Energy Efficiency – EEOI
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Introduction
What is the EEOI

• The EEOI provides a tool to calculate the operational energy efficiency of a ship. The EEOI is not mandatory

  Should not be confused with the EEDI and SEEMP

• The EEOI is similar to the EEDI in that it is a calculation that presents the ratio of carbon emissions emitted over the useful work done (capacity transported).

• The units are presented in grams of CO$_2$ per capacity-mile. However, this time the equation is influenced by operational variables rather than design features of the ship.
The EEOI can be applied to all ships (new and existing) that perform transport work, including:

- Dry cargo carriers
- Tankers
- Gas tankers
- Containerships
- Ro-Ro Cargo ships
- General cargo ships
- Passenger ships including Ro-Ro passenger ships

The types of cargo these ships can carry include, but are not limited to:

- All gas
- Liquid and solid bulk cargo
- Frozen and chilled goods
- Timber and forest products
Introduction

What is the EEOI

EEOI = Fuel \cdot \text{Carbon Conversion Factor} \cdot \frac{\text{Cargo Quantity}}{m_{\text{cargo}}} \cdot \frac{\text{Distance}}{D}

EEOI = \frac{\sum_{j} FC_j \times CF_j}{m_{\text{cargo}} \times D}

EEOI = \frac{\text{tonnes CO}_2}{t \cdot \text{nm}}
## Introduction

### What is the EEOI

\[
\text{EEOI} = \frac{\sum_{j} FC_j \times C_{F,j}}{m_{\text{cargo}} \times D}
\]

### Table

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>( j )</td>
<td>is the Fuel type</td>
</tr>
<tr>
<td>( FC )</td>
<td>tonnes</td>
</tr>
<tr>
<td>( C )</td>
<td>Non dimensional</td>
</tr>
<tr>
<td>( D )</td>
<td>Nautical miles</td>
</tr>
</tbody>
</table>
# Introduction

What is the EEOI

<table>
<thead>
<tr>
<th>$M_{\text{cargo}}$</th>
<th>types of ships:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Metric tonnes (t)</strong></td>
<td>Dry cargo carriers, liquid tankers, gas tankers, Ro-Ro cargo ships and general cargo ships</td>
</tr>
<tr>
<td><strong>Number of containers (TEU)</strong></td>
<td>Containers carrying solely containers</td>
</tr>
<tr>
<td><strong>Metric tonnes (t)</strong></td>
<td>Containers carrying containers and cargo (where it can be assumed that for a loaded container 1 TEU = 10 t and for an empty container 1 TEU = 2t)</td>
</tr>
<tr>
<td><strong>Number of passengers or gross tonnes of the ship</strong></td>
<td>Passenger ships, including Ro-Ro passenger ships</td>
</tr>
</tbody>
</table>
### Introduction

**What is the EEOI**

<table>
<thead>
<tr>
<th>$M_{\text{cargo}}$</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of car units or occupied lane meters</strong></td>
<td><strong>Car ferries and car carriers</strong></td>
</tr>
<tr>
<td><strong>Number of TEUs (Empty or full)</strong></td>
<td><strong>Container ships</strong></td>
</tr>
<tr>
<td><strong>Number of railway cars and freight vehicles, or occupied lane meters</strong></td>
<td><strong>Railway and Ro-Ro ships</strong></td>
</tr>
</tbody>
</table>

*(where more than one type of cargo is transported a weighted average could be used)*
Calculation
Rolling Average

To use the rolling average a suitable time period needs to be selected for evaluation; e.g. one year (closest to the end of a voyage), number of voyages, etc.

\[
\text{Average EEOI} = \frac{\sum_{i} \sum_{j} (FC_{ij} \times C_{Fj})}{\sum_{i} (m_{\text{cargo},i} \times D_{i})}
\]

\( i \) is the voyage number

The calculate the EEOI the following steps must be followed:

- Define the time period for the rolling average calculation
- Define the data sources for data collection (e.g. bridge and engine log books, bunker delivery note)
- Collect data
- Convert the data to the required format
- Calculate the EEOI
Advantages
What is the EEOI

• The EEOI provides a **standardised method (tool) to quantify** the operational energy efficiency of ships/fleet

• The EEOI is **non – prescriptive** and just performance based.

• If a ‘good’ EEOI is obtained then this could be publicised and used as a **positive competitive attribute**

• Performance monitoring of the EEOI will **help assessment and review, and hence incentivise operational improvements** over time.
Limitations
What is the EEOI

• The EEOI is **not yet mandated** and thus its calculation is not necessary.

• The accuracy of the EEOI calculated **depends on the data used** to calculate it.

• As with the SEEMP, reductions in fuel consumption and maximisation of carrying capacity (loaded cargo) **requires successful communication and cooperation between all stakeholders**, particularly between the charterers, ship operators, seafarers, etc.

• Due to the great diversity in ship design, operational patterns, cargo contracts, changing sailing environments (weather conditions), as well as possible changes in the type of trade, **the EEOI varies greatly between ships, and even for the same ships**.