adverse environmental and health impacts associated with it. Self-regulation schemes may also speed up regulatory processes at the regional and international levels.

PRIMARY USERS

Shippers, carriers, and to a lesser extent, ports are primary users of CSI. As of late 2017, CSI has 30 affiliated cargo owners, such as Volvo, Volkswagen, H&M, Philips, Stora Enso and Tetra Laval, and 74 affiliated shipping companies.¹² More than 2,250 ships have a CSI rating. CSI fleet ratings can also be used by banks and investors to assess the environmental performance during the loan approval process of new ships.

vi. More information about the calculation of EEOI can be found at the IMO Guidelines for Voluntary Use of the Ship Energy Efficiency Operational Indicator (MEPC.1/Circ.684), <http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Documents/Circ-684.pdf>

HOW DOES IT WORK FOR PORTS?

The CSI was not originally developed as an incentive scheme for receiving discounts at ports and other organizations, although currently several ports do provide discounts to ships registered with CSI. These include Canada’s two major West Coast seaports, Port of Vancouver and the Port of Prince Rupert, which provide discounts based on a vessel’s rating under CSI.⁹ In addition, Swedish ports under the Swedish Maritime Administration, such as the Port of Gothenburg, have from January 2018 started using an amended environmentally differentiated fairway dues systems (discussed later in this paper), which provides discounts on fairway dues to vessels based on their CSI rating. CSI also started collaborating in late 2017 with ESI, with the aim of presenting ESI scores in the CSI database and aligning their criteria for SO_x & NO_x.⁹

HOW DOES IT WORK FOR SHIPOWNERS AND SHIPPING COMPANIES?

To be included in the Clean Shipping Index, shipowners are required to complete an online questionnaire consisting of 25 questions concerning their operational environmental impacts. These cover 5 categories of (i) NO_x, (ii) SO_x and PM, (iii) CO₂, (iv) chemicals, and (v) water and waste. Each category has a maximum score of 30 points each.

Scores for SO_x, PM, and NO_x can only be obtained for measures that go beyond existing IMO regulations. For NO_x, 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. For SO_x & PM, the basis for scoring is the average SO_x content in fuels for main and auxiliary engines used during a running year (or the measured PM emissions for PM only). For CO₂ emissions, scores are calculated by how well a vessel performs compared to a reference ship. The calculation of scores is provided further below.⁹

Information is entered on a ship-by-ship basis, but is also added to a total carrier fleet score for an overall ranking of a shipowner. Furthermore, as a minimum, third-party verification of at least two vessels in each fleet is required to be a part of the CSI. Verification is conducted by Classification Societies that have been accredited by the CSI.

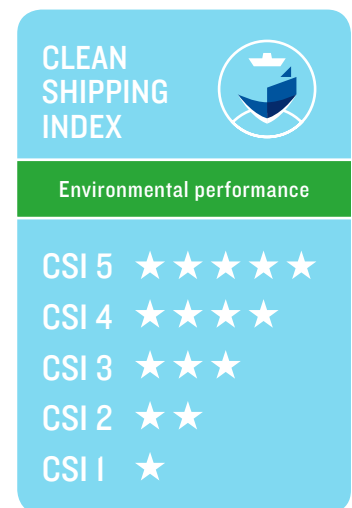
At an individual ship level, the CSI rating is based on the total number of points achieved across all 5 categories. The final CSI score at the carrier level is the total average score across all ships from that carrier that are registered with the CSI, multiplied by the percentage of CSI reported ships of the totally owned or managed fleet by that carrier.¹²

In early 2017, CSI introduced a new rating scheme. Its previous three performance categories of red / low, yellow / medium and green / high have now been replaced by a new rating ranging from the low CSI-class 1 (one star) to the highest CSI-class 5 (5 stars) category, as represented in the image.

Scores are calculated both at individual vessel and at aggregated carrier basis. In total 150 points can be obtained, 30 points in each of the 5 different performance categories, including NO_x, SO_x and PM, CO₂, chemical use, and water and waste management. The aggregated carrier score is based on the weighted total score of all the carrier’s vessels.¹⁰

TABLE 7: SCORING SYSTEM FOR CARRIERS AND VESSELS UNDER CSI, FROM 2017 ONWARDS¹⁰

TOTAL NO. OF POINTS ACHIEVED	CSI RATING
125-150	CSI 5
100-124	CSI 4
75-99	CSI 3
38-74	CSI 2
0-37	CSI 1



For general information purposes, CSI’s previous scoring system is briefly explained here. Till recently CSI used rating shown as red, yellow, and green. On a carrier level, the green rating--corresponding to good performance--referred to a carrier (1) with at least 90% of its vessels reported in CSI, (2) with the carrier having been verified, and (3) with the total weighed score of its vessels amounting to at least 40% or more. Yellow carriers were those (1) having achieved at least 10% as total weighed score for their fleet and (2) reporting at least 20% of their owned and/or managed fleet in CSI. Red referred to carriers (1) with a total weighed score of less than 10% and/or (2) reporting less than 20% of their owned and/or managed fleet.

At an individual vessel level, a green rating referred to vessels that (1) had been verified and scored at least 50% in total, (2) at least a minimum score of 35% in all five categories, and (3) scored in all subgroups of the categories Chemicals and Waste & Water. Yellow referred to vessels scoring at least 20% on average across categories, while red referred to vessels scoring less than 20% on average across categories.¹²

TABLE 8: PREVIOUS SCORING SYSTEM OF CARRIERS AND VESSELS UNDER CSI, VALID TILL END 2016 ¹²

CARRIERS		VESSELS
GREEN	≥ 90 % vessels reported, carrier verified	Vessel verified, total score 50%
	≥ 40% weighed total score	≥ 35% score in all five categories
YELLOW	≥ 20% vessels reported	Total score ≥ 20%
	≥ 10% weighed total score	
RED	< 20% vessels reported or	Total score < 20%
	< 10% weighed total score	

Carriers who report data on their vessels to CSI can receive an annual feedback report with general information about the environmental performance of their ships, benchmarking information in relation to other carriers, performance on specific shipping routes and suggestions for improvements.¹²

WHO OPERATES THE SCHEME?

The non-profit association Clean Shipping Network is comprised of members, including cargo owners and forwarders from a variety of sectors, who participate in the development of the index and its proper use. A secretariat supports daily operations, administering of the scheme, as well as strategy development. Three to four times a year the Network meets for common strategy developments and general discussions on topics relevant for the organization.¹²

WHO PAYS FOR THE SCHEME?

Clean Shipping Network members are charged €2,800 a year for administration and development of the network and index. Shipowners have to bear their own costs for providing data, and have at least two of their vessels verified through a number of appointed external verification bodies, such as Bureau Veritas, DNV-GL, Lloyds Register, RINA, and Korean Register.¹²

WHAT DATA ARE REQUIRED?

Calculation of NO_x score

NO_x scores are connected to how the NO_x emissions from main and auxiliary engines relate to the standards as set in the revised IMO MARPOL Annex VI. Reference emission levels correspond to the same levels as defined in the Tier I, II, and III of the Annex VI, with the exception that between Tier II and III, two extra levels (respectively NO_x performance 30% or 40% below Tier II levels) are included to reward different NO_x reduction techniques. Both pre- and post-combustion reduction techniques are rewarded, such as Selective Catalytic Reduction (SCR). In case onshore power facilities are installed and used in all applicable ports, the maximum score for auxiliary engines applies.

Calculation of SO_x and PM score

Scores can be obtained if the SO_x content in fuel, or in the treated exhaust gases, during a 12-month rolling period is lower than the global (IMO) standards for both main and auxiliary engines. A distinction is made between operations in the Emission Control Areas (ECAs) and non-ECA areas. Extra points are awarded to ships for using low sulfur fuel in main

engines, auxiliary engines, and/or boilers when navigating in port areas outside ECAs.

Particulate matter is included because of the close link between SO_x emissions and PM emissions and is based on the sulfur content in fuels for main and auxiliary engines used during 12-month rolling period. Measured PM levels are also accepted.

