Standard Club

By your side

Route to decarbonization in shipping

Capt. Akshat Arora, Senior Surveyor

Loss Prevention

1 December 2021

IMO’s GHG Strategy

Decarbonisation timeline

2008

Base year

2018

IMO adopted **initial strategy** to reduce GHG emissions

2018 - 2023

Short term measures
Technical & operational measures for new/existing ships (EEXI / CII)
Improvement of EEDI & SEEMP

2023 - 2030

Mid-term measures to reduce carbon intensity of the fleet by at least 40%

2030 - 2050

Long term measures to reduce carbon intensity of the fleet by at least 70%

2050

At least 50% reduction of total annual GHG emissions

As soon as possible in this century

Zero GHG emissions

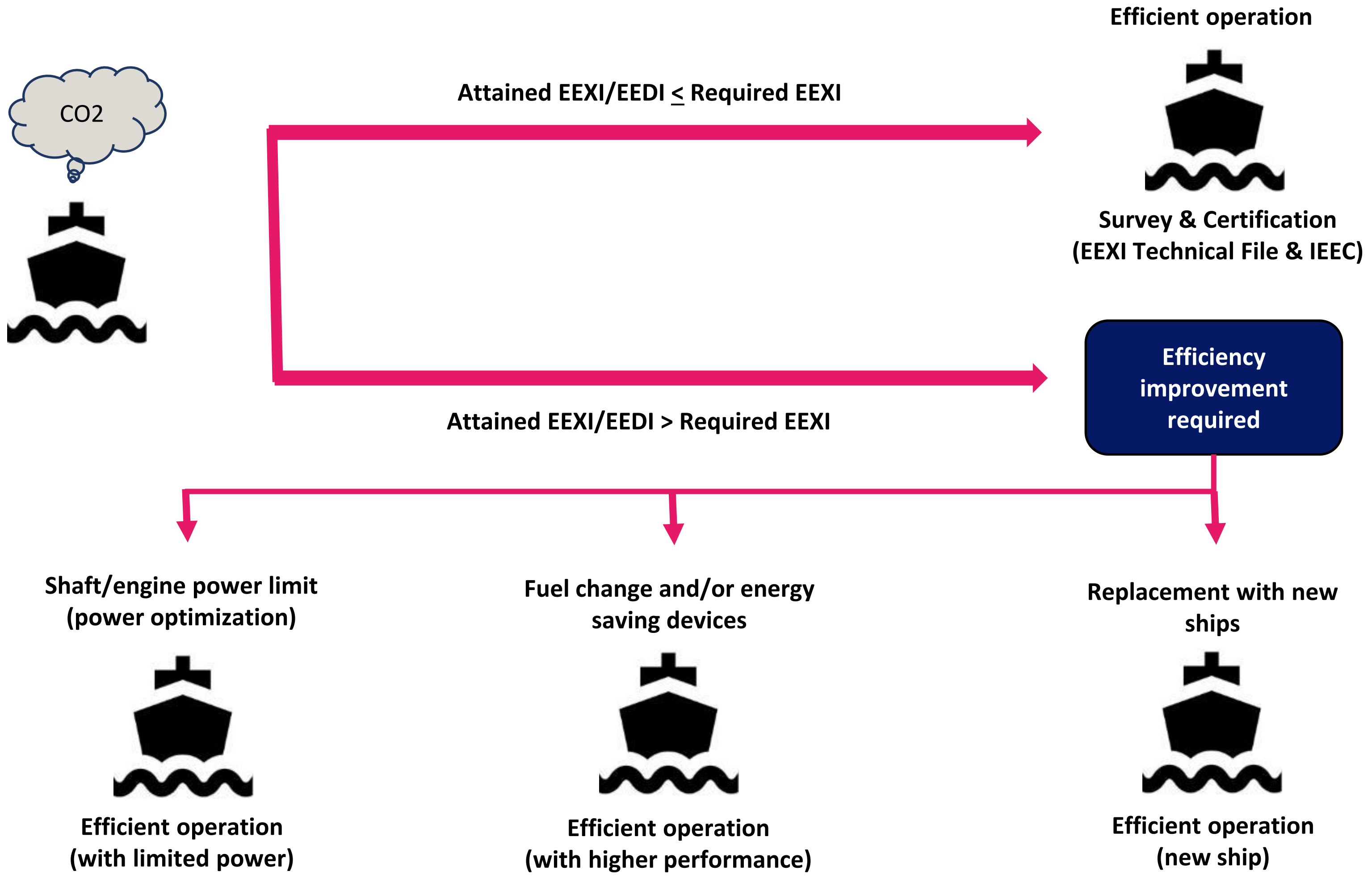
IMO's GHG Strategy

Decarbonisation timeline

- IMO's strategy envisages a reduction of the average carbon intensity (carbon dioxide (CO_2) emissions per transport work) of international shipping by at least 40% by 2030, pursuing efforts towards 70% by 2050, as compared to 2008 levels;
- and to reduce total annual GHG emissions from shipping by at least 50% by 2050 compared to 2008, while pursuing efforts towards phasing them out entirely within this century.
- The year 2008 is the baseline against which future reduction targets are based, while 2050 represents an important milestone in the Paris Agreement, which the IMO explicitly references in its strategy.
- These ambitions are to be accomplished by a blend of measures applicable in the short, medium, and long-term.

