

THE HISTORY AND STATUS OF GHG EMISSIONS CONTROL IN INTERNATIONAL SHIPPING

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ABSTRACT

The paper outlines the history of development of GHG emissions control requirements at the International Maritime Organization and the current status of development of the various measures to control GHG emissions from international shipping. Technical and operational measures are most advanced with specifications developed for calculating a ship's Energy Efficiency Design Index and Energy Efficiency Operational Indicator; guidance for developing a Ship Energy Efficiency Management Plan and draft Energy Efficiency regulations for ships. Progress in developing a market based measure which could offset the projected increase in shipping emissions associated with future growth in world trade has been limited to date. However a considerable body of information on various potential market based measures which could be applied to international shipping has been amassed and will assist in the selection and development of a market based measure in due course.

Keywords: Greenhouse gas emissions, CO₂, shipping, IMO, Energy Efficiency Design Index, Energy Efficiency Operational Indicator, Ship Energy Efficiency Management Plan, Energy Efficiency regulations, Market based measures

NOMENCLATURE

CO ₂	Carbon dioxide
EEDI	Energy Efficiency Design Index
EEOI	Energy Efficiency Operational Indicator
GHG	Greenhouse gas
HCFC	Hydrochlorofluorocarbon
HFC	Hydrofluorocarbon
IMO	International Maritime Organization
IPCC	Intergovernmental Panel on Climate Change
MARPOL	International Convention for the Prevention of Pollution from Ships
MEPC	Marine Environment Protection Committee
MBM	Market based measure
NO _x	Oxides of nitrogen
SEEMP	Ship Energy Efficiency Management Plan
SO _x	Oxides of sulphur
UNCLOS	United Nations Convention on the Law of the Sea
UNFCCC	United Nations Framework Convention on Climate Change

1. INTRODUCTION

Evidence that increasing concentrations of carbon dioxide (CO₂) were being recorded in the atmosphere led to the creation of the Intergovernmental Panel on Climate Change (IPCC) in 1988 by the World Meteorological Organization and the United Nations Environment Programme. The IPCC issued a first assessment report in 1990 which called for action on global warming.

This led to the creation of the United Nations Framework Convention on Climate Change

(UNFCCC) in 1992. The Kyoto Protocol, an international agreement linked to the UNFCCC, was subsequently adopted in Kyoto in 1997. This Protocol set binding targets for greenhouse gas (GHG) emissions reductions from industrialised (Annex 1) countries. It also contained provisions for reducing GHG emissions from international aviation and shipping which, due to the international nature of these sectors, were to be pursued through the International Civil Aviation Organization and the International Maritime Organization (IMO) respectively. Domestic aviation and shipping emissions were included in national targets for Annex I countries.

Climate change resulting from anthropogenic GHG emissions is currently the key environmental concern globally. The 4th IPCC report estimates that a CO₂ concentration below 450 ppm is necessary to limit the average global temperature increase to 2°C (IPCC, 2007). To achieve this, it is estimated that global emissions need to be reduced by at least 50% below 1990 levels by 2050. Although shipping is key to the world economy and widely acknowledged to be one of the most energy efficient forms of transport, it too must contribute to GHG emission reductions.

2 .SIGNIFICANT GHG EMISSIONS

Carbon dioxide is the most important GHG emitted by international shipping, both in terms of quantity and of global warming potential. In 2007 international shipping is estimated to have emitted 870 million tonnes, equivalent to approximately 2.7% of the total annual anthropogenic emissions of CO₂. This is projected to increase by a factor of 2.4

- 3.0 by 2050 in the absence of regulation to control CO₂ emissions based on future growth projections for the human population and world trade (IMO, 2009a).

Refrigerant gases, such as HCFC and HFC, which may be utilised in shipboard refrigeration or air conditioning systems, may have significant global warming potential. However these gases are not included in the current IMO discussions on the control of GHG emissions. Whilst HCFC are addressed in MARPOL Annex VI (IMO, 2009b), HFC are not covered since they are not ozone depleting substances.

Black carbon rich particulate matter is becoming acknowledged as a significant GHG emission on account of its impact on the rate of warming in the Arctic region. This in turn could have a significant wider impact due to the global effects of Arctic climate processes. Although the IMO has not undertaken consideration of black carbon in any detail to date, the increasing recognition of the importance of this issue would suggest action on black carbon is likely in future.

