INTERNATIONAL MARITIME ORGANIZATION

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MARINE ENVIRONMENT PROTECTION COMMITTEE
60th session
Agenda item 4

MEPC 60/4/7
18 December 2009
Original: ENGLISH

PREVENTION OF AIR POLLUTION FROM SHIPS

Guidelines for calculation of baselines for use with the Energy Efficiency Design Index

Submitted by Denmark and Japan

SUMMARY

Executive summary:	The submitters propose guidelines for calculating baselines for use with the energy efficiency design index (EEDI) framework and for documenting the selection of the input data needed in a transparent and robust way. Further, it is proposed to include refrigerated cargo carriers as a special category of ship types in the interim guidelines on the method of calculation of the energy efficiency design index for new ships (MEPC.1/Circ.681).
Strategic direction:	7.3
High-level action:	7.3.1
Planned output:	7.3.1.1 and 7.3.1.3
Action to be taken:	Paragraph 29
Related documents:	GHG-WG 1/2/1; MEPC 58/4/8, MEPC 58/WP.8, MEPC 58/23; GHG WG 2/2/7, GHG WG 2/2/9; MEPC 59/4/2, MEPC 59/4/20, MEPC 59/4/44 and MEPC 60/4/6

Introduction

1 MEPC 59 considered the report from the Working Group on GHG emissions from ships (MEPC 59/WP.8) and noted the progress made on the energy efficiency design index baselines in paragraphs 6.26 to 6.34. In particular, the Chairman of the Working Group suggested (paragraph 6.32.3) that the calculation for obtaining the parameter for *a* and *c* in the baseline formula should be conducted in a transparent manner within the Organization.

2 MEPC 59 agreed to invite Member Governments and observers to submit proposals and comments on the Working Group Chairman's summary to the next session, MEPC 60 (MEPC 59/24, paragraph 4.137.6). This submission is a response to MEPC 59/WP.8, paragraph 6.32.3.

Objective

3 The objective of this proposal is to define the procedure for calculating baselines for use with the energy efficiency design index (EEDI) framework and to document the selection of input data needed. The purpose of the EEDI is to provide a fair basis for comparison, to stimulate the development of more efficient engines and ships in general, and to establish the minimum efficiency of new ships depending on ship type and ship size. Hence, a transparent and robust procedure for calculating baselines needs to be established. Further, the objective is to establish a special category of ship types for refrigerated cargo carriers in the annex to MEPC.1/Circ.681.

Definition of a baseline

4 For this purpose, a baseline is defined as a line representing an average index value fitted on a set of individual index values for a defined group of vessels. One baseline will be developed for each ship type ensuring that only data from comparable existing ships are included in the calculation of the baseline.

5 The average index value is a function of Capacity and formulated as a power law regression curve expressed as $Baseline\ value = a \cdot Capacity^{-c}$, where a and c are constants determined from the regression curve fit.

6 The group of vessels used for determining the average index value per ship type is defined as the vessels built in a defined period and with data points more than two standard deviations beyond the regression curve removed.

Data sources and access

7 Lloyd's Register Fairplay (LRFP) database is proposed as the database delivering the primary input data for the baseline calculation. The data, which are typically provided by shipyards, are consolidated by LRFP, taking into account data from other sources such as IACS, owners, and engine manufacturers.

8 The LRFP data available to subscribers are continuously updated and possible different versions of the database are in parallel use. Therefore, different data sets may be used by different organizations or the data may be dependent on the date of their retrieval. For the purpose of the EEDI baseline calculations, a defined version of the database should be documented and agreed with LRFP.

Database robustness

9 The robustness of the data in the LRFP database has been debated. The attained EEDI should be calculated in a specific EEDI condition at 75% main engine loading and in calm weather, but the data in the database (service speed, deadweight and main engine power) may reflect a slightly different condition – especially for container ships which should be evaluated at 65% of the maximum deadweight.

10 To investigate this, an analysis was carried out for 170 container ships and 11 ro-ro cargo ships, which were not more than 10 years old. Original data from model tests, full-scale observations on board or sea trials were available from the yard or the owner and converted to the EEDI condition by the Technical University of Denmark using standard power prediction methods common in naval architecture. On this basis one EEDI value was calculated for each

ship according to the methodology described in MEPC.1/Circ.681. This EEDI was then compared to another EEDI calculated for the same ship according to the same methodology but this time based on the data in the LRFP database.

11 The analysis showed the following:

.1 The mean EEDI was 2.6% lower for container ships and 5.4% higher for ro-ro cargo ships when using the LRFP database compared to using original data.

.2 The service speed in the LRFP database was on average 1.3% higher than the speed at 65% deadweight and 75% main engine power for container ships.

.3 The service speed in the LRFP database was on average 0.5% higher than the speed at 100% deadweight and 75 % engine power for ro-ro cargo ships.

.4 The main engine power in the LRFP database was on average 1.6% lower for container ships and 0.2% lower for ro-ro cargo ships.

