INTERNATIONAL MARITIME ORGANIZATION

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INTERSESSIONAL MEETING OF THE
GREENHOUSE GAS WORKING GROUP
2nd session
Agenda item 2

GHG-WG 2/2/7
4 February 2009
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CONSIDERATION OF THE ENERGY EFFICIENCY DESIGN INDEX FOR NEW SHIPS

Recalculation of energy efficiency design index baselines for cargo ships

Submitted by Denmark

SUMMARY

Executive summary:	This document proposes recalculated baseline values for cargo ships based on the definition of auxiliary engine power P_{AE}, capacity, the conversion factor between fuel consumption and the CO_2 emission, and the rated installed power for main engines agreed on at MEPC 58
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 12
Related documents:	GHG-WG 1/2/1; MEPC 58/4/8, MEPC 58/WP.8 and MEPC 58/23

Introduction

1 This document is submitted in accordance with MSC-MEPC.1/Circ.2, Guidelines on the Organization and Method of Work.

2 At the fifty-eighth session of the Marine Environment Protection Committee, MEPC 58, it was agreed to use the following definitions of auxiliary engine power (P_{AE}) for cargo ships when calculating the attained energy efficiency design index for new ships:

For cargo ships with a main engine power of 10000 kW or above P_{AE} is defined as:

$$P_{AE(MCRME \geq 10000KW)} = \left(0.025 \times \sum_{i=1}^{nME} MCR_{MEi} \right) + 250$$

For ships with a main engine power below 10000 kW P_{AE} is defined as:

$$P_{AE(MCRME < 10000KW)} = 0.05 \times \sum_{i=1}^{nME} MCR_{MEi}$$

3 Further, MEPC agreed to define the capacity of dry cargo carriers, tankers, gas tankers, containerships and ro-ro cargo and passenger ships and general cargo ships as the deadweight (DWT). MEPC 58 also agreed that the conversion factor between fuel consumption and CO_2 emission should be according to the 2006 IPCC guidelines and that $P_{ME(I)}$ is 75% of the rated installed power (MCR) for each main engine.

4 With the new definition of P_{AE} for cargo ships the auxiliary power can be estimated on the basis of the Main Engine power. Thereby exact information on the auxiliary engine is no longer needed. Information on the main engine power only has made it possible to use the Lloyds Register Fairplay database for ships built from January 1998 to December 2007. Furthermore, the number of ships included in the recalculation is remarkably larger than the number used in the earlier calculations presented in document MEPC 58/4/8 as the information on auxiliary power is not always available in the database.

5 The baselines for cargo ships have been recalculated in accordance with the above and using the following assumptions:

.1 The carbon emission factor is constant for all engines, i.e. $C_{F,ME} = C_{F,AE} = CF =$ 3.13 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 $P_{ME(I)}$ is 75% of the rated installed power (MCR) for each main engine;

.4 The specific fuel consumption for all ship types is constant for all auxiliary engines, i.e. $SFC_{AE} = 210$ g/kWh;

.5 $$P_{AE(MCRME \geq 10000KW)} = \left(0.025 \times \sum_{i=1}^{nME} MCR_{MEi}\right) + 250$$

$$P_{AE(MCRME < 10000KW)} = 0.05 \times \sum_{i=1}^{nME} MCR_{MEi};$$

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

.7 None of the ships use waste heat recovery systems, $P_{WHR} = 0$;

.8 None of the ships get diesel electric propulsion power from auxiliary engines, $P_{PTI} = 0$; and

.9 None of the ships use innovative energy efficient technology, $P_{eff} = 0$.

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

$$Average\ Index\ Value = 3.13 \cdot \frac{190 \cdot \sum_{i=1}^{NME} P_{MEi} + 210 \cdot P_{AE}}{Capacity \cdot V_{ref}}$$

The index unit depends on the selected capacity. For example, if capacity is measured in tonnes, the index unit becomes: g CO2/(t nm).

