

EEXI and CII Review & Update

ACS Seminar 2022

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- **Introduction**
- **EEXI**
- **CII**
- **The Role of the Classification Society**
- **Conclusion**

According to recently studies, this period has the warmest temperature recorded, with global average temperature reaching 1.1°C above pre-industrial levels in 2019. If we continue as we are, the targets would result in warming above 3 degrees by 2100.

By limiting the global warming to 1.5 degrees Celsius, inline with Paris Agreement, with the hope is to eliminate the negative impact to the natural environment and human health and wellbeing.

Unfortunately, the world is currently not on track to limit the global warming to 1.5 °C.

And, Green House Gas (GHG) is the main reason of global warming.

In 2018, IMO adopted an initial strategy on the reduction of GHG emissions from ships, setting out a vision which confirms IMO's commitment to reducing GHG emissions from international shipping, Which include:

- a reduction in carbon intensity of international shipping includes to reduce CO₂ emissions per transport work by at least **40% by 2030**, pursuing efforts towards **70% by 2050**, compared to 2008.
- and that total annual GHG emissions from international shipping should be reduced by at least **50% by 2050** compared to 2008.

The initial strategy represents a framework for Member States, which includes setting out the future vision for international shipping and the levels of ambition to reduce GHG emissions.

In addition to the previous adopted requirements (EEDI, DCS, SEEMP Part I, II), from 2020 the new requirements have been adopted such as:

- EEDI (Energy Efficiency Design Index) (strengthen Phase 3 requirement)
- EEXI (Energy Efficiency Existing ship Index)
- CII (Carbon Intensity Indicator)
- SEEMP Part III (Ship operational Intensity plan)

Currently, GHG have been regulated by the Annex VI MARPOL

	GHS group							
Polluted Air Composition	HCFCs	NOx	SOx	VOC (CH4)	CO2	CO	PM	HC
Annex VI Marpol	12	13	14	15	22->28			
Method to reduce pollution	Not permit to use	Limit, EGR SCR	Limit, EGC	Limit, VOC Plan	Technical Method (EEDI, EEXI) Operation Method (SEEMP, DCS, CII)			
Dedicated to safe ships and clean seas								

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The EEXI (Energy Efficiency Existing ship Index) is a one-time certification equivalent to the EEDI. The EEXI is a measure related to the technical design of ship.

EEXI applied to the following ship type from **400 GT and above**

- Bulk Carrier
- Gas Carrier
- Tanker
- Chemical tanker
- Containership
- General Cargo ships
- Refrigerated cargo carrier
- Combination carrier
- LNG carrier
- Ro-ro cargo ship (vehicle carrier)
- Ro-ro cargo ship
- Ro-ro passenger ship
- Cruise passenger ship having non-conventional propulsion

Ship is to comply with the EEXI at the first annual, intermediate or renewal survey or the initial survey of IEE Certificate whichever is the first, on or after 1 January 2023.

Satisfactory condition: **Attained EEXI \leq Required EEXI**

General form of Attained EEXI

$$\text{Attained EEXI} = \frac{\text{CO}_2 \text{ emission}}{\text{Transport work}} \Leftrightarrow \frac{\text{Engine Power} \cdot \text{consumption} \cdot \text{CO}_2 \text{ Conversion factor}}{\text{Ship speed} \cdot \text{Dead weight} \cdot \text{Correction factor}}$$

Attained EEXI formula in Marpol Annex VI

Emission from ME

Emission from AE

$$\text{Attained EEXI} = \frac{(\prod_{j=1}^M f_j) (\sum_{i=1}^{n_{ME}} P_{ME(i)} \cdot C_{FME(i)} \cdot SFC_{ME(i)}) + (P_{AE} \cdot C_{FAE} \cdot SFC_{AE})}{f_i \cdot f_c \cdot f_l \cdot \text{Capacity} \cdot f_w \cdot V_{ref} \cdot f_m}$$

Emission from shaft motor and energy saving for AE

$$+ \frac{(\prod_{j=1}^M f_j \cdot \sum_{i=1}^{n_{PTI}} P_{PTI(i)} - \sum_{i=1}^{n_{eff}} f_{eff(i)} \cdot P_{AEeff(i)}) \cdot C_{FAE} \cdot SFC_{AE}}{f_i \cdot f_c \cdot f_l \cdot \text{Capacity} \cdot f_w \cdot V_{ref} \cdot f_m}$$

Emission from energy saving for ME

$$- \frac{(\sum_{i=1}^{n_{eff}} f_{eff(i)} \cdot P_{eff(i)} \cdot C_{FME} \cdot SFC_{ME})}{f_i \cdot f_c \cdot f_l \cdot \text{Capacity} \cdot f_w \cdot V_{ref} \cdot f_m}$$

The factors, parameters are defined clearly in MEPC.308(73), MEPC.333(76)