.5 For one container ship and two ro-ro cargo ships, the deadweight in the LRFP database deviated more than 10% from the correct deadweight. This error in the deadweight did not affect the average EEDI due to the large population of container ships. However, due to the small population of ro-ro cargo ships the average EEDI was heavily affected by the error in deadweight. Without this error the 5.4% mentioned above would have been only 1.5%. However, it should be kept in mind that the small population was a result of the fact that there were only original data available for 11 ro-ro cargo ships.

12 From the above analysis it is concluded that an accurate baseline can be established using data from the LRFP database – also for container ships evaluated at 65% deadweight without adjustment of the reported service speed.

Selection of input data

13 At MEPC 59, the Working Group on GHG emissions from ships agreed that the data used should be those on new buildings in the recent 10 years, and outliers which are more than two standard deviations from the regression line should be removed before a new regression line is calculated.

Ship types

14 In the annex to MEPC.1/Circ.681, Interim guidelines on the method of calculation of the energy efficiency design index, paragraph 1, the following ship types are defined: *Passenger ship, dry cargo carrier, gas tanker, tanker, containership, ro-ro cargo ship vehicle carrier* (a multi-deck ro-ro cargo ship designed for the carriage of empty cars and trucks), *ro-ro cargo ship volume carrier* (a ro-ro cargo ship with a deadweight per lane metre less than 4 tons/m designed for the carriage of cargo transportation units), *ro-ro cargo ship weight carrier* (a ro-ro cargo ship with a deadweight per lane metre of 4 tons/m or above designed for the carriage of cargo transportation units), *general cargo ship and ro-ro passenger ship*.

15 The annex to MEPC.1/Circ.681, paragraph 2, includes the note that "*this formula may not be able to apply to diesel-electric propulsion, turbine propulsion or hybrid propulsion system*". It should be noted that a large number of gas tankers, in particular LNG carriers, have steam

turbine main engines. Therefore, in obtaining the baseline for gas tankers, steam turbine ships in LRFP should be excluded from the input data in order to keep consistency with the annex to MEPC.1/Circ.681.

16 *Refrigerated cargo carriers*, which would be categorized as *general cargo ships* if the present categories in the annex to MEPC.1/Circ.681 are followed, should be treated as a separate ship type. *Refrigerated cargo carriers* generally navigate at a higher speed than general cargo ships due to the service requirement to reduce the transport time of fresh foods, thus making their baseline deviate considerably from the baseline for *general cargo ships*. A rationale for such a separate ship category is provided in annex 2 to this document.

17 To ensure a uniform interpretation, a table presenting the association of ship types given in the annex to MEPC.1/Circ.681 compared to the ship types given by the LRFP Stat codes is shown in annex 1 to this document. Table 2 in annex 1 lists the LRFP ship types which clearly should not be used when calculating the baselines for the specific ship types in the annex to MEPC.1/Circ.681, e.g., ships built for sailing on the Great Lakes, bulk/oil carrier (OBO), landing craft.

Blank data entries

18 For some LRFP ships, some data entries may be blank or contain a zero (0). Datasets with blank power, capacity and/or speed data should be removed from the baseline calculations. For the purpose of later references, the omitted ships should be listed.

Speed

19 The definition of speed in the annex to MEPC.1/Circ.681 is: "V_{ref} is the speed, measured in nautical miles per hour (knot), on deep water in the maximum design load condition *(Capacity)* as defined in paragraph 3 at the shaft power of the engine(s) as defined in paragraph 5 and assuming the weather is calm with no wind and no waves. The maximum design load condition shall be defined by the deepest draught with its associated trim, at which the ship is allowed to operate. The condition is obtained from the stability booklet approved by the Administration.".

20 The condition for the LRFP service speed information is not clear. Normally, the service speed of a ship is given at 85-90% MCR combined with a sea margin of 10-15%. This was indeed the rationale for defining the power ($P_{ME(l)}$) for calculation of the attained index as 75% of the rated installed power (MCR). Accordingly the service speed information in LRFP will be the most accurate speed to use as V_{ref} when computing average index values and baselines.

Capacity

21 The capacity for each ship type is defined in the annex to MEPC.1/Circ.681.

Installed power

22 The installed main power $P_{ME(i)}$ and the required auxiliary power P_{AE} are defined in the annex to MEPC.1/Circ.681. For cargo ships with a main engine power of 10,000 kW or above, the P_{AE} should be calculated according to paragraph 2.5.6.1, and for cargo ships with a main engine power below 10,000 kW, the P_{AE} should be calculated according to paragraph 2.5.6.2. For passenger ships with conventional propulsion systems, the P_{AE} value should be estimated by the consumed electric power (excluding propulsion) in conditions when the ship is engaged in a voyage at reference speed ($V_{ref.}$) as given in the electrical power table divided by the weighted average efficiency of the generator(s).

23 Information on the P_{AE} value for passenger ships with conventional propulsion is not available in the LRFP database. In order to establish a baseline for these ships, the factor on the relation between the electric load at normal sea load according to the ship's power balance and the total installed auxiliary power has been calculated for a number of existing ships. The average of these factors is rounded off to the nearest figure that can be divided by 5. This factor divided by 100 is 0.35 and this is proposed to be multiplied by the information on the total installed auxiliary power in the LRFP database when calculating the baseline for conventionally driven passenger ships and ro-ro passenger ships (see annex 3).

