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PREVENTION OF AIR POLLUTION FROM SHIPS

Development of a CO_2 Design Index for New Ships

Submitted by the Community of European Shipyards' Associations (CESA)

SUMMARY

Executive summary:	This document comments on the outcome of the intersessional meeting of the Working Group on Greenhouse Gas Emissions regarding the optimal strategy to reduce emission from ships. The European shipbuilders support the development of CO_2 index systems for information purposes and provide technical background for the necessary improvement of the draft design index. CESA believes that a mandatory design index would not be an optimal tool as it would fail to achieve a rapid reduction of the specific CO_2 emissions from international maritime transport. Complementing market-based instruments are therefore considered indispensable.
Strategic direction:	7.3
High-level action:	7.3.1
Planned output:	7.3.1.1 and 7.1.3.3
Action to be taken:	Paragraph 20
Related documents:	MEPC 57/4/3; GHG-WG 1/2/1, GHG-WG 1/2/2, GHG-WG 1/4, GHG-WG 1/5/3, GHG-WG 1/5/7 and MEPC 58/4

General comments on the report and the IMO strategy on GHG emissions

1 CESA welcomes the progress made by the intersessional meeting of the Working Group on Greenhouse Gas Emissions (GHG) and reiterates the position that a convincing and effective approach towards reduction of the specific CO_2 emissions from international maritime transport is urgently needed. The European shipbuilders and ship repairers are confident that they can contribute significantly to the global combat against climate change through technical innovation implemented in new ships and incorporated in major conversions of existing ships. However, any contribution from new ships will only gradually become effective while the existing fleet will be replaced over time. It is therefore encouraging that the IMO GHG emission study and many other relevant research results show that operational measures have an even higher reduction potential compared to the available options at newbuilding stage.

2 Most of the available studies on climate change indicate that time is a crucial factor in the development of measures to effectively limit the negative consequences of global warming. Therefore, the IMO strategy on the limitation of GHG emissions has to take the opposite course compared to the traditional method of work of this Organization. Effective measures should focus on existing ships firstly and the experiences gained should be used for the development of measures for new ships that will come into operation in the future.

3 CESA is convinced that technical innovations offer a significant reduction potential. Prescriptive regulations or the combination of a mandatory index system and pre-described reduction schedules are not considered as the optimal approach to utilize this potential. The achievability of reduction goals cannot be predicted with sufficient reliability due to the uncertainties of technical developments in ship technology and ship operation. The state of affairs after the Oslo session indicates a preference of several Member States for market-based instruments. CESA shares the view that this option should be developed further and recommends using the input by Germany (GHG-WG 1/5/7) and the EC (GHG-WG 1/5/3) as base documents.

4 Since no clear priorities were agreed at the intersessional meeting, CESA recommends further exploring all options with a view to prioritizing them according to their effectiveness on both the emissions and time-scale. Economic incentives offer immediate and significant limiting effects on the maritime CO_2 production and have the potential to raise the necessary budget to stimulate the technical development in ship production and ship operation. This approach would utilize a market-based system as an effective mandatory instrument to target the actual pollution based on actual emission figures (in contrast to theoretical estimations based on CO_2 indexing).

5 Operational and design indexing systems can serve the purpose of providing information and orientation regarding best practices in ship design and ship operation, identifying and honouring good performers among innovative shipyards, equipment manufacturers and ship operators. For the time being, indexing systems may be considered as quality stamps but not as tools for setting design requirements. The European shipbuilders are open towards the further development of a design index as contained in annex 5 of the report of the working group. CESA, however, considers it inappropriate and premature to use even a modified and improved design index in a prescriptive way as outlined in annex 6 of the working group report.

Discussion of problems encountered with the development of a CO_2 index

6 Regardless of the final status of any indexing system, the indexing formulas have to use suitable parameters in a consistent, implementable, verifiable and fraud-resistant manner. It seems to be widely accepted that the core of the indexing formula should be formed by the ratio between environmental burden (= CO_2 emissions) and benefit for the society (= work performed). A closer look reveals that a proper definition of both the numerator and denominator is not a trivial task, especially when the necessary evaluation and scaling standards for their numerical assessment are taken into account. The complexity increases with the assessment of the vast variety of ship types. In particular, cruise ships, as well as special purpose vessels, tugs, dredgers, etc., whose main purpose is not transportation, require a careful and appropriate consideration of their undisputed benefits to society.

