

## MARITIME TECHNOLOGY COOPERATION CENTRE – PACIFIC (MTCC-PACIFIC)

CAPACITY BUILDING FOR CLIMATE MITIGATION IN THE  
MARITIME SHIPPING INDUSTRY  
THE GLOBAL MTCC NETWORK (GMN) PROJECT

# Guidelines supporting Chapter 4 of MARPOL Annex VI on SEEMP & EEOI

The Global MTCC Network (GMN) project is funded by the European Union and implemented by the IMO.

**SEEMP Guidelines (MEPC.213(63))**

**SEEMP - Main Elements**

**Implementation aspects**

**EEOI Guidelines (MEPC.1/Circ.684)**

**EEOI calculation process**

**Video - Best Practice For Fuel-Efficient Operation**

## Guidelines for development of SEEMP

Resolution MEPC.213(63):  
2012 Guidelines for the development of a SEEMP, adopted 2 March 2012

## **SEEMP purpose (Clause 3.2):**

- The purpose of a SEEMP is to establish a mechanism for a company and/or a ship to improve the energy efficiency of a ship's operation.

## **A SEEMP provides:**

- A possible approach for improving ship and fleet efficiency performance over time
- Some options to be considered for optimizing the performance of the ship.



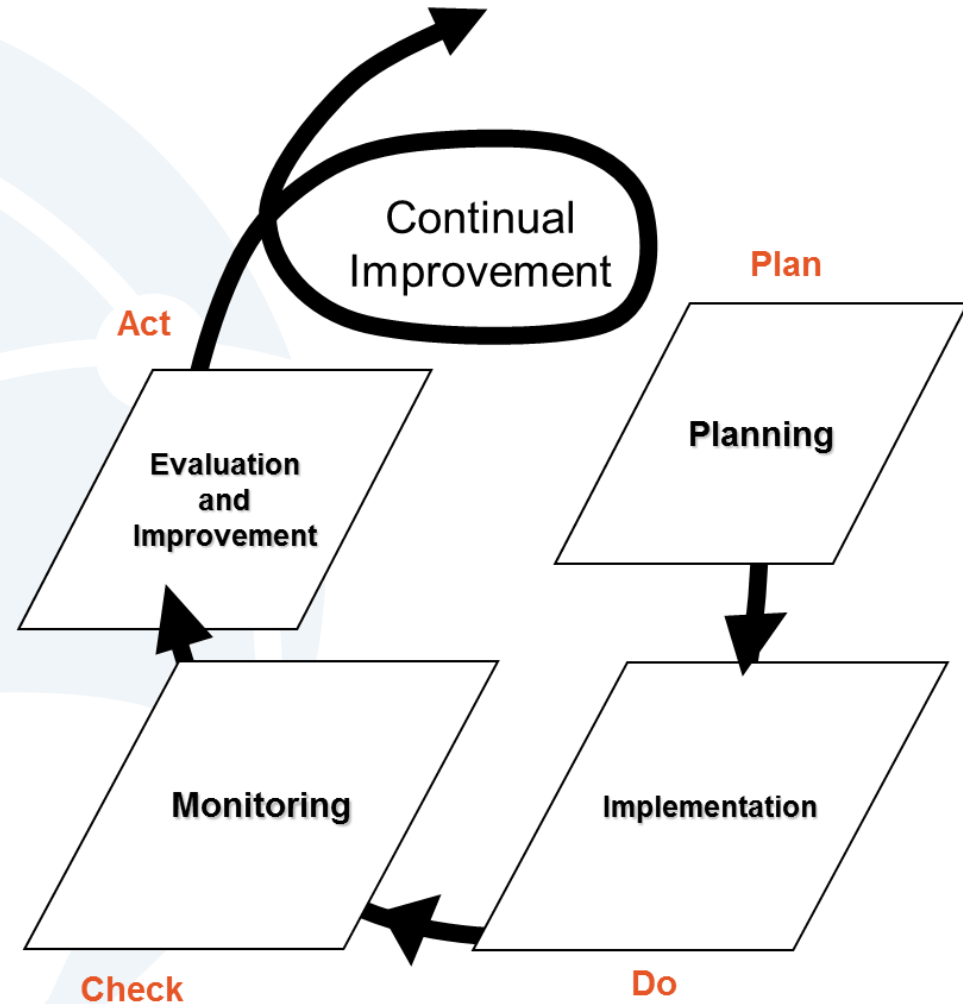
- SEEMP is intended to be a management tool.
- ... SEEMP should be adjusted to the characteristics and needs of individual companies and ships.
- ... it is recommended that ... the SEEMP is developed in a manner which limits any on-board administrative burden to the minimum necessary.
- SEEMP should be developed as a ship-specific plan by the company.
- ...it is recommended that a company also establishing an “energy management plan” to improve fleet energy performance and stakeholders’ coordination (Clause 4.1).