Calculation of CO₂ score

Information needed for carrying out the CO₂ calculations is the cargo carried, the distance travelled and the fuel consumption covering in a 12-month period. Operational factors are accounted for by using estimates of average load- and payload factors. Four options for submitting CO₂ data are available:¹⁰

- (1) CO₂ emissions in grams/ton-nm calculated according to IMO's EEOI Guidelines; or
- (2) For cruise ships and passenger ships, the actual EEOI is calculated in grams / passenger-nm;
- (3) For RoPax ships, the EEOI is calculated in grams per year / (transport work for freight + 0.7 × transport work for passengers), reflecting the ship's transport work for both passengers and freight over a 12-month period;
- (4) For container vessels, CO₂ emissions are calculated in grams/TEU-km according to the calculation formula of the Clean Cargo Working Group, an environmental performance scheme for container vessels.

The reported CO₂ 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 in the Clean Shipping Index.

GHG EMISSIONS RATING

PURPOSE OF THE SCHEME

RightShip, an independent ship vetting company that provides ratings for commercial vessels, developed the GHG Emission Rating to rate the design energy efficiency of ocean going vessels. In collaboration with the Carbon War Room, a US-based non-profit organization, it launched an initiative in 2010, which made this information freely accessible online (www.shippingefficiency.org). The website helps increase transparency in the industry on ship efficiency.. The GHG Emissions Rating ranks vessels using an A to G scale to compare an individual vessel's design energy efficiency to vessels of a similar size and class. Scale A represents the most efficient and G the least efficient.²

Around 76,000 existing ships have been captured by the website using data from the world's largest ship registry, IHS Fairplay. The ships captured by the website include tankers, bulk carriers, cargo ships, container ships, cruise ships and ferries, representing as much as 82% of the total number of OGVs worldwide.³ This means that the GHG Emission Rating scheme does not wait for ships to report or register with the scheme. Instead, ships are automatically rated if their data are registered in the IHS Fairplay ship registry. The rating, which is managed by RightShip, was developed in Australia by major shippers, who ship their products mainly via bulk carriers and tankers.¹³

The information on www.ShippingEfficiency.org gives a topline overview of vessels' design energy efficiency. For more detailed information on the various components that determine the design efficiency, paid subscribers to the RightShip system are able to access an enhanced version of the metrics provided to the Shipping Efficiency website. The more detailed information provides the shipper with a vetting history of its carriers to better recognize environmental behaviors of their carriers over time, including a better understanding of what measures may improve a vessel's rating in the system.¹⁷ Meanwhile incentive providers are given access to the RightShip database at no cost.¹⁴

BENEFITS OF PARTICIPATING IN THE SCHEME

The data used to rate a vessel under the GHG Emissions Rating are often approximations and provide an indication of the likely fuel efficiency of a vessel, rather than the actual (verified) efficiency. For bulk carriers and tankers, such a rating works well for procurement purposes as the entire load capacity of a vessel is generally being tendered and dedicated to one customer and with the charterer paying for the fuel about 70% of the time. Cargo owners therefore can exert greater influence on the ship operators they work with, and can benefit from direct fuel cost savings if energy efficiency measures are adopted. This can be a very different proposition for other types of vessel, such as container, Ro-Ro and cruise vessels, where the relationship between CO₂ emissions reduction and fuel cost savings for the customer may be less clear.¹³

PRIMARY USERS

Carriers (charterers), shippers, and to a lesser extent, banks and ports are the primary users of the GHG Emissions Rating. Amongst the carriers, the main focus is on bulk carriers and tankers, because the shippers that hire services of these vessels typically pay for the fuel consumed (as discussed above in this paper). Shippers (including oil, commodity, and mining companies) procuring bulk and tanker loads can use the rating to select more fuel-efficient vessels, while they can also use the system for vetting and as a risk mitigation tool, for example to verify or assure that ships are efficient as they claim to be, as it is often the shipper who pays for the fuel of a voyage.¹³

As of late 2017, 54 charterers - representing over 20% of global shipped tonnage - use the GHG Emissions Rating as part of their vessel selection process in which they implement policies where they exclude F and G rated ships from their selection. Several shipowners^{vii} utilize the rating to demonstrate the benefits of investing in efficiency. Furthermore, four finance or insurance institutions (including ABN AMRO, HSH Nordbank, and KfW IPEX) and two Canadian ports (Vancouver and Prince Rupert) use the rating to offer incentives to better performing ships or shipping companies.¹⁵

HOW DOES IT WORK FOR PORTS?

The GHG Emissions Rating was not specifically developed as an incentive scheme to provide discounts at ports and other organizations. However, on behalf of RightShip, the Carbon War Room has previously lobbied ports to adopt the rating and going forward, RightShip will start promoting the rating again to other ports. Two major Canadian ports have adopted the rating—being Port of Vancouver and the Port of Prince Rupert. These ports provide discounts based on a vessel's rating under the GHG Emissions Rating and a number of other incentive schemes (as well as in the case of Port of Vancouver, various other qualifying emission reduction measures and green certifications), as part of their EcoAction and Green Wave programs respectively (discussed in a subsequent section).¹⁶

For ports, it is important to realize if considering using the GHG Emission Rating to provide incentives to ships, that vessels are all scored relative to each other. This means that a vessel score might actually change even if the ship itself did not do anything to alter its emission performance; this could however occur as a result of the score of other similar vessels having changed. Likewise, such a change can occur at any time; that is, scores are not updated just monthly or annually. This means that offering incentives to ships based on the Rating requires a real-time check to confirm the eligibility of their rating when they call at port.

HOW DOES IT WORK FOR SHIPOWNERS AND SHIPPING COMPANIES?

With the GHG Emission Rating using data from the world's largest ship registry, the majority of OGVs worldwide are captured by the Rating, regardless of whether shipowners and shipping companies actively collaborate with RightShip or not. Vessels are classified on the basis of the Existing Vessel Design Index (EVDI), plus a database of underlying (in part operational) data as developed by RightShip. The EVDI uses IMO's Energy Efficiency Design Index (EEDI) methodology for existing vessels. A technical algorithm is used to derive a vessel's GHG rating. Vessels are grouped by ship-class and compared to the closest 50, 100 or 200 vessels in that vessel type or class by dead weight tonnage (DWT), gross tonnage, TEU's, and cubic meters, in order to obtain a more representative rating.²

Shipowners and operators are encouraged to update their records in the system when efficiency improvements to their vessels have been implemented. They can do so by submitting additional data to RightShip, which helps ensure that their vessel ratings are as accurate as possible. RightShip subsequently verifies the data and if correct, will upgrade the rating. As many shipowners have reported not being able to get a charter because of their poor rating in the GHG Emissions Rating system, an increasing number of shipowners actively update their information in the system in order to improve their ratings.

Subsequently, a vessel's GHG emissions rating is presented using the standard European A - G energy efficiency scale with its relative performance rated from A to G. The rating is based on the EVDI size score, which indicates the number of standard deviations a vessel varies from the average for similar sized vessels of the same ship type.¹⁷

WHO OPERATES THE SCHEME?

RightShip hosts the ship registration data, which are provided by IHS Fairplay/Maritime, verified by owners, engine manufacturers and yards.

WHO PAYS FOR THE SCHEME?

The Carbon War Room pays for the Shipping Efficiency website, in order to make part of the RightShip database freely available to users around the world. Paid subscribers to RightShip's GHG Emissions Rating pay a fee to obtain full access.

vii. Including Bernhard Schulte Shipmanagement, Carisbrooke Shipping, Fednav, Gearbulk Shipping, J. Lauritzen, KLCMSM Ship Management, Laurin Maritime, Mastermind Shipmanagement Ltd, Odjell and the China Navigation Company (Swire).

WHAT DATA ARE REQUIRED?

Shipowners do not have to self-report in order for their ships to be included in the GHG Emissions Rating and in fact their ships are automatically included in the Rating if their ships are registered with the IHS Fairplay ship registry. They are however being encouraged to update their records in the RightShip system when efficiency improvements to their vessels have been implemented.