Assumptions for index formula input parameters

24 As all the data required to calculate the exact index value for each ship cannot be obtained from the LRFP database, such as the fuel used, the specific fuel consumption, waste heat recovery, etc., the following assumptions should be made:

.1 the carbon emission factor is constant for all engines, i.e. $C_{F,ME} = C_{F,AE} = CF =$ 3.1144 g CO_2/g fuel;

.2 the specific fuel consumption for all ship types is constant for all main engines, i.e. $SFC_{ME} = 190$ g/kWh.;

.3 $P_{ME(l)}$ is 75% of the rated installed power (MCR) for each main engine without any deduction for shaft generators;

.4 the specific fuel consumption for all ship types is constant for all auxiliary engines, i.e. $SFC_{AE} = 215$ g/kWh.;

.5 P_{AE} is the installed auxiliary power and for cargo ships it is calculated according to paragraphs 2.5.6.1 and 2.5.6.2 of the annex in MEPC.1/Circ.681. For passenger ships P_{AE} is calculated as the total installed auxiliary power according to the information in the LRFP database multiplied by 0.35;

.6 all correction factors f_j, f_i and f_w are set to 1; and

.7 innovative mechanical energy efficiency technology, shaft motors and other innovative energy efficient technologies are all excluded from the baseline calculation, i.e. $P_{AEeff} = 0$, $P_{PTI} = 0$, $P_{eff} = 0$.

25 The equation for calculating the estimated index value is then as follows:

$$Estimated\ \ Index\ Value = 3.11 \cdot \frac{190 \cdot \sum_{i=1}^{NME} P_{MEi} + 215 \cdot P_{AE}}{Capacity \cdot V_{ref}}$$

Proposal

26 It is proposed that the baselines for the different ship types defined in the annex to MEPC.1/Circ.681, with an additional ship type category definition for refrigerated cargo carriers, are calculated based on the formula in paragraph 25 and the information on the relevant ship type from the LRFP database on new buildings in the period from 1 January 1999 to 1 January 2009.

27 When calculating the baselines, the following modifications should be used:

.1 passenger ships and ro-ro passenger ships with a reference speed below 15 knots should be removed from the calculations (as done so far); and

.2 it is further proposed to align guidelines for calculation of baselines for use with the EEDI with possible submissions on the recalculated EEDI baseline for container ships and on ro-ro cargo ships subgroups as described in document MEPC 60/4/6.

Documentation

28 For purposes of transparency, the ships used in the calculation of the baselines should be listed with their IMO numbers and the nominator and denominator of the index formula, as given in paragraph 25. The documentation of the aggregated figures preserves the individual data from direct access but offers sufficient information for possible later scrutiny.

Action requested of the Committee

29 The Committee is invited to consider the proposal and take action as appropriate.

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ANNEX 1

To ensure a uniform interpretation, the association of ship types given in MEPC.1/Circ.681 must be compared to the ship types given in the Lloyds Register Fairplay database (LRFP).

The LRFP Stat code system provides several levels of definition as follows:

Highest level:

A	Cargo carrying
B	Work vessel
W	Non-seagoing merchant ships
X	Non-merchant
Y	Non-propelled
Z	Non-ship structures

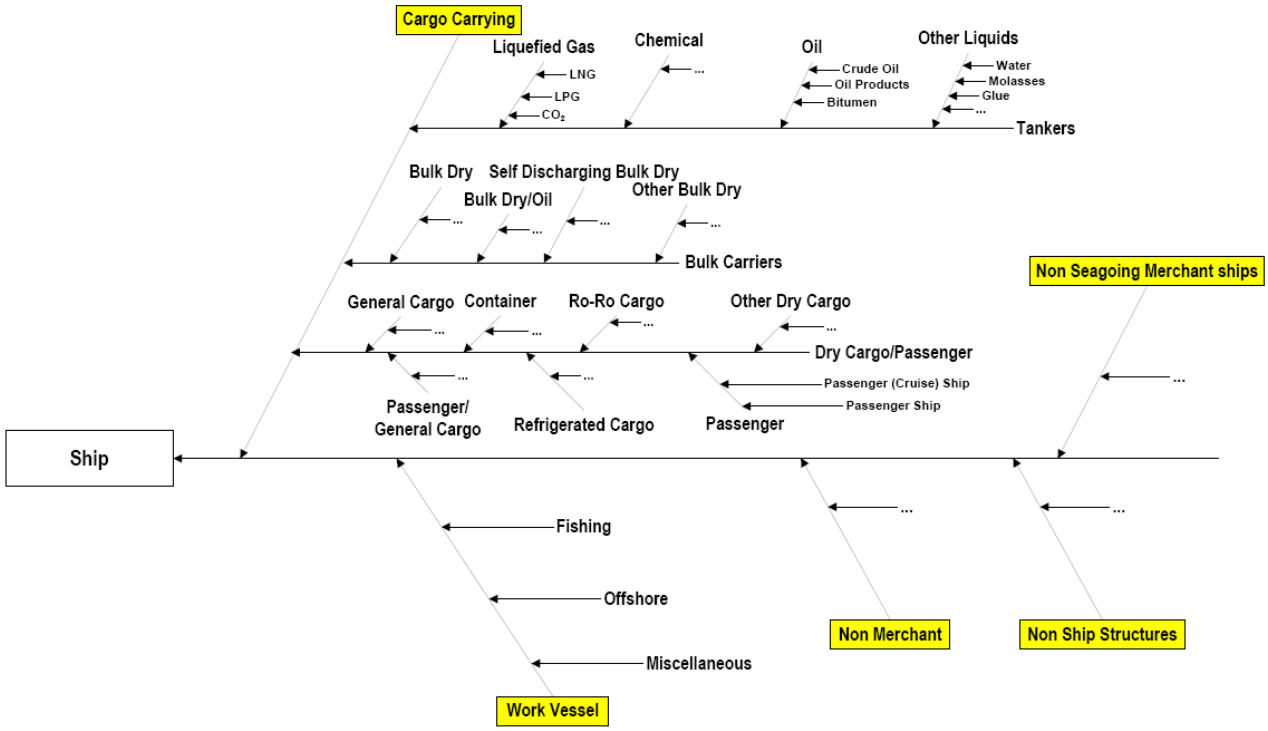
For the purpose of the EEDI, only group "A cargo carrying" needs to be considered. A graphical representation of this is given below.