## SEEMP - Main Elements



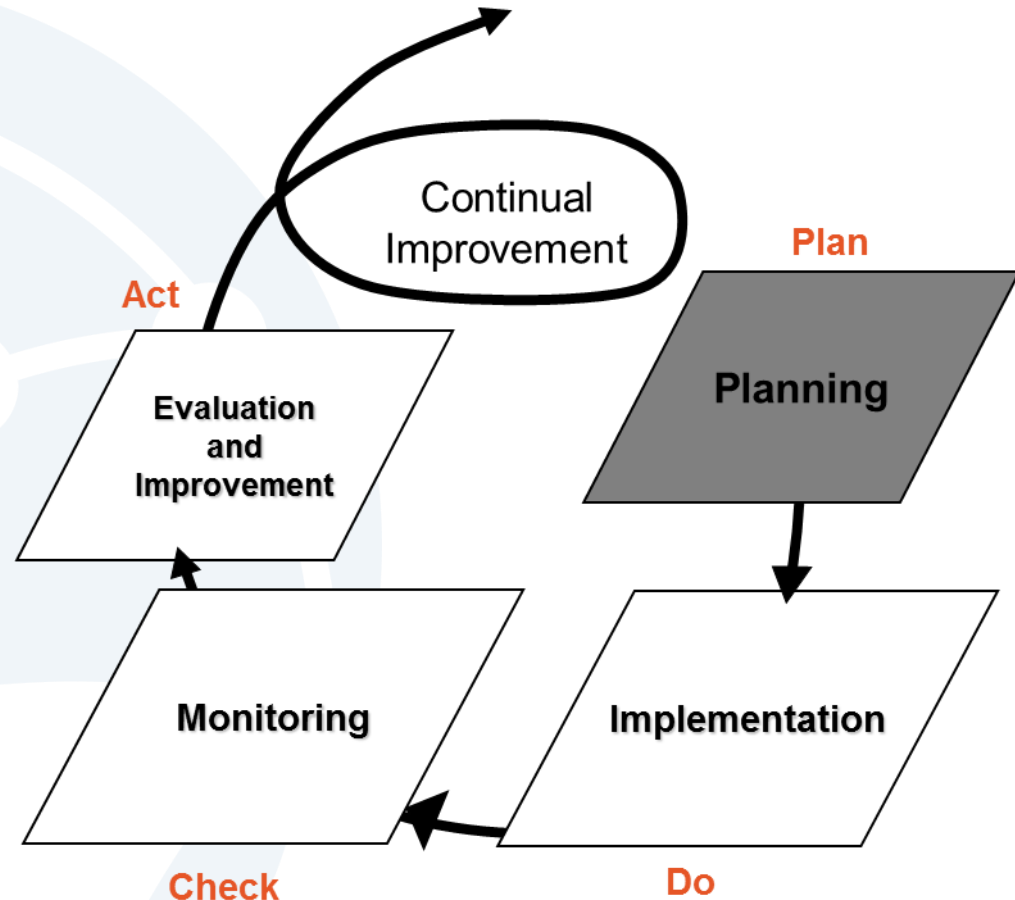
# SEEMP framework (Clause 4)

- SEEMP works through four steps:
  - Planning,
  - Implementation
  - Monitoring, and
  - Self-evaluation
- These components play a critical role in the continuous cycle to improve ship energy management.



