

Curbing GHG Emissions –

## **INTRODUCTION TO THE LATEST MARPOL 2023 REGULATION**

# **EEXI, CII & SEEMP III 2023**



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# Content

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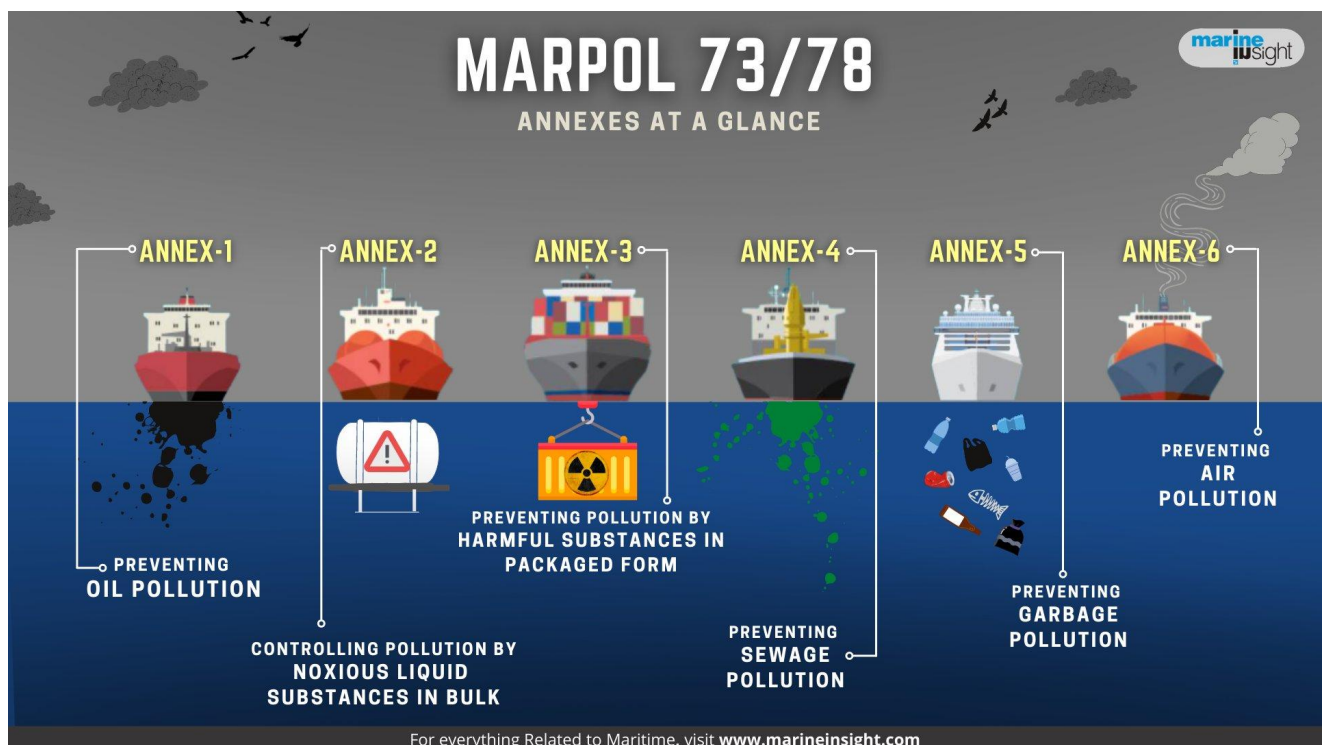
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## Chapter 1

### *Introduction and background*

The IMO Green House Gas (GHG) reduction strategy was introduced under MARPOL Annex VI, which -

- specifically addresses the air pollution from ships - measures to reduce and control them
- entered into force on 19 May 2005






This annexe of MARPOL talks about 3 critical points to curb various types of air pollutants from ships -

1. To minimise airborne emissions from ships (like SO<sub>x</sub>, NO<sub>x</sub>, ODS, VOC, the emission from shipboard incineration, etc.) and different methods to tackle these kinds of emissions such as the use of scrubber systems, VLSFO, and alternate marine fuel, etc.
2. To reduce the amount of CO<sub>2</sub> emissions from international shipping (by improving energy efficiency measures - This includes EEDI and SEEMP)
3. Data collection to improve the energy efficiency and align with the Paris climate change conference of achieving a 50% carbon intensity reduction in 2050 compared to 2008 with business as usual.

## **2013...**

IMO introduced the EEDI or Energy efficiency design Index in 2013 as a substantial requirement for all new ships. At the same time, SEEMP Part 1 was introduced as an operational measure onboard ships.



As per the IMO strategy to achieve required targets in the coming year, these requirements are reviewed and constricted incrementally every five years.

### **2019...**

In the year 2019, IMO introduced Data Collection System for fuel consumption. SEEMP Part II was formed, which had the process of collecting and reporting the data.

### **2022...**

In 2022, IMO initiated EEXI or The Energy Efficiency existing ship Index as a technical measure similar to EEDI. It covers all the existing ships of 400GT. As an operational measure to curb CO<sub>2</sub> pollution from ships, SEEMP (Part III) will be introduced in 2023, including the Carbon Intensity Indicator or CII calculation methodology.