The next level comprises:

A1	Tankers
A2	Bulk carriers
A3	Dry cargo/passenger

There are further differentiations until level five, e.g., "A31A2GX General Cargo Ship", and each category is described.

The complete list is attached.



The ship types from the LRFP Stat code 5 (Statcode5v1075) that are proposed to be used for the calculation of baselines for the ship types given in MEPC.1/Circ.681 are set out in Table 1 and the LRFP ship types which clearly should not be used in the calculations for the specific ship types are set out in Table 2, e.g., ships built for sailing on the Great Lakes, bulk/oil carrier (OBO), landing craft.

Table 1 – Ship types from LRFP to be used for the calculation of baselines for use with the EEDI

.1 Passenger ship	Passenger	A37B2PS	Passenger ship	A vessel certificated to carry more than 12 passengers, some of whom may be accommodated in cabins.
	Passenger	A37A2PC	Passenger/ cruise	A vessel certificated to carry more than 12 passengers, all of whom may be accommodated in cabins.
.2 Dry cargo carrier	Bulk dry	A21A2BC	Bulk carrier	A single deck cargo vessel with an arrangement of topside ballast tanks for the carriage of bulk dry cargo of a homogeneous nature.
	Bulk dry	A21B2BO	Ore carrier	A single deck cargo ship fitted with two longitudinal bulkheads. Ore is carried in the centreline holds only.
	Self-discharging bulk dry	A23A2BD	Bulk cargo carrier, self-discharging	A bulk carrier fitted with self-trimming holds, a conveyor belt (or similar system) and a boom which can discharge cargo alongside or to shore without the assistance of any external equipment.
	Other dry bulk	A24A2BT	Cement carrier	A single deck cargo vessel fitted with pumping arrangements for the carriage of cement in bulk. There are no weather deck hatches. May be self-discharging.
		A24B2BW	Wood chips carrier, self-unloading	A single deck cargo vessel with high freeboard for the carriage of wood chips. May be self-discharging.
		A24C2BU	Urea carrier	A single deck cargo vessel for the carriage of urea in bulk. May be self-discharging.
		A24D2BA	Aggregates carrier	A single deck cargo vessel for the carriage of aggregates in bulk. Also known as a sand carrier. May be self-discharging.
		A24E2BL	Limestone carrier	A single deck cargo vessel for the carriage of limestone in bulk. There are no weather deck hatches. May be self-discharging.
.3 Gas tanker	Liquefied gas	A11A2TN	LNG tanker	A tanker for the bulk carriage of liquefied natural gas (primarily methane) in independent insulated tanks. Liquefaction is achieved at temperatures down to -163 deg C.
		A11B2TG	LPG tanker	A tanker for the bulk carriage of liquefied petroleum gas in insulated tanks, which may be independent or integral. The cargo is pressurized (smaller vessels), refrigerated (larger vessels) or both ("semi-pressurized") to achieve liquefaction.
		A11C2LC	CO_2 tanker	A tanker for the bulk carriage of liquefied carbon dioxide.
		A11A2TQ	CNG tanker	A tanker for the bulk carriage of compressed natural gas. Cargo remains in gaseous state but is highly compressed.

