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**GUIDELINES FOR VOLUNTARY USE OF THE SHIP ENERGY EFFICIENCY  
OPERATIONAL INDICATOR (EEOI)**

- 1 The Marine Environment Protection Committee, at its fifty-ninth session (13 to 17 July 2009), agreed to circulate the Guidelines for voluntary use of the Ship Energy Efficiency Operational Indicator (EEOI) as set out in the annex.
- 2 Member Governments are invited to bring the Guidelines to the attention of all parties concerned and recommend them to use the Guidelines on a voluntary basis.
- 3 Member Governments and observer organizations are also invited to provide information on the outcome and experiences in applying the Guidelines to future sessions of the Committee.

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**ANNEX****GUIDELINES FOR VOLUNTARY USE OF THE SHIP ENERGY EFFICIENCY  
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1 The Conference of Parties to the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto, held from 15 to 26 September 1997 in conjunction with the Marine Environment Protection Committee's fortieth session, adopted Conference resolution 8, on CO<sub>2</sub> emissions from ships.

2 IMO Assembly resolution A.963(23) on IMO policies and practices related to the reduction of greenhouse gas emissions from ships urged the Marine Environment Protection Committee (MEPC) to identify and develop the mechanism or mechanisms needed to achieve the limitation or reduction of Greenhouse Gas (GHG) emissions from international shipping and, in doing so, to give priority to the establishment of a GHG baseline; and the development of a methodology to describe the GHG efficiency of a ship in terms of GHG emission indicator for that ship.

3 As urged by the Assembly, MEPC 53 approved Interim Guidelines for Voluntary Ship CO<sub>2</sub> Emission Index for Use in Trials.

4 These Guidelines can be used to establish a consistent approach for voluntary use of an EEOI, which will assist shipowners, ship operators and parties concerned in the evaluation of the performance of their fleet with regard to CO<sub>2</sub> emissions. As the amount of CO<sub>2</sub> emitted from a ship is directly related to the consumption of bunker fuel oil, the EEOI can also provide useful information on a ship's performance with regard to fuel efficiency.

5 These Guidelines may be updated periodically, to take account of:

- Operational experiences from use of the indicator for different ship types, as reported to MEPC by industry organizations and Administrations; and
- Any other relevant developments.

6 Industry organizations and interested Administrations are invited to promote the use of the attached Guidelines or equivalent approaches and their incorporation in company and ship environmental management plans. In addition, they are invited to report their experience in applying the EEOI concept back to MEPC.

7 In addition to these Guidelines, due account should be taken of the pertinent clauses within the ISM Code in voluntary basis along with reference to relevant industry guidance on the management and reduction of CO<sub>2</sub> emissions.

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ANNEX

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## 1 INTRODUCTION

In 1997 IMO adopted a resolution on CO<sub>2</sub> emissions from ships<sup>1</sup>.

IMO Assembly further adopted resolution A.963(23) on IMO policies and practices related to the reduction of greenhouse gas emissions from ships, which requests the MEPC to develop a greenhouse gas emission index for ships, and guidelines for use of that index.

This document constitutes the Guidelines for the use of an Energy Efficiency Operational Indicator (EEOI) for ships. It sets out:

- what the objectives of the IMO CO<sub>2</sub> emissions indicator are;
- how a ship's CO<sub>2</sub> performance should be measured; and
- how the index could be used to promote low-emission shipping, in order to help limit the impact of shipping on global climate change.

## 2 OBJECTIVES

The objective of these Guidelines is to provide the users with assistance in the process of establishing a mechanism to achieve the limitation or reduction of greenhouse gas emissions from ships in operation.

These Guidelines present the concept of an indicator for the energy efficiency of a ship in operation, as an expression of efficiency expressed in the form of CO<sub>2</sub> emitted per unit of transport work. The Guidelines are intended to provide an example of a calculation method which could be used as an objective, performance-based approach to monitoring the efficiency of a ship's operation.