7 The Average Index Values are used as the basis for calculating an exponential regression line. The regression line expresses the baseline value, which can then be calculated by using the following formula:

$$Baseline\ value = a \cdot Capacity^{-c}$$

Where *a* and *c* are constants deriving from the regression line.

8 Outliers which are more than two standard deviations from the regression line are removed, and a new regression line is calculated. This ensures that special ships and erroneous data are excluded from the calculation.

9 The following results using the mentioned information, definitions and assumptions are obtained[1]:

Ship type	a	Capacity	c	Number of samples	Excluded	R^2
Dry bulk carriers	1354.0	DWT	0.5117	2365	59	0.93
Tankers	1950.7	DWT	0.5337	3116	59	0.97
Gas carriers	1252.6	DWT	0.4597	416	11	0.93
Container ships	139.38	DWT	0.2166	2189	87	0.66
General cargo ships	290.28	DWT	0.3300	1824	90	0.63
Ro-ro cargo ships	19788	DWT	0.7137	402	27	0.80

R^2 describes the correlation of the baseline value. A correlation close to 1 or -1 represents a high degree of correlation.

10 Figures showing the recalculated baselines for dry cargo carriers, tankers, gas tankers, containerships and ro-ro cargo ships are set out in annex 1 to this submission.

11 In annex 2 to this submission the above baseline values are compared to the value from document MEPC 58/4/8 (Denmark). The new calculated baselines are slightly lower than those calculated in document MEPC 58/4/8 for dry cargo carriers, tankers, container ships and general cargo ships, mainly because of the new definition of P_{AE}.

Action requested of the Intersessional Meeting

12 The Intersessional Meeting is invited to consider the proposal for recalculated baselines for cargo ships and take action as appropriate.

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[1] The baselines for dry bulk ships, tankers, gas carriers and ro-ro ships were calculated by Det Norske Veritas, and for containerships and general cargo ships by Germanischer Lloyd.

ANNEX 1

RECALCULATION OF ENERGY EFFICIENCY DESIGN INDEX BASELINES FOR CARGO SHIPS

The baselines for cargo ships have been recalculated for ships built in the period from January 1998 to December 2007 using the following assumptions:

.1 The carbon emission factor is constant for all engines, i.e. $C_{F,ME} = C_{F,AE} = CF =$ 3.13 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;

.4 The specific fuel consumption for all ship types is constant for all auxiliary engines, i.e. $SFC_{AE} = 210$ g/kWh;

.5 $$P_{AE(MCRME \geq 10000KW)} = \left(0.025 \times \sum_{i=1}^{nME} MCR_{MEi}\right) + 250$$

$$P_{AE(MCRME < 10000KW)} = 0.05 \times \sum_{i=1}^{nME} MCR_{MEi};$$

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

.7 None of the ships use waste heat recovery systems, $P_{WHR} = 0$;