RightShip uses a range of source data for the rating of each vessel, based on the following hierarchy in terms of the most or least preferred data from the view of data reliability:¹⁸

TABLE 9: CATEGORIES OF SOURCE DATA USED BY RIGHTSHIP FOR ASSIGNING AN 'A TO G' RATING TO A VESSEL

PREFERENCE / VERIFICATION LEVEL	DATA TYPE	DATA SOURCE / EXAMPLE
Most preferred / Highest level of verification	Energy Efficiency Design Index	1. Classification Societies, e.g., EEDI Technical Files
	Ship specific specifications	2. Ship-sourced data, e.g., sea trial and ship test supplied by the vessel owner / manager
	Industry / Third Party data sources	3. Engine manufacturer's specifications 4. Data sourced from ship yards
Least preferred / Benefits from verification	IHS Maritime database Industry publications	5. IMO publications 6. IHS Maritime Database

GREEN AWARD

The Green Award program was designed as an incentive to encourage large vessels to improve safety and environmental protection by certifying ships that are particularly clean and safe.

PURPOSE OF THE SCHEME

In 1994, the Green Award Foundation was established as a collaboration between the Rotterdam Municipal Port Authority and the Dutch Ministry of Transport and Water Management to initiate market incentives in the Netherlands and beyond that promote quality shipping.¹⁹ The Green Award Foundation has been independent since 2000. Green Award aims to create market preference for quality tonnage resulting in less incidents and accidents that can jeopardize the (marine) environment.

The Green Award program was designed as an incentive to encourage large vessels to improve safety and environmental protection by certifying ships that are particularly clean and safe. Ships with a Green Award certificate can reap various financial and non-financial benefits, including receiving a discount of port dues at major ports in 12 countries. Non-financial benefits may exist of, for example, receiving free premium support for a year from various companies providing support to the marine industry.

Green Award includes a wide range of criteria and subsequently attributes points for various parts of ship operations, performance under MARPOL 73/78, SOLAS 74^{viii} and ISO 9001:2000, general management, maintenance & repair, and crew. Vessels can gain points by going beyond what is required according to international standards and regulations.¹ As part of the extensive Green Award audit requirement criteria, mitigating air emissions can contribute to a maximum of over 17% of the total number of ranking points available.

viii. SOLAS stands for International Convention for the Safety of Life at Sea. It is an international treaties rectified by the IMO that requires Signatory flag states to ensure that ships under their flag comply with minimum safety standards in construction, equipment and operation. SOLAS 74 is the version of the Convention amended in 1974.

BENEFITS OF PARTICIPATING IN THE SCHEME

Ports providing discounts under the Green Award scheme are sending a market signal to ship operators that they value lower emissions. As a result of the monetary reward, companies operating ships that regularly call at participating ports are more likely to use cleaner fuel or retrofit their vessels with emission control technologies. In addition, participating ports can benefit from reduced shipping risks in port and near-waters, as the environmental and safety performance of the Green Award certified vessels calling at their ports are regularly checked by the scheme.

For ships obtaining Green Award certification, they can demonstrate to charterers / shippers procuring loads that they meet high environmental and safety standards, which in addition to mitigating risks can also help them gain international recognition in promoting excellence in shipping.

For ships obtaining Green Award certification, they can demonstrate to charterers / shippers procuring loads that they meet high environmental and safety standards, which in addition to mitigating risks can also help them gain international recognition in promoting excellence in shipping.

PRIMARY USERS

The Green Award certification scheme is open to oil and chemical tankers, dry bulk, LNG, LPG, and container carriers, and most inland navigation vessels. As of late 2017 almost 900 ships were certified, of which one-third OGVs and two-thirds are inland ships. More than 30 applications are currently in process and waiting to be audited by Green Awards in-house auditors.²⁰ Most of the OGVs audited are larger than 50,000 DWT.¹

In addition, around 34 ports accepting OGVs^{ix} offer reduced port dues for vessels that carry a Green Award Certificate. The majority of these 33 ports are located in Western Europe, as the scheme started in the Netherlands. Currently 26 ports receiving inland ships offer discounts on dues as well. The level of discount on port dues varies from 3-23%, although most common is a discount of between 5 and 10%.¹

TABLE 10: PARTICIPATING OGV ACCEPTING PORTS IN GREEN AWARD BY REGION²¹

EUROPE	ASIA	AFRICA	CANADA	MIDDLE EAST	LATIN AMERICA	OCEANIA
14	3	8	4	1	1	3
e.g., Rotterdam, Amsterdam, Hamburg, Lisbon	Yokohama, Nagoya and Kitakyushu	South African ports	e.g., Vancouver, Prince Rupert	Sohar in Oman	Buenos Aires	e.g., Wellington in New Zealand

Green Award has approximately 45 other non-port incentive providers, many of which are based in the Netherlands, although they can also be found in the USA, UK, Greece and Germany. These providers include banks and providers of maritime technology and maritime services, and incentives they offer include discounts to the services they provide to shipping companies, and in the case of banks, reimbursement of Green Award certification costs to shipping bank clients.²¹

ix. Ports that offer reduced port dues to ships carrying Green Award Certificate can be found here: [http://www.greenaward.org/greenaward/22-all-incentive-providers-\(list\).html](http://www.greenaward.org/greenaward/22-all-incentive-providers-(list).html)

HOW DOES IT WORK FOR PORTS?

Most ports registered with Green Award offer discounts of 5-10% on port dues.^{viii} To receive a discount, the shipowner or its agent sends a request to the port, including a copy of the Green Award certificate, upon which the port verifies the validity of the certificate and pays the incentive to the certificate holder either on a quarterly or monthly basis. Examples of the incentives provided by selected ports in Europe are summarized in the table below.

TABLE II: OVERVIEW OF GREEN AWARD INCENTIVES PROVIDED BY A SELECT NUMBER OF EUROPEAN PORTS ^x

PORT	COUNTRY	INCENTIVES OFFERED UNDER GREEN AWARD
Hamburg Port Authority	Germany	A reduction of 3% in port fees for crude oil, product and chemical tankers and LNG carriers of any size that hold the Green Award certificate
Port of Rotterdam	The Netherlands	Vessels holding a Green Award certificate receive a discount on port dues: - 6% discount for crude oil/product tankers - 6% discount for LNG carriers - 15% discount for inland vessels with a Green Award certificate and a Green Award score less than 400 points for the main engine - 30% discount for inland vessels with a Green Award certificate dated later than 17 June 2014 and a score of 400 points or more for the main engine
Port of Amsterdam	The Netherlands	6% premium on the port fees for Crude oil/Product Tankers and for Cargo Bulk Carriers Discounts on port dues for inland barges are determined by Green Award level achieved: Bronze - 5% Silver - 10% Gold - 15%
Port of Prince Rupert	Canada	Vessels holding Green Award certificates are granted 10% fee reduction on harbor dues
Port of Vancouver	Canada	23% savings over the basic harbor dues. Port Metro Vancouver recognizes Green Award certified vessels as eligible at the Bronze level under the EcoAction program.

To become an incentive provider, a port applies by filling in the Green Award application form, with the port deciding on the level of incentive and the date it enters into force. The port enters into a mutual partnership with Green Award and communicates with the Bureau Green Award what joint public relations and marketing activities it would like to undertake.

Furthermore, the port can decide whether it would like to have a handover ceremony for the Green Award of Plaque, in order to attract media attention. It is also allowed to use the Green Award logo in its publications, presentations, and promotional materials.

The process from application to becoming an official incentive provider can take as little as 1.5 months (depending on communications between port and Green Award), with the various steps of the application process in the figure shown on the next page^{xi}. The application process is free, that is, ports don't have to pay to become a Green Award incentive provider.

The 17 staff members working at Bureau Green Award are available to assist, consult and discuss any obstacles faced or suggestive ideas with (prospective) incentive providers. Furthermore, Green Award has 32 honorary non-executive board members that help govern the program and are all representatives from the maritime industry. In its main governing board (Committee), Green Award currently has 2 positions vacant for representatives from Asia, while it would also welcome an Asian representative in its Board of Experts.

x. More information can be found at the Green Award website: <http://www.greenaward.org/greenaward/22-list-of-incentive-providers.html#agreena48>

xi. Step 3b "possible verification audit" does not apply to ports.