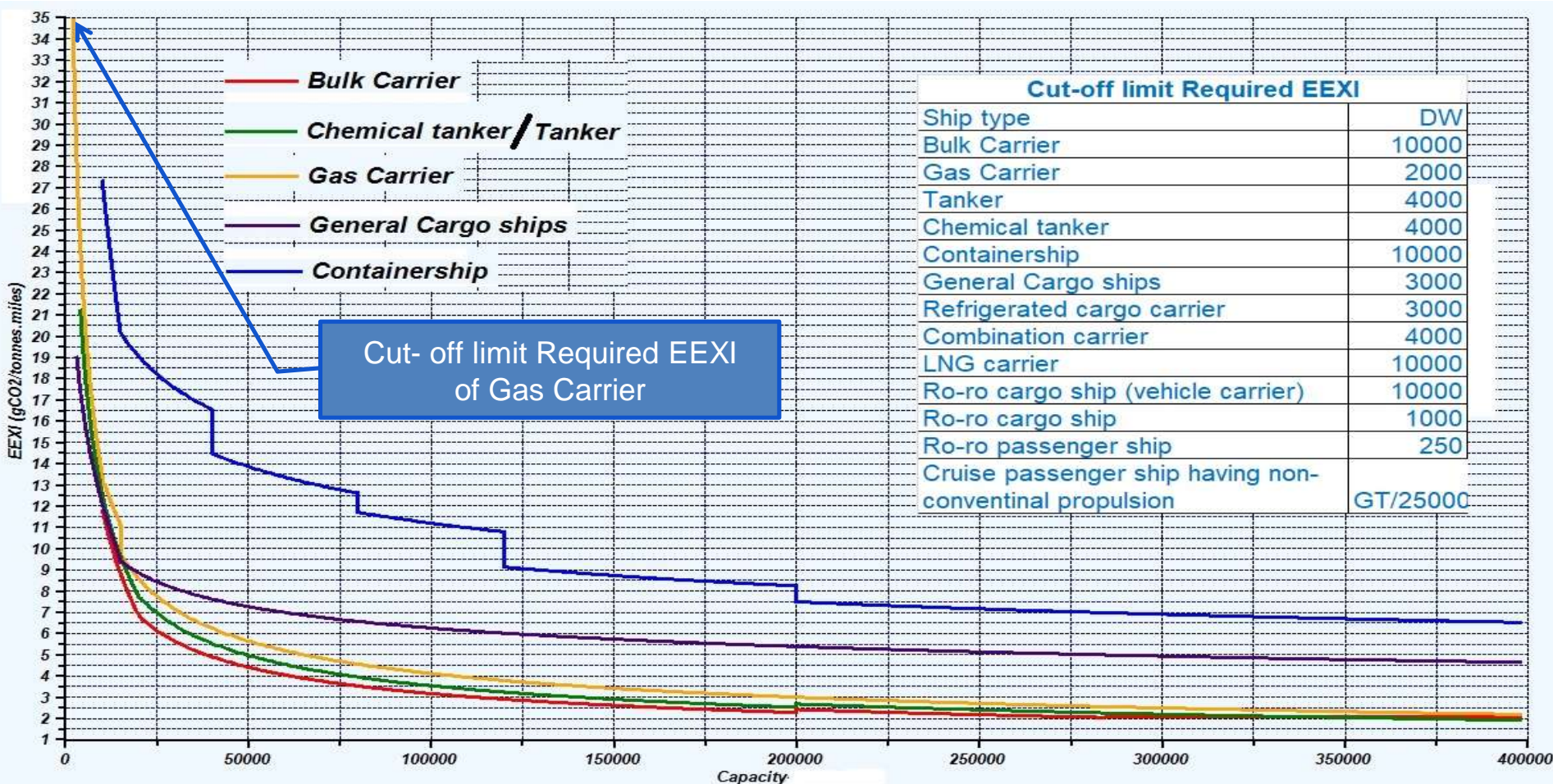
Reference Speed V_{ref} can be obtained with the following options

No	Case	Method	Formula
1	Ships in scope of the EEDI requirement	From the approved speed-power curve	Interpolation speed-power curve
2	Ship not falling in to the scope of the EEDI requirement	a) Whose sea trial results, which may have been calibrated by the tank test, under the EEDI draught	$V_{ref} = V_{S,EEDI} \times \left[\frac{P_{ME}}{P_{S,EEDI}} \right]^{\frac{1}{3}} \quad [\text{knot}]$
		b) For containerships, bulk carriers or tankers, whose sea trial results, which may have been calibrated by the tank test, under the design load draught and sea condition	$V_{ref} = k^{\frac{1}{3}} \times \left(\frac{DWT_{S,service}}{Capacity} \right)^{\frac{2}{9}} \times V_{S,service} \times \left[\frac{P_{ME}}{P_{S,service}} \right]^{\frac{1}{3}} \quad [\text{knot}]$
		c) For ship other than containerships, bulk carriers or tankers, whose sea trial results, which may have been calibrated by the tank test, under the design load draught and sea condition	Reference to Admiralty equation
		d) Speed-power curve is not available or the sea trial report does not contain the EEDI or design load draught condition	the V_{ref} is obtained by the in-service performance measurement method MEPC.1/Circ.902 (MEPC 78)
		e) Speed-power curve is not available or the sea trial report does not contain the EEDI or design load draught condition	the V_{ref} is obtained by approximately from statistical mean MEPC.333(76)