# Planning - Importance

- Planning is the most crucial stage of the SEEMP.
- It primarily determines both the current status of ship energy usage and the expected improvements.
- Therefore, it is encouraged to devote sufficient time to planning.



# Planning – Identification of ship-specific measures

Recognizing that:

- There are a variety of options to improve efficiency.
- That the best measures differs to a great extent for ship type, cargoes, routes and other factors,
- The specific measures for the ship to improve energy efficiency should be identified in the first place.
- After identification of the EEMs (Energy Efficiency Measures), they should be listed as a package for implementation.

# Planning – Company-specific measures



- Improvement of energy efficiency of a ship does not necessarily depend on ship management only. A number of stakeholders are involved.
- More coordination between stakeholders is more rewarding ...
- Company should do the coordination rather than the ship.
- ... a “company energy management plan” is recommended to manage the fleet and make stakeholders’ coordination.

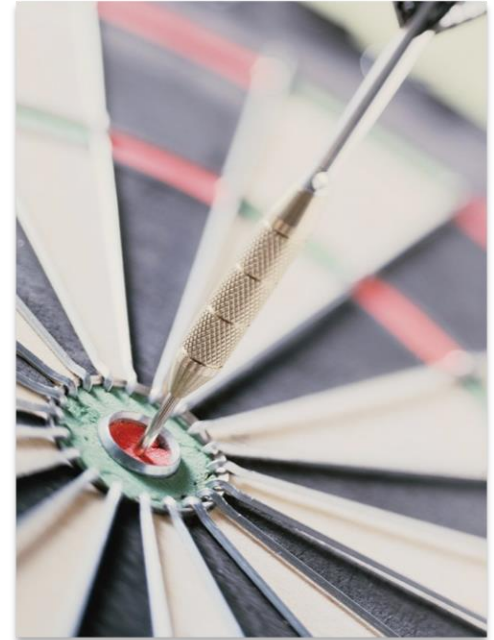


- Raising awareness and providing necessary training for personnel both on-shore and on-board are important elements.
- Such human resource development is encouraged and should be considered as an important component of planning as well as a critical element of implementation.



# Planning - Goal setting

- Goal setting is part of planning.
- Goal settings are voluntary and there is no need for announcement to public nor are they subject to external inspection.
- Purpose of goal setting is to increase commitment to improving energy efficiency.
- The goal can take any form:
  - Annual fuel consumption
  - EEOI targets
- The goal should be measurable and easy to understand.



## Implementation aspects



# Implementation – Establishment of implementation system

- A system for implementation of the selected measures by developing the procedures, tasks and responsibilities ...
- The SEEMP should describe how each measure should be implemented and who the responsible person(s) is.
- The implementation period (start and end dates) of each selected measure should be indicated.
- The development of such a system can be considered as a part of planning, and therefore may be completed at the planning stage.

# Implementation – Record keeping

- The planned measures should be implemented in accordance with the predetermined implementation system.
- Record-keeping for the implementation of each measure is beneficial for self-evaluation and should be encouraged.
- If any identified measure cannot be implemented for any reason(s), the reason(s) should be recorded for internal use.



# Monitoring tools

- Consistent data collection is the foundation of monitoring.
- The monitoring system, including the procedures for collecting data and the assignment of responsible personnel, should be developed.
- The development of such a system can be considered as a part of *planning*, and therefore should be completed at the planning stage.
- ...to avoid ... burdens on ships' staff, monitoring should be carried out as far as possible by shore staff, ...

# Self-evaluation and improvements

- Self-evaluation and improvement is the final phase of the management cycle.
- This phase should produce meaningful feedback for the next improvement cycle.
- The purpose of self-evaluation is to evaluate the effectiveness of the planned measures and of their implementation.
- For this process, procedures for self-evaluation of ship energy management should be developed.
- Furthermore, self-evaluation should be implemented periodically by using data collected through monitoring.