7 Concerning the **capacity,** the deadweight tonnage is the traditional choice for bulk carriers and tankers. But for passenger ships and ferries, a parameter is needed, which also introduces the necessary infrastructure and equipment required for the transportation of such a demanding cargo (cabins, restaurants, ro-ro ramps, etc.) into the capacity. The alternative use of the gross tonnage (gt) does encompass the superstructure, but only by means of the vessel's size. Using volume

instead of weight for one ship type only contradicts the necessary consistent definition of capacity, power (*P*) and speed (V_{ref}), which is requested by paragraph 6 of the Draft Guidelines (annex 5), since V_{ref} and *P* have no hydrodynamically significant correlation with gt.

8 The use of TEU for container ships will also produce indexes, which are not comparable across ship-type boundaries and will induce uncertainties if the container capacity is not properly defined. Finally, it has to be acknowledged that the demand for multi-purpose ships results in a gradual and almost seamless transition between ship types. The usual combination of different cargoes makes the use of ship type specific parameters difficult unless the ship types are very clearly defined and opportunities to manipulate the index can definitely be avoided.

9 The ship type related problems continue when the cargo capacity is transformed to the **transport work** by multiplication with the design speed. It has to be acknowledged that the benefit for society is not adequately modelled by the transport work alone. A higher **speed** (V_{ref}) at which the transport work is performed may also be considered as a benefit for society because certain cargoes are only accessible for maritime transport if an appropriate speed provides an attractive schedule/timetable in comparison to other modes of transport. Again, this effect is particularly significant with regard to passenger ships and ferries, but the concern is also valid regarding container feeder, reefer and ro-ro services or other trades in marginal seas or short sea shipping, where the ships are in direct competition with road transport or other less environmentally friendly transport modes. Therefore, intermodal aspects have to be taken into account if adverse modal shift is to be avoided, although it appears difficult to do so with an indexing approach alone.

10 A similar reasoning applies when the **economy of scale** is considered. In global trade the significant increase in transport efficiency or reduction of specific CO_2 emission with the ship size is an important effect, which has been exploited for a long time without the existence of an indexing system. But this effect does not abolish the need for a wide range of ship sizes, which are necessary to perform the various transport tasks in all regions and on all waterways worldwide in an efficient and economical manner. A CO_2 index giving an incentive or mandating requirements favouring a further size growth of ships would only limit or reduce CO_2 emissions in deep sea traffic. If one follows the transport chain towards the end user, such an index would only induce an early mode shift towards less energy efficient vehicles, which has to be avoided from an holistic intermodal perspective of environment protection.

11 Regarding the emission side of the indexing formula, it is only at first glance a straightforward task to estimate the CO_2 production by means of the input values of the installed power (*P*), specific fuel consumption (*SFC*) and a fuel type related factor (*C*). Care has to be taken to ensure that the *P*, V_{ref} and the capacity are consistent with each other for all ship types assessed. Passenger ships, ferries and other vessels, having a significant power demand for non-propulsion purposes, require clear provisions for the calculation of the CO_2 production for all configurations of main and auxiliary power generation and propulsion systems.

12 The design of a vessel must take into account the entire **operational profile** of the intended use. With passenger vessels and reefer container vessels, the climatic conditions of the operating area and the number of passengers/crew or reefers carried will significantly influence their power demand introducing uncertainties in the relevance for actual CO_2 emission of an index at design stage. Other ship types, such as tugs, fire-fighting ships, offshore support vessels that usually operate at relatively moderate speeds, or are resting in a standby position, are required to occasionally operate at very high speed or to deliver high thrust. Optimizing such ships with regard to CO_2 emissions differs significantly from the optimization strategy appropriate for cargo-carrying ships, which are constantly trading. In addition, ship types that

mostly sail at an intermediate draught have to be distinguished from vessels sailing at either full load or in ballast. It is unclear how the transport work for ship types like tankers or bulk carriers shall be identified; which travel often in ballast condition without cargo or container vessels; and which might carry a high number of empty containers due to unbalanced flow of commodities.

13 The CO_2 index has also to take account of **safety aspects**. An unbalanced strategy of pure reduction of the installed propulsion and auxiliary power could induce negative side effects such as manoeuvrability and stopping ability and the ability of a ship to safely navigate in ice-covered waters. A proposed CO_2 reduction schedule might lead to requirements that are incompatible with minimum power and redundancy demands by existing mandatory IMO safety regulations or by an enhanced safety policy of the owners.

14 The problems outlined above clearly indicate that the draft new ship design CO_2 index can only be meaningful and realistic if it were to be used separately for different ship types, size classes and speed ranges. Taking, for example, the 67 categories concerning size and ship type already referred to in document GHG-WG 1/4 by the Secretariat, the introduction of speed ranges would increase the number of categories to a high three-digit figure. Such an approach is only theoretically feasible. Apart from the administrative burden, the categorization carries the risk of errors and misuse. In addition, new ship types are continuously being developed.

