

Climate Change and Marine Industry

An aerial photograph of a port area. In the foreground, there is a marina with several small boats docked at piers. Two large red cargo ships are visible in the water. The background shows a wide river or estuary with a sandy bank on the left and a road or railway line running along the bottom edge of the frame.

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Climate change is one of the most serious environmental threats facing the world today.

- Various measures have been taken into account from United Nations in order to achieve the reduction of Greenhouse Gas Emissions (GHG), responsible for climate change.

➡ **Kyoto Protocol** being an important step to this direction.

International Shipping and aviation are the only GHG emitting sectors, not covered by the Kyoto Protocol, reportedly due to:

- ❖ lack of reliable emission data &
- ❖ lack of an agreed approach for defining responsibility by country.



International Maritime Organisation (IMO),

responsible for maritime sector, has not yet been able to agree upon any effective measure and mitigation policy to reduce GHG emissions from shipping. As a result:



While shipping is the most energy-efficient mode of transport, its participation to global GHG emissions has increased significantly.

However, the Marine Environment Protection Committee (MEPC) of IMO has made substantive progress in developing technical and operational measures to address CO₂ emissions from ships and assessed alternative market-based instruments related to their possible effects on the CO₂ emissions abatement measures.



Some of these measures include:

- ❖ the development of a **CO₂ Operational Index** for ships, which would serve as a basis for any future mandatory mechanism with GHG-reduction potential for international shipping
- ❖ a **global levy scheme &**
- ❖ an **emission trading scheme.**



A global levy scheme

Under a global levy scheme on marine bunker fuel, all ships engaged in international voyages would be subjected to a bunker levy established at a given cost level per ton of fuel bunkered.

A carbon charge on bunker fuels would increase fuel costs for the vessels, which are a large proportion of shipping costs and play an important role in the decisions of ship builders and owners.

A carbon charge on bunker fuels might reduce bunker demand and associated CO₂ emissions through the following measures:



- Energy efficiency improvements in ships engines and ship design
- Changes in operating practices including load factors, routing and sailing speeds
- Switching to different vessel types
- Switching to alternative fuel.

However,

- It would be necessary to reach an agreement between countries on implementing such a charge.
- Unless implemented globally, bunker charges can be easily evaded.



An emission trading scheme

Emission trading is one of the flexible mechanisms approved by the Kyoto Protocol and represents cooperation between two countries, companies or organizations that have emissions reduction commitments. Any company in a country that has reduced its emissions below the determined commitment can sell its surplus units to another country that may find it more difficult to reduce its emissions and meet its reduction commitment.



In order to operate an emission trading scheme in international shipping, there are two options:

- ❖ either international shipping emissions should be included in national emissions inventories or
- ❖ they should be included in the Kyoto Protocol outside the assigned amounts of participant countries (under auspices of IMO).



However, including shipping emissions in national inventories requires that they can be allocated to countries and it is highly unlikely that any allocation method could be agreed between them. Some countries would require their emissions reductions obligations to be changed and, therefore, national emissions inventories would need to be changed.



- The second option, including shipping emissions in Kyoto Protocol outside the assigned amounts of participant countries, also presents problems in practical implementation. A cap on total emissions from international shipping should be established and ship owners would have to buy emission allowances to cover their emissions. If this cap on emissions from international shipping includes only the ships registered in participant countries, there would be an incentive to register ships in non-participant countries instead.



The development of a CO₂ Emission Index for ships


A CO₂ Emission Index describes the CO₂ efficiency of a ship, the CO₂ emission per tonne cargo per nautical mile and is defined as the ratio of mass of CO₂ per unit of transport work:

➔ Index = $m\text{CO}_2 / \text{transport work}$ or
Index = $m\text{CO}_2 / (\text{mcargo} * \text{transport distance})$

where $m\text{CO}_2$ is total CO₂ emitted for transport work and transport work is equal to total cargo carried during this voyage or period x the distance travelled for this voyage or period.



The CO₂ Emission Index is calculated as follows:


$$\text{Index} = \frac{\sum_i FC_i \times C_{\text{Carbon}}}{\sum_i m_{\text{cargo},i} \times D_i}$$

where FC_i is the fuel consumption of a voyage or period, C_{Carbon} is the carbon content of the fuel used, $m_{\text{Cargo},i}$ is the total payload carried and D_i is the distance travelled during this voyage or period.



Based on data from the world fleet database, a ship emissions calculator has been developed by the Laboratory for Maritime Transport (NTUA, 2008), which incorporates the main categories of ships, each further broken down into size-categories and typical routes and calculates the CO₂ emissions of an average ship according to its type, size and the route that it follows.