- **Optimised ship handling**
  - Optimum trim
  - Optimum ballast
  - Optimum propeller inflow.
  - Optimum use of rudder and autopilot
- **Hull and propeller maintenance**
  - Hull maintenance
  - Propeller maintenance
- **Engines maintenance**
  - Propulsion (main) engines maintenance
  - Auxiliary engines maintenance.
- **Auxiliary machinery maintenance and use**

# SEEMP format

A proposed format is included in the Guideline



## General information

SEEMP Number	SEEMP-005
IMO No.	90323423
Ship Name	MV Pacific
Ship Type	Cargo
Ship Builder	Pacific Heavy Industries
Year of Delivery	2005
Net Tonnage - tons	23,000
Gross Tonnage - tons	8,000

## SEEMP Development Information

Date of development	2017-10-13	Developed by : Name
Implementation period	Start : 2017-12-01 Expiry: 2050 - 12-01	Implemented by : Name
Planned date of next evaluation	2018-05-01	

## 1. Measures

Energy Efficiency Measures	Implementation	
Turning the lights off on deck when not required	All accommodation outside lights to be turned off during daylight. Turn OFF all cargo lights when not in use	Captain and mates, a clear procedure and notice to be implemented for mates on watch to get the deck hand to turn off the lights when not needed.

## 2. MONITORING

Chief engineer and Captain. Report to office if need reinforcement.

Notice will be made at toolbox meetings

## 3. GOAL

10,000L DO

## 4. EVALUATION

Follow-up with the administration office with pictures and engine log book for fuel consumption



- SEEMP framework is based on Plan-Do-Check-Act continuous improvement cycle.
- When developing SEEMP, all the above elements needs to be defined at the planning phase.
- At its core, SEEMP has a number of EEMs together with their:
  - Implementation methods
  - Monitoring and checking
  - Self assessment
  - Roles and responsibility
  - Processes and procedures.

# Energy Efficiency Operational Indicator



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A global network for energy-efficient shipping



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**EEOI guidelines**

**EEOI formula, data needed .....**

**Calculation aspects**

**Experience so far**

**Summary and conclusions**

# EEOI Guidelines:

## Some extracts from MEPC.1/Circ.684

- These Guidelines can be used to establish a consistent approach for voluntary use of an EEOI.
- It will assist ship-owners/operator... in the evaluation of the performance of their fleet with regard to CO<sub>2</sub> emissions.
- Industry organizations and interested Administrations are invited to promote the use of these Guidelines or equivalent approaches and their incorporation in company and ship environmental management plans.

# Objectives of the EEOI Guidelines (MEPC.1/Circ.684)

- These Guidelines present the concept of an indicator for the energy efficiency of a ship, .....
- The Guidelines are intended to provide an example of a calculation method ..... for monitoring the efficiency of a ship's operation.
- These Guidelines are recommendatory in nature and present a possible use of an operational indicator.
- Shipowners .... are invited to implement either these Guidelines or an equivalent method in their environmental management systems.

# EEOI Formula

- $j$  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  $CO_2$  mass conversion factor for fuel  $j$
- $m_{cargo}$  is cargo mass (tonnes) or work done (number of TEU , passengers, etc.) depending on ship type.
- $D$  is the distance in nautical miles corresponding to the cargo carried or work done

$$EEOI = \frac{\sum_j FC_j \times C_{Fj}}{m_{cargo} \times D}$$

# Definitions (1)

## Fuel consumption (FC)

- FC is defined as all fuel consumed at sea and in port or for a voyage or period in question, by main and auxiliary engines including boilers and incinerators