This requires ships to follow a Carbon Intensity Indicator to measure how efficiently a ship transports goods or passengers. The value is in grams of CO<sub>2</sub> emitted per cargo-carrying capacity and nautical mile.



## **2023...**

The start of 2023 will see new requirements for ships to start collecting CII data, an operational measure to tackle carbon dioxide emissions.

It applies to ships of 5,000 GT and above, which aligns with the requirements for recording vessel fuel consumption per the IMO Data Collection System (IMO-DCS), introduced in 2019.

With the current strategy in place, by 2025, EEDI phase 3 will be achieved to aim for a 30% reduction in the carbon intensity of the ship.

By 2050, with its GHG strategy, IMO aims to reduce 50% of total annual GHG emissions and the carbon intensity of the fleet by at least 70% with its Long-term measures.

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## Chapter 2

### ***Important Terminologies***

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The IMO's GHG reduction strategy comprises various technical and operational measures which are being implemented onboard ships to curb CO2 emissions.

#### ***Technical measure and Operational measure:***

Technical measures can be defined as the measures and controls applied to systems and machinery during their construction and staging period.

The operational measure means a modification to any ship-based operation that minimises the impact of CO2 emissions from ships.

#### ***Important Terms:***

EEDI is a technical measure, i.e. a tool that can be implemented during the design and construction stage of the vessel, and it measures the amount of CO2 emitted by the ship per capacity mile (tonne-mile) or

CO2 emission/ Tonne-mile.

Tonne-mile is the unit that represents work done by a ship. E.g., a ship with a deadweight of 10000 T travels 20 NM. It has done 20000 tonne-mile of work.

Hence EEDI for this ship will be - the amount of CO2 emitted in gms/200000-tonne mile.


Required EEDI is more of a reference value provided by IMO based on various research, and it changes as per ship type.

Attained EEDI- Once the construction or conversion of the ship is completed, the actual EEDI value is calculated for that ship, which we call the attained EEDI.

Attained EEDI should always be less than the Required EEDI for the ship to be energy efficient.

SEEMP - It is an approach for shipping companies to manage ship and fleet efficiency performance with operational measures and using tools like the Energy Efficiency Operational Indicator (EEOI)





EEOI - EEOI or Energy Efficiency operational indicator allows ships to monitor carbon emissions, which can be determined by the ship's fuel consumption in a particular voyage carrying a certain amount of cargo. The formula to calculate the EEOI is provided in EEDI technical file.


EEDI technical is a document containing the information necessary to calculate the attained EEDI and show the calculation process.

The above requirement and regulations are for new ships, i.e. those delivered on or after 1st July 2015.

For existing ships or ships built and delivered before this date, IMO is introducing new regulation, EEXI, from 2023.

Energy Efficiency eXisting ship Index (EEXI) aims to reduce CO<sub>2</sub> emissions of existing vessels by setting minimum requirements for technical efficiency and comes into force on 1 January 2023 for ships of 400GT and Above.

CII or Carbon intensity indicator is an in-service/operational efficiency indicator that measures a vessel's carbon intensity over time.



The CII regulates the operational or real life of CO2 emissions from ships.

It is based on the annual fuel oil consumption, and from 1st January 2023, all ships will have to report their CII each year based on their actual fuel oil consumption.

DCS or data collection system is a requirement, which is already in force, for all ships of 5,000 gross tonnage and above to collect consumption data for each type of fuel oil they use.

Ships will have a SEEMP part II which should include a description of the methodology that will be used to collect the data and the processes to report the data to the ship's flag State.

EEXI Technical File has all the necessary formulas, details, and processes to verify compliance with EEXI requirements.

SEEMP Part III is a mandatory, ship-specific document that lays out the plan to improve the CII and, therefore, the vessel's operational energy efficiency.