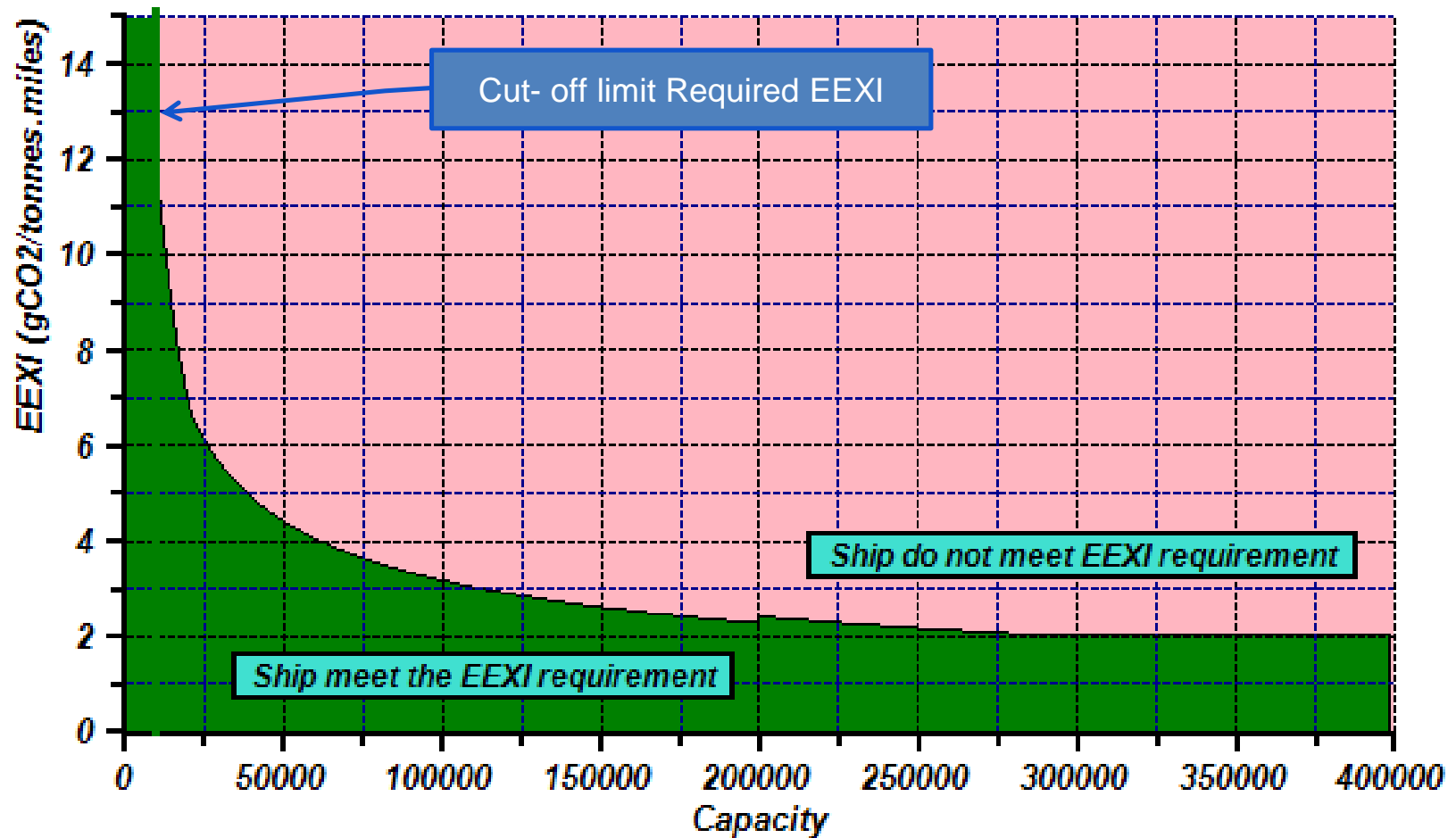
Required EEXI

$$\text{Required EEXI} = \left(1 - \frac{Y}{100}\right) \cdot \text{EEDI Reference line value}$$