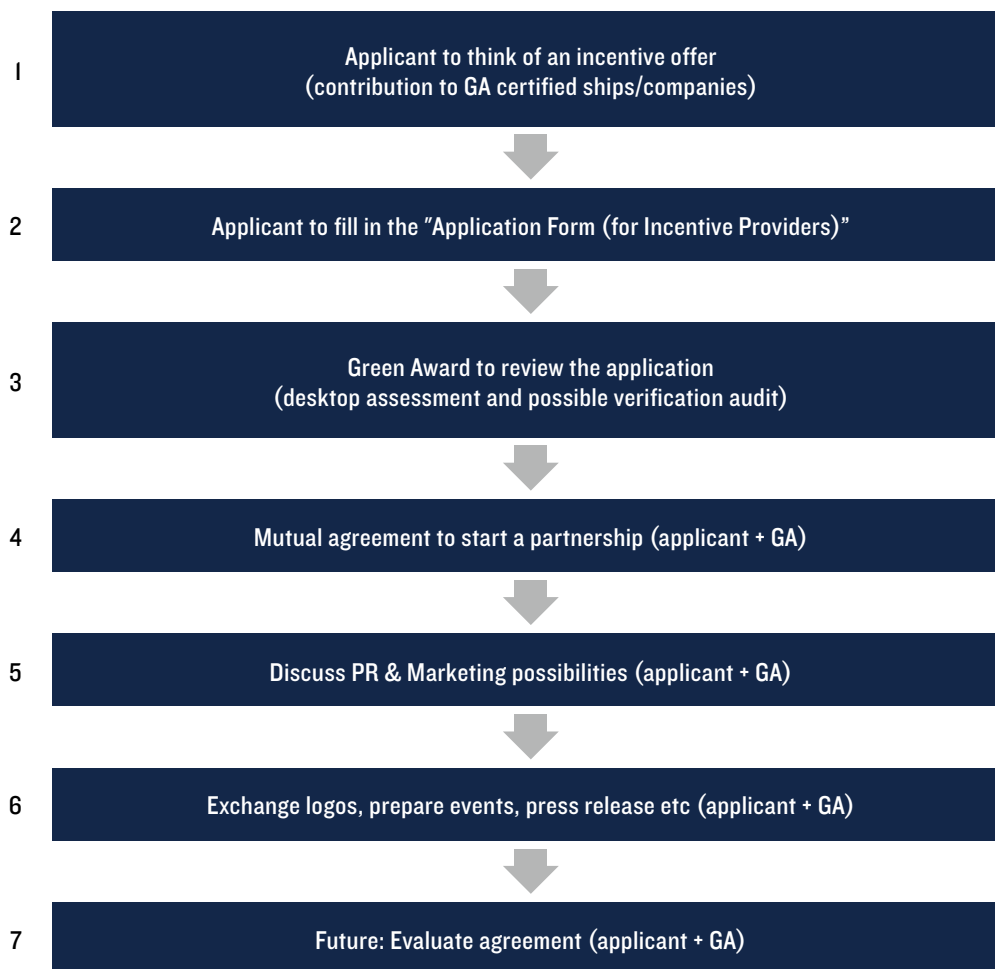
HOW DOES IT WORK FOR SHIPOWNERS AND SHIPPING COMPANIES?

To be eligible for Green Award benefits, vessels will have to be certified. The shipowner pays an application fee to Green Award, all costs associated with audits and surveys, as well as an annual fee once certified. Fees depend in part on the GWT of the vessel. The Green Award certification procedure for OGVs consists of three steps: first, the shipowner submits an application with required documents; second, the Green Award auditors audit the operator to verify procedures and processes; and third, the Green Award in-house auditors survey each individual ship to determine if the procedures are implemented properly. Amongst many others, the assessment focuses on crew, operational, environmental, and managerial elements.^{1, 22}

If eligible, the shipowner receives a Green Award certificate, which remains valid for three years, during which annual checks will be carried out. After three years, a renewal of the ship's certificate is required. If the requirements for Green Award certification are amended during a period of certification, shipowners are given a grace period of up to 12 months to comply. After certification, Green Award will publish the vessel in a list on its website and inform incentive providers on a monthly basis.²²

The certification program for inland barges follows the same procedure, although the scope of requirements for the survey is narrower and the frequency of the ship survey is once every three years. As a result, inland barges pay a lower fee compared to OGVs.²⁰

FIGURE 1: OVERVIEW OF THE PROCESS OF BECOMING A GREEN AWARD INCENTIVE PROVIDER



WHO OPERATES THE SCHEME?

The Green Award procedure is carried out by the Bureau Green Award, the executive body of the independent non-profit Green Award Foundation.²² The Bureau is based in Rotterdam, and has its own teams of surveyors and researchers to support its operations.²⁰

WHO PAYS FOR THE SCHEME?

To be certified through Green Award, shipowners pay:²²

1. an application fee (valid for 12 months),
 - in 2017, the application fee included a basic fee of €3,475 for the shipholder's office, plus an additional fee that ranged from €4,815 to €8,255 per ship, depending on the ship type and DWT class;
2. all costs associated with office audits (once every three years) and ship surveys (initially every year for the first 3-year cycle; thereafter depends in part on performance); and
3. an annual fee (valid for 12 months, starting a year after initial certification date)
 - in 2017, the annual fee ranged from €2,645 to €4,845 per ship, depending on the ship type and DWT class.

A Green Award incentive provider does not have to contribute financially to Green Award. As with other schemes, the incentive providers decide on the percentage discount given, therewith remaining in control of the cost incurred in running the scheme. Many ports run the Green Award (or any other discount) scheme on a cost-neutral basis, slightly increasing the port dues for non-qualifying ships which pays for the discounts provided to qualifying ships. To do so, ports generally make some estimates of the number of Green Award certified vessels they expect to call at their port. Where needed, they can adjust these on an annual basis.

In addition, ports have to invest some initial effort in incorporating the discount on port dues in their (automated) tariff and invoicing system, such that the discount is automatically applied to invoices for qualifying ships. Ports can also submit a request to other ports to share their experience with running the scheme, while the Bureau Green Award is very active in supporting incentive providers with implementing and running the scheme.

WHAT DATA ARE REQUIRED?

The Green award requirements for a ship to become certified consist of three parts, including:

1. Basic requirements (statutory elements related to International Safety Management code (ISM), IMO MARPOL);
2. Ranking requirements (weighted items, minimum % to be attained); and
3. Visual inspection (seaworthiness, good housekeeping).

The scope of the Green Award audits and surveys include a broad range of subjects covering more than 50 different elements. These include, for example, criteria covering air emissions, waste management and garbage handling onboard, sewage and grey water management, change over, bunker fuel testing, ballast water management, and other safety, training, and environmental elements.

Specifically with respect to air emissions, the requirements for NO_x and SO_x emissions focus on encouraging shipowners to reduce emissions below the current IMO regulatory limits. For PM and CO₂, shipowners are encouraged to establish the current emission level of their ship and then implement measures that reduce emissions below the ship's current level.

Furthermore, participation in the Environmental Ship Index (ESI) is recommended for those pursuing Green Award certification. Ships with high ESI scores can also gain extra points under the Green Award requirements. In addition, having a Green Award certificate will generate an additional rating score for Rightship's GHG Emissions Rating.²²

EXAMPLE OF A PORT USING MULTIPLE SCHEMES TO INCREASE PARTICIPATION

To increase the number of vessels eligible for discounts and therewith encourage uptake of cleaner fuels and clean/efficient technologies, some ports offer incentives under multiple schemes. Good examples are the Port of Vancouver and the Port of Prince Rupert, both in western Canada. In 2007, Vancouver introduced its EcoAction program, while in 2013, Prince Rupert introduced its Green Wave program, which modeled after the Vancouver program.

ECOACTION PROGRAM, PORT OF VANCOUVER

Port of Vancouver's EcoAction program recognizes a variety of cleaner fuels and technologies, as well as different incentive / rating schemes for reducing ambient air and carbon emissions, providing vessels with 3 different levels of discounts on port dues. Ships may qualify for gold, silver or bronze levels, which qualify them for a 23%, 35% or a maximum 47% discount.

In addition, the Port's Blue Circle Awards recognize marine carriers with the greatest fleet-wide participation in the EcoAction Program. Marine carriers must have a minimum of five eligible calls over the course of a year at reduced, EcoAction

rates, and more than 50% of all calls by their vessels calling at the Port of Vancouver at reduced, EcoAction rates.