## Chapter 3

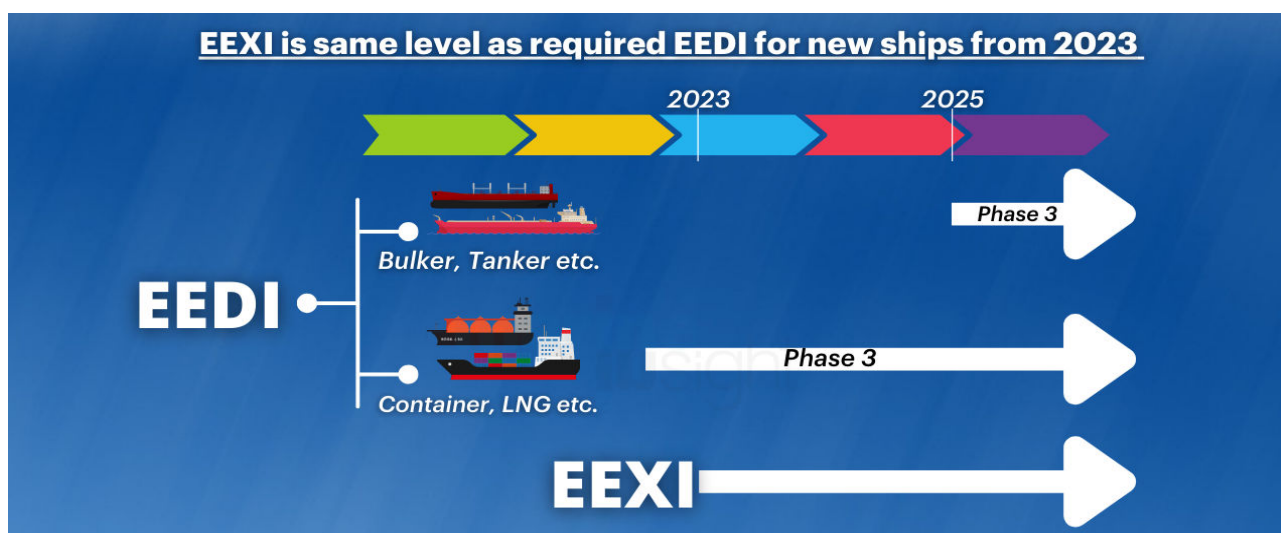
### ***EEXI and CII***


#### **Energy Efficiency eXisting ship Index (EEXI)**

The Energy Efficiency eXisting ship Index (EEXI) is a new IMO regulation that will apply to ships from 1st January 2023. It aims to reduce CO2 emissions of existing vessels by setting minimum requirements for technical efficiency.

The EEXI must be calculated for all cargo and cruise vessels above 400 GT under MARPOL Annex VI. A required EEXI is applicable for all cargo and cruise vessels above a certain size threshold, depending on the ship type.

The required EEXI is based on the EEDI reference lines. This, in most cases, is equal to the required EEDI in Phase 2 or 3.





The EEXI Technical File, which contains the details, and processes to verify compliance with EEXI, must be approved and the International Energy Efficiency Certificate re-issued by the flag administration or Recognized Organization at the first annual survey after 1 January 2023 at the latest.

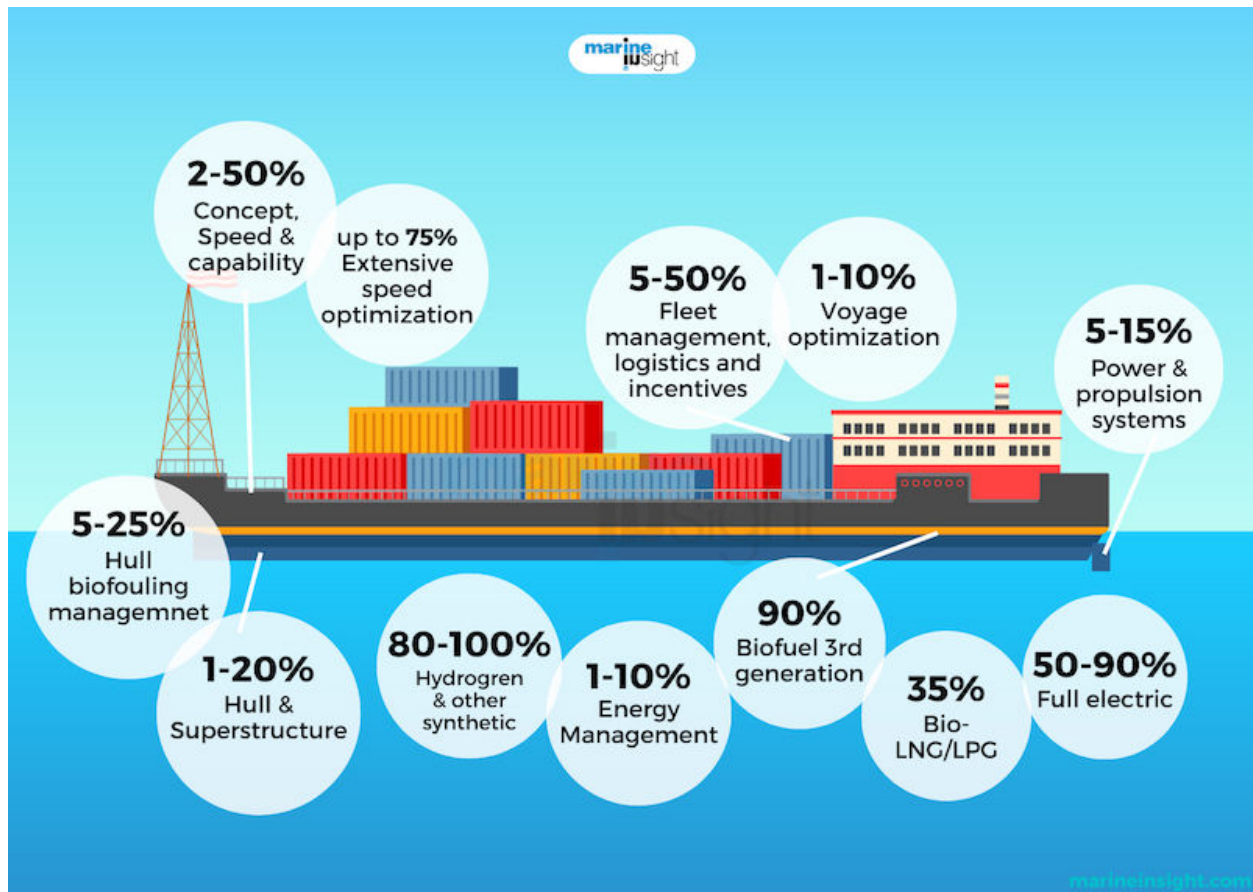
### **Recommendation for achieving the EEXI certification**