.4 Tanker	Chemical	A12A2LP	Molten sulphur tanker	A tanker for the bulk carriage of molten sulphur in insulated tanks at a high temperature.
		A12A2TC	Chemical tanker	A tanker for the bulk carriage of chemical cargoes, lube oils, vegetable/animal oils and other chemicals as defined in the International Bulk Chemical Code. Tanks are coated with suitable materials which are inert to the cargo.
		A12B2TR	Chemical/ products tanker	A chemical tanker additionally capable of the carriage of clean petroleum products.
		A12C2LW	Wine tanker	A cargo ship designed for the bulk transport of wine in tanks. Tanks will be stainless steel or lined. New vessels will be classified as chemical carriers.
		A12D2LV	Vegetable oil tanker	A cargo ship designed for the bulk transport of vegetable oils in tanks. Tanks will be stainless steel or lined. New vessels will be classified as chemical carriers.
		A12E2LE	Edible oil tanker	A cargo ship designed for the bulk transport of edible oils in tanks. Tanks will be stainless steel or lined. New vessels will be classified as chemical carriers.
		A12F2LB	Beer tanker	A tanker for the bulk carriage of beer.
		A12G2LT	Latex tanker	A tanker for the bulk carriage of latex.
		A12H2LJ	Fruit juice tanker	A tanker for the bulk carriage of fruit juice concentrate in insulated tanks.
	Oil	A13A2TV	Crude oil tanker	A tanker for the bulk carriage of crude oil.
		A13A2TW	Crude/oil products tanker	A tanker for the bulk carriage of crude oil but also for carriage of refined oil products.
		A13B2TP	Products tanker	A tanker for the bulk carriage of refined petroleum products, either clean or dirty.
		A13B2TU	Tanker (unspecified)	A tanker whose cargo is unspecified.
		A13C2LA	Asphalt/ Bitumen tanker	A tanker for the bulk carriage of asphalt/bitumen at temperatures between 150 and 200 degrees C.
		A13E2LD	Coal/oil mixture tanker	A tanker for the bulk carriage of a cargo of coal and oil mixed as a liquid and maintained at high temperatures.
	Other liquids	A14A2LO	Water tanker	A tanker for the bulk carriage of water.
		A14F2LM	Molasses tanker	A tanker for the bulk carriage of molasses.
		A14G2LG	Glue tanker	A tanker for the bulk carriage of glue.
		A14H2LH	Alcohol tanker	A tanker for the bulk carriage of alcohol.
		A14N2LL	Caprolactam tanker	A tanker for the bulk carriage of caprolactam, a chemical used in the plastics industry for the production of polyamides.
	Chemical	A12A2TL	Parcels tanker	A chemical tanker with many segregated cargo tanks to carry multiple grades of chemicals as defined in the International Bulk Chemical Code. Typically these can have between 10 and 60 different tanks.

.5 Container ship	Container	A33A2CC	Container ship (fully cellular)	A single deck cargo vessel with boxed holds fitted with fixed cellular guides for the carriage of containers.
.6 Ro-ro cargo ship vehicle carrier	Ro-ro cargo	A35B2RV	Vehicles carrier	A multi-deck cargo ship for the carriage of new cars and trucks which are loaded via ramps.
	Ro-ro cargo	A35B2RA	Car carrier	A vehicles carrier for the carriage of new cars which are loaded via ramps.
.7 Ro-ro cargo ship volume carrier .8 Ro-ro cargo ship weight carrier	Ro-ro cargo	A35A2RR	Ro-ro cargo ship	A single or multi-deck cargo ship for the carriage of laden vehicles which are loaded via ramps.
		A35A2RT	Rail vehicles carrier	A single or multi-deck cargo ship with rails for the carriage of rail vehicles which are loaded via ramps.
.9 General cargo ship	General cargo	A31A2GX	General cargo ship	A single or multi-deck cargo vessel for the carriage of various types of dry cargo. Single deck vessels will typically have box shaped holds. Cargo is loaded and unloaded through weather deck hatches.
	Other dry cargo	A38H2GU	Pulp carrier	A vessel designed for carrying paper pulp.
.9*bis* Refrig-erated cargo ship	Refrigerated cargo	A34A2GR	Refrigerated cargo ship	A multi-deck cargo ship for the carriage of refrigerated cargo at various temperatures.
.10 Ro-ro passenger ship	Passenger/ ro-ro cargo	A36A2PR	Passenger/ ro-ro ship (vehicles)	A ro-ro cargo ship with accommodation for more than 12 passengers.
		A36A2PT	Passenger/ ro-ro ship (vehicles/rail)	A ro-ro cargo ship for the additional carriage of rail-vehicles and with accommodation for more than 12 passengers.