These Guidelines are recommendatory in nature and present a possible use of an operational indicator. However, shipowners, ship operators and parties concerned are invited to implement either these Guidelines or an equivalent method in their environmental management systems and consider adoption of the principles herein when developing plans for performance monitoring.

## 3 DEFINITIONS

### 3.1 Indicator definition

In its most simple form *the Energy Efficiency Operational Indicator* is defined as the ratio of mass of CO<sub>2</sub> ( $M$ ) emitted per unit of transport work:

$$\text{Indicator} = M_{\text{CO}_2}/(\text{transport work})$$

For more details of indicator calculation, see 3.2 to 3.4 and Appendix 1.

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<sup>1</sup> Resolution 8 of the 1997 International Conference of Parties to MARPOL 73/78.

### 3.2 Fuel consumption

*Fuel consumption*, FC, is defined as all fuel consumed at sea and in port or for a voyage or period in question, e.g., a day, by main and auxiliary engines including boilers and incinerators.

### 3.3 Distance sailed

*Distance sailed* means the actual distance sailed in nautical miles (deck log-book data) for the voyage or period in question.

### 3.4 Ship and cargo types

The Guidelines are applicable for all ships performing transport work.

#### .1 Ships:

- dry cargo carriers
- tankers
- gas tankers
- containerships
- ro-ro cargo ships
- general cargo ships
- passenger ships including ro-ro passenger ships

#### .2 Cargo:

Cargo includes but not limited to:

all gas, liquid and solid bulk cargo, general cargo, containerized cargo (including the return of empty units), break bulk, heavy lifts, frozen and chilled goods, timber and forest products, cargo carried on freight vehicles, cars and freight vehicles on ro-ro ferries and passengers (for passenger and ro-ro passenger ships)

### 3.5 Cargo Mass Carried or Work Done

In general, cargo mass carried or work done is expressed as follows:

- .1 for dry cargo carriers, liquid tankers, gas tankers, ro-ro cargo ships and general cargo ships, metric tonnes (*t*) of the cargo carried should be used;
- .2 for containerships carrying solely containers, number of containers (TEU) or metric tons (*t*) of the total mass of cargo and containers should be used;
- .3 for ships carrying a combination of containers and other cargoes, a TEU mass of 10 t could be applied for loaded TEUs and 2 t for empty TEUs; and
- .4 for passenger ships, including ro-ro passenger ships, number of passengers or gross tonnes of the ship should be used;

In some particular cases, work done can be expressed as follows:

- .5 for car ferries and car carriers, number of car units or occupied lane metres;

- .6 for containerships, number of TEUs (empty or full); and
- .7 for railway and ro-ro vessels, number of railway cars and freight vehicles, or occupied lane metres.

For vessels such as, for example, certain ro-ro vessels, which carry a mixture of passengers in cars, foot passengers and freight, operators may wish to consider some form of weighted average based on the relative significance of these trades for their particular service or the use of other parameters or indicators as appropriate.

### **3.6 Voyage**

*Voyage* generally means the period between a departure from a port to the departure from the next port. Alternative definitions of a voyage could also be acceptable.

## **4 ESTABLISHING AN ENERGY EFFICIENCY OPERATIONAL INDICATOR (EEOI)**

The EEOI should be a representative value of the energy efficiency of the ship operation over a consistent period which represents the overall trading pattern of the vessel. Guidance on a basic calculation procedure for a generic EEOI is provided in the Appendix.

In order to establish the EEOI, the following main steps will generally be needed:

- .1 define the period for which the EEOI is calculated\*;
- .2 define data sources for data collection;
- .3 collect data;
- .4 convert data to appropriate format; and
- .5 calculate EEOI.

\* Ballast voyages, as well as voyages which are not used for transport of cargo, such as voyage for docking service, should also be included. Voyages for the purpose of securing the safety of a ship or saving life at sea should be excluded.