The GHG reduction goal of the International Maritime Organization (IMO) is to reduce greenhouse gas emissions by 40 percent until 2030 and subsequently by another 50 percent until 2050. The shipping companies/ ship operators must have improvement measures to achieve these targets.

Here are the technical methods to achieve the EEXI norms:


- Engine power limitation: ~37%.
- Change in fuel type from marine diesel oil (MDO) to liquefied natural gas (LNG): 25%
- Propeller retrofit with MMG-Redesign propeller 10%
- Installation of a shaft generator: 5.6%

- Installation of energy-saving devices (e.g., PBCF, wake equalising duct): up to 4%.
- Installation of rotor sails: 3.8%
- 10% increase in transport capacity (deadweight): 3%



Classification societies may have rules for engine limitation (e.g. if Ice class applies to your vessel).

Once the EPL is carried out, the following documents should be submitted: EPL Report (by engine manufacturer),



Survey statement by class surveyor after EPL installation, and EPL Management Plan.

## **Calculation of EEXI**


EEXI calculations are based on the methodology developed for the Energy Efficiency Design Index (EEDI) for new builds.

The EEXI describes a vessel's CO<sub>2</sub> emissions, determining standardised CO<sub>2</sub> emissions related to installed engine power, transport capacity, and ship speed. Emissions are calculated based on the installed power of the main engine, fuel oil consumption, and a conversion factor between fuel and the corresponding CO<sub>2</sub> mass.

## **Carbon Intensity Indicator (CII)**

The CII requirements will take effect from 2023 for all cargo, RoPax, and cruise vessels above 5,000 GT trading internationally.

The CII helps measure how efficiently the ships transport goods or passengers. Its value is given in grams of CO<sub>2</sub> emitted per cargo-carrying capacity and nautical mile.



At the end of the year, the ship is given an annual rating ranging from A to E, A being good, and E requires changes in the plan to achieve a better rating. The rating thresholds will become increasingly stringent towards 2030.

While the EEXI is a one-time certification based on the technical measures and targeting design parameters, the CII addresses the actual emissions and is implemented while the ship is in operation.

### **Calculation of CII**

A ship's CII is calculated as the ratio of the total mass of CO<sub>2</sub> emitted to the entire transport work undertaken in a calendar year.

A vessel's performance rating is determined by comparing a ship's operational carbon intensity performance with the average performance of other ships of the same type.