Table 2 – Ship types from LRFP which should not be included in the calculation of baselines for use with the EEDI

.2 Dry cargo carrier	Bulk dry	A21A2BG	Bulk carrier, laker only	A single deck cargo vessel with dimensions suited to the limitations of Great Lakes of North America trade, unsuitable for open sea navigation. Hatches are more numerous than standard bulk carriers, and much wider than they are long.
	Bulk dry	A21A2BV	Bulk carrier (with vehicle decks)	A bulk carrier with movable decks for the additional carriage of new vehicles.
	Bulk dry/oil	A22A2BB	Bulk/oil carrier (OBO)	A bulk carrier arranged for the alternative (but not simultaneous) carriage of crude oil.
	Bulk dry/oil	A22B2BR	Ore/oil carrier	An ore carrier arranged for the alternative (but not simultaneous) carriage of crude oil.
	Bulk dry/oil	A22A2BP	Ore/bulk/ products carrier	A bulk carrier arranged for the alternative (but not simultaneous) carriage of oil products.
	Self-discharging bulk dry	A23A2BK	Bulk cargo carrier, self-discharging, laker	A Great Lakes bulk carrier fitted with a conveyor belt (or similar system) and a boom which can discharge cargo alongside or to shore without the assistance of any external equipment.
	Other bulk dry	A24H2BZ	Powder carrier	A single deck cargo vessel for the carriage of fine powders such as fly ash. There are no weather deck hatches.
	Other bulk dry	A24G2BS	Refined sugar carrier	A single deck cargo vessel for the carriage of refined sugar. Sugar is loaded in bulk and bagged in transit (BIBO – Bulk In – Bag Out).
.3 Gas tanker	Liquefied gas	A11B2TH	LPG/chemical tanker	An LPG tanker additionally capable of the carriage of chemical products as defined in the International Bulk Chemical Code.
.4 Tanker	Oil	A13A2TS	Shuttle tanker	A tanker for the bulk carriage of crude oil specifically for operation between offshore terminals and refineries. Is typically fitted with bow loading facilities.
.5 Container ship	Container	A33B2CP	Passenger/ container ship	A container ship with accommodation for the carriage of more than 12 passengers.
.6 Ro-ro cargo ship vehicle carrier	Ro-ro cargo	A35D2RL	Landing craft	An open deck cargo vessel onto which cargo is loaded and unloaded over a bow door/ramp.
	General cargo	A31A2GA	General cargo ship (with ro-ro facility)	A general cargo ship with the additional capability to be loaded and unloaded by ro-ro access to a limited portion of the cargo space.
.7 Volume carrier	General cargo	A31B2GP	Palletized cargo ship	A single or multi-deck cargo ship loaded and unloaded by way of pallets lift(s). There are no weather deck hatches.
.8 Weight carrier	Ro-ro cargo	A35C2RC	Container/ ro-ro cargo ship	A hybrid of a container ship and a ro-ro cargo ship in independent sections

.9 General cargo ship	General cargo	A31A2GO	Open hatch cargo ship	A large single deck cargo vessel with full width hatches and boxed holds for the carriage of unitized dry cargo such as forest products and containers. Many are fitted with a gantry crane.
	General cargo	A31A2GS	General cargo/tanker (container/oil/ bulk – COB ship)	A general cargo ship with reversible hatch covers; one side is flush and the other is fitted with baffles for use with liquid cargoes. Containers can be carried on the hatch covers in dry cargo mode.
	General cargo	A31A2GT	General cargo/tanker	A general cargo ship fitted with tanks for the additional carriage of liquid cargo.
	General cargo	A31C2GD	Deck cargo ship	A vessel arranged for carrying unitized cargo on deck only. Access may be by use of a ro-ro ramp.
	Passenger/ general cargo	A32A2GF	General cargo/ passenger ship	A general cargo ship with accommodation for the carriage of more than 12 passengers.
	Other dry cargo	A38A2GL	Livestock carrier	A cargo vessel arranged for the carriage of livestock.
	Other dry cargo	A38B2GB	Barge carrier	A cargo vessel arranged for the carriage of purpose built barges (lighters) loaded with cargo. Typically loading is by way of a gantry crane. Also known as Lighter Aboard SHip vessels (LASH).
	Other dry cargo	A38C3GH	Heavy load carrier, semi-submersible	A heavy load carrier which is semi-submersible for the float on loading/unloading of the cargoes.
	Other dry cargo	A38C3GY	Yacht carrier, semi-submersible	A semi-submersible heavy load carrier specifically arranged for the carriage of yachts.
	Other dry cargo	A38D2GN	Nuclear fuel carrier	A cargo vessel arranged to carry nuclear fuel in flasks.
	Other dry cargo	A38D2GZ	Nuclear fuel carrier (with ro-ro facility)	A nuclear fuel carrier which is loaded and unloaded by way of a ro-ro ramp.
	Other dry cargo	A38B3GB	Barge carrier, semi-submersible	A barge carrier which is semi-submersible for the float on loading/unloading of the barges.
	Other dry cargo	A38C2GH	Heavy load carrier	A cargo vessel able to carry heavy and/or outsized individual cargoes. Cargo may be carried on deck or in holds and may be loaded by crane and/or ro-ro ramps.
.10 Ro-ro passenger ship	Passenger/ ro-ro cargo	A36B2PL	Passenger/ landing craft	A landing craft certificated to carry more than 12 passengers.

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ANNEX 2

RATIONALE FOR HAVING A SEPARATE SHIP TYPE CATEGORY FOR REFRIGERATED CARGO CARRIERS

With the current ship type categorization in the MEPC.1/Circ.681 interim guidelines for voluntary verification of the energy efficiency design index, refrigerated cargo carriers would belong to general cargo ships. The annex to MEPC.1/Circ.681 also stipulates that, if a ship can be categorized to more than one ship type, the ship type with a lower baseline (i.e. more stringent standard) would apply.