## Distance sailed (D)

- Means the actual distance sailed in nautical miles

## 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

# Definitions (2)

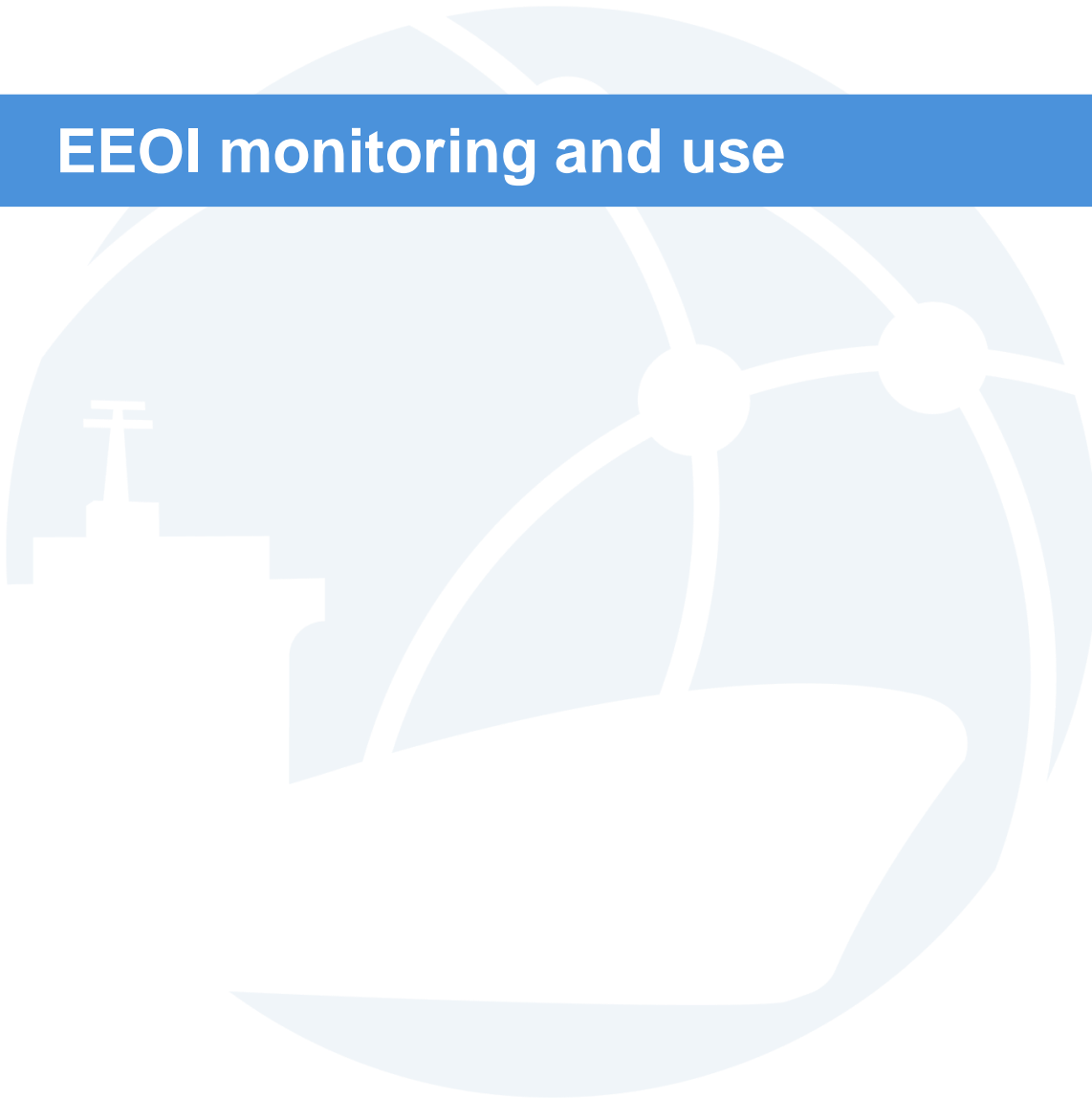
## Cargo mass carried ( $m_{\text{cargo}}$ )

- For cargo ships (dry, wet, etc.): **Metric tonnes (t)** of the cargo carried.
- For container ships (carrying solely containers): **Number of containers (TEU)** or **metric tons (t)** of the total mass of cargo and containers.
- 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.
- Passenger ships, including Ro-Ro passenger ships: **Number of passengers** or **gross tonnes** of the ship.

# Establishing the EEOI

- Main steps for establishing an EEOI are:
  1. Define the period for which EEOI is calculated (or the voyage)
  2. Define data sources for data collection
  3. Collect data
  4. Calculate EEOI
- Port operation and 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.

