IDWAL

DECARBONISATION
REPORT

Example Vessel

IMO Number: 1234567

INSPECTED IN EXAMPLE COUNTRY
12th JANUARY 2022

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6.08

$gCO_2/t.Nm$

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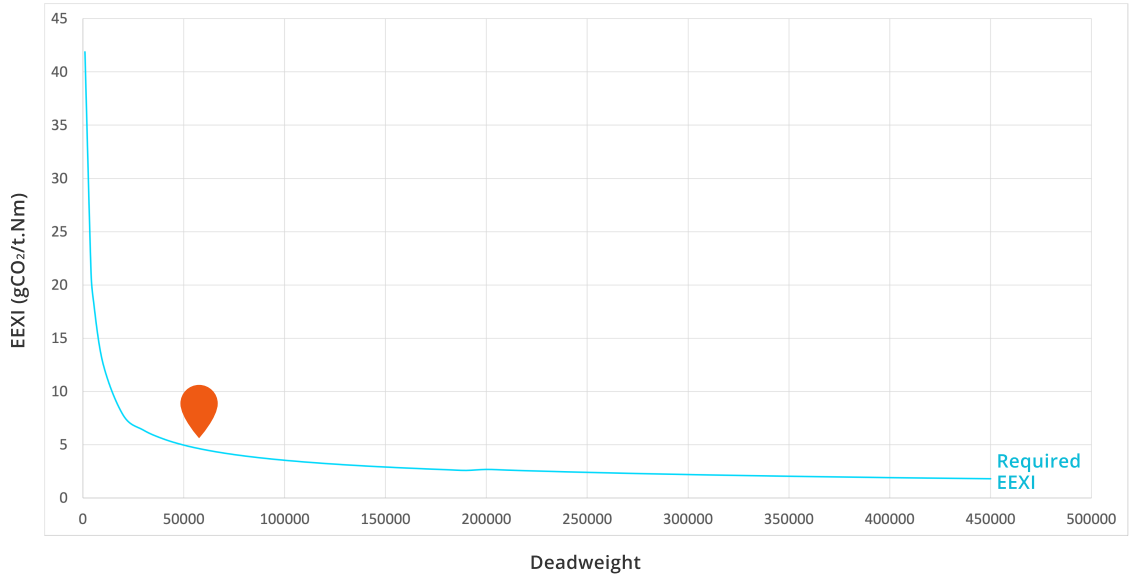
5.07

$gCO_2/t.Nm$



DECARBONISATION: VESSEL SUMMARY

Carbon Intensity Indicator (CII)

The CII is a calculated score of a vessel's operational efficiency in terms of the total carbon output per ton-mile of cargo carried. It is calculated from the vessel's speed, distance and consumption figures provided to the IMO Data Collection Service (DCS) every year and is measured in grams of CO2 per ton-nautical mile gCO2/t.Nm).

The obtained CII is then used to place the vessel in one of 5 bands (A to E), based on the vessel's type and size. Vessels in bands A and B are below the required CII and may receive favourable port fees and attract investment. Vessels in Band C are at the required and have no incentive or penalty. Vessels in Bands D and E will be required to produce a carbon reduction plan that will require verification by a Recognised Organisation.

The Latest CII score for the "Example Vessel" was C/A. **This means that the vessel is currently in Band C, and therefore will not be subject to any penalties.** If the vessel maintains this obtained CII without increase or reduction, the vessel is on track to remain in Band C by 2023, when the regulations come into force, though will cross into Band D in 2024 with no further reductions.