Specific proposals for the improvement of a CO_2 index

15 Although some of the aspects discussed above have been considered at the intersessional meeting of the GHG working group, the draft attained new design CO_2 index contained in annex 5 is far from offering convincing solutions to all the problems presented. Further in-depth investigations are needed to consider the feasibility of this approach and to obtain the necessary improvements in the formula of the CO_2 design index. Therefore, CESA recommends performing the future development of the design CO_2 index in a step-wise approach:

.1 As a first step, the scope of the index should be limited to a hull/propulsion and engine/fuel-related CO_2 efficiency. The development should be focused on identifying a well-defined set of parameters that can be used with all ship types without discriminating certain speed ranges or specific types of cargo. Instead of implying that only large and slow ships are acceptable, the index should define a consistent index for all ships against which the improvements in hull/propulsion performance (*P/V* ratio) and engine/fuel efficiency (*SFC*) can be measured, which represent a significant CO_2 reduction potential;

.2 The task of incorporating aspects of safety, auxiliary power generation for non-propulsion purposes, ship type specific equipments (f_j and f_k) should be performed at a second stage. As explained above, CESA considers it necessary to incorporate these influences if the index is to be used with a broad scope aiming at an assessment of all potential CO_2 emission improvements. This development should, however, be performed with utmost care and transparency in order to avoid ship type related inconsistencies or loopholes within the implementation; and

.3 Thirdly, or in parallel with step two, the CO_2 design index developed under .1 should be expanded by operational aspects. Instead of using the *P/V* ratio with design values only, it could also be used with operational speeds and the corresponding propulsion power demand, offering the opportunity to demonstrate CO_2 reductions with existing ships without the need to perform major conversions. For newly-designed ships it will demonstrate the effectiveness of energy and propulsion systems that have been optimized for operational profiles instead of single design points. The importance of this aspect may be illustrated by the parallel example of the emission performance of cars, where a speed profile (highway and city) is used for performance assessments. A hybrid car will outperform the conventional car only if city traffic is taken into account as well.

16 In accordance with this approach, CESA suggests the following considerations be taken into account when endeavouring to enhance the indexing formula:

Capacity: In order to avoid the production of "paragraph ships" and deliberately misleading changes in ship type, the same unit of measurement should be used for all ships. The parameter used should encompass not only the payload or payload + consumables but should take into account the light ship weight in order to incorporate the equipment necessary to perform the transport work with all cargo types. Therefore, CESA suggests using the mass of displacement of the vessel at the design draught.

Speed: In order to encourage improvements in the fuel efficiency for all ship types and speed classes without limiting the options to speed reduction, the design index must take into account the physical relationship between speed, power and length of ships. The speed at which transport work is performed is crucial for the access of maritime transport to certain cargoes and therefore beneficial for the society and the environment. Optimizing the hydrodynamics of a given design is an essential part of this process and must correctly take into account all physical phenomena of the hydrodynamic design. This requirement might necessitate the use of the speed to a power of more than 1 or, alternatively, the introduction of the (dimensionless) "Froude Number" (F_n) in the denominator of the index formula.

Power: should be the propulsion power of the main engine(s) required to obtain the speed at the design draught corresponding to the displacement. The separate assessment of more than one engine is only needed if different engines or fuel types contribute to the auxiliary engine power required to operate the vessel under the reference condition, including systems and equipment necessary for the operation of the ship at design speed.

Influence factors: The factors f_j and f_k should be reassessed for the long-term development at step two, and in order to successfully incorporate the various operational aspects briefly outlined in paragraph 13, even more factors might be needed to meaningfully adapt the CO_2 index to the design specifics and to the operational profiles of all ship types. The factor f_w is an expression of a desirable principle as it accounts for realistic operating conditions, but the actual method of establishing the value of this factor still has to be investigated and agreed upon. For any factors and corrections it is imperative that a transparent and verifiable method of establishing the factors is found.

17 The displacement and the speed as well as the specific fuel consumption and engine power should all be the values appropriate for the design condition of the vessel. They will be specified at an early stage and confirmed by an as-built survey that would preferably be part of the sea trials. The SFC will be well-known for certain engine loads from test bed trials of the engine and may be interpolated if the relevant engine load is not known from the test bed.

18 The certification of the index should be performed by a certified body on behalf of the flag State with due consideration of intellectual property rights (IPR). The index itself should be made publicly available, but it is necessary that the basis of the index – the design calculations

and the sea trial results – are considered as sensitive, confidential data and are not disclosed and are only known to the Administration or Recognized Organization that verifies the calculation and approves the attained index.

19 The European shipbuilders and ship repairers will continue contributing to the further development of methods for CO_2 indexing as well as instruments for implementation including the necessary measures for IPR protection.

Action requested of the Committee

20 The Committee is invited to consider the views presented and take action as appropriate.

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