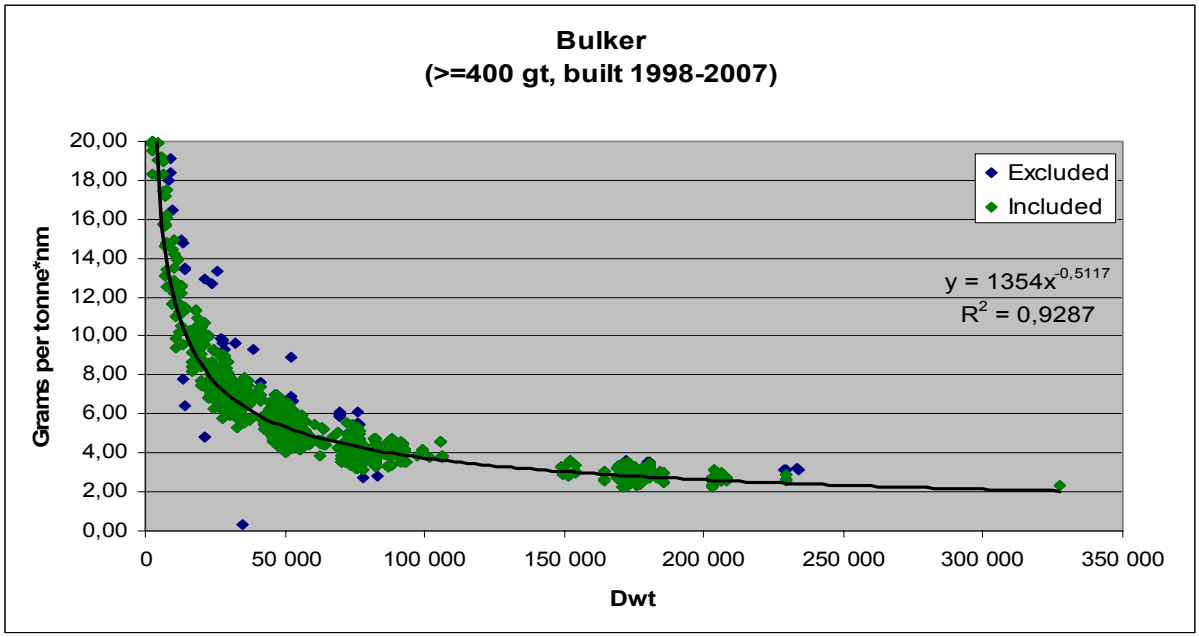
.8 None of the ships get diesel electric propulsion power from auxiliary engines, $P_{PTI} = 0$; and

.9 None of the ships use innovative energy efficient technology, $P_{eff} = 0$.

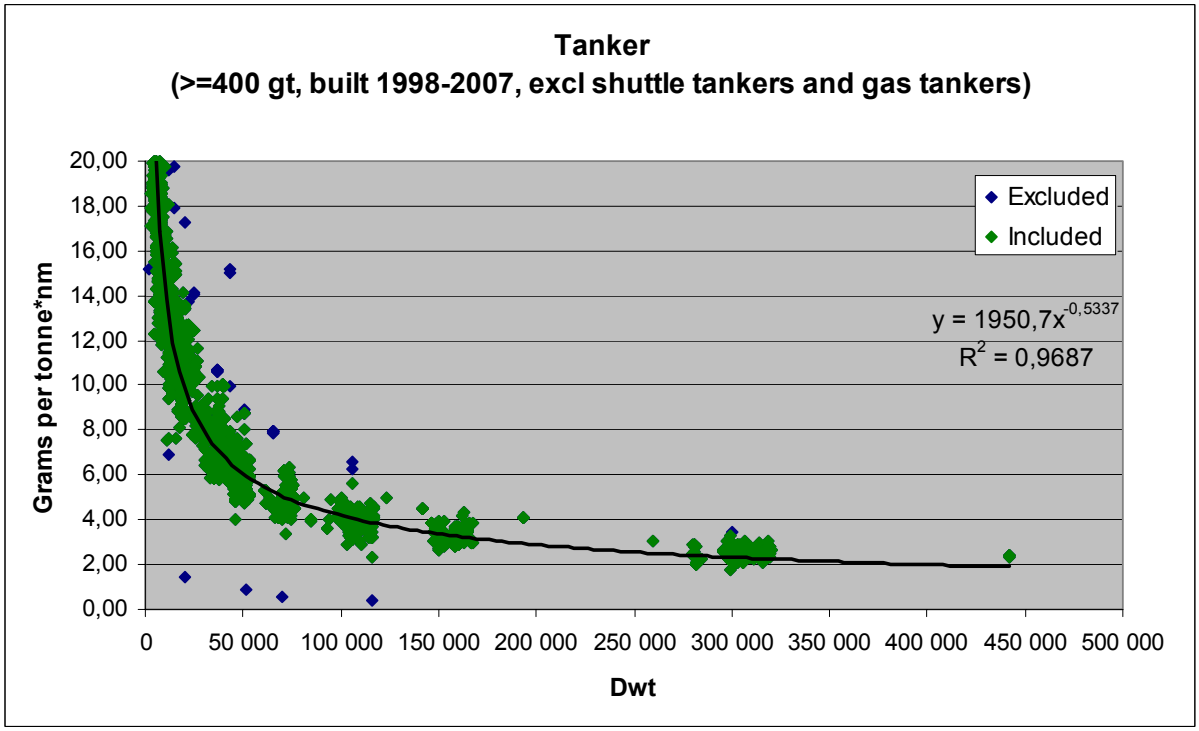
The equation for calculating the estimated index value is then as follows:

$$Average\ Index\ Value = 3.13 \cdot \frac{190 \cdot \sum_{i=1}^{NME} P_{MEi} + 210 \cdot P_{AE}}{Capacity \cdot V_{ref}}$$

Dry bulk carriers:

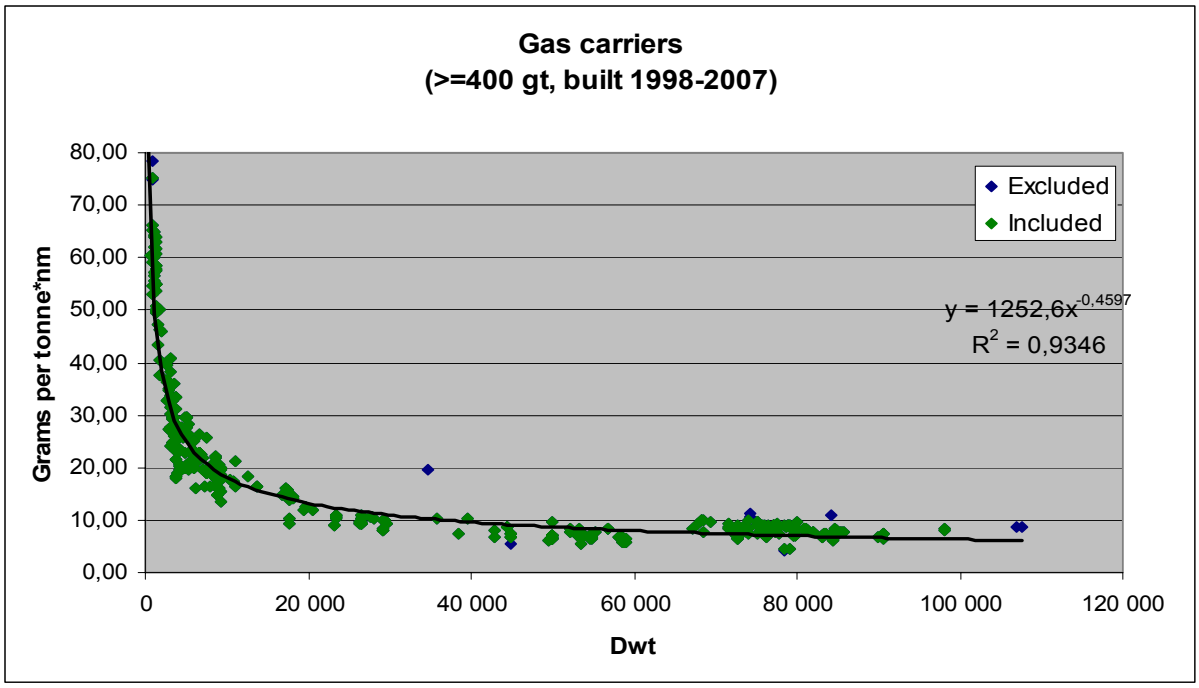


Tankers
Tankers excluding shuttle tankers[2] and gas carriers

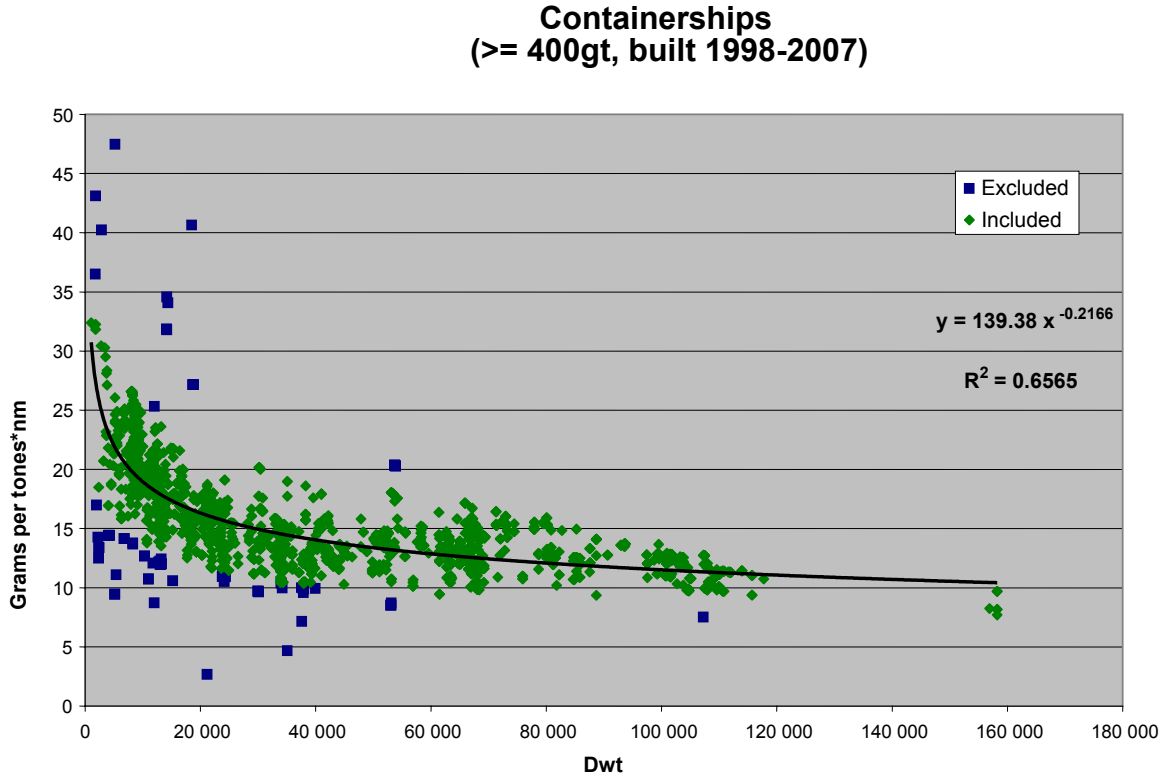


[2] Shuttle tankers are tankers which carry crude oil from offshore fields to onshore storages. They are quite different from ordinary tankers with much higher installed power. They do not cover long distances, are equipped with dynamic positioning systems and are designed for complex operations in rough seas and are therefore excluded.