Current CII Band

C

2020

5.91

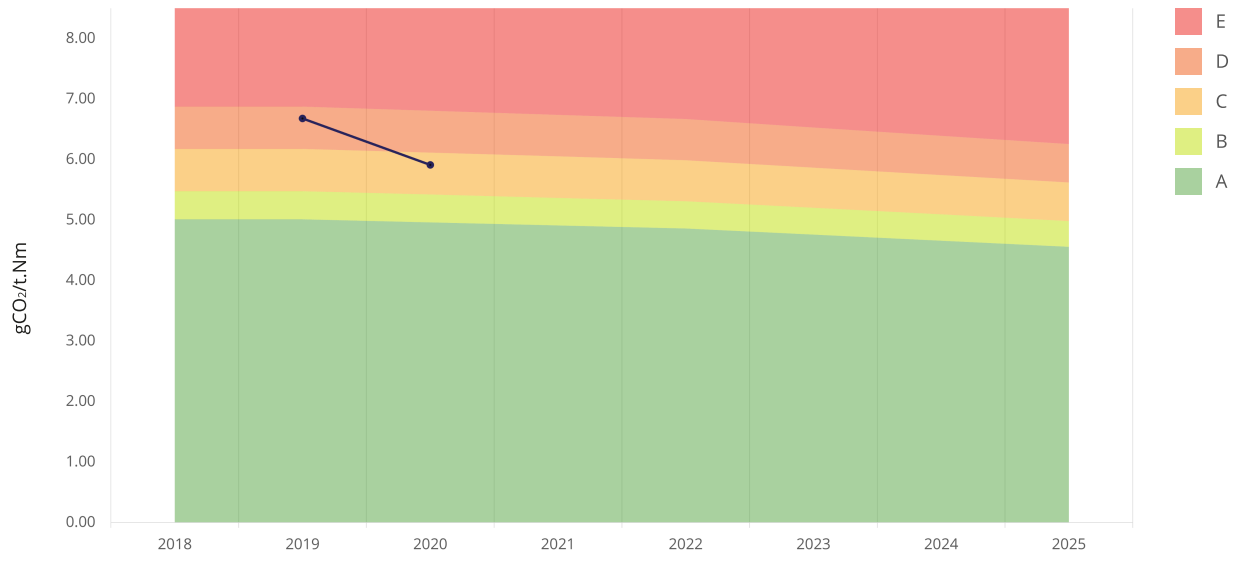
$gCO_2/t.Nm$

2019

6.68

$gCO_2/t.Nm$

CII HISTORY



EEXI CALCULATION / METHODOLOGY

The Attained EEXI for this vessel was calculated using the following formula provided by the IMO:

$$\frac{\left(\prod_{j=1}^{n} f_j\right)\left(\sum_{i=1}^{nME} P_{ME(i)} \cdot C_{FME(i)} \cdot SFC_{ME(i)}\right) + \left(P_{AE} \cdot C_{FAE} \cdot SFC_{AE}*\right) + \left(\left(\prod_{j=1}^{n} f_j \cdot \sum_{i=1}^{nPTI} P_{PTI(i)} - \sum_{i=1}^{neff} f_{eff(i)} \cdot P_{AEeff(i)}\right) C_{FAE} \cdot SFC_{AE}\right) - \left(\sum_{i=1}^{neff} f_{eff(i)} \cdot P_{eff(i)} \cdot C_{FME} \cdot SFC_{ME}**\right)}{f_i \cdot f_c \cdot f_l \cdot Capacity \cdot f_w \cdot V_{ref} \cdot f_m}$$

[redacted]

Attained EEXI = [redacted] = **6.08** gCO₂/t.Nm

Required EEXI

5.07

gCO₂/t.Nm

Based on this calculation, the vessel does not meet the required EEXI and will require the retrofitting of additional technologies to reduce the Attained EEXI.