## **5 GENERAL DATA RECORDING AND DOCUMENTATION PROCEDURES**

Ideally, the data recording method used should be uniform so that information can be easily collated and analysed to facilitate the extraction of the required information. The collection of data from ships should include the distance travelled, the quantity and type of fuel used, and all fuel information that may affect the amount of carbon dioxide emitted. For example, fuel information is provided on the bunker delivery notes that are required under regulation 18 of MARPOL Annex VI.

If the example formula given in the Appendix is used, then the unit used for distance travelled and quantity of fuel should be expressed in nautical miles and metric tonnes. The work done can be expressed using units appropriate for the ship type in paragraph 3.5.

It is important that sufficient information is collected on the ship with regard to fuel type and quantity, distance travelled and cargo type so that a realistic assessment can be generated.

The distance travelled should be calculated by actual distance travelled, as contained in the ship's log-book.

Amount and type of fuel used (bunker delivery notes) and distance travelled (according to the ship's log-book) could be documented by the ship based either on the example described in the Appendix or on an equivalent company procedure.

## **6 MONITORING AND VERIFICATION**

### **6.1 General**

Documented procedures to monitor and measure, on a regular basis, should be developed and maintained. Elements to be considered when establishing procedures for monitoring could include:

- identification of operations/activities with impact on the performance;
- identification of data sources and measurements that are necessary, and specification of the format;
- identification of frequency and personnel performing measurements; and
- maintenance of quality control procedures for verification procedures.

The results of this type of self-assessment could be reviewed and used as indicators of the System's success and reliability, as well as identifying those areas in need of corrective action or improvement.

It is important that the source of figures established are properly recorded, the basis on which figures have been calculated and any decisions on difficult or grey areas of data. This will provide assistance on areas for improvement and be helpful for any later analysis.

In order to avoid unnecessary administrative burdens on ships' staff, it is recommended that monitoring of an EEOI should be carried out by shore staff, utilizing data obtained from existing required records such as the official and engineering log-books and oil record books, etc. The necessary data could be obtained during internal audits under the ISM Code, routine visits by superintendents, etc.

### **6.2 Rolling average indicator**

As a ship energy efficiency management tool, the rolling average indicator, when used, should be calculated by use of a methodology whereby the minimum period of time or a number of voyages that is statistically relevant is used as appropriate. "Statistically relevant" means that the period set as standard for each individual ship should remain constant and be wide enough so the accumulated data mass reflects a reasonable mean value for operation of the ship in question over the selected period.



## **7 USE OF GUIDELINES**

Methodology and use of EEOI, as described in these Guidelines, provide an example of a transparent and recognized approach for assessment of the GHG efficiency of a ship with respect to CO<sub>2</sub> emissions. The Guidelines are considered to be suitable for implementation within a company environmental management system.

Implementation of the EEOI in an established environmental management system should be performed in line with the implementation of any other chosen indicator and follow the main elements of the recognized standards (planning, implementation and operation, checking and corrective action, management review).

When using the EEOI as a performance indicator, the indicator could provide a basis for consideration of both current performance and trends over time.

One approach could be to set internal performance criteria and targets based on the EEOI data.

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APPENDIX

**CALCULATION OF ENERGY EFFICIENCY OPERATIONAL INDICATOR (EEOI)  
BASED ON OPERATIONAL DATA**

**1 General**

The objective of the Appendix is to provide guidance on calculation of the Energy Efficiency Operational Indicator (EEOI) based on data from the operation of the ship.

**2 Data sources**

Primary data sources selected could be the ship's log-book (bridge log-book, engine log-book, deck log-book and other official records).