- A CO₂ emission indexing scheme can be used to determine the average CO₂ index (baseline) for the existing world fleet.
- Based on this average CO₂ index, a mandatory design CO₂ index for new ships can be developed which will require them to meet a design CO₂ limit that will be set at a level below the average CO₂ index.
- The design CO₂ index for new ships will serve as a fuel-efficiency tool at the design stage of ships.

A Design CO₂ Index can be defined as the ratio between the environmental cost of shipping and the benefit for society:

➡ Design CO₂ Index = Environmental cost / Benefit
for society



The establishment of a CO₂ emission index

In order to establish the CO₂ emission index, information needs to be collected on:

- ❑ Distance travelled
- ❑ Quantity and quality of fuel used
- ❑ All fuel information that may affect the amount of carbon dioxide emitted
- ❑ The type and weight of cargo on board in the appropriate measurement unit

And the following main steps need to be executed:

- ✓ Define data sources for data collection
- ✓ Collect data
- ✓ Convert data to appropriate format
- ✓ Calculate CO₂ index.

- The data recording method used in particular ship types must be uniform so that information can be easily analyzed to facilitate the extraction of the required conclusions.
- Documented procedures to monitor and measure, on a regular basis, should be developed and maintained.
- Implementation of the CO₂ index should follow the main elements of recognized standards (planning, implementation and operation, checking and corrective action, management review).



The application of the CO₂ emission index from a Greek Shipping Company

Five large containerships of Greek shipping company are the first worldwide to operate in full compliance with an operational CO₂ emission indexing scheme.

- This action presents special as it takes place before the relative decisions are taken by the IMO and carried out by the member states of the European Union.



The CO₂ emission index operates in the way shown below:

- ✓ The CO₂ index records fuel consumption, transported cargo and distance between two consecutive ports.
- ✓ It is calculated for each voyage and later averaged for a defined period, usually a year.
- ✓ Based on checks of data recorded during the period, a surveyor of the classification society will check the recorded data and eventually issue a certified operational CO₂ index, which is then valid for the next period.



- By entering data for more than one vessel, it is possible to compare CO₂ indices across a fleet, a function that is expected to be of particular significance, as it will expose differences in fuel consumption associated with individual vessel and voyage segments and enable ship owners to make comparisons between vessels' and fleets' carbon emissions.



- Once certified CO₂ index values become public, it will promote the use of ships with a low index for more cargo and thus improve their record even further, while ships with poor values will loose cargo and worsen their economic efficiency.
- A transparent and public CO₂ indexing system would therefore encourage the development of ships with low emissions.



The application of the CO₂ emission index provides a **relative advantage to the Shipping company** for the following reasons:

1. The company demonstrates its commitment to environmental protection and contributes significantly to the future wide implementation of the CO₂ emission index as it is a leader in gaining widespread experience with the CO₂ indexing methodology in general.



2. Taking into account the future environmental regulation for maritime transport, ship owners pay special attention to an energy-efficient way of transport and the application of the CO₂ index could build experience with the IMO-based CO₂ indexing methodology - including reporting procedure and monitoring - that would be useful to shipping companies and flag states.
3. Applied on five ships of the company's fleet, the CO₂ emission index allows a comparison of CO₂ indices. This function in particular is expected to trigger a learning effect as differences in fuel consumption will be made explicit and more transparent with the data associated to each vessel and voyage segment.



4. Ship operators and managers could use a “CO₂ Index Data Analysis” to reduce their fuel costs, as the first step towards optimizing a ship’s fuel consumption is to evaluate the fuel efficiency performance and investigate the drivers of unexpected fuel consumption patterns.
5. Thus, a “CO₂ Index Data Analysis” is a first step towards improving fuel efficiency and cutting operating costs generating a four-fold evaluation of a ship’s fuel consumption patterns:
 - Identification of voyages with unexpectedly high or low fuel consumption



- Comparison of operational CO₂ index with respective design index (actual vs. potential efficiency) and of design index with other vessels' design indices
- Identification of deviations in the following: fuel consumption from the yearly average; long legs with similar cargo loads; sailed distances for identical voyages
- Comparison of a ship's operational CO₂ index with those of sister vessels.



5. Implementing the operational CO₂ index on five ships and using the “CO₂ Index Data Analysis”, the company will have accomplished an appropriate starting point for reducing GHG emissions, as it will be able to evaluate the fuel efficiency performance of its ships and thus participate in a future mechanism with GHG-reduction potential for international shipping.



Thank you for your attention