EEXI REDUCTION TECHNOLOGIES

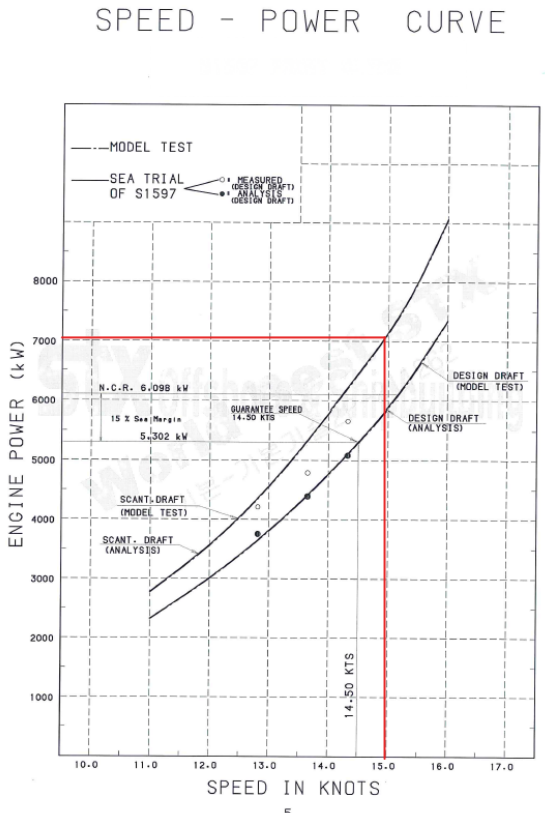
As the EEXI is a measure of the technical efficiency of a vessel, the Attained EEXI can only be lowered by making structural or technological changes the vessel itself, and not by operational changes. Below are a number of technologies the vessel can use to reduce the Attained EEXI, however, it is anticipated that the majority of vessels will opt for the Engine Power Limiter, which is generally likely to be cheaper and more effective in reducing the Attained EEXI.

Engine Power Limiter / Overridable Power Limiter

This device is a mechanical modification or software patch installed to the mechanical or electronic governor of the Main Engine to reduce the maximum power of the engine. For accurate costs and installation times, the Main Engine manufacturer should be consulted, however, costs are likely to be below €50,000 with minimal disruption to the vessel's operations.

For the "Example Vessel", the Main Engine would be required to be limited to 74% of the current MCR to achieve an Attained EEXI of 5.05.

Based on the information provided in the vessel's sea trials report, this would result in a new maximum service speed of 14.5 knots, with a new relative fuel consumption of 90 tonnes/day.



EEXI REDUCTION TECHNOLOGIES

Fuel conversion

The vessel's main and auxiliary engines are currently designed to run on Diesel or Heavy Fuel Oil, which have a carbon factor (CF) of 3.206 and 3.114 respectively. However, other fuel types have a lower carbon factor, whose use would result in a lower Attained EEXI.

TYPE OF FUEL	LOWER CALORIFIC VALUE (kJ/kg)	CARBON CONTENT	CO2 (t)/t Fuel	GRAMS OF CO2 PER kJ
Diesel/Gas Oil	42,700	0.8744	3.206	0.075
Light Fuel Oil (LFO)	41,200	0.8594	3.151	0.077
Heavy Fuel Oil (HFO)	40,200	0.8493	3.114	0.075
Liquefied Petroleum Gas (LPG) - Propane	46,300	0.8182	3.000	0.065
Liquefied Petroleum Gas (LPG) - Butane	45,700	0.8264	3.030	0.066
Liquefied Natural Gas (LNG)	48,000	0.7500	2.750	0.057
Methanol	19,900	0.3750	1.375	0.069
Ethanol	26,800	0.5217	1.913	0.071

Depending on the type of engines installed on the vessel, it may be possible to perform modifications to allow the engines to operate on one of these fuels with a lower carbon factor (CF).

However, the SFOC (Specific Fuel Oil Consumption) of the engines will also be affected by running on a fuel with a different calorific value, requiring more fuel to achieve the same power output if the calorific value is lower. The largest effect on the Attained EEXI will be achieved by selecting the fuel with the smallest ratio of carbon per kilojoule of energy.

EEXI REDUCTION TECHNOLOGIES

	Technology	Technical Commentary	Cost	Vessel offhire time
	Air Lubrication	This device forces compressed air around the hull to reduce friction and therefore power consumed. This improves the vessel's energy efficiency, thus reducing the Attained EEDI.	High	High
	Fuel Improvement Devices	This covers a range of technologies that aim to improve the combustion efficiencies of the main and auxiliary engines, thereby reducing the SFOC and in turn reducing the Attained EEDI, e.g. water injection introduces a small amount of purified water to the fuel, which turns to steam when entering the combustion space, creating finer atomization of fuel, resulting in a more efficient flame path.	Medium	Medium
	Electric Inverters	Motor inverters are variable frequency drives fitted to large electric motors on board to reduce their speed when full speed is not required, e.g. when a vessel is sailing in cold water the full flow of sea water may not be required form the central cooling pumps, therefore they can be slowed down, saving energy.	Medium	Medium
	Boss Cap Fins	Boss cap fins are small propeller like devices fitted to the boss of the vessel's propeller. These improve the flow of water through the propeller, reducing friction losses and improving the efficiency of the propeller.	Low	High
	Wind Assistance technologies	This covers a range of experimental technologies that aim to harness wind power to reduce the power demand on the Main Engine, thereby improving the Attained EEDI.	High	High