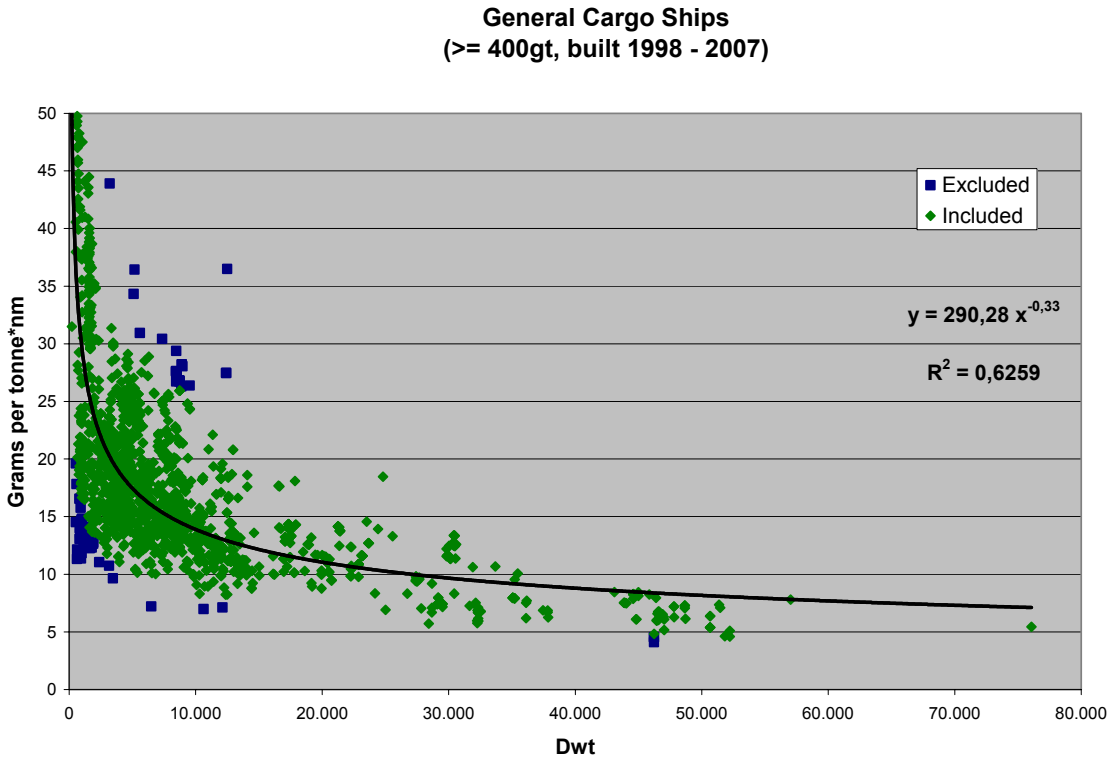
Gas tankers:



Containerships:

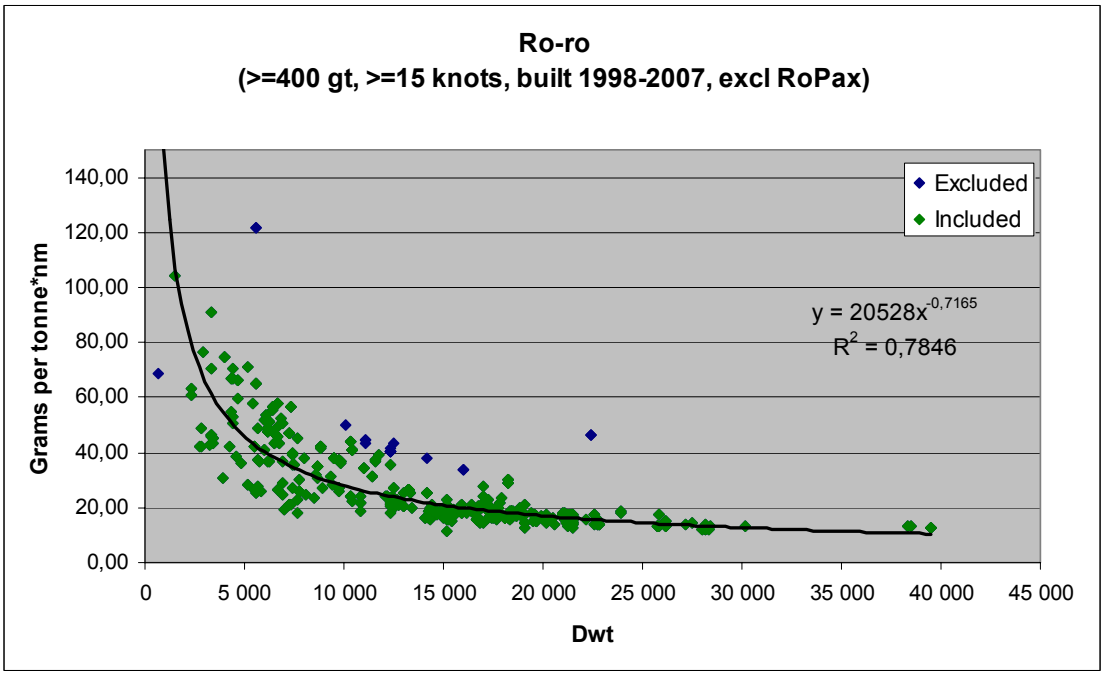


General cargo ships:



Ro-ro cargo ships

For ro-ro cargo ships it was found that vessels with a speed below 15 knots tended to create a lower average for certain ship sizes and therefore these ships were cut off from the calculations. These ships are excluded to avoid a too low index average, and slow steaming ships will comply anyhow. Further ships with diesel-electric propulsion have been excluded as the main engine power cannot be separated from the auxiliary power.



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ANNEX 2

RECALCULATION OF ENERGY EFFICIENCY DESIGN INDEX BASELINES FOR CARGO SHIPS

Below are the results of the baseline values calculated in accordance with this submission compared to the values from document MEPC 58/4/8.

The new calculations are based on a significantly higher amount of ships as more ships in the database contain the necessary data when excluding data on auxiliary engine power. Further, the ships are built in the period January 1998 to December 2007.

The new calculated baseline values are slightly lower than those calculated in document MEPC 58/4/8 for dry cargo carriers, tankers, containerships and general cargo ships. This is mainly because of the new definition of P_{AE}.

At MEPC 58 it was agreed to define $P_{ME(I)}$ as 75% of the rated installed power (MCR). This $P_{ME(I)}$ was proposed and used in document MEPC 58/4/8.

At MEPC 58 it was also agreed that the conversion factor between fuel consumption and CO_2 emission should be according to the 2006 IPCC guidelines. Accordingly the conversion factor *CF* is set to 3.13 instead of 3.114.

The new baselines for gas tankers and ro-ro cargo ships are not comparable to the baselines from document MEPC 58/4/8 as the capacity has been changed from tank volume and gross tonnage to deadweight.

Dry bulk	**Index calculation – new**	**Index Calculation MEPC 58/4/8**
No. of samples	2365	955
Capacity	DWT	DWT
5,000	17.33	21.21
25,000	7,61	8.61
100,000	3.74	3.96
250,000	2.34	2.37

Tanker	**Index calculation – new**	**Index Calculation MEPC 58/4/8**
No. of samples	3116	1209
Capacity	DWT	DWT
5,000	20.70	24.15
25,000	8.77	10.13
100,000	4.18	4.79
250,000	2.57	2.92

Gas carrier	Index calculation – new	Index Calculation MEPC 58/4/8
No. of samples	416	178
Capacity	DWT	Tank volume
5,000	24.97	26.40
25,000	11.91	12.08
100,000	6.30	6.16
250,000	4.13	3.95

Container ship	Index calculation – new	Index Calculation MEPC 58/4/8
No. of samples	2189	188
Capacity	DWT	DWT
10,000	18.96	20.89
20,000	16.31	18.49
50,000	13.38	15.73
100,000	11.51	13.93

General cargo ship	Index calculation – new	Index Calculation MEPC 58/4/8
No. of samples	1824	238
Capacity	DWT	DWT
2,000	23.63	27.63
8,000	14.96	18.10
25,000	10.27	12.78
50,000	8.17	10.35

Ro-ro cargo ship	Index calculation – new	Index Calculation MEPC 58/4/8
No. of samples	402	205
Capacity	DWT	GT
2,000	87.49	85.81
8,000	32.42	31.52
15,000	20.70	20.02
30,000	12.62	12.13