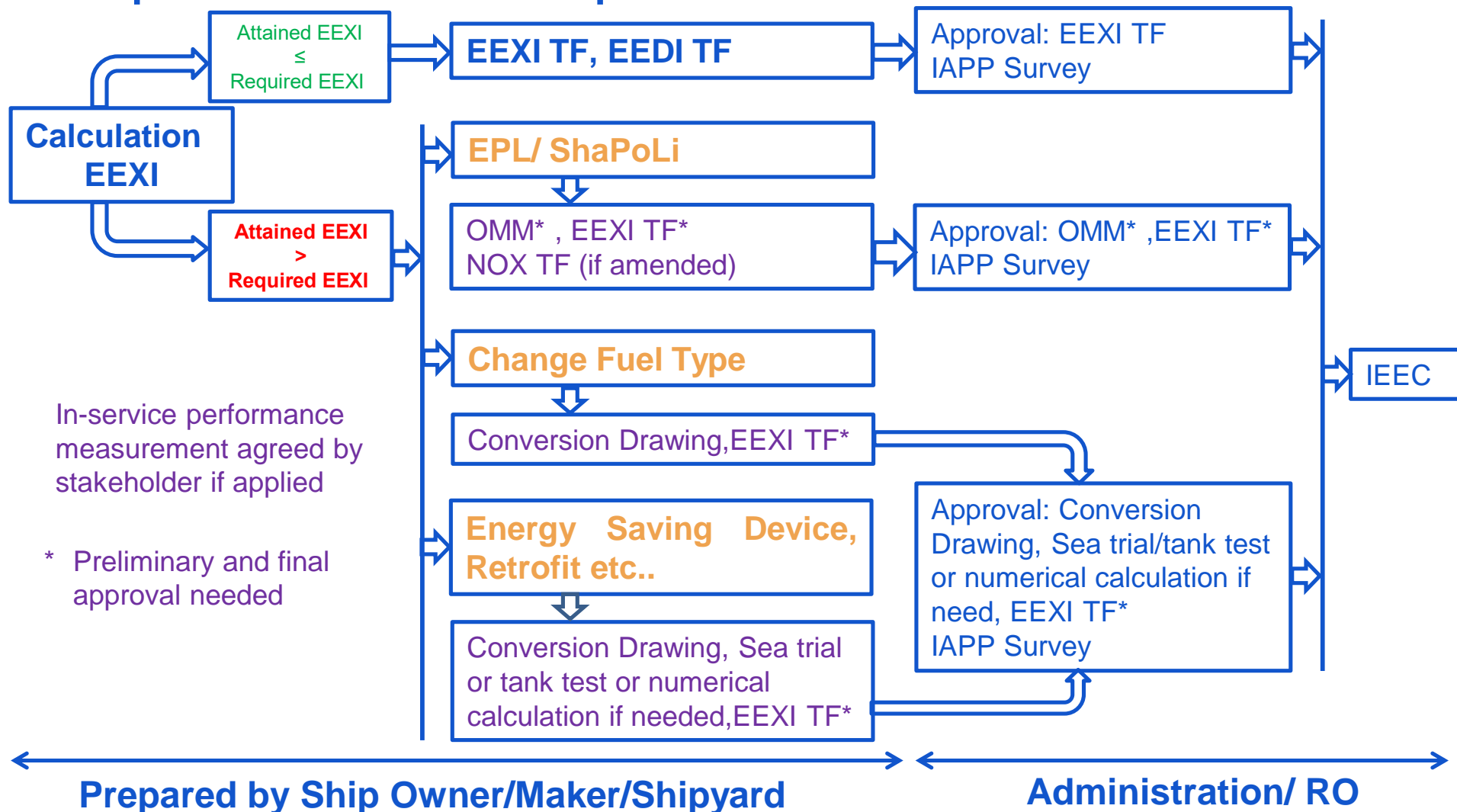
Y is the reduction factor, depending on type and capacity of ship



Ship requires $\text{Attained EEXI} \leq \text{Required EEXI}$



The procedure for EEXI compliance



In-service performance measurement agreed by stakeholder if applied

* Preliminary and final approval needed

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It measures the CO₂ emission per cargo-carrying capacity and distance in nautical miles. CII is an indicator for operation. It is applied to ships from **5000 GT** and above **with the ship type same as EEXI**.

CII is assessed annually from 2023 by CII Rating, with stricter emission limits over the years.

The MARPOL also defines the **Attained annual operational CII**, **Required annual operational CII**. The **CII Rating** is based on Required annual operational CII and is divided into A, B,C,D, E zone.

MARPOL requires that Attained annual operational CII rated D for 3 consecutive years or rated as E shall develop a plan of corrective actions as shown in SEEMP Part III to achieve the required annual operational CII.

Attained annual operational CII Formula has two options:
Firstly, this is the formula without correction factor and voyage adjustment.

$$\frac{FC_j \cdot C_{Fj}}{Capacity \cdot D_t}$$

The second option: Attained annual operational CII Formula with correction factor and voyage adjustment as updated by MEPC.355(78) as follows

$$\frac{\sum_j C_{Fj} \cdot \left\{ FC_j - \left(FC_{voyage,j} + TF_j + (0.75 - 0.03y_i) \cdot (FC_{electrical,j} + FC_{boiler,j} + FC_{other,j}) \right) \right\}}{f_i \cdot f_m \cdot f_c \cdot f_{iVSE} \cdot Capacity \cdot (D_t - D_x)}$$