3. DEVELOPMENT OF IMO GHG EMISSION CONTROL REGULATIONS

During the development of Annex VI to MARPOL on the prevention of air pollution from ships in the early to mid 1990's, the issue of CO₂ and whether it should be included in Annex VI was discussed periodically. However, due to the difficulties in obtaining agreement on the measures to be adopted to control NO_x and SO_x emissions and the often inverse relationship between NO_x emissions and energy efficiency (and consequently CO₂ emissions), it was agreed not to pursue incorporation of CO₂ in MARPOL Annex VI at that time. However, at the International Conference of Parties which adopted Annex VI to the MARPOL Convention in September 1997, resolution 8 on CO₂ emissions from ships was adopted.

This resolution invited the Marine Environment Protection Committee (MEPC) to consider CO₂ reduction strategies and, in cooperation with the UNFCCC, to undertake a study of CO₂ emissions from ships to establish the amount of CO₂ generated by shipping and its contribution to the global total. The study, published in 2000, estimated that ships engaged in international trade in 1996 contributed about 1.8 per cent of the world total anthropogenic CO₂ emissions (IMO, 2000).

Subsequently, the IMO Assembly adopted resolution A.963(23) IMO Policies and practices related to the reduction of greenhouse gas emissions from ships in 2003, which urged the MEPC to identify and develop the mechanism(s) needed to achieve reduction of GHG emissions

from international shipping. Although considerable time was devoted to this issue, progress was slow and by July 2005 only Interim Guidelines for Voluntary Ship CO₂ Emission Indexing for Use in Trials had been approved. These guidelines enabled ship operators to generate data voluntarily on CO₂ emissions per unit of cargo carried per unit distance and were essentially the forerunner of today's Energy Efficiency Operational Indicator (EEOI).

For the next three years, little progress was made as IMO resources were focused on the task of revising MARPOL Annex VI, which had entered into force in May 2005, rather than on GHG emissions. However with the adoption of the revisions to MARPOL Annex VI in 2008, attention once more focused on measures for the control of GHG emissions and in particular CO₂ emissions.

4. APPROACHES TO CONTROL OF CO₂ EMISSIONS

In recent times, IMO has adopted two distinct approaches to developing measures to control CO₂ emissions:

- Technical and operational measures, primarily aimed at improving energy efficiency of ships;
- Market Based Measures (MBM) aimed at stabilisation or overall reduction of GHG emissions from international shipping.

This dual approach has been necessary to try to ensure that any technical and operational measures which may be implemented to reduce GHG emissions on a ship by ship basis are not counteracted by increased emissions associated with the predicted future growth in the world fleet and increased shipping activity (IMO, 2009a).

4.1 TECHNICAL AND OPERATIONAL MEASURES

Carbon dioxide is formed from the oxidation of carbon in hydrocarbon fuels. Therefore to reduce CO₂ emissions, either less fuel must be burnt or the carbon content of the fuel burnt must be reduced or eliminated. These approaches essentially translate to either the implementation of energy efficiency measures, both technical and operational, or the use of alternative low or zero carbon fuels – or preferably a combination of both.

The development of technical and operational measures has been aimed primarily at improving energy efficiency since it is generally accepted that it will be some time before use of alternative low or

no carbon fuels will have a significant impact on CO₂ emissions (IMO, 2010a).

Milestones have included the agreement and dissemination of various interim voluntary technical and operational measures in July 2009 as follows:

- Interim guidelines on the method of calculation, and voluntary verification, of an Energy Efficiency Design Index (EEDI) for new ships, in terms of CO₂ per unit cargo carried per unit distance, which are intended to stimulate innovation and technical development of energy efficiency at the design phase;
- Guidance on the development of a Ship Energy Efficiency Management Plan (SEEMP) for ships in service, which incorporates best practice for the energy efficient operation of ships; and
- Guidelines for voluntary use of a Ship Energy Efficiency Operational Indicator for new and existing ships, which are designed to help operators measure the fuel efficiency of a ship in service in a consistent manner and therefore assist assessment of the effectiveness of energy efficiency measures. Although the units of CO₂ per unit cargo carried per unit distance are the same as the EEDI, values will be different to the more theoretical design index.