On the other hand, the trial calculation of the EEDI for refrigerated cargo carriers has shown quite different EEDI values compared to those of *general cargo ships*.

Figure 1 shows the baselines of refrigerated cargo carriers (assuming that they are a separate category), general cargo ships and container ships[1].

There are considerable differences in the baselines between the refrigerated ship and the other two ship categories. As a way of further illustrating the different characteristics of those ship types, figure 2 presents the distribution of the MCR and ship speed, based on the LRFP data.

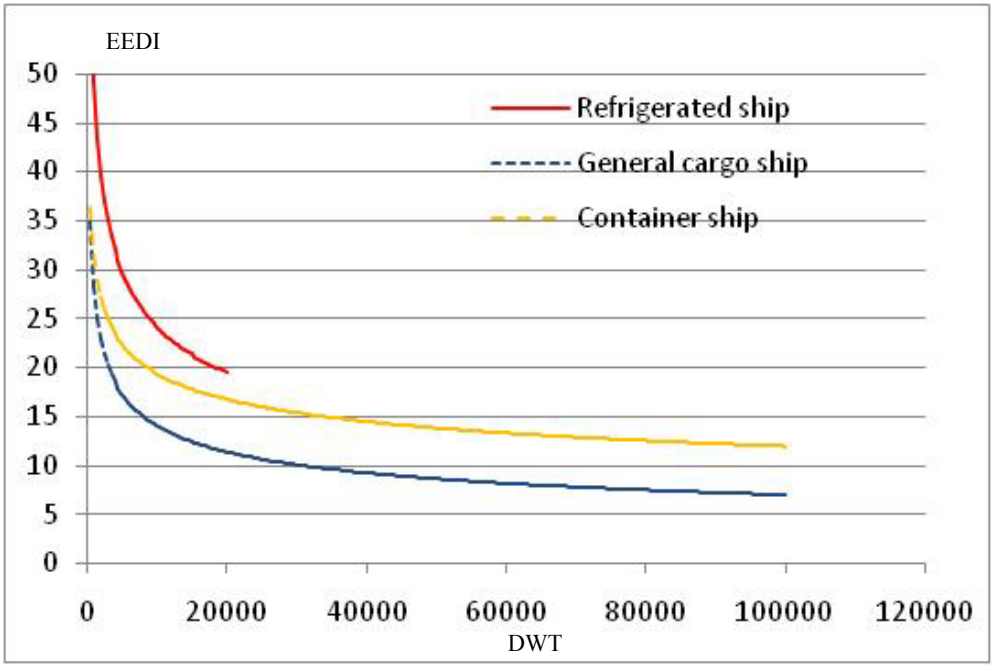
Refrigerated ships generally navigate at a higher speed than other ship types, due to the service requirement to transport fresh foods quickly. Such characteristics lead to relatively high EEDI values, which could be much higher than the baselines of container ships and general cargo ships.

This problem is not a local one. Figure 3 shows the owner nationalities of refrigerated cargo ships from the LRFP database on new buildings in the period from 1999 to 2009 and reveals that they are utilized worldwide.

In view of the above, it would be appropriate to treat the baseline of the refrigerated cargo carriers as a separate ship category, and a new definition of refrigerated cargo carriers should be added to the annex to MEPC.1/Circ.681 (or to the text of the mandatory instrument as appropriate), as follows:

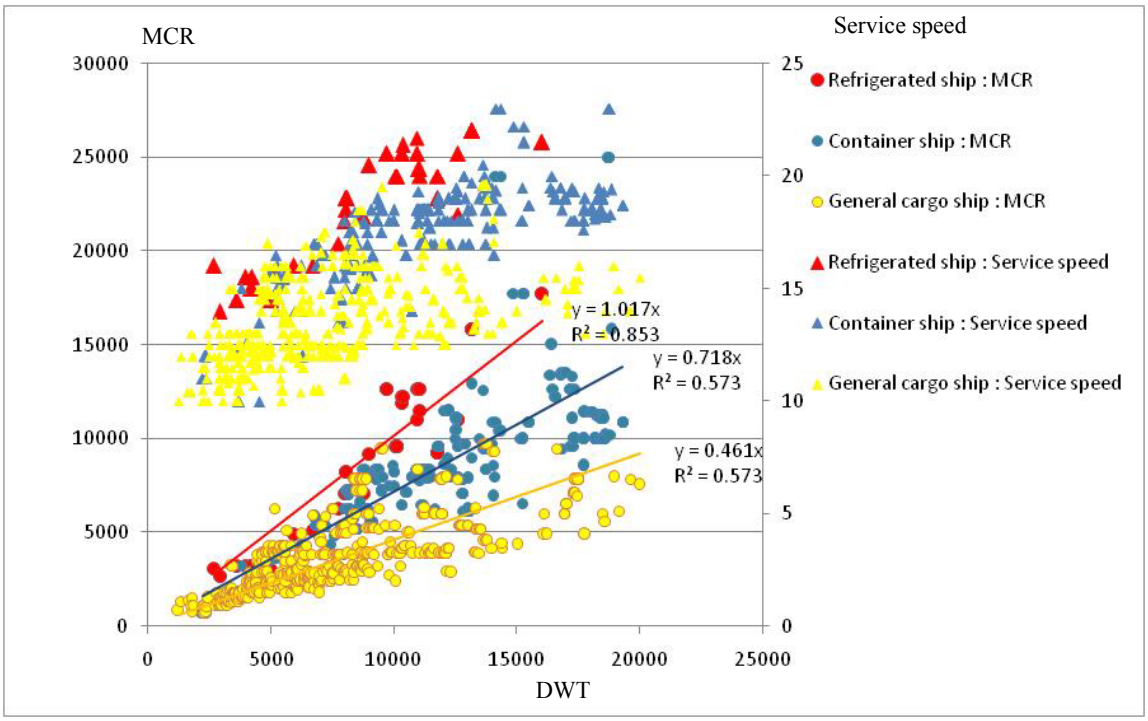
Refrigerated cargo carrier means *a ship designed exclusively for the carriage of refrigerated cargoes in holds.*