j	Number of fuel type	$FC_{other,j}$	Mass of fuel type in gram for discharge pump
FC_j	Mass of fuel type in gram	f_i	Capacity correction factor for ice-class
C_{Fj}	Carbon Conversion factor	f_m	Factor for ice-class
$FC_{voyage,j}$	Mass of fuel type in gram for purpose secure safety of ship or during damage	f_c	Cubic capacity correction factor
TF_j	Correction for ship during STS or shuttle tanker	f_{iVSE}	Correction factor for self-unloading bulk carrier
y_i	consecutive numbering system starting at y2023=0, y2024=1, y2025=2...	$Capacity$	Deadweight or gross tonnage depend on ship type
$FC_{electrical,j}$	Mass of fuel type in gram for refrigerated container, cooling and reliquification of Gas Carrier	D_t	Travel distance in nautical miles
$FC_{boiler,j}$	Mass of fuel type in gram for cargo heating and discharge pump	D_x	Travel distance in nautical miles which may deduct from CII calculation

Required annual operational CII is obtained with the Reference line being median operational carbon intensity performance and annual reduction factor.

The Reference line is the CII in the year 2019 as a function of capacity for each ship type with the following formula

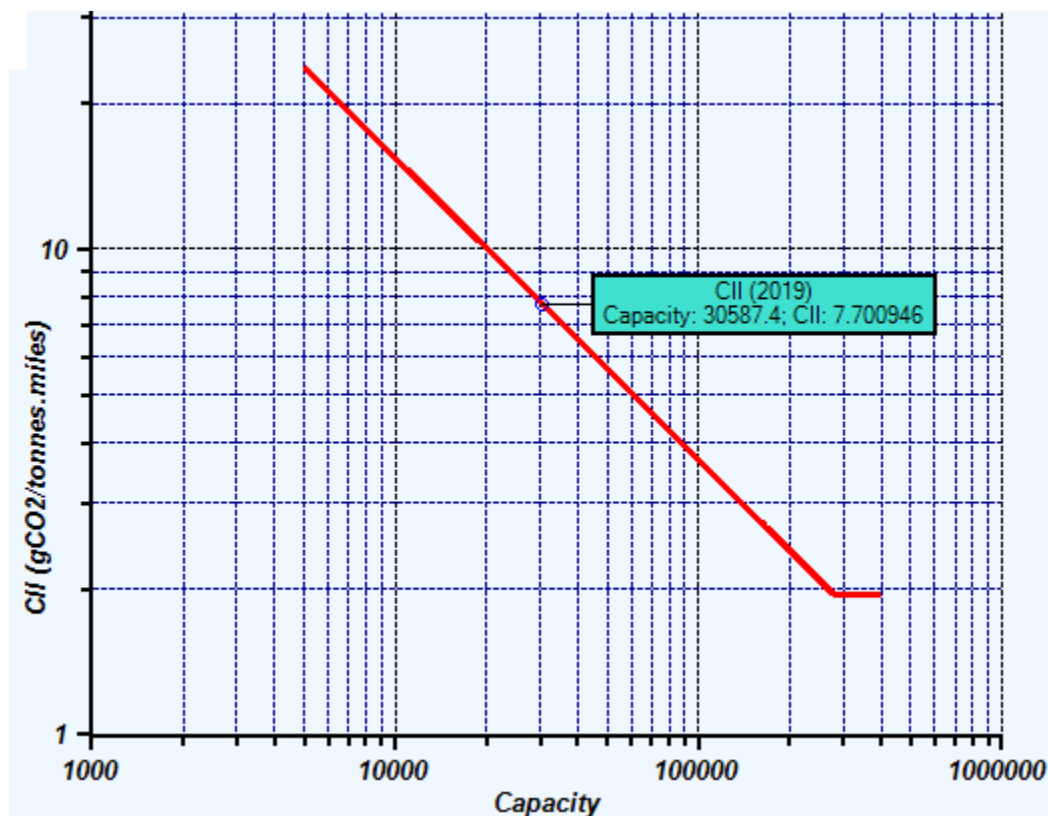
$$CII_{ref} = a \cdot Capacity^{-c}$$

a and c are parameters estimated through median regression fits

Required annual operational CII

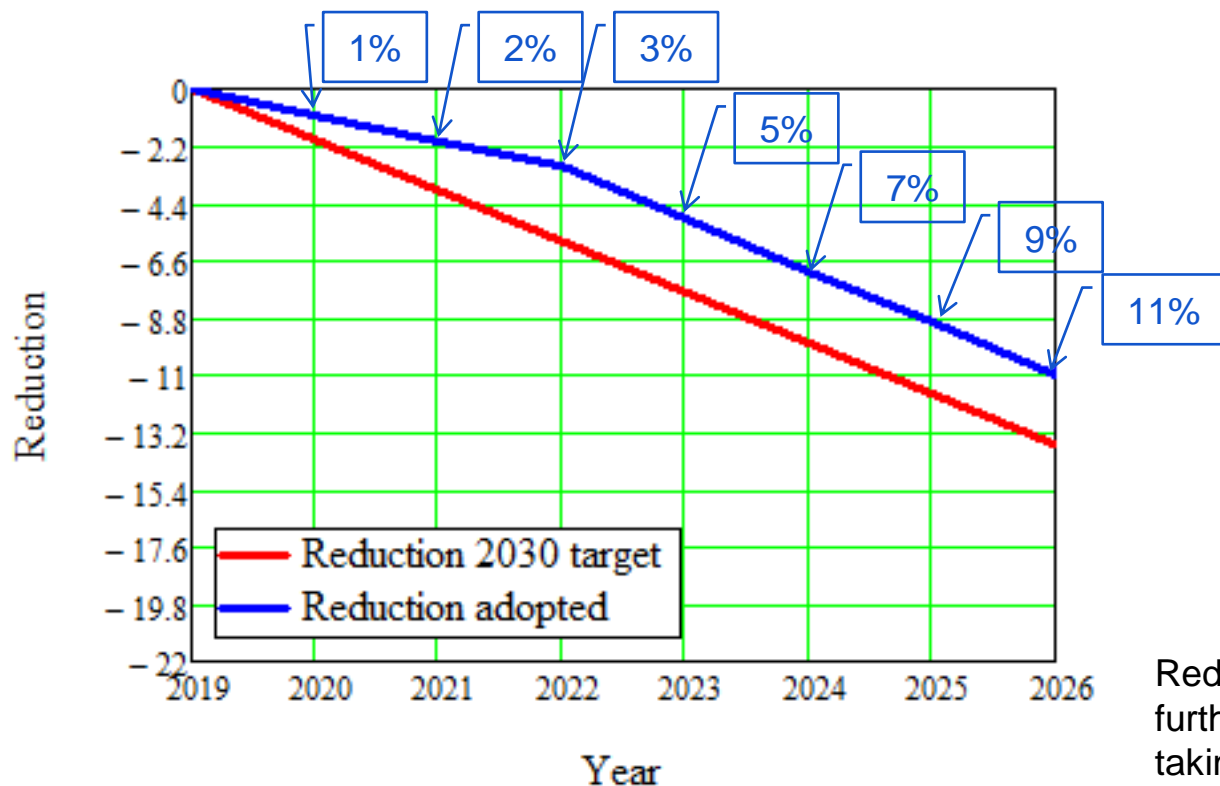
$$CII = \left(1 - \frac{Z}{100}\right) CII_{ref}$$

Z : reduction factor



The Reference line of bulk carrier

The annual reduction factor of Required annual operational CII in line with IMO's initial GHG strategy, according to Fourth IMO GHG Study 2020, the attained CII (on supply-based metric) has reduced to year 2019 by 23.6% compare to 2008. We need to have 21.5% improvement to 2030.



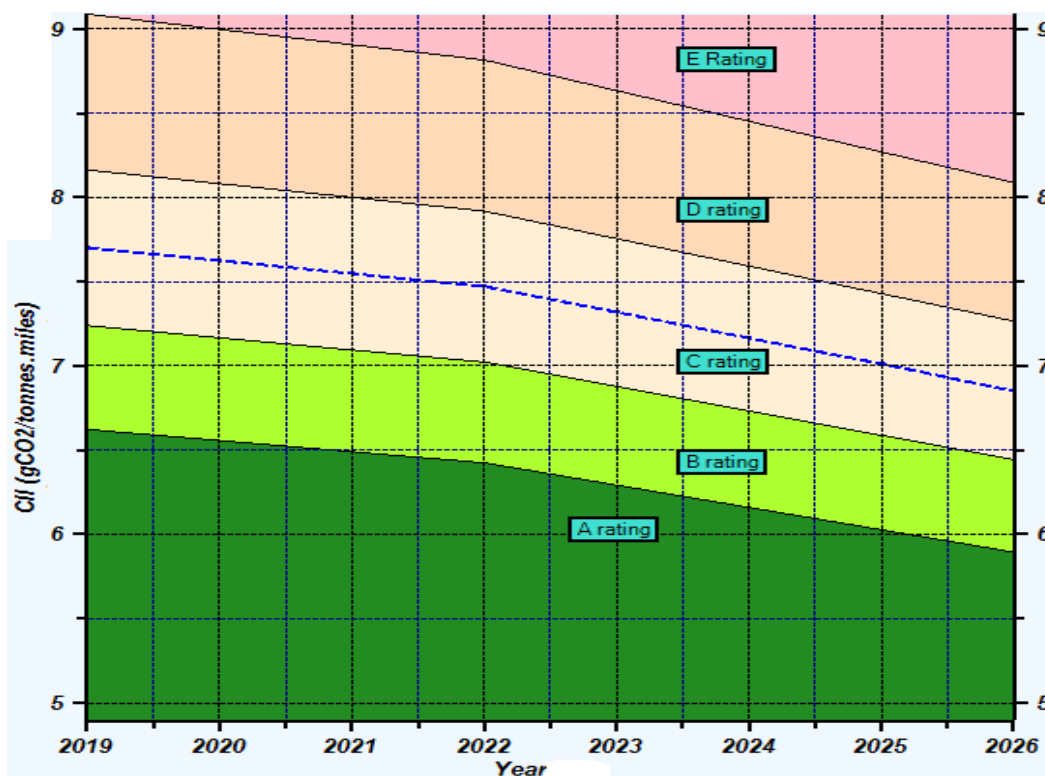
Year	Reduction factor relative to 2019
2023	5%*
2024	7%
2025	9%
2026	11%
2027	- **
2028	- **
2029	- **
2030	- **

Reduction from 2027 to 2030 is to be further strengthened and developed taking into account the review of the short-term measure.