Action to reduce GHG emissions from ships

Technical measures: Energy Efficiency Existing Ship Index (EEXI)



Action to reduce GHG emissions from ships

Technical measures: Energy Efficiency Existing Ship Index (EEXI)

- EEXI regulation is applicable to all ships of 400 GT and above falling under MARPOL Annex VI
- For ships where the calculated (or attained) EEXI is greater than the required, there will be a need to implement countermeasures to improve its efficiency index.
- Being a technical or 'design' efficiency index, this may include alterations to the ship's design or machinery. Some of the available options are:
    - introduction of an engine power limitation (EPL) or shaft power limitation (ShaPoLi)
    - switching to carbon-neutral fuel or utilising energy efficiency technologies (EETs) – high retrofitting cost/CAPEX
    - replace tonnage, with due consideration to ship's age against the cost and payback time of improvement option
- The regulations are not prescriptive on which improvement method should be deployed and the right solution may vary based on ship type and size.

Action to reduce GHG emissions from ships

Operational measures: Carbon Intensity Indicator (CII) & Ship Energy Efficiency Management Plan (SEEMP)

- Applicable to ships of 5,000 GT and above
- Aligns with the IMO-DCS requirements
- Calculate attained annual operational CII each calendar year
- CII rating will indicate ship's performance over previous year
- Demonstrate reductions of carbon intensity from 2023 to 2030
- Ships rated 'D' for 3-years or 'E' for 1-year, will have to implement a corrective action plan
- Record CII rating, calculation and corrective measures in enhanced SEEMP

A	• Major superior
B	• Minor superior
C	• Moderate
D	• Minor inferior
E	• Inferior

Standard Club

Energy efficiency technologies (EETs)

- Hull form optimization
- Hull coatings
- Air lubrication
- Propellers and rudders
- Electric or hybrid propulsion
- Hydrogen fuel cells
- Shore to ship power (cold ironing)
- Waste heat recovery systems
- Carbon capture and storage
- Solar panels
- Wind assisted propulsion systems

Energy efficiency technologies (EETs)

- In terms of the alternative fuels and emerging technologies, there is no one-size-fits-all solution, and a lot of considerations will go into selecting appropriate option based on ship type/age, trading area, retrofitting costs, operating budget, fuel price/availability, infrastructure development, etc.
- Most of the alternative fuels and emerging technologies are still undergoing technical, economic, and environmental review.
- However, in order to illustrate some of the considerations, we have listed below some of the pros and cons of the options available.

Alternative Fuels

Pros and cons

FUEL	ADVANTAGES	DISADVANTAGES
Liquefied Natural Gas (LNG)	• Mostly methane • Already in use • Rapidly developing infrastructure • Low cost • IGF code	• Transition fuel • Cryogenic • Low volumetric density • Complicated handling • Methane slip
Biofuels	• Carbon neutral • Blended with traditional fuels • Compatible with current main engines	• Higher in cost • Storage stability • Acidity / filter plugging / engine deposits • Low availability
Hydrogen	• No CO2 emission • Fuel cell usage for small vessels • Global availability • Green production	• Not natural resource • Produced from fossil fuels • Low energy density • Large fuel volume • Not for large vessels • Immature bunkering • Explosive • Capital investment

FUEL	ADVANTAGES	DISADVANTAGES
Liquefied Petroleum Gas (LPG)	• Mix of propane and butane • Global availability • Low cost	• Reduction of CO2 emissions is limited • Limited operational experience • Lack of infrastructure • GHG slippage • Fossil fuel
Ammonia	• No CO2 emission • Green production • High energy density • Well understood and available	• Made from natural gas • Large fuel volume • N2O + NOx emissions • Toxic • Capital investment
Methanol	• Ambient temperature • Easy to store / handle • Minor modifications • Well understood and available • Biodegradable • Higher energy density • Low SOx/NOx/particles	• Produced from fossil fuel • Large fuel volume • Toxic • Fire & corrosion risk • Capital investment

Alternative Fuels

Pros and cons

- LNG, LPG, biofuel, methanol, ammonia, and hydrogen, as well as the usage of fuel cells and batteries, are some of the main options. Each has its own set of advantages and disadvantages and switching between them is not easy - engines and other machinery will need to be capable of burning the fuel in question.
- There are numerous other considerations in relation to the various fuel options. For example, biofuel brings a handful of technical challenges such as oxidation stability, cold flow properties, risk of microbial growth, clogging of filters, and increased engine deposits; and hence, it requires careful handling.
- Handling of other alternative fuel options on vessels could be complex as well and will require a highly trained crew.
- Most of the gases in liquid form requires storage at cryogenic temperature - specific safety standards will need to be satisfied. Hydrogen, for example, has a wide flammability range, while ammonia is highly toxic. Stringent measures will be required to protect crew from exposure.
  - Hydrogen is a clean fuel; however, manufacturing hydrogen fuel is energy-intensive and has carbon by-products.
  - Brown hydrogen is created through coal gasification.
  - Grey hydrogen from natural gas throws off carbon waste.
  - Blue hydrogen uses carbon capture and storage for the greenhouse gases produced in the creation of grey hydrogen.
  - Green hydrogen production – the ultimate clean hydrogen resource – uses renewable energy to create hydrogen fuel, which could be quite expensive.
- Similarly, green ammonia will cost two to four times as much to make as conventional ammonia. The green and blue ammonia value chains differ in the hydrogen production method used.
- In terms of storage capacity, energy density/calorific value of the fuel is critical. More storage space on the ship will be required if a fuel does not have an energy density that is at least comparable to what it has now. Hydrogen, ammonia, and methanol, for example, have a lower density, requiring larger tanks onboard ships.
- For a fuel to become widely used, it must have adequate scalability, i.e., both the infrastructure and the demand must be there. This may be easier for ships on regular liner route, but ships traveling between ports will have a difficult time finding the relatively scarce option.

Standard Club

By your side

Thank you