## EEOI monitoring and use



- Documented procedures to monitor should be developed, maintained and assessed.
- The results of this self-assessment could be used as indicators of the system's success and reliability
- It is important that the source of figures established are properly recorded.

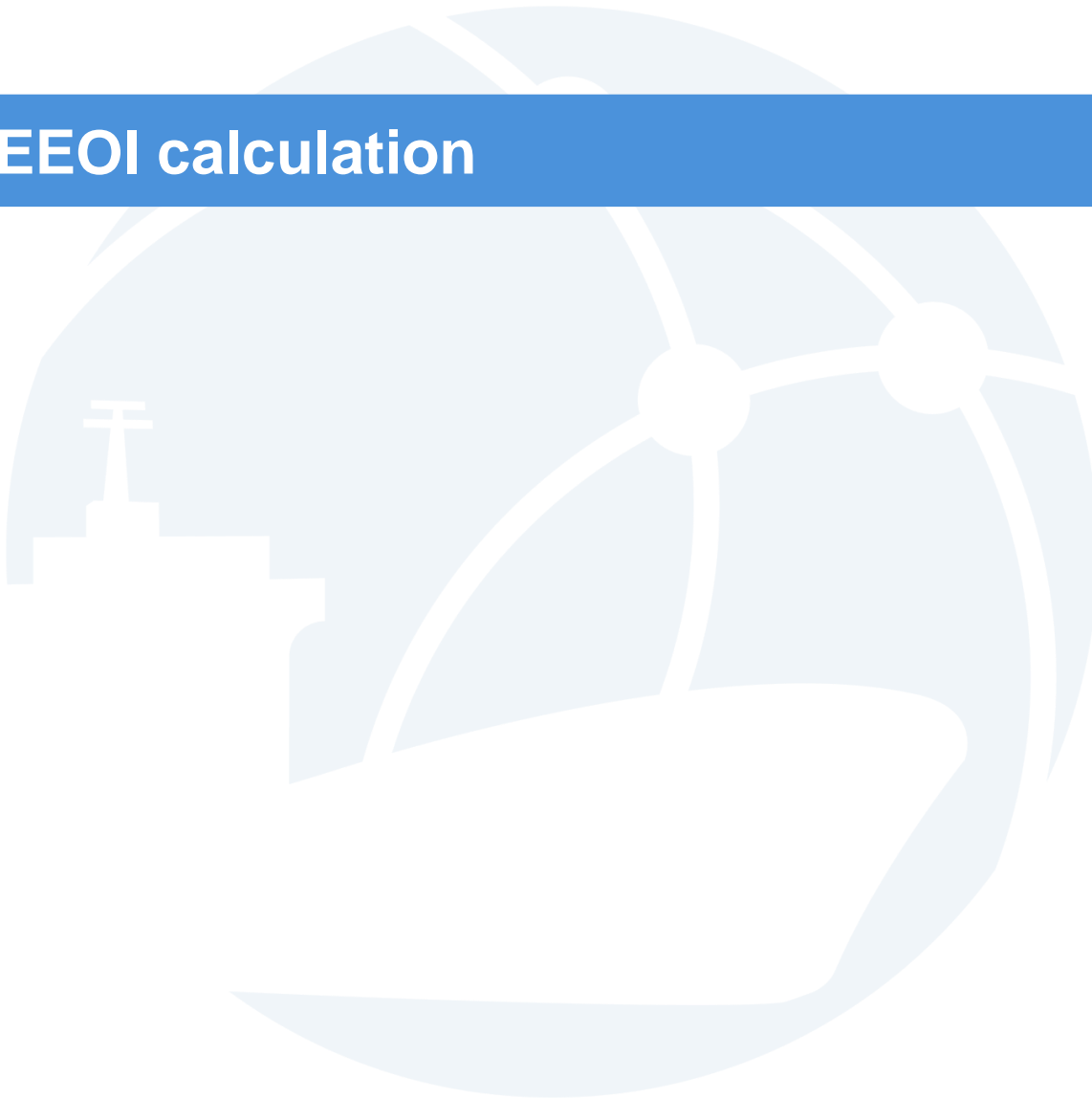
**This part is included in SEEMP**

# Monitoring by shore staff

- 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.
- Data obtained from existing records such as the official and engineering log-books and oil record books, etc. can be utilised.
- The necessary data could be obtained during internal audits under the ISM Code, routine visits by superintendents, etc.