The EcoAction program provides discounts through one of five qualifying incentive schemes, four of which are being covered in this paper. The fifth scheme is called Green Marine, which is an environmental performance certification scheme for the North-American marine industry (U.S. and Canada). In recognizing the RightShip/Carbon War Room GHG Emissions Rating, the Port also considers a ship's safety and sustainability performance based on RightShip's Qi Rating that ranks a ship from 1 to 5 stars (5 being the best).^{xii} Ships may also qualify for discounts based on their EEDI score.

In addition, ships can receive discounts for:

- The use of cleaner fuels, distinguishing between LNG and biodiesel blends;
- The implementation of vessel and engine technologies, such as a shore power installation, vapor control/recovery, seawater scrubber, direct water injection, combustion air humidification, fuel / water emulsion, selective catalytic reduction, and exhaust gas recirculation; or
- By having achieved a certain designation through a ship classification society, such as the Lloyd's Register's Environmental Protection Designation.

TABLE 12: DISCOUNT ON PORT DUES FOR SHIPS CALLING AT PORT OF VANCOUVER BASED ON EACH INCENTIVE SCHEME AND EEDI

INITIATIVE	CRITERIA FOR SHIPS TO QUALIFY FOR DIFFERENT LEVELS OF DISCOUNT		
	Bronze (23% discount on port dues)	Silver (35% discount)	Gold (47% discount)
RightShip GHG Emissions Rating and Qi Rating	GHG C & Environmental 3+ stars	GHG B & Environmental 3+ stars	GHG A & Environmental 3+ stars
ESI	20 ≤ Score < 31	31 ≤ Score < 40	Score ≥ 40
Green Award	Award certificate		
CSI	Score of 3	Score of 4	Score of 5
Green Marine	Level 3 GHG & min. Level 2 others	Level 4 GHG & min. Level 2 others	Level 5 GHG & min. Level 2 others
Energy Efficiency Design Index (EEDI)	Attained EEDI 5% better than Required EEDI	Attained EEDI 10% better than Required EEDI	Attained EEDI 15% better than Required EEDI

The Port of Vancouver decided to also offer incentives to ships that adopt clean fuels or technologies, or get a better than required EEDI score, regardless of whether participate in any incentive scheme, because some shipowners that apply these measures do not participate in the discussed third-party rating systems as they may sometimes find the registration process too onerous. Therefore, the Port of Vancouver's flexible program still helps reward these ships for the clean fuels and technologies adopted. The downside is that such flexibility comes with considerable administration efforts that have to be dedicated by the Port for verifying ships' eligibility, staying on top of how the different incentive schemes develop, and for processing the various discounts.²³

The Port of Vancouver therewith offers perhaps the most flexible incentive program of any major port, with discounts being provided for about every incentive scheme as well as for the use of cleaner fuels and a wide range of technologies, and for holding an environmental designation from a classification society. Although it appears that uptake of the program has remained at roughly the same level over the past 7 years, as shown in the following table which has the number of qualifying calls at the Port from 2010 to 2016, a key reason for this are the many changes to the program over the years, having included several incentive schemes that were previously not covered by the scheme, as well as having raised the minimum criteria for ships to qualify for a discount and therewith helping to raise the bar on environmental performance in the industry.

TABLE 13: NUMBER OF VESSEL CALLS QUALIFYING FOR DISCOUNTS UNDER PORT OF VANCOUVER'S ECOACTION PROGRAM, 2010-2016

RESULTS	2016	2015	2014	2013	2012	2011	2010
Number of qualifying vessel calls	612	416	520	521	440	332	498

xii. More information about the Green Marine program and the RightShip Qi Rating can be found at <https://www.green-marine.org/program/> and <https://site.rightship.com/ship-owners/risk-rating/> respectively.

GREEN WAVE PROGRAM, PORT OF PRINCE RUPERT

The Green Wave program offers reduced harbor dues to vessels that have implemented emission reduction measures and/or other environmental practices to improve their environmental performance through one of five qualifying incentive schemes, being the four schemes covered in this paper, plus the North-American “Green Marine” scheme. The GHG Emissions Rating is jointly considered with the RightShip Qi Rating that assesses a ship’s safety and sustainability performance. In addition, ships may qualify for discounts based on their EEDI score.

Vessels can qualify for one of three tier levels of discounts on port dues, based on their environmental performance. For example, a ship is eligible for a 50% discount on port dues (Tier 3) if it can prove to have received at least a score of A under the GHG Emission Rating or at least a score of 50 points or more under the ESI rating. The following matrix illustrates these three tiers of discounts and the minimum criteria per each scheme necessary to qualify for a discount rate when a ship calls at the Port in 2017. Ships cannot receive double discounts for being registered with and qualifying through multiple schemes.²⁴

TABLE 14: DISCOUNT ON PORT DUES FOR SHIPS CALLING AT PORT OF PRINCE RUPERT BASED ON EACH INCENTIVE SCHEME AND EEDI

INITIATIVE	CRITERIA FOR SHIPS TO QUALIFY FOR DIFFERENT TIERS		
	TIER 1 (10% discount on port dues)	TIER 2 (20% discount)	TIER 3 (50% discount)
RightShip GHG Emissions Rating and Qi Rating	Environmental 4 + stars & GHG D; or GHG C & Environmental 3+ stars; or GHG B	GHG B and Environmental 3+ stars	GHG A
ESI	20 ≤ Score ≤ 30	30 < Score ≤ 50	Score >50
Green Award	Award certificate		
CSI	Score of 3	Score of 4	Score of 5
Green Marine	Level 3 GHG & min. Level 2 overall	Level 4 GHG & min. Level 2 overall	Level 5 GHG & min. Level 2 overall
Energy Efficiency Design Index (EEDI)	Attained EEDI 15% better than Required EEDI	Attained EEDI 25% better than Required EEDI	

Country-specific Schemes



The NO_x Fund has been a main driver for the use of LNG and NO_x after-treatment technologies in the marine sector in Norway.

In addition to the industry-led green shipping incentive programs, several countries have implemented national incentive programs to encourage the adoption of green marine fuel, technologies, and operational practices. This section summarizes the programs that have been introduced in Norway, Sweden, and Singapore.

NORWAY – BUSINESS SECTOR NO_x FUND

In 2007, Norway introduced a NO_x tax for all sectors, whereby those operating engines exceeding 750 kW, boilers over 10 MW as well as flaring are subject to a fixed NO_x tax rate of NOK 21.17 for every kilogram of NO_x emitted.²⁵

The tax applies to emissions from ships within Norwegian territorial waters irrespective of nationality. In reality, mostly Norwegian-registered vessels are affected, with the tax applying to emissions in “near waters,” which are defined as sea areas within 250 nautical miles of the Norwegian coast. All ships in international traffic are tax exempt, including vessels operating in direct traffic between Norway and foreign ports. The tax is calculated on the basis of actual NO_x emissions. If these are not known, the tax is calculated on the basis of a source-specific emission factor. If no source-specific factor is known either, standard values are used as emission factors. These depend on the engine’s maximum revolutions per minute, thereby differentiating between four different emission factors.¹

Since the introduction of the NO_x tax, 15 business organizations and the Norwegian Ministry of the Environment have signed an Environmental Agreement on NO_x emissions, leading to the establishment of the so-called Business Sector’s NO_x Fund. Each business organization represents a number of companies, effectively leading to more than 90% of the emissions that were initially subject to the tax now being covered under agreements with the NO_x Fund. Participating enterprises are exempt from paying the NO_x tax for a period of three years. Instead, they pay a fee into the NO_x Fund for every kg of NO_x emitted (NOK 4 per kg of NO_x for all sectors, except the oil & gas sector, which pays a higher fee). Participating enterprises also have to commit themselves to investigate measures to reduce NO_x emissions and report the expected emission reduction results back to the Board of Directors of the NO_x Fund. The NO_x Fund fee is lower than the NO_x tax that they would have to pay if they did not participate in the NO_x Fund, thereby creating a powerful incentive to participate and accelerating the development and uptake of low-NO_x solutions.

Based on member proposals received regarding measures that could be implemented for reducing NO_x, the Board of the NO_x Fund annually evaluates and selects the most cost-effective projects for reducing NO_x, such as SCR, low-NO_x engine modifications, or LNG propulsion. The selected projects can subsequently be qualified for reimbursements of up to 80% of their investment costs by the NO_x Fund.