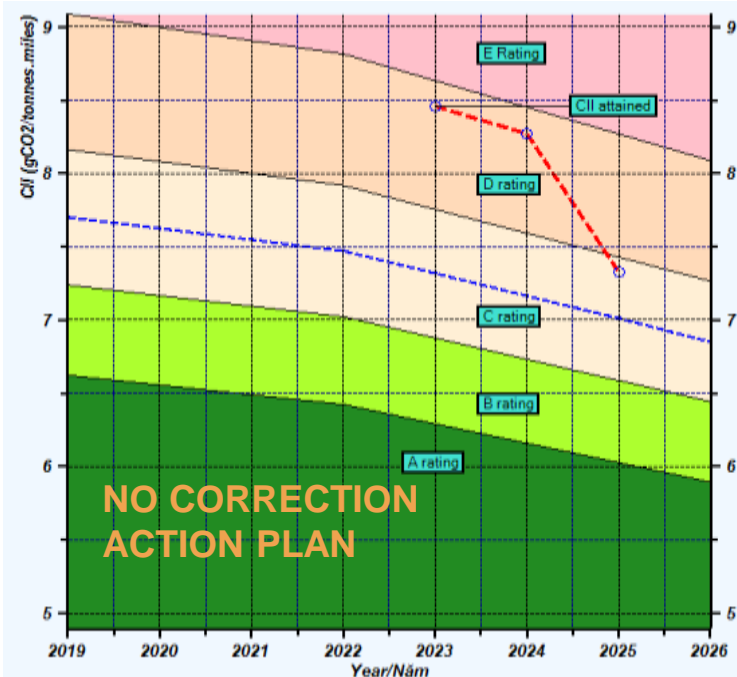
The satisfactory of the CII requirement is obtained by CII Rating. The CII Rating is based on Required annual operational CII in conjunction with the vectors, indicating the direction and distance they deviate from the required value.

The CII Rating divides into rating namely A, B, C, D, E in separated five areas.

Attained annual operational CII which is rated D for 3 consecutive years or rated as E shall develop a plan of corrective actions.



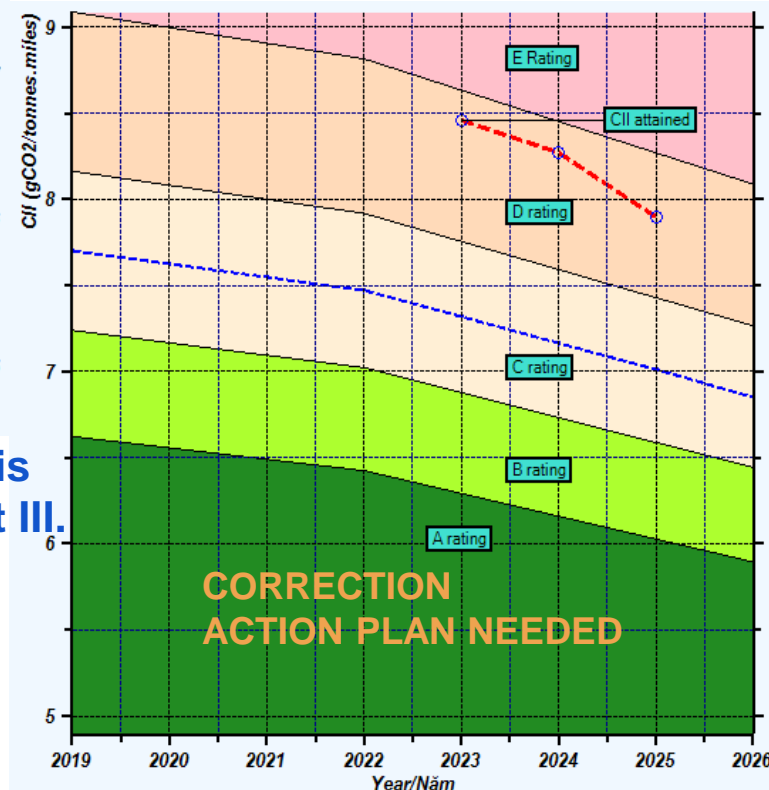
SCENARIO WITH AND WITHOUT CORRECTION ACTION PLAN NEEDED



The CII calculation and assessment is explained and proved in SEEMP Part III.

The revised SEEMP Part III shall be submitted with a plan of corrective actions.