**EEOI calculation should not impose extra work on ship staff**

## EEOI calculation



# Calculation of the EEOI – Formula

- Basic expression of the EEOI
- Average EEOI (rolling average)

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

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

j fuel type

i voyage number

$FC_{ij}$  mass of consumed fuel j at voyage i

$C_{Fj}$  fuel mass to CO<sub>2</sub> mass conversion factor for fuel j

$m_{\text{cargo}}$  cargo carried (tonnes) or work done (number of TEU or passengers) or gross tonnes for passenger ships

D distance in nautical miles corresponding to the cargo carried or work done

# Calculation of the EEOI – Data sources

- Data sources
  - Bridge log-book
  - Engine log-book
  - Deck log-book
  - Other official records
- Fuel mass to CO<sub>2</sub> mass conversion factors (CF)

Type of fuel	Reference	Carbon content	$C_F$ (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

# Calculation of the EEOI – Rolling average

- EEOI is normally calculated for one voyage.
- Average EEOI for a number of voyages can be carried out.
- Rolling average, when used, can be calculated in a suitable time period, e.g.:
  - One year or
  - Number of voyages, for example six or ten voyages, which are agreed as statistically relevant to the initial averaging period

# Calculation of the EEOI – Data sheet template

Name of Ship:

Gross Tonnage:

Ship Type:

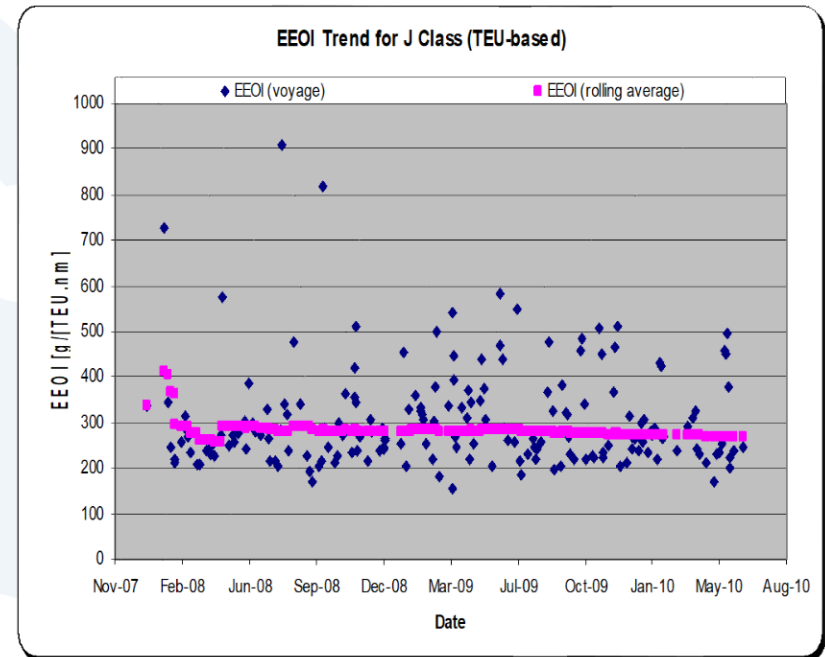
Point of Departure	Date	Time (Hrs)	Point of Arrival	Date	Time (Hrs)	Duration	Distance	Speed	DO Consumed (L)	No. of Pax	Cargo(tons)	Ballast (tons)

## EEOI evaluation and experience



# EEOI Variability

- Significant variations (voyage to voyage)
- Reasons for changes include:
  - Ship size/type
  - Cargo level (load)
  - Ship speed
  - Length of ballast voyages
  - Idle and waiting times
  - Weather and current
  - Measurement errors
- In short, every operation aspect of ship has its own impact on EEOI and causes its variability.





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**Thank you**



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