CII CALCULATION / METHODOLOGY

The Carbon Intensity Indicator is calculated from the information supplied on a yearly basis to the IMO Data Collection System (DCS), using the following equation:

$$\text{Attained CII} = \frac{\text{Annual } CO_2 \text{ mass}}{\text{Distance} \times \text{DWT}}$$

The annual CO_2 mass is calculated from the fuel consumed multiplied by the carbon factor of the fuel.

The Attained CII for the vessel for the year 2019 and 2020 was 6.68 and 5.91 respectively. This places the vessel in band C for the year 2020. However, as the band requirements reduce each year, if the vessel were to maintain its 2020 score, it would remain in Band C come 2023, when the regulations come into force.

Based on the required CII for 2023 and the current Attained CII for 2020, the vessel will not require a reduction in the Attained CII score over the next 3 years to remain in Band C when the regulations come into force in 2023. However, a further reduction will be required to remain in Band C for 2024, or to move into Bands A or B for 2023.

Current CII Band

C

2020

5.91

$gCO_2/t.Nm$

2019

6.68

$gCO_2/t.Nm$

CII REDUCTION STRATEGIES

As the EEXI is a measure of the technical efficiency of a vessel, the Attained EEXI can only be lowered by making structural or technological changes the vessel itself, and not by operational changes. Below are a number of technologies the vessel can use to reduce the Attained EEXI, however, it is anticipated that the majority of vessels will opt for the Engine Power Limiter, which is generally likely to be cheaper and more effective in reducing the Attained EEXI.

Engine Power Limiter / Overridable Power Limiter

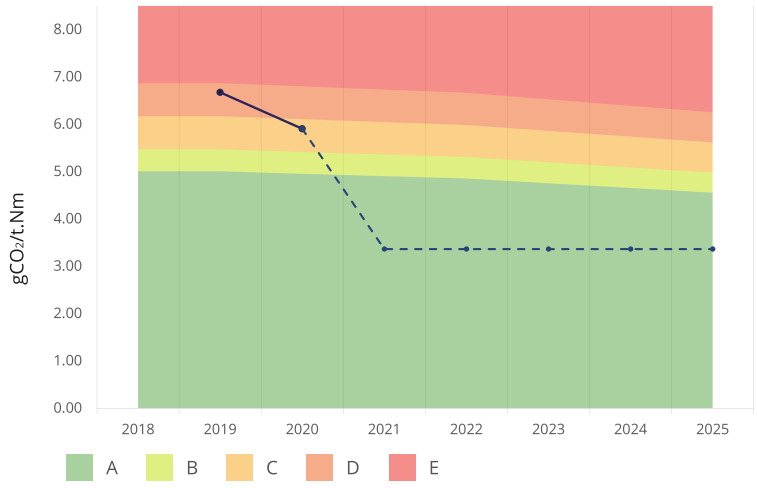
This device is a mechanical modification or software patch installed to the mechanical or electronic governor of the Main Engine to reduce the maximum power of the engine. For accurate costs and installation times, the Main Engine manufacturer should be consulted, however, costs are likely to be below $50,000 with minimal disruption to the vessel's operations.

For the "Example Vessel", the Main Engine would be required to be limited to 74% of the current MCR to achieve the Required EEXI. This limiting of the Main Engine power, and therefore reduction in speed and fuel consumption will have a significant impact on the vessel's Attained CII score. The quantity of the reduction cannot be calculated as other factors also affect the Attained CII, such as the average speed of the vessel over the year and energy usage in other areas of the vessel.