4.2 DRAFT REGULATIONS ON ENERGY EFFICIENCY FOR SHIPS

Building on the work carried out to develop the EEDI, SEEMP and EEOI and further work on potential values for mandatory EEDI requirements for the major ship types, draft regulations on Energy Efficiency for Ships were developed and finalised at MEPC 61 in September – October 2010. These draft regulations include the following requirements:

(a) Attained Energy Efficiency Design Index

Attained EEDI to be calculated for each new ship specified within the draft regulations, which cover most ship types. A technical file is also to be provided containing the information necessary for the calculation of the attained EEDI and the process of calculation. The EEDI is to be independently verified.

(b) Required EEDI

Most of the major ship types, including bulk carriers, gas tankers, tankers, container ships, general cargo ships, refrigerated cargo carriers and combination carriers are required to adhere to "Required EEDI"

limits. These limits include stepwise improvements from 2015 in three five year phases leading to a 30% reduction in the "Required EEDI" value as compared to the original value for most ships by 2030. For ship types that are not included, it is intended that required EEDI values will be developed when sufficient information is available to set the required values.

(c) Ship Energy Efficiency Management Plan

All ships will be required to develop and keep on board a ship specific Ship Energy Efficiency Management Plan, which will be required to be developed in accordance with (as yet undeveloped) IMO guidelines.

(d) Surveys and certification

New ships will be required to undergo an initial survey before the ship is put in service to verify the attained EEDI and the presence onboard of the SEEMP. Ships of 400 gross tonnage and above will be required to have an International Energy Efficiency Certificate which confirms that the ship complies with the applicable energy efficiency requirements.

At present, the means by which the Energy Efficiency requirements will be implemented is uncertain. Some States party to the MARPOL Annex VI Regulations for the Prevention of Air Pollution from Ships have requested that these regulations are adopted as an amendment to MARPOL Annex VI and they have been circulated to Parties as such. The advantage is that this could allow relatively rapid entry into force. For example, if the regulations were adopted as an amendment to MARPOL Annex VI in July 2011 at the next meeting of IMO's MEPC, the regulations could enter into force in 2013. However, this seems unlikely as there was opposition to this from a number of countries.

Alternative routes to adoption are likely to lead to delay in implementing the regulations. However, voluntary implementation of EEDI and SEEMP by some ship owners and operators ahead of a mandatory implementation can be expected on the basis of past experience.

4.3 MARKET BASED MEASURES

In addition to the technical and operational measures developed by the IMO for the control of CO₂ emissions from international shipping,

overarching market based measures are also under discussion. This dual approach has been necessary to try to ensure that any technical and operational measures which may be implemented to reduce GHG emissions on a ship by ship basis are not counteracted by increased shipping emissions associated with the predicted future growth in world trade. An MBM may also, dependent upon its design, serve as an incentive for the industry to invest in more fuel efficient and/or low or zero carbon technologies.

Although all discussions at IMO on the matter of CO₂ emission control from international shipping have been hampered by on-going differences of opinion as regards the applicability of the UNFCCC principle of common but differentiated responsibility, it is the discussion of market based measures that has been most severely impacted over the years. The main problem has been that many developing countries ("non-Annex I" in terms of the Kyoto Protocol) consider that any mandatory regime aimed at reducing GHG emissions from ships should be applicable to the countries listed in Annex I to the UNFCCC only.

However, other delegations at IMO consider that the IMO regulatory framework on the GHG issue should be applicable to all ships irrespective of the flags they fly, consistent with other IMO Conventions. Moreover, as at least two thirds of the world's merchant fleet fly the flag of countries not listed in Annex I to the UNFCCC (Table 1), any regulatory regime on the reduction of GHG from shipping would be ineffective for the purpose of combating climate change, if it were made applicable only to Annex I countries.