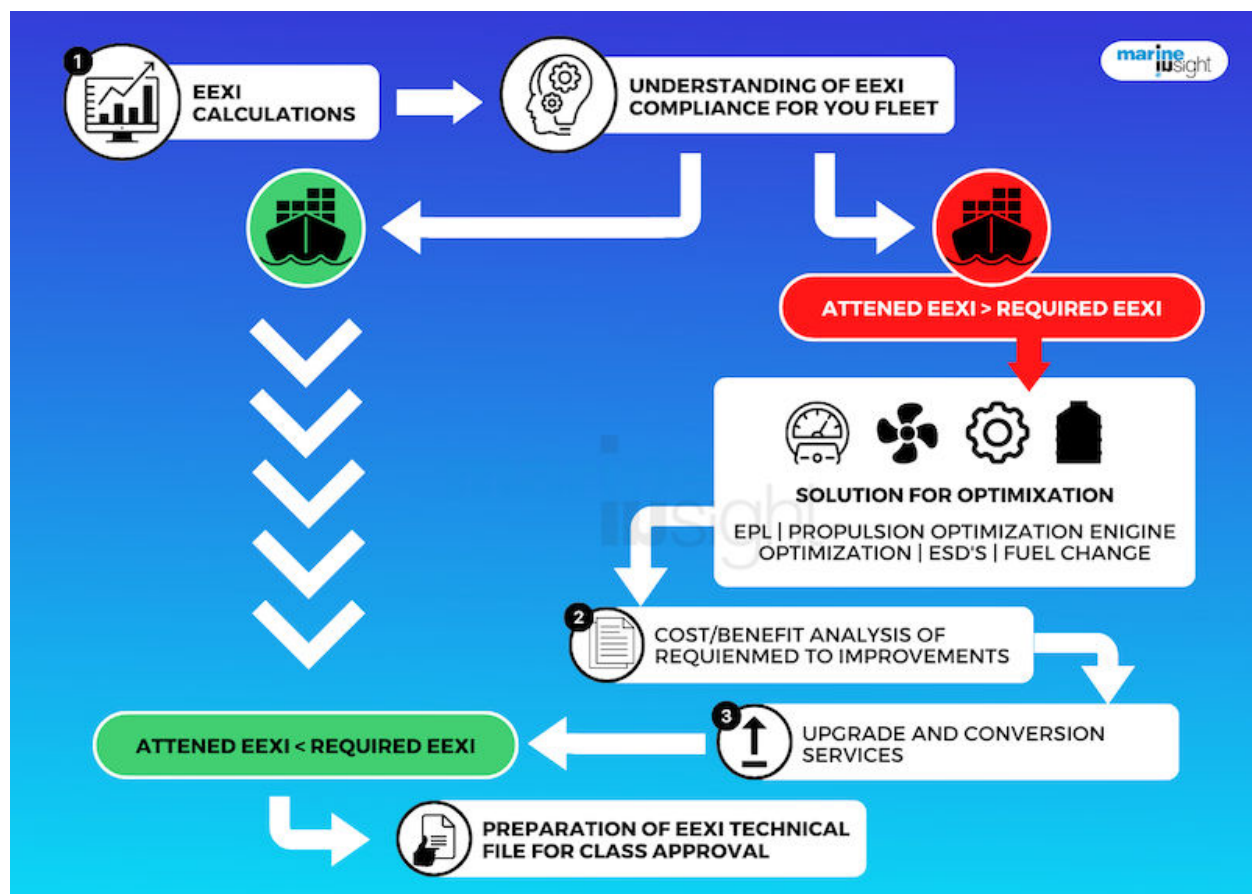
### **Responsibility for CII**

Ship managers or operators must decide on ships' carbon intensity profiles and create an optimised *Ship Energy Efficiency Management Plan* (SEEMP) by the end of 2022.

Other options for technical and operational improvements are to be considered, which may include - switching to

low-carbon fuels, limiting engine loads, reducing speed, retrofitting vessels with energy-efficient technology, etc.

The essential purpose of the EEXI and CII is to create a mindset among maritime industry stakeholders to focus on the ongoing improvements to drive down onboard carbon emissions.





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## Chapter 4

### ***Understanding SEEMP***


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As the concept of EED was introduced for newly built ships, IMO developed and structured a unique tool called the Ship Energy Efficiency Management Plan to measure and control GHG emissions from the already existing shipping fleet.

The Ship energy efficiency Management Plan provides a practical approach for ship operators and management companies to manage operations and fleet efficiency performance over time using the Energy Efficiency Operational Indicator (EEOI) as a monitoring tool.

The SEEMP is a ship-specific plan that must be implemented according to the ship type, cargo carried, ship routes, and other relevant factors. Hence, SEEMP cannot be implemented on a company or fleet level.

Even Two sister ships will need to have a separate Ship Energy Efficiency Management Plan as they will operate in different conditions.



The basics of creating the SEEMP for a particular ship are to estimate and determine the current energy consumption of the vessel and implement various measures to reduce the same.

## **Key Features of SEEMP**

- Broader Corporate energy management policy

As said earlier, SEEMP needs to be implemented on an individual ship level. However, a company operating multiple ships must have a more comprehensive energy management policy for all vessels in its fleet, which will act as a base to form the SEEMP for an individual type of ship.

- Enhancement of ship efficiency

The primary objective of the SEEMP is to improve the overall operating efficiency of the ship in the long run by implementing correct and optimised energy and fuel-saving methods.

- Reduction in fuel consumption

Any ship operator will be happy to save more cost on the marine oil used as ship fuel. A critical function of the

SEEMP is to implement methods that can reduce the overall fuel consumption of the ship as it leads to a reduction in air pollution and fuel cost, which is one of the high operating costs of the vessel.

- A decrease in GHG emissions from the ship

SEEMP emphasises reducing greenhouse gas emissions from ships by providing methods for reducing fuel consumption and using alternative fuel, which causes less GHG emissions.





## ***Implementing SEEMP onboard:***

SEEMP is ship specific plan which can be efficiently implemented on vessels in 4 steps:

### **1. Planning**

Before implementing any method, there must be “planning” of how the process should be implemented.

Planning is the most critical step for implementing SEEMP; it essentially defines the current status of the energy used by the ship and how the current energy consumption can be reduced further by creating and implementing an effective plan.

The shipping management company has to compile the ship's energy consumption in different forms such as the use of fuel, machinery installed, the efficiency of the machinery and systems, condition of the ship's hull and paint, and last dry-dock record, etc.

Once the data has been collected, the company's Broader Corporate energy management policy is taken as a base to draw the SEEMP for the ship.

## **2. Implementation**

Once the planning for SEEMP is in place, the next important step is to identify different ways of implementing the measures selected during the planning.

The Ship Energy Efficiency Management plan will consist of implementation methods and roles/responsibilities of the stakeholders involved (Company representative, Ship operator, Seafarers, etc.).

Again, the implementation system has to be drawn during the planning stage to ensure smooth execution of SEEMP on the ship at the earliest.