Year	CII rating
2023	D
2024	D
2025	C



Year	CII rating
2023	D
2024	D
2025	D

The ship applied CII requirements is also provided with SEEMP Part III

On and before 1 January 2023, the SEEMP Part III shall have on board of the ship with gross tonnage from 5000

SEEMP PART III shall include:

- the methodology that will be used to calculate the ship's attained annual operational CII
- an implementation plan documenting how the required annual operational CII will be achieved during the next 3 years
- a procedure for self-evaluation and improvement
- a plan of corrective actions (ship rated as D for 3 consecutive years or rated as E)

The SEEMP Part III shall be subjected to verification and company audits

The procedure for CII, SEEMP PART III compliance

The SEEMP Part III shall have on board + CoC on or **before 1 January 2023**

30 November, 2023, Company audits, if conducted

31 December, 2023, End of DCS

31 December
End of DCS

31 March
submission of CII
for verification

30 November
Company audits,
if conducted

Repeat
every year
from 2024

30 April
3xD or E, submission of
Corrective Action Plan
Revised SEEMP

30 June
verifier to transfer
verified DCS data to IMO

31 May
issuance of SoC

SEEMP Part III updates every three years

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- Most of Classification Societies as verifiers have available tools/software to assist ship-owners on process of prepare document for compliance with EEXI and CII.
- Actively communication with owner/maker/ shipyard to solve matters that are raised during certification EEXI and CII & SEEMP Part III.
- Regularly organize the dissemination seminar pertaining the change of legislation of EEXI and CII to stake holders.

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- On and before 1 January 2023, the SEEMP Part III shall be on board of the ship with gross tonnage from 5000. We suggest the ship-owner to submit the SEEMP Part III as soon as possible from now.
- All the concerned parties should accelerate the preparation of submitting documents for the certification of EEXI and CII.
- According to preliminary assessment of EEXI and CII, large portion of the pre-EEDI ships do not meet criteria. We recommend that the ship-owner should carry out assessment in advance and apply some methods to change the Attained EEXI as necessary to avoid any abrupt of ship operation.
- The method of apply ELP/ShaPoLi is considered as the most favorable and feasible solution.

Guidelines and Circulars related to EEXI, CII have been adopted at MEPC 78

- **MEPC.346(78)** 2022 GUIDELINES FOR THE DEVELOPMENT OF A SHIP ENERGY EFFICIENCY MANAGEMENT PLAN (SEEMP)
- **MEPC.347(78)** GUIDELINES FOR THE VERIFICATION AND COMPANY AUDITS BY THE ADMINISTRATION OF PART III OF THE SHIP ENERGY EFFICIENCY MANAGEMENT PLAN (SEEMP)
- **MEPC.348(78)** 2022 GUIDELINES FOR ADMINISTRATION VERIFICATION OF SHIP FUEL OIL CONSUMPTION DATA AND OPERATIONAL CARBON INTENSITY
- **MEPC.349(78)** 2022 GUIDELINES FOR THE DEVELOPMENT AND MANAGEMENT OF THE IMO SHIP FUEL OIL CONSUMPTION DATABASE
- **MEPC.350(78)** 2022 GUIDELINES ON THE METHOD OF CALCULATION OF THE ATTAINED ENERGY EFFICIENCY EXISTING SHIP INDEX (EEXI)
- **MEPC.351(78)** 2022 GUIDELINES ON SURVEY AND CERTIFICATION OF THE ATTAINED ENERGY EFFICIENCY EXISTING SHIP INDEX (EEXI)
- **MEPC.352(78)** 2022 GUIDELINES ON OPERATIONAL CARBON INTENSITY INDICATORS AND THE CALCULATION METHODS (CII GUIDELINES, G1)
- **MEPC.353(78)** 2022 GUIDELINES ON THE REFERENCE LINES FOR USE WITH OPERATIONAL CARBON INTENSITY INDICATORS (CII REFERENCE LINES GUIDELINES, G2)
- **MEPC.354(78)** 2022 GUIDELINES ON THE OPERATIONAL CARBON INTENSITY RATING OF SHIPS (CII RATING GUIDELINES, G4)
- **MEPC.355(78)** 2022 INTERIM GUIDELINES ON CORRECTION FACTORS AND VOYAGE ADJUSTMENTS FOR CII CALCULATIONS (CII GUIDELINES, G5)
- **MEPC.1/Circ.901** GUIDANCE FOR SUBMISSION OF DATA TO THE IMO DATA COLLECTION SYSTEM OF FUEL OIL CONSUMPTION OF SHIPS FROM A STATE NOT PARTY TO MARPOL ANNEX VI
- **MEPC.1/Circ.902** GUIDANCE ON METHODS, PROCEDURES AND VERIFICATION OF IN-SERVICE PERFORMANCE MEASUREMENTS

An aerial photograph of a large cargo ship sailing on a deep blue ocean. The ship is moving from the upper left towards the lower right, leaving a white wake behind it. The horizon is visible in the upper third of the image, with a pale blue sky above it. The text "THANK YOU" is centered in the upper half of the image.

THANK YOU

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