The NO_x Fund has to meet the NO_x emission reduction targets as per the Agreement between national government and business organizations participating in the fund instead of paying the NO_x tax. Collective sanctions can be applied if annual targets are missed by more than 10%, with participants having to pay the NO_x tax for the percentage of obligation to which the non-compliance applies. In addition, because the agreement work best if there is significant participation, the agreement can be terminated if the NO_x emission reduction targets are under-fulfilled by more than 25% for a given year. If this happens, participating enterprises are required to pay the full NO_x tax as of January 1st of the current year. In the period of 2011 - 2017, the emission reduction target amounted to 16,000 tons of NO_x.²⁶

The NO_x Fund has been a main driver for the use of LNG and NO_x after-treatment technologies in the marine sector in Norway. As of May 2017, 106 ships were powered by LNG worldwide - with 115 ships on order - and 57 of these were in Norway, thanks in part to the NO_x Fund. Nearly one quarter of the NO_x reductions from the marine sector in Norway in the period of 2011-17 will have come from the use of NO_x after-treatment technologies, such as SCR and selective non-catalytic

reduction devices.²⁷ Annual NO_x emission targets from 2008-2014 have all been met.²⁸ The NO_x tax and NO_x Fund were the main reason Norway could achieve its 2020 NO_x emission reduction target in 2015.²⁹

SWEDEN – ENVIRONMENTALLY DIFFERENTIATED FAIRWAY DUES



In 1996, the Swedish Maritime Administration (SMA), the Swedish Port and Stevedores Association, and the Swedish Shipowners' Association agreed to use differentiated dues to encourage the reduction of emissions of SO_x and NO_x from shipping in Swedish fairways and ports. The original goal was to reduce NO_x and SO_x emissions by 75% over ten years.

The objective of the program is to encourage vessels to adopt cost-effective NO_x (and previously also SO_x) abatement techniques. The basic principle used for the differentiation in fairway dues are the 'environmental costs borne' by society, the most important factor of which are the impacts of air pollution from vessels. Following the tightening of the SO_x emission limits in the Emission Control Areas (ECA) per 1 January 2015, the SO_x fee was discontinued in 2015, while the NO_x fee was discontinued at end 2017 and replaced by the ship's CSI score.³⁰

Vessels calling at a Swedish port in international traffic and loading or unloading cargo or passengers, are liable for the payment of fairway dues in the first Swedish port of call. Vessels in domestic traffic are liable for fairway dues in the port where cargo or passengers are loaded. Till end 2017, the fairway dues consisted of two portions, one portion being assessed based on the vessel's gross tonnage and the other on the amount of cargo loaded and unloaded. For each gross tonnage, vessels paid a fee for NO_x emissions

The objective of the Swedish program is to encourage vessels to adopt cost-effective NO_x (and previously also SO_x) abatement techniques.

emitted depending on the type of vessels, such as passenger, oil tanker, cruise and other types of vessels. Until December 2015, on top of the fee for NO_x, vessels were charged an additional fee per gross tonnage for SO_x emissions unless they used fuels containing less than a certain percentage of SO_x (half that permitted by ECA regulation), and operated on this fuel continuously while in Swedish waters.²⁹

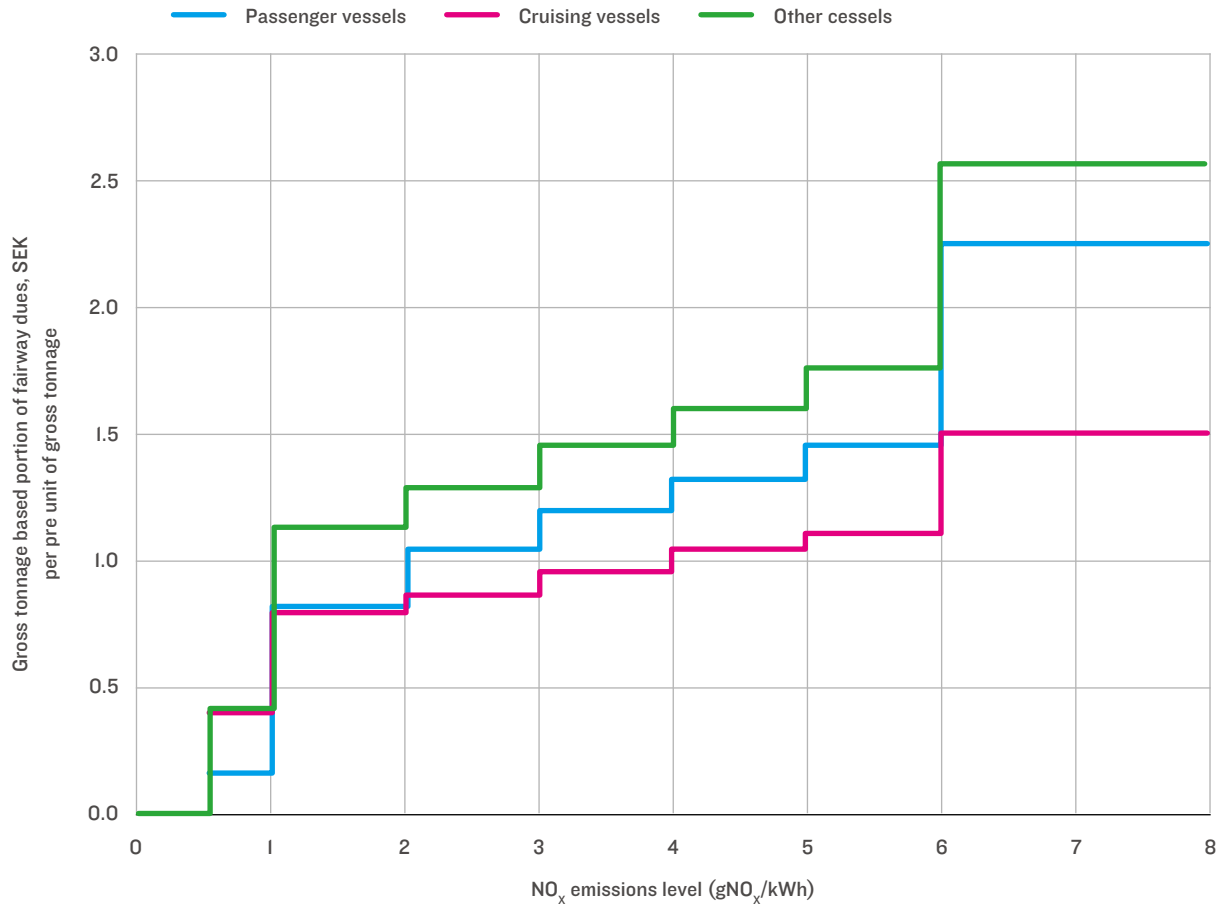
The number of calls at Swedish ports subject to fairway dues on total gross tonnage is limited to five per calendar month for passenger and cruise vessels and two per month for other vessels, after which any further calls that month for the same vessel are only charged per ton of cargo loaded or unloaded. The table below lists the NO_x fee in Swedish Krone charged from 2015 till the end of 2017 for NO_x emissions per unit of the vessel's gross tonnage.¹

TABLE 15: FAIRWAY DUES IN SWEDISH KRONE FOR NO_x EMISSIONS PER UNIT OF GROSS TONNAGE FOR SHIPS CALLING AT SWEDISH PORTS³⁰

TYPE OF VESSEL	FAIRWAY DUES FOR NO _x FOR THE CALL OF THE MONTH (SEK/UNIT OF GROSS TONNAGE)				
	1 st	2 nd	3 rd	4 th	5 th
Passenger vessels and railway ferries	2.25	2.25	2.25	2.25	2.25
Cruise vessels	1.5	1.5	1.5	1.5	1.5
Vessels with cargo of mineral oil products in bulk	2.55	2.55	0	0	0
Other vessels	2.55	2.55	0	0	0

Vessels that have installed equipment for the reduction of NO_x emission and possess a NO_x reduction certificate received a reduction on the gross tonnage-based fairway dues for NO_x. The reduction ranged from a base emission level of 6 g/kWh to less than 0.5 g/kWh, at which point the vessel is totally exempted from gross tonnage-based fairway dues. The following chart shows the reduction in fairway dues based on NO_x emission levels.