Record keeping should be a part of all the post-planning stages as the records taken during the implementation stage can be used for the later stage of self-evaluation, which will help improve the plan.

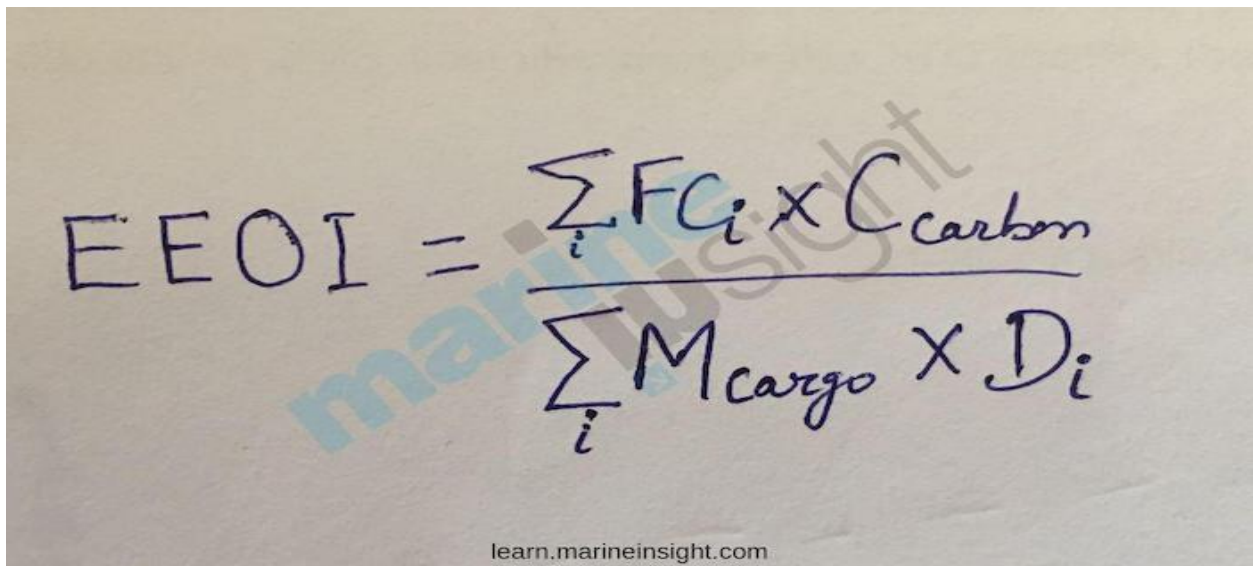
## **3. Monitoring**

Once the SEEMP is implemented on a ship, the monitoring of the plan will come into action, which will observe the effectiveness of the implemented SEEMP.

There are pre-determined approved methods of international standards available to monitor the performance of SEEMP, such as EEOI (as per the Guidelines developed by the IMO – MEPC.1/Circ.684).

EEOI is an Energy Efficiency operational indicator determined by the ship's fuel consumption in a particular voyage carrying a certain amount of cargo.

To calculate the EEOI, the following data is needed:



A photograph of a piece of paper with a handwritten formula for EEOI. The formula is written in dark ink and is as follows:

$$EEOI = \frac{\sum_i F_{Ci} \times C_{carbon}}{\sum_i M_{cargo} \times D_i}$$

The formula is written on a light-colored background. A faint watermark "marineinsight.com" is visible in the background. At the bottom of the image, the text "learn.marineinsight.com" is printed.

Where  $j$  is the fuel type

“ $l$ ” is the voyage number

“ $FC_i$ ” is the mass of fuel consumed during the voyage



“Mcargo” is a mass of cargo carried in tonnes

‘Di’ is the nautical miles distance for the cargo carried

‘Ccarbon’ is the mass of the fuel to the CO<sub>2</sub> mass conversion factor of the fuel.

Other methods for measurement and monitoring can also be used.

In the planning stage, the monitoring method can be stated, and how to use it can also be established, making it easier for the user (seafarers and operators) to implement the system and know their responsibility within the system.

#### **4. Self-evaluation and improvement**

The result of the Monitoring stages needs to be evaluated to understand the effectiveness of the SEEMP, which will be done at the last stage.

This stage highly depends on constructive feedback, which can be assessed to improvise the plan if needed, and the same is used to enhance the planning, implementation, and monitoring stages.

These four stages work in a cycle and are interdependent for the evaluation and evolution of the complete SEEMP.





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## Chapter 5

### ***SEEMP III***

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From 2023, ships must calculate the carbon intensity index. A verified SEEMP Part III containing Ship Operational Carbon Intensity Plan will serve as the implementation plan for achieving the required CII.

This dynamic plan will be amended and revised to achieve the CO<sub>2</sub> reduction rating; hence, unlike SEEMP 1, it will be subject to verification and company audits.

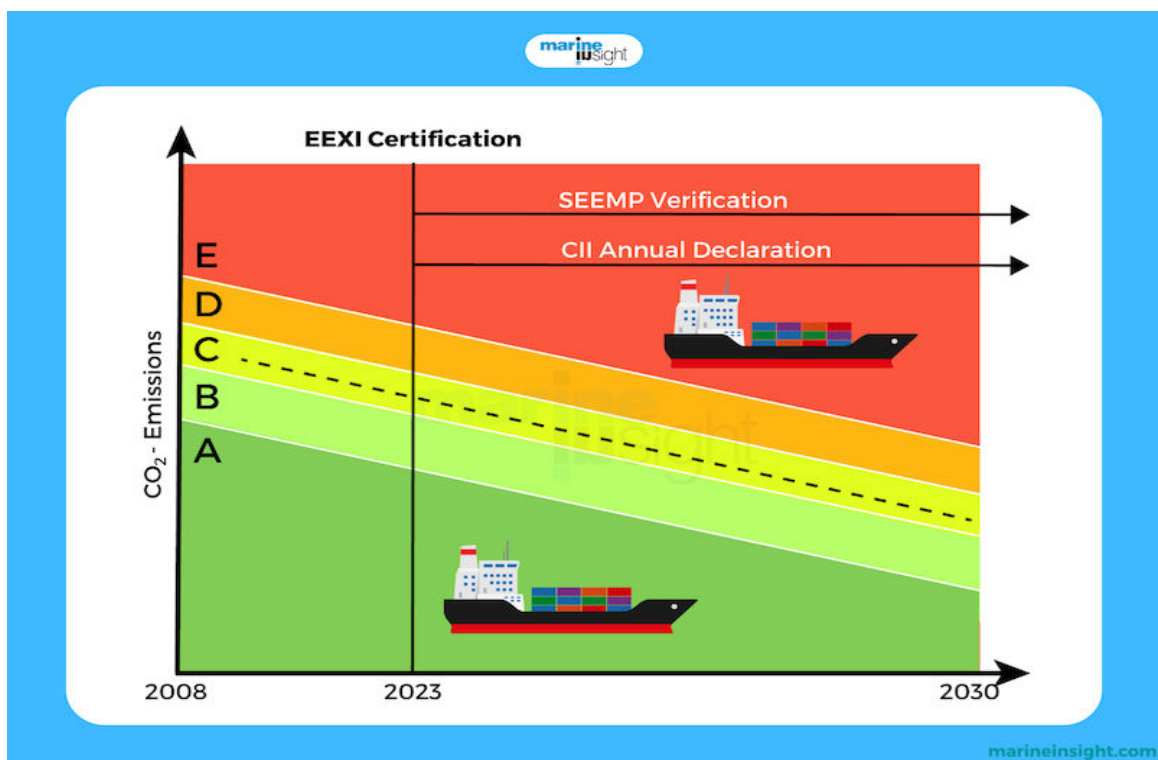
#### **What is a CO<sub>2</sub> reduction rating?**

Similar to Required and Attained EEDI, we have Required and Attained CII.

Whatever CII value the ship will attain at the end of 2023 in comparison with 2019 data, it will be rated annually from A to E, where A is the best rating and E will be considered unacceptable, and the SEEMP III needs revision and improvement.


C rating in the chart is the acceptable mark and the required minimum rating.

The required CII, and thereby the rating thresholds, will be reduced yearly. The reduction rates are set for 2023 to 2026, and subsequent reduction factors will be set during a review in 2025.




## Requirement for SEEMP III

- It has to be kept on board from 1 January 2023 to document how you plan to achieve your CII targets.

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- It should include the methodology used for calculating the CII and how to report it.
  - The required CII for the next three years, calculated based on the individual vessel's specifications
  - A 3-year implementation plan documenting how the required CII will be achieved during the next three years, with yearly targets
  - Procedures for self-evaluation and improvement
  - Corrective action plan in case of inferior rating
  - Collecting annual fuel data from 1 January to 31 December

Suppose a ship gets an E rating in any year or a D rating for three consecutive years. In that case, it is necessary to complete a corrective action plan in the SEEMP III and obtain confirmation from the Administration or an RO.

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- Verification of the reporting data, including the CII rating result, and issuance of a Statement of Compliance by the Administration or an RO
  - Company audits on SEEMP Part III within six months after issuing the Statement of Compliance.
  - Access to the disaggregated data that underlie the reported data

It should also be noted that the new SEEMP III comes in addition to the SEEMP I and SEEMP II and will be handled as a separate document.

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## Chapter 6

# ***SEEMP III Operational Measures***

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### **Operational Measures Under SEEMP III**

The SEEMP III intends to ensure continuous improvement, and its implementation will be subject to company audits.

A vessel can reduce its carbon intensity by a combination of measures:

- Speed optimisation -- 5-10% reduction
- Optimisation of operations and logistics (ship planning and Vessel ETA are achieved)- 2-5% reduction
- Implementation of energy efficiency technologies (installing heat recovery methods)
- Voyage optimisation (making a course change to tackle rough weather) - 3-10%reduction
- Effective maintenance management - 2-10% reduction

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- Alternate fuel : 3-6% reduction

### **Responsibilities of Ship staff/ seafarers:**

- Monitoring the performance of the SEEMP procedures and how it affects the ship's operation - Responsibility lies with the Master/ Chief engineer.
- Collecting reports and sending the logs, performance, etc., to the company for evaluation - Responsibility lies with the Master/ Chief engineer.
- Establishing a safety and sustainability culture on the ship to add to the vessel's energy efficiency - Responsibility lies with the Master/ Chief engineer.
- Efficiently managing the cargo operation when in port and maintaining the ship's machinery to avoid breakdown and delays to the shipping schedule - Responsibility lies with the Master.
- Implementing correct and modern navigation techniques for optimised voyage planning- Responsibility lies with the Master.


- Effective maintenance management - Responsibility lies with the Chief Engineer
- Reducing carbon footprint by optimising the ship tasks
  - All ship staff

### **Responsibilities of Ship operator/ Company:**

Ship managers and operators should be aware of the revised MARPOL Annex VI and arrange the steps for implementation.

1. Arrange with the classification society the EEXI technical file/measurements and survey for the International Energy Efficiency certificate development
2. Revise the SEEMPs of their fleet to include arrangements for initial operational CII calculation and rating yearly.

SEEMP III will be subject to company audits based on the guidelines issued by IMO relevant workshop



Shipowners and ship operators have to analyse potential measures to consider to reduce carbon emissions from ships.

Some of the options available in hand are:

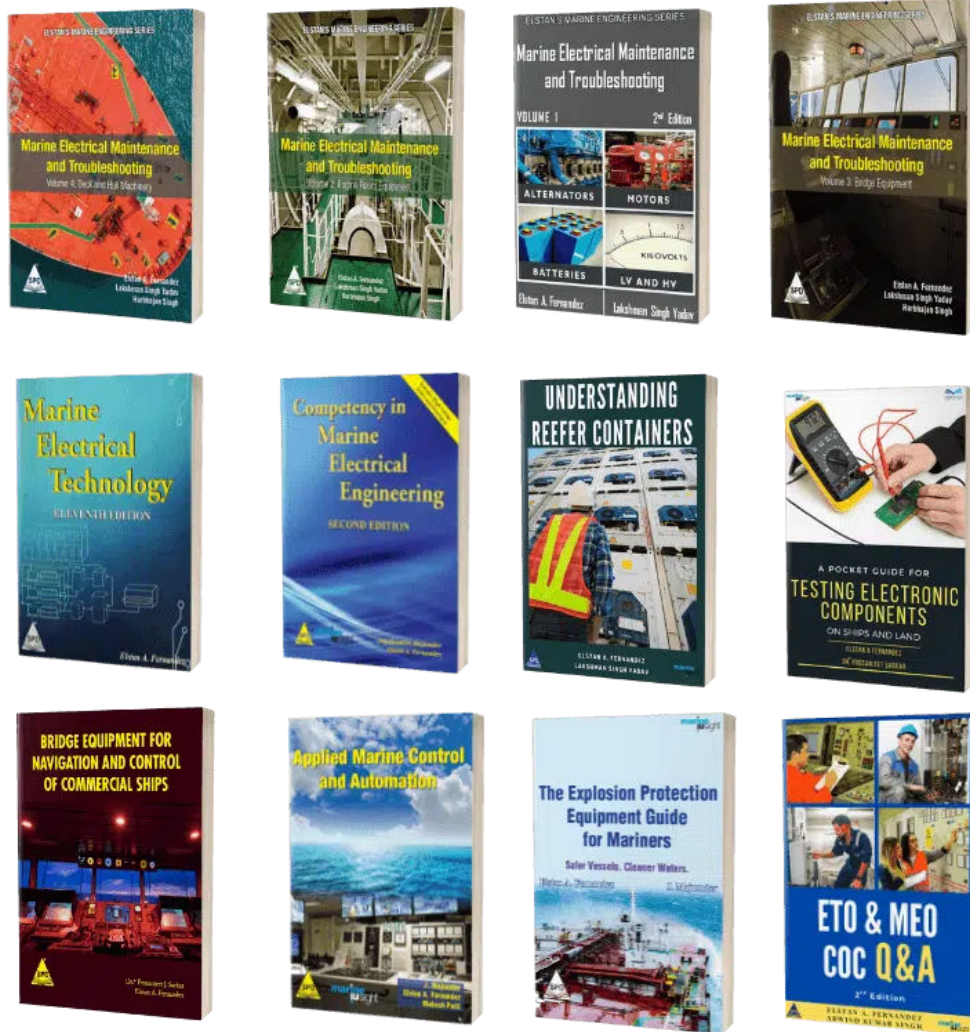
1. Propulsion optimisations
2. Engine optimisations
3. Energy efficiency technologies
4. Engine Power Limitation (EPL)
5. Time of installation
6. Cost and payback time of improvement option
7. Vessel age
8. Speed Loss

For anything which involves technical preparation, the ship operators must contact the engine manufacturer, who will calculate the new SFOC and provide an Engine Power Limitation (EPL) report. After that, an EPL management plan will be created, reviewed, and approved by the regulatory authority, and the date for installation needs will be fixed.



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