However, for a basic estimate, if the average speed is reduced by 20% over the year, the average fuel consumption may also reduce by 49%, based on the basic relationship of:

$$F^{3/4} \propto v^3$$

This would reduce the Attained CII by 49% for a new Attained CII of 5.37 gCO2/t.Nm, placing the vessel firmly in Band A for the foreseeable future. This method assumes an average of 20% reduction in average vessel speed over the year, which would potentially affect commercial competitiveness.



Further Reductions

The graph to the left shows the regulatory adjustment in years if the crew were to implement a 20% speed reduction.

Our calculations estimate this could result in a lower CII score of 5.37 gCO2/t.Nm and allow the vessel to maintain Band A compliance past 2025.

CII REDUCTION STRATEGIES

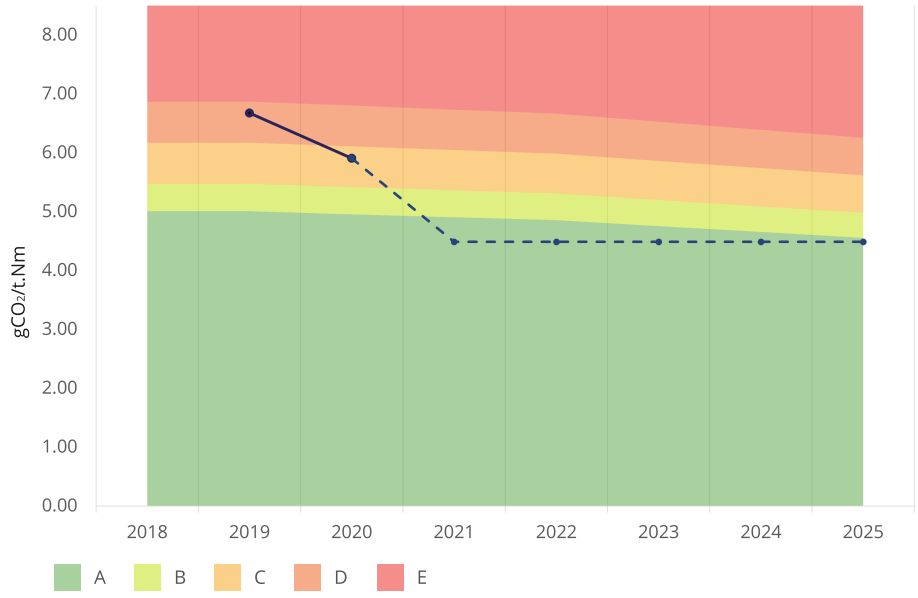
Fuel conversion

The vessels main and auxiliary engines are currently designed to run on Diesel or Heavy Fuel Oil, which have a carbon factor (CF) of 3.206 and 3.114 respectively. However, other fuel types have a lower carbon factor, whose use would result in a lower Attained CII.

Depending on the type of engines installed on the vessel, it may be possible to perform modifications to allow the engines to operate on one of these fuels with a lower carbon factor (CF).

Modifications will also have to be made to the fuel delivery systems, and it is highly recommended that a feasibility study is performed by an accredited organisation to ascertain an approximate cost and timescale.

For example, if the vessel were to convert to LNG, the new Attained CII would be approximately 4.49 gCO2/t.Nm



Further Reductions

The graph to the left shows the trajectory adjustment in black if the vessel were to convert to LNG.

Our calculations estimate this would result in a lower CII score of 4.49 gCO2/t.Nm and allow the vessel to maintain Band A compliance until 2025.

CII REDUCTION STRATEGIES

As the CII is a measure of the operational efficiency, it can only be reduced by making operational changes the way the vessel is run. However, as the Engine Power Limiter, which is a device to reduce the EEDI, limits the Main Engine power, and therefore consumption, it will also have a positive effect on the Attained CII. This is also true for changing the fuel type, as the carbon factor is reduced.