[1] Calculated with a capacity corresponding to 100% deadweight.



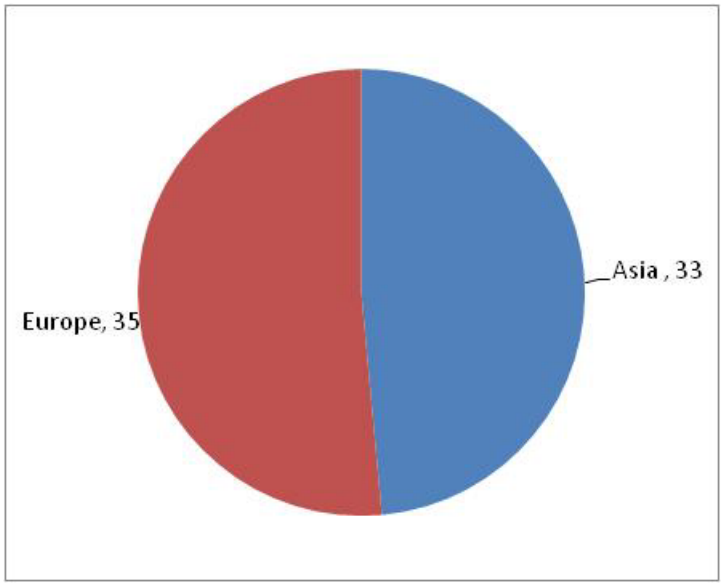
Source: LRFP database.

Figure 1 – Baselines of refrigerated cargo carriers, general cargo ships and container ships



Source: LRFP database.

Figure 2 – The distribution of MCR and ship speed



Source: LRFP database.
*Domestic ships are included.

Figure 3 – Owner nationality of refrigerated cargo carriers built in the period from 1999 to 2009

***

ANNEX 3

The installed main power $P_{ME(i)}$ and the required auxiliary power P_{AE} are defined in the annex to MEPC.1/Circ.681. For passenger ships with conventional propulsion systems, the P_{AE} value should be estimated by the consumed electric power (excluding propulsion) in conditions when the ship is engaged in a voyage at reference speed ($V_{ref.}$) as given in the electrical power table divided by the weighted average efficiency of the generator(s).

Information on the P_{AE} value for passenger ships and ro-ro passenger ships with conventional propulsion is not available in the Lloyds Register Fairplay (LRFP) database. In order to establish a baseline for these ships, the factor on the relation between the electric load at normal sea load according to the ship's power balance and the total installed auxiliary power has been calculated for a number of existing ships. The average of these factors is rounded off to the nearest figure that can be divided by 5. This factor divided by 100 is proposed to be multiplied with the information on the total installed auxiliary power in the LRFP database when calculating the baseline for conventionally driven passenger ships.

Table 1

GT	DWT	Normal sea load (kW)	Total installed auxiliary power (kW)	Normal sea load in % of total installed auxiliary power	Year Built
16071	2671	800	3648	22	1981
16071	5345	800	3648	22	1980
40039	2800	2475	9000	28	1989
16794	3318	700	1920	36	1993
14379	4030	850	2528	34	1996
14379	4030	850	2528	34	1996
14822	2400	904	2800	32	1997
14822	2400	904	2800	32	1997
10067	2860	475	1395	34	1997
3380	574	196	570	34	1998
1617	204	147	402	37	1999
22382	5625	750	4350	17	2002
13906	3630	738	1545	48	2005
13906	3630	738	1545	48	2005
12670	2652	1248	2410	52	2005
4630	820	304	624	49	2009

The average normal sea load in per cent of the total installed power 34.3.

The factor to be used with the auxiliary power information in LRFP when calculating the baseline value is proposed to be 35/100 = 0.35.