FIGURE 2: GROSS-TONNAGE BASED PORTION OF THE DIFFERENTIATED FAIRWAY DUE BY NO_x EMISSIONS LEVEL



For payment, all vessels liable for fairway dues submit a declaration for fairway dues—by either the shipowner or by an agent—no later than 7 days after departure. However, if a shipowner does not have any credit agreement with the SMA, fairway dues are to be paid to the agent or directly to the SMA before the vessels’ departure.³⁰ The declaration can also be submitted via the e-services available at the homepage of the Swedish Maritime Administration (SMA).³¹ Those vessels sailing in scheduled traffic and with a credit agreement with the SMA are able to submit a declaration of fairway dues once a month. The owner or operator of a vessel that has adopted NO_x mitigation measures (and/or uses lower sulfur fuel before 2015) can submit an attestation to apply for subsidies.

Once approved, the SMA issues a compliance certification that is valid for three years. The SMA periodically verifies the SO_x and NO_x performance of certified vessels, such as taking fuel samples on board of berthing vessels and monitoring ship emissions by remote measurement.

The program has been designed to be cost-neutral, charging polluting ships (ship emissions at or over 6g/kWh of NO_x) more while providing discounts to cleaner ships. As polluting ships have to pay more, the extra dues which become therewith available are used to pay the discount on dues which is given to cleaner ships. The program was restructured in 2005, 2010, 2014, 2016 and 2017 – the latter approving the switch to CSI scores - to reflect changes of fuel regulation and advances in emission control technologies, and to ensure sufficient incentives continue to be provided.³²

Although the Swedish program has in recent times focused on NO_x emissions only, it has been successful in the period up to December 2014 (after which the IMO tightened the permissible SO_x levels in fuel in all ECA zones) in encouraging ships operating within Swedish waters to use fuels with much lower sulfur levels than required by the regulation, particularly in the early years of the program. About 1,350 ships calling at Swedish ports participated in the sulfur program in 1999. In 2005, 1,127 vessels, which accounted for 80% of the ferry tonnage and 50% of the cargo tonnage calling Swedish ports that year, participated by using fuel with less than 1% sulfur content (compared to the then-current fuel sulfur standard of 4.5%). Its success has been partly attributed to the financial incentives, and partly because shippers and carriers value the “green” profile through participating in the program.³³

For the recently discontinued NO_x program, the majority of vessels regularly affected by the fairway dues have opted for installing selective catalytic reduction (SCR) on their main engines, resulting in, on a ship basis, an average NO_x reduction of 87 percent after SCR installation. To overcome the hurdle of additional capital investments for reducing NO_x emissions, the program initially offered financial support, covering up to 40 percent of capital cost of low-NO_x retrofit technology for equipment installed before January 2000 and 30 percent for projects completed before January 2003.³⁴

A proposal to differentiate Swedish fairway dues according to the CSI score of a ship was approved in April 2017, in order to induce practices that would reduce overall environmental impacts of ships.^{35, 36} The new system has come into place in January 2018, and the higher a vessel scores in CSI, the greater reduction of fairway dues are. For example, a vessel with 125 or more verified CSI points will pay as little as 10% of the normal fairway dues.

To calculate the discount, the vessel has to be first placed in an environmental category A to E, as per the following table, and verified in accordance with verification requirements as per CSI. The environmental class held by the vessel at the start of the calendar month will subsequently apply for the remainder of the calendar month.

TABLE 16: ENVIRONMENTAL CLASSIFICATION OF VESSELS FOR PURPOSE OF CALCULATING THE FAIRWAY DUE

ENVIRONMENTAL CLASSIFICATION	TOTAL POINTS
A	125-150
B	100-124
C	75-99
D	0-74
E	Vessels not linked to CSI

For the first and second call at a Swedish port in one calendar month, the vessel-based fairway fee is charged in Swedish Krone (SEK) per the following table below. For the third to fifth calls in one calendar month, a lower fee is paid, as a percentage of the full fairway fees. For the third call, 75%, for the fourth call, 50%, and for the fifth call, 25% of the fees as per the table are being charged³⁷.

TABLE 17: ENVIRONMENTAL FAIRWAY DUES FOR THE FIRST AND SECOND CALL OF THE MONTH

NET TONNAGE CLASS	VESSEL-BASED FAIRWAY FEE, SEK			
	ENVIRONMENTAL CLASSIFICATION			
	A	B	C	D-E
0-999	260	780	2,330	2,590
1,000-1,999	990	2,970	8,900	9,890
2,000-2,999	1,940	5,830	17,480	19,420
3,000-5,999	3,100	9,290	27,860	30,960
6,000-9,999	5,690	17,060	51,170	56,860
10,000-14,999	8,260	24,790	74,380	82,640
15,000-29,999	10,580	31,750	95,250	105,830
30,000-59,999	12,140	36,410	109,230	121,370
60,000-99,999	14,210	42,630	127,880	142,090
100,000-	16,790	50,360	151,080	167,870

SINGAPORE - MARITIME GREEN INITIATIVE



In 2011, the Maritime and Port Authority of Singapore (MPA) introduced the Maritime Singapore Green Initiative to reduce the environmental impact of shipping and related activities and to promote clean and green shipping in Singapore.

In 2011, the Maritime and Port Authority of Singapore (MPA) introduced the Maritime Singapore Green Initiative to reduce the environmental impact of shipping and related activities and to promote clean and green shipping in Singapore. The Singapore government pledged to invest S\$100 million over five years for the initiative. The Initiative consists of three programs, including:³⁸

1. Green Ship Program (GSP)

Encourages Singapore-flagged ships to reduce CO₂ and SO_x emissions by providing a reduction of Initial Registration Fees and a rebate on Annual Tonnage Tax to those adopting energy efficient ship designs exceeding IMO's Energy Efficiency Design Index (EEDI) and/or those adopting approved SO_x scrubber technology exceeding IMO's emission requirements.

2. Green Port Program (GPP)

Encourages OGVs calling at the Port of Singapore to reduce air emissions by giving them a discount on port dues if they use type-approved abatement/scrubber technology or burn clean fuels.

3. Green Technology Program (GTP)

Encourages local maritime companies to develop and adopt green technologies by providing grants up to 50% of total qualifying costs for co-funding the development and adoption of green technological solutions/ systems.

In mid-2016, Maritime and Port Authority extended and expanded the scheme till end 2019, as follows:

- the GSP was expanded to cover ships using LNG;
- the maximum fuel sulfur content to qualify for a GPP discount was reduced to 0.5%;
- the GTP was extended till the end of 2019; and
- two new programs were introduced: the Green Awareness Program (GAP) focuses on creating greater awareness on possible avenues towards sustainable shipping, and the Green Energy Program (GEP), which promotes the adoption of alternative or cleaner marine fuels, as well as the wider adoption of energy efficient operational measures.^{1,39}

GREEN SHIP PROGRAM

Singapore-flagged ships that adopt energy efficient ship designs exceeding IMO's Energy Efficiency Design Index (EEDI) receive a 50% reduction of Initial Registration Fees and 20% rebate on Annual Tonnage Tax. In addition, ships that use approved SO_x scrubber technology that exceeds IMO's emission requirements receive a 25% reduction of Initial Registration Fees and a 20% rebate on Annual Tonnage Tax. Ships adopting both energy efficient ship designs and approved SO_x scrubber technology exceeding IMO's requirements receive a 75% reduction of Initial Registration Fees and 50% rebate on Annual Tonnage Tax.

To qualify for the incentives related to the adoption of energy efficient ship designs, shipowners need to submit a copy of their International Energy Efficiency (IEE) Certificate or pre-verification report as proof that the attained EEDI of the ship exceeds IMO's requirements on EEDI for that particular ship type and size. To qualify for incentives relating to the adoption of approved SO_x scrubber technology, shipowners need to submit an application to the MPA, with supporting documents showing the installation of the scrubber and the emission reductions achieved.³⁶ From July 1st, 2016, GSP incentives have been extended to ships using LNG.⁴⁰

GREEN PORT PROGRAM

Ocean-going ships that use approved abatement/scrubber technology or clean fuels during their entire stay of 5 days or less within the Singapore Port Limits (from the point of entry into Singapore Port Limits till the point of exit) are granted a 25% reduction in port dues. The criterion of clean fuel was initially set at a maximum of 1% sulfur content, and lowered to a maximum of 0.5% in June 2016.¹ Those vessels that use the clean technology or clean fuels only when berthing are granted a 15% reduction in port dues. In terms of logistics, the switch to clean fuel at berth must be made within 1 hour after completion of berthing and continue throughout the time of berthing. The ship cannot switch back to high sulfur fuel until 1 hour before departing.