**3 Fuel mass to CO<sub>2</sub> mass conversion factors (C<sub>F</sub>)**

C<sub>F</sub> is a non-dimensional conversion factor between fuel consumption measured in g and CO<sub>2</sub> emission also measured in g based on carbon content. The value of C<sub>F</sub> is as follows:

Type of fuel	Reference	Carbon content	C <sub>F</sub> (t-CO <sub>2</sub> /t-Fuel)
1. Diesel/Gas Oil	ISO 8217 Grades DMX through DMC	0.875	3.206000
2. Light Fuel Oil (LFO)	ISO 8217 Grades RMA through RMD	0.86	3.151040
3. Heavy Fuel Oil (HFO)	ISO 8217 Grades RME through RMK	0.85	3.114400
4. Liquified Petroleum Gas (LPG)	Propane	0.819	3.000000
	Butane	0.827	3.030000
5. Liquified Natural Gas (LNG)		0.75	2.750000

**4 Calculation of EEOI**

The basic expression for EEOI for a voyage is defined as:

$$EEOI = \frac{\sum_j FC_j \times C_{Fj}}{m_{cargo} \times D} \quad \text{Equation 1}$$

Where average of the indicator for a period or for a number of voyages is obtained, the Indicator is calculated as:

$$\text{Average EEOI} = \frac{\sum_i \sum_j (FC_{ij} \times C_{Fj})}{\sum_i (m_{cargo,i} \times D_i)} \quad \text{Equation 2}$$

Where:

- $j$  is the fuel type;
- $i$  is the voyage number;
- $FC_{ij}$  is the mass of consumed fuel  $j$  at voyage  $i$ ;
- $C_{Fj}$  is the fuel mass to CO<sub>2</sub> mass conversion factor for fuel  $j$ ;
- $m_{\text{cargo}}$  is cargo carried (tonnes) or work done (number of TEU or passengers) or gross tonnes for passenger ships; and
- $D$  is the distance in nautical miles corresponding to the cargo carried or work done.

The unit of EEOI depends on the measurement of cargo carried or work done, e.g., tonnes CO<sub>2</sub>/(tonnes • nautical miles), tonnes CO<sub>2</sub>/(TEU • nautical miles), tonnes CO<sub>2</sub>/(person • nautical miles), etc.

It should be noted that Equation 2 does not give a simple average of EEOI among number of voyage  $i$ .

## **5 Rolling average**

Rolling average, when used, can be calculated in a suitable time period, for example one year closest to the end of a voyage for that period, or number of voyages, for example six or ten voyages, which are agreed as statistically relevant to the initial averaging period. The Rolling Average EEOI is then calculated for this period or number of voyages by Equation 2 above.

## **6 Data**

For a voyage or period, e.g., a day, data on fuel consumption/cargo carried and distance sailed in a continuous sailing pattern could be collected as shown in the reporting sheet below.

**CO<sub>2</sub> Indicator reporting sheet**

NAME AND TYPE OF SHIP						
Voyage or day (i)	Fuel consumption (FC) at sea and in port in tonnes				Voyage or time period data	
	Fuel type ( )	Fuel type ( )	Fuel type ( )		Cargo (m) (tonnes or units)	Distance (D) (NM)
1						
2						
3						

NOTE: For voyages with  $m_{\text{cargo}}=0$ , it is still necessary to include the fuel used during this voyage in the summation above the line.

**7 Conversion from g/tonne-mile to g/tonne-km**

The CO<sub>2</sub> indicator may be converted from g/tonne-mile to g/tonne-km by multiplication by 0.54.

**8 Example:**

A simple example including one ballast voyage, for illustration purpose only, is provided below. The example illustrates the application of the formula based on the data reporting sheet.

NAME AND TYPE OF SHIP						
Voyage or day (i)	Fuel consumption (FC) at sea and in port in tonnes				Voyage or time period data	
	Fuel type (HFO)	Fuel type (LFO)	Fuel type ( )		Cargo (m) (tonnes or units)	Distance (D) (NM)
1	20	5			25,000	300
2	20	5			0	300
3	50	10			25,000	750
	10	3			15,000	150

$$EEOI = \frac{100 \times 3.114 + 23 \times 3.151}{(25,000 \times 300) + (0 \times 300) + (25,000 \times 750) + (15,000 \times 150)} = 13.47 \times 10^{-6}$$

unit: tonnes CO<sub>2</sub>/(tons • nautical miles)

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