Table 1: Distribution of the world fleet (ships above 400GT), Source: LR Fairplay, March 2008

Flag States	Number of ships	Gross tonnage	Deadweight
Annex I	33.4%	26.1%	22.82%
Non-annex I	66.6%	73.9%	77.18%

In order to progress consideration of market based measures, in March 2010, MEPC 60 agreed to establish an Expert Group to undertake a feasibility study and impact assessment of the various proposals submitted for a market based instrument to control CO₂ emissions from international shipping. These proposals included schemes based on a contribution or levy on CO₂ emissions from international shipping, emission trading schemes and schemes based on a ship's efficiency.

The proposals were assessed with regard to:

- environmental effectiveness;

- cost-effectiveness and potential impact(s) on trade and sustainable development;
- potential to provide incentives to technological change and innovation – and the accommodation of current emission reduction and energy efficiency technologies;
- practical feasibility of implementing the proposed MBM;
- need for technology transfer to, and capacity building within, developing countries, in particular the least developed countries and the small island developing states, in relation to implementation and enforcement of the proposed MBM, including the potential to mobilize climate change finance for mitigation and adaptation actions;
- MBM proposal's relation with other relevant conventions such as UNFCCC, Kyoto Protocol and World Trade Organization, as well as its compatibility with customary international law, as depicted in UNCLOS;
- potential additional administrative burden, and the legal aspects for National Administrations by implementing and enforcing the proposed MBM;
- potential additional workload, economic burden and operational impact for individual ships, the shipping industry and the maritime sector as a whole, of implementing the proposed MBM; and
- MBM's compatibility with the existing enforcement and control provisions under the IMO legal framework.

The Expert Group compiled information on the basis of research and knowledge and expertise within the Group. Consultants were also commissioned to undertake specific studies to address particular aspects where data was lacking. A substantial report (IMO, 2010b) was submitted to MEPC 61 in September 2010. However, recommendations in terms of identifying particular MBM which were considered promising to progress further were not provided as this had been outside the agreed scope of the work. An intersessional Working Group subsequently met in March 2011 to consider the need and purpose of market based measures as a mechanism to reduce GHG emissions from international shipping and to evaluate further the MBM considered by the Expert Group. However, little progress was made in terms of selecting and further developing a MBM for international shipping. Further consideration of a MBM addressing GHG from international shipping is unlikely to take place at IMO until MEPC 63 in 2012 due to the focus on technical and operational measures at the forthcoming MEPC 62 meeting in July 2011.

5. CONCLUSIONS

Consideration of measures to control GHG emissions from international shipping has been ongoing at the International Maritime Organization for a considerable time. However, progress in developing technical and operational measures and considering market based measures has been made recently.

Technical and operational measures aimed at improving ship energy efficiency are most advanced with specifications developed for an Energy Efficiency Design Index and Energy Efficiency Operational Indicator and guidance for developing a Ship Energy Efficiency Management Plan.

Draft regulations on Energy Efficiency for Ships have also been developed which incorporate the concept of required EEDI values for major ship types and incorporate progressive improvements from 2015 leading to a 30% reduction in the required EEDI value by 2030.

If adopted at the forthcoming MEPC 62 meeting in July 2011, the Energy Efficiency regulations could be in force as early as 2013.

Progress in developing a market based measure to offset the projected increase in shipping emissions has been limited to date, hampered by on-going differences of opinion as regards the applicability of the UNFCCC principle of common but differentiated responsibility to international shipping.

However, a considerable body of information on various potential market based measures which could be applied to international shipping is being amassed and will assist in the selection and development of a market based measure in due course.

REFERENCES

IMO (2000) 'Study of Greenhouse Gas Emissions from Ships', International Maritime Organization, London

IMO (2009a). 'Second IMO GHG Study 2009', International Maritime Organization, London

IMO (2009b). 'Revised MARPOL Annex VI Regulations for the Prevention of Air Pollution from Ships and NOx Technical Code 2008, 2009 Edition', International Maritime Organization, London

IMO (2010a). 'Assessment of energy efficiency measures for the control of GHG emission from ships', MEPC 60/INF 18, International Maritime Organization, London

IMO (2010b). 'Full report of the work undertaken by the Expert Group on Feasibility Study and Impact Assessment of possible Market-based Measures', MEPC 61/INF 2, International Maritime Organization, London

IPCC (2007). 'Summary for Policymakers. In: Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment. Report of the Intergovernmental Panel on Climate Change', B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds), Cambridge University Press, Cambridge and New York