University of Strathclyde Engineering

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.

Introduction

What is the EEOI

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

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

EEOI = Fuel . Carbon Conversion Factor

Cargo Quantity . Distance

EEOI = $\frac{\text{tonnes}_{CO2}}{\text{t . nm}}$

Introduction

What is the EEOI

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

j		is the Fuel type
FC	*tonnes*	*is the Mass of fuel consumed (FC consumed (j) for the voyage (i). This can be split into fuel consumed at sea and in port. FC includes fuel*
C	*Non dimensional*	*is the fuel mass to CO fuel j*
D	*Nautical miles*	*is the distance travelled for voyage i*

Introduction

What is the EEOI

M_{cargo} types of ships:	
Metric tonnes (t)	***Dry cargo carriers, liquid tankers, gas tankers, Ro-Ro cargo ships and general cargo ships***
Number of containers (TEU)	***Containers carrying solely containers***
Metric tonnes (t)	***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***
Number of passengers or gross tonnes of the ship	***Passenger ships, including Ro-Ro passenger ships***

Introduction

What is the EEOI

M_{cargo}	
Number of car units or occupied lane meters	***Car ferries and car carriers***
Number of TEUs (Empty or full)	***Container ships***
Number of railway cars and freight vehicles, or	***Railway and Ro-Ro ships***
(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.

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

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.**