	Technology	Technical Commentary	Cost	Potential Commercial Impact
	Reduce Speed	The most effective way to reduce the fuel consumed, and therefore the Attained CII is to reduce the speed of the vessel. However, this must be balanced against the commercial requirements and charter party agreement.	Low	High
	Improve Engine Room Operation	Increased training in plant operation for the vessel's engineers and improved awareness and management procedures could lead to the vessel's auxiliary machinery being operated more efficiently, reducing waste.	Low	Medium
	Domestic Energy Saving Measures	This covers a range of measures such as reducing electricity usage on board, not always operating the AC system etc. These measures are likely to have limited effects on the CII compared to the other measures.	Low	Low

TIMELINE

The requirements of the EEXI regulations are for the vessel to have:

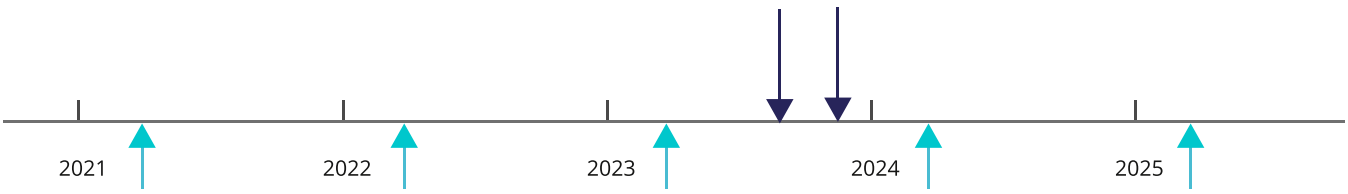
- The Attained EEXI less than the Required EEXI
- An approved EEXI Technical file
- The International Energy Efficiency Certificate re-issued

By the first full, intermediate or annual renewal of the IAPP after the 1st January 2023. For the "Example Vessel", the first renewal of the IAPP after the 1st January 2023 is the **7th November 2023**.

Given the time required for approval and re-issuing of the EEIC certificate, we highly recommend the vessel send the Technical File to the Recognised Organisation by the **7th August 2023**.

EEXI Calculation and technical file recommended
3 months before renewal of the of IAPP Certificate

7th November 2023 - First annual renewal of
the of IAPP Certificate after January 2023



Fuel usage must be submitted to
IMO DCS for CII Calculation each March

TIMELINE

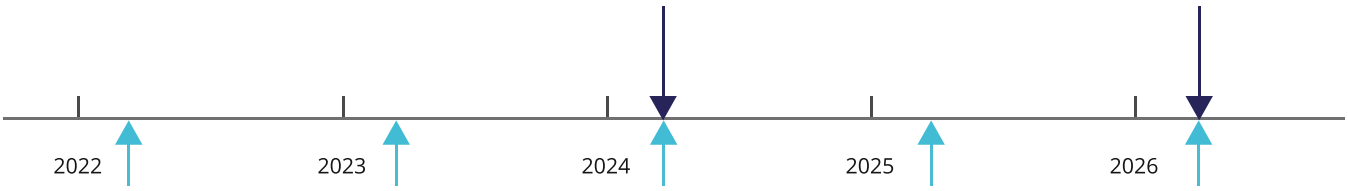
CII requirements

The requirements of the CII regulations are for the vessel to have the CII calculated from the information submitted to the IMO DCS in early 2024. If the calculated CII shows the vessel to be in:

- **Band D** - The vessel will be required to develop a carbon reduction plan and have it verified by the Recognised Organisation
- **Band E** - The vessel will be required to attempt to reduce the CII, as, if it remains in Band E for 3 consecutive years, then it will be required to develop a carbon reduction plan and have it verified by the Recognised Organisation
- **Band C** - The vessel will receive no sanctions
- **Bands A or B** - The vessel may receive incentives such as reduced port fees and attract "green" investment.

March 2024 - Deadline for reporting distance and consumption data for 2023. Requirements become enforced. Vessels in Band E face sanctions.

March 2026 - Deadline for reporting distance and consumption data for 2025. Requirements in force. Vessels that have been in Band D for 2023, 2024 and 2025 face sanctions.



Deadline for the submission of the data and calculation of the CII score for the previous year (March)