The participation rate of the Green Port program is modest. Fewer than 3% of the annual vessel calls participated in the program in 2016, representing roughly 3,700 vessel calls.^{37,41} The low participation rate is probably because this scheme only applies to the Port of Singapore and does not operate at any other ports. This can pose a barrier to uptake, as port-specific schemes require vessels owners / operators to look into and fulfill the requirements of each individual port they call at. The time burden involved will therefore have many vessels foregoing the discount, except perhaps for the ports they call at most regularly.

GREEN TECHNOLOGY PROGRAM

The GTP provides grants to Singapore-registered companies to co-fund the development and adoption of green technologies in the maritime sector. Businesses eligible to apply include for instance companies involved in terminal operations, ship operations and harbor craft operations. For projects that involve ships and harbor crafts, those ships and harbor crafts must be registered in Singapore for a specified period upon completion of the project. Grants are capped at S\$ 2 million per project; the cap can be increased to S\$ 3 million for projects on solutions or systems that achieve more than 20% reduction in emission levels.⁴² As of June 2016, the GTP has provided grants to more than 20 projects involving 60 vessels.³⁷

Comparison of the Four Industry-led Green Shipping Incentive Initiatives

	ESI	CSI	GHG EMISSIONS RATING	GREEN AWARD
Purpose	Reducing port dues for registered vessels with good NO _x , SO _x and/or CO ₂ performance	Rating and benchmarking of environmental performance on ship-to-ship + aggregated carrier basis – can be used by shippers for shipping service procurement, vetting or risk mitigation as well as by ports to attract green ships by offering port due discounts	Rating and benchmarking of CO ₂ performance on the vessel basis – can be used by shippers for shipping service procurement, vetting or risk mitigation as well as by ports to attract green ships by offering port due discounts	Certifying vessels to incentivize improvements in safety of shipping and environmental protection – can be used by incentive providers, including ports, to provide financial or non-financial benefits
Primary users	Ports, carriers	Carriers, shippers, and to a lesser extent, ports including the Swedish Maritime Administration	Carriers (mainly bulk carriers and tankers), shippers, and to a lesser extent, banks and ports	Carriers, shippers, ports, and to a lesser extent, maritime service providers and banks
Ease of entry for owners of OGVs	Easy – self-registration with small chance of being audited	Moderate – more effort needed and verification required for highest score	None – nearly all OGVs in the world are already captured and scored in database; companies can submit edits if they do not agree with score	Difficult – scheme aims to attract frontrunners. All registered OGVs go through rigorous audits and verification.
Popularity of the scheme	Late 2017: <ul style="list-style-type: none"> ~7,130 ships with valid ESI score 47 participating ports 6 non-port incentive providers 	Late 2017: <ul style="list-style-type: none"> >2,250 ships with CSI score 30 members (cargo owners, forwarders, ports, shipowners, clean tech providers) 74 affiliated shipping companies (reporting shipowners) 6 ports 1 national authority (Sweden) 	Late 2017: <ul style="list-style-type: none"> 54 affiliated charterers 24 shipowners/managers (although 76,000 vessels listed) 3 private terminals 2 participating ports 4 participating finance or insurance providers 	Late 2017: <ul style="list-style-type: none"> 45 ship companies 257 ships (sea) 630 ships (inland) 60 participating ports, of which 33 are seaports
Modal scope	All types of OGVs	All types of OGVs	All OGVs, but key focus on bulk carriers and tankers	Several types of OGVs + inland vessels
Use of actual data or approximations & verification	Actual; self-registration by shipowners – some ports are allowed to conduct audits	Actual; self-registration + requirement to have at least 2 vessels of the fleet verified by audit	N.A. - design efficiency (approximation based on a global database)	Actual; office audit and ship survey; for OGVs, annual checks once certified, for inland vessels, survey conducted once every three years; certification is renewed every 3 years
How is the scheme paid for?	ESI incentive providers contribute to the costs for maintaining the ESI website, with contributions based on the port's "tonnage handled". Shipowners pay no fee.	CSI network members (shipping companies, cargo owners and forwarders) are charged €2,800 a year for administration and further development.	Carbon War Room pays for creating and maintaining the Shipping Efficiency website, through which companies can have free access to design efficiency information of listed ships. Companies can pay a fee to RightShip if they want to obtain full access to data.	Incentive providers pay no fee. Shipowners pay a fee for application, audits and surveys; once certified, shipowners pay an annual fee.

Conclusion

As discussed in this paper, a number of industry- or government-initiated schemes exist to incentivize vessels to reduce ambient air emissions such as SO_x, NO_x and PM from fuel exhaust when at or near port areas, and/or reduce carbon emissions.

Schemes that achieve high voluntary uptake by ships are those that (1) provide access to a good number of financial incentive providers in locales that are regularly visited by OGVs (such as major ports in Europe and Asia) and (2) have low entry barriers for shipowners/operators to become a participant. A clear example of this is the Environmental Ship Index (ESI). For ports, ESI also offers a flexible framework that allows ports to adjust their level of discounts based on the importance of a particular ESI component (NO_x, SO_x, PM or CO₂), which enables them to address the ports' own priorities.

It is worth noting, however, that a self-registration program like ESI needs a system of compliance checks to reduce the risk of cheating and freeriding. Increasing the likelihood of compliance checks increases the incentive that ships will actually implement on-board emission reduction measures.

Schemes like Green Award use a rigorous certification process to provide a clear safeguard against non-compliance. In this program, certified ships having to prove their 'worthiness' every year (or every three years for inland ships) in order to have their certification renewed. Due to the relatively laborious demands and higher costs, schemes like Green Award attract a much smaller number of vessels, but those who join are generally keen to be seen as frontrunners.

The experiences of the country-led programs suggest that a country program that covers all ports in the entire country and offers sufficient savings (such as the large difference between paying the NO_x tax and the fees for participating in the NO_x Fund in Norway) could accelerate adoption of clean fuel and technologies, particularly by vessels that travel often within the national waters. For vessels that are more likely to travel between countries, a country-led program will prove less attractive compared to an incentive scheme that covers at least multiple ports on shipping routes they often visit.



In sum, ports receiving OGVs that are interested in promoting green shipping through voluntary incentives could consider joining one of the industry-led programs, or introducing their own scheme that recognizes or aligns with one or more of these programs. Good case studies to consider for the second option are the EcoAction and the Green Wave programs introduced respectively by the Port of Vancouver and the Port of Prince Rupert in Canada, which both incorporate four international and one North-American programs. By taking one of these approaches, ports could leverage incentives offered by all other participating ports to attract more clean ships at their ports, while reducing the administrative burden on shipowners/operators to demonstrate eligibility for receiving the incentives.

For ports that serve a broad mix of OGVs, coastal ships and inland ships, they may consider adopting a more flexible approach similar to the Port of Vancouver program, by awarding ships based on industry-led programs, and the use of clean fuels and technologies. As most of the inland ships and coastal ships may not have joined the industry-led programs, a flexible program could encourage these ships to reduce air emissions, although this will require the ports to dedicate more administrative resources to such a program.

Chinese port cities that are interested in promoting green shipping through voluntary incentives could consider joining one of the industry-led programs, or introducing their own scheme that recognizes or aligns with one or more of these programs.



Furthermore, for stakeholders who are interested in developing a national or regional incentive scheme to promote green shipping, it will be important that the adopted / designed scheme adheres to at least the following criteria:

1. All local ports and other relevant incentive providers are allowed and encouraged to join the scheme, in order to create an attractive, large enough base of incentive providers;
2. Entry requirements for ships to register or to become a member are set to be relatively low, at least in the beginning, both in administrative burden and in terms of cost, in order to attract more ships to join; and
3. Clear checks and balances are created to reduce the likelihood of non-compliance in order to discourage free riders.

Furthermore, it would be recommendable that ports which are on the same common shipping routes are encouraged to provide incentives based on the same incentive schemes and possibly eligibility criteria, to attract more ships to participate in the schemes